For a
Healthy
Nation

Returns on Investment
in Public Health

U.S. Department of Health and Human Services
Public Health Service
For a Healthy Nation

RETURNS ON INVESTMENT IN PUBLIC HEALTH

U.S. Department of Health and Human Services
Public Health Service
U.S. Department of Health & Human Services

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# For a Healthy Nation: Returns on Investment in Public Health

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## Acknowledgements
Over the past 50 years, the American medical care system has made remarkable gains in saving lives and ameliorating suffering. Clinical medicine, however, is credited with only five of the 30 years that have been added to life expectancy since the turn of the century. The public health approaches detailed in this report have provided the foundation for the many significant improvements in both health and life expectancy. Using population-based strategies for disease and injury prevention, public health has contributed to declines in illness and injury including heart disease and stroke, smoking, infectious disease, and motor vehicle and workplace injuries.

For a Healthy Nation: Returns on Investment in Public Health reviews public health activities as they are carried out at national, state, and local levels. There are numerous success stories including the virtual elimination of polio, declines in dental decay due to fluoridated community water supplies, and reductions in childhood blood lead levels. At the same time, there are persistent problems that demand the continued vigilance and unique competence of public health. Outbreaks of new infectious diseases, such as the acquired immune deficiency syndrome (AIDS), and familiar diseases that have evolved to become resistant to therapeutic drugs, as in the case of tuberculosis, illustrate the ongoing need for a strong public health presence.

In addition to its focus on traditional concerns such as clean water and safe food supplies, public health is adapting to meet emerging health problems. Particularly troublesome are health threats to the nation's youth: unintended teenage pregnancies, violence, substance abuse, sexually transmitted diseases, and other conditions associated with high-risk behaviors—all of which can lead to an enormous health burden on the nation.
Numerous prevention and protection measures are underway in communities across the country to reduce the incidence of these problems.

An appropriate investment in public health will lead to substantial future savings in medical care. Conservative estimates of the impact of population-based strategies aimed at six of the areas discussed in this report—heart disease, stroke, fatal and nonfatal occupational injuries, motor-vehicle-related injuries, low birthweight, and gunshot wounds—suggest that $69 billion in medical care system spending could be averted by the year 2000. Because the payoff from public health efforts will occur over a long period, the savings in medical care costs for these six conditions alone will accelerate over time. By the year 2000 costs averted are projected to reach 11% of medical care spending for these conditions.

Despite the centrality of public health to the well-being of Americans, its funding is jeopardized by competing demands in the health sector. The expansion of spending on personal care has eroded financial support for core public health functions as a proportion of overall health expenditures. Public health activities accounted for less than 1% of the aggregate amount spent on health care in the United States in 1992. Relative divestments in public health have resulted in decreased capacity in many public health agencies throughout the country. These decreases have occurred at a time of increasing imperatives for public health intervention.

The fulfillment of public and personal health objectives will increasingly require close collaboration between the changing medical care and public health systems. Health care reform is likely to improve access to curative services and encourage new incentives for prevention within the medical care system. However, even a reformed medical care system cannot mount the appropriate actions to address many of the conditions responsible for death and disability in the United States today. These require responses encompassing the broader efforts of monitoring, research, education, as well as community protection and mobilization. A strengthened public health system is vital as our nation confronting current—and future—challenges to the health of the public.
The estimated one million cases of poliomyelitis (polio) that have been prevented since 1955 reflect the success of a concerted nationwide effort to conquer a devastating illness. The story might have been different without a skilled public health response.

In the early 1950s, polio had infected hundreds of thousands of Americans, leaving paralysis and death in its wake. The specter of polio closed county schools in Pennsylvania, the disease struck five of eight children in an upstate New York family, and eight of 11 children were infected in an Iowa family. In Van Nuys, California, the press followed the story of a woman in an iron lung who struggled to continue her work for the local parent-teacher association. Urban families kept their children indoors during summer as swimming pools and camps were closed.

The development of the Salk vaccine, which was tested in 1954 and licensed for use the next year, represented the first step in eliminating polio in the United States. A national program to vaccinate all children against the disease began immediately. Schools, local public health clinics, and private physicians cooperated to defeat a disease that was striking the young and the middle-aged, the affluent and the poor throughout the country.

Early in the vaccination campaign, however, a series of events took place that could have undermined the entire national effort to immunize children against polio. On April 25, 1955, a case of polio in a Chicago baby was reported to the U.S. Communicable Disease Center (CDC). The child had been inoculated with the Salk vaccine nine days earlier. On April 26, five additional vaccine-related cases of polio were reported in California. It appeared that the vaccine itself could cause the disease.

State and local public health officials, working with CDC investigators, rapidly determined that all six cases of polio could be traced to vaccine made by one manufacturer, Cutter Laboratories. On April 27, Cutter Laboratories recalled its vaccine. Further investigation revealed that a number of vaccine lots had been treated

"I can remember no experience more horrifying than watching by the bedside of my five-year-old boy stricken with polio. The disease attacked his right leg, and we watched helplessly as his limb steadily weakened. On the third day, the doctor told us that he would survive and that paralysis was the worst he would suffer. I was grateful, although I continued to agonize about whether my wife and unborn child would be affected. What a blessing that no other parent will have to endure the terror that my wife and I and thousands of others shared that August."

Morton Clurman, Sarasota, Florida
inadequately and contained active virus capable of causing polio.

The public health investigation succeeded just in time. Hours before initiating a campaign that would have administered the Cutter vaccine to thousands of Los Angeles residents, the California Health Department received word and canceled the effort. A tragedy was averted at the local level, and the public confidence that sustained the success of the polio vaccination program was preserved. The vaccination campaign for the nation continued on schedule.

Now, fewer than 40 years later, polio has been eliminated from the western hemisphere (see Figures 1-1 and 1-2). This triumph demonstrates the remarkable gains that can be made from the synergistic efforts of the medical and public health systems.
Medical Care and Public Health: Complementary Roles

Over the past 50 years, medical care has made remarkable achievements in saving lives and ameliorating suffering. Dramatic cures for infectious and metabolic disease and medical and surgical therapies for cancer have contributed to the health and well-being of the nation.

But it is important to keep in perspective the relative contribution of curative medicine to health. Since the turn of the century, the life expectancy of Americans has increased from 45 to 75 years. A recent report suggests that only five of these 30 additional years can be attributed to the work of the medical care system (Bunker et al., 1994). The majority of the gain has been achieved through improvements in our external environment—encompassing better nutrition, housing, sanitation, and occupational safety. Even now, medical care is but an indirect route to reducing morbidity and mortality from the most important causes of illness. An estimated 50% of premature deaths are associated with choices people make—for example, the abuse of tobacco and other toxic substances, unhealthy diets, and sedentary lifestyles (PHS, 1980).

Largely unheralded, the public health approach has provided the basis for dramatic improvements in health and life expectancy during the past century. Public health is the steady force behind the substantial decreases in cigarette smoking, declines in the rates of heart disease and motor vehicle-associated fatalities, control of infectious diseases, and improved safety in the workplace that have been achieved in recent years. The public health system, operating at community, state, and national levels, is the stronghold of prevention activity.

The fulfillment of public and personal health objectives, as laid out in Healthy People 2000 (DHHS, 1991), will require even closer collaboration between the changing medical care delivery and public health systems. Health care reform is likely to encourage new incentives for prevention within the personal health services system as reimbursement for medical services is restructured. With full coverage for Americans, the historical role of public health as a medical care provider for uninsured populations will diminish. At the same time, public health will be able to expand its population-based prevention strategies to address ongoing and emerging challenges to the nation's health. The role of public health in linking individuals and groups to the medical system, community organizations, and other elements of the community will be increasingly important, as will public health's leadership in leveraging public and private resources for the benefit of the health of entire populations.

The accomplishments of modern medicine have at their root a watchful, responsive, and adaptable public health system. The nation's investment in public health is an investment in the well-being and productivity of our population.

The Public Health Model: A Population Approach

Public health and clinical medicine are long-term partners in caring for the health of the public. While they frequently address the same health problems, their attention is directed at different stages of illness or injury. An important outcome of an effective public health program is avoidance or reduction of the need for specific medical services.

There are inherent differences in the way public health and clinical medicine approach
health. Clinical medicine focuses primarily on caring for and curing existing health problems in individuals; public health focuses on prevention in populations. Clinical medicine devotes its most intensive resources to restoring health or palliating disease in a relatively small number of individuals; public health uses strategies that promote health in large populations, but are not targeted toward any one individual.

The content of public health practice can be described fairly concisely:

- Public health focuses on primary prevention—prevention that occurs prior to the onset of disease. Tools of secondary prevention are used in the medical care setting to detect illnesses such as hypertension or breast cancer in their early treatable stages. Public health prevention strategies precede these measures. They identify environmental and behavioral factors that are associated with conditions such as lung cancer or heart disease and educate the community or protect it from the risk.

- Public health protects communities through monitoring and surveillance for infectious and toxic agents. The public health system gathers information to control and, where possible, prevent health problems resulting from these agents.

- Public health responds to unanticipated natural and human-generated disasters. Public health teams assess health risks posed by contaminated food, water, or air and inform the public and the medical care system of sources of danger and strategies for appropriate response.

- Public health promotes the well-being of the public through programs to notify and educate people about risks and protective measures that can be applied at the community level. For example, public health programs targeting the risks of cholesterol teach people to monitor their own cholesterol and encourage communities to change school and restaurant menus and the foods sold locally. These interventions form the population-based counterpart to the clinical interventions of screening for cholesterol and counseling individuals about the risk of heart disease.

- Public health targets hard-to-reach populations with clinical services. Outreach programs link high-risk populations to medical services to address individual health care needs, as well as to interrupt the spread of disease in the community. Public health efforts in prenatal outreach and care have been critical in improving the health status of mothers and infants. In the area of sexually transmitted diseases, public health programs control the illness, infertility, and death that stem from multiple infectious agents.

- Public health maintains diagnostic laboratory services to support diverse monitoring and prevention programs. These facilities permit identification of emerging threats from infectious agents and environmental toxins. Public health sets and enforces standards for new and existing laboratory tests conducted in medical settings.

- Public health collects information on health outcomes to ensure the quality of services provided through hospitals, nursing homes, and other medical care delivery institutions. This information has been used to develop referral systems for high-risk perinatal care and to plan regionalization of trauma and cardiac care. Aggregate information on health outcomes informs consumers and medical care professionals about the quality of care being delivered at the community level.

The public health approach fits contemporary issues such as teen pregnancy and violence, as well as more traditional public health concerns, such as clean water and infectious disease. In each case, public health works by:

- Defining the health problem;
- Identifying the risk factors associated with the problem;
Developing and testing community-level interventions to control or prevent the causes of the problem;  Implementing interventions to improve the health of the population; and  Monitoring those interventions to assess their effectiveness.

### Declines in Support for Public Health

Despite the centrality of public health in providing the basis for the health of Americans, its funding is jeopardized by competing demands in the health sector. Total national expenditures for population-based public health activities were estimated at $8.4 billion in 1993, an amount representing less than 1% of aggregate health care spending in the United States that year (PHS, 1994) (see Figure 1-3).

Between 1981 and 1993, total U.S. health expenditures increased by more than 210%. During that same period, funding for population-based health strategies, as a proportion of the health care budget, declined by 25% (PHS, 1994). The reduced priority accorded public health funding occurred at a time of increasing imperatives for public health intervention. During this period, the acquired immune deficiency syndrome (AIDS) epidemic surfaced, tuberculosis and measles outbreaks reemerged, and the problems of substance abuse, violence, and teenage pregnancy escalated.

Funding for health agencies has declined in many states in recent years (see Figure 1-4). Twenty-two state health agencies reported cuts in state funding and 33 reported cuts to services and positions in their fiscal year 1992 budget. More than 95 percent of state laboratory directors reported a hiring freeze or a loss of positions in 1992 (Dowdle, 1993). Many localities have seen sharp cuts in state support. As a result of these budgetary shortfalls, over the past decade states and localities have decreased their support for such important public health activities as disease and injury surveillance, health education, and children's programs (Public Health Foundation, 1992).

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**Figure 1-3 Health Care Pyramid**

- **Tertiary Medical Care**: Subspecialty referral care requiring highly specialized personnel and facilities.
- **Secondary Medical Care**: Specialized attention and ongoing management for common and less frequently encountered medical conditions, including support services for people with special challenges due to chronic or long-term conditions.
- **Primary Medical Care**: Clinical preventive services, first-contact treatment services, and ongoing care for commonly encountered medical conditions.
- **Population-Based Public Health Services**: Interventions aimed at disease prevention and health promotion that shape a community's overall health profile.

Source: PHS
Offsetting Costs to the Medical Care System

This report covers a range of health problems that can only be successfully controlled and prevented through strong public health programs. The case studies highlighted here are intended to give the reader a sense of the breadth and depth of action involved in protecting the public’s health. A strong public health system will reduce premature death, preventable disability, and impaired quality of life.

In addition, appropriate investments in public health will lead to substantial savings in the medical care system through the prevention of disease and injury. Conservative estimates of the impact of population-based strategies aimed at six of the 16 areas discussed in this report—heart disease, stroke, fatal and nonfatal occupational injuries, motor vehicle-related injuries, low birthweight, and gunshot wounds—suggest that, for these conditions alone, $68.9 billion in medical care spending could be averted between now and the year 2000 (Battelle).

Public Health and Health Care Reform

Universal access to medical services must be achieved to lessen the burden of disease and injury to society. But reform of the medical care delivery system and improvements in access to medical care alone will make possible only limited gains in health. The remaining gains require the community-level interventions that public health provides. Although health care reform holds the potential for enhancing the focus and involvement of the medical care delivery system on population-wide concerns, the fundamental obligation falls to public health. Public health has the perspective, research base, incentives, and leverage to assume these basic responsibilities.

As this country works to recraft its health care system, it is imperative that the difficult task of restructuring the medical care delivery system be linked with ensuring a strengthened public health system. The close collaboration of both is necessary to achieve personal and public health objectives. This document describes the public health approach to prevention of illness, premature death, and injury at state, local, and national levels. It provides evidence of the successes of public health and looks at instances where the failure to support public health has carried a high cost not only in dollars, but in human life.
The daily activities of maintaining the public’s health are often not highly visible. The public health system protects the health of individuals, the community, and the nation—and preserves the quality of life in ways that people rarely notice unless a breakdown in the system occurs. State and local health departments are ultimately responsible for the frontline defense of the public’s health. They monitor and assess the health status of the communities they serve; identify health problems and their causes; develop, implement, and enforce prevention and control measures; establish policies, standards, and regulations; provide leadership; mobilize and develop partnerships with such groups as schools, health care providers, and voluntary, professional, and other community-based organizations; develop new knowledge, often in conjunction with academic partners; and ensure the quality of, access to, and, occasionally, provision of medical care services.

At the federal level, agencies provide national leadership; establish policies, standards, and regulations; conduct and provide resources for research; maintain specialized expertise and laboratories; conduct public health surveillance; provide technical and financial assistance to states and community-based organizations; ensure the quality of, access to, and, sometimes, provision of medical care services; and work with domestic and international organizations to improve health worldwide.

To prevent disease and promote health, the public health system must integrate efforts at local, state, and national levels. Although the functions and responsibilities of the various levels of government may differ among regions, the public health system acts in concert to attain its complex goals.

This chapter presents examples of how the public health system acting at the local, state, and national levels carries out its mandate of protecting and improving the public’s health. A description of a foodborne outbreak demonstrates the importance of surveillance, research advances, laboratory capability, and effective collaboration with the media. Another example illustrates the quality assurance and evaluation components of public health. A third provides an example of public health surveillance and strategies to make the workplace safer and protect the health of workers.
Assuring Food Safety

As many as 6.5 million cases of foodborne disease occur each year in the United States. This estimate is based on data from states and may represent substantial underreporting because of differences in monitoring and reporting requirements. Approximately 500 outbreaks of foodborne illness are reported by state and local health departments each year, with an average of 50 cases per outbreak. In 1993, a multistate outbreak of *Escherichia coli*, strain 0157:H7, emphasized the importance of the complex infrastructure needed for an adequate public health response.

In January 1993, a physician in a Seattle hospital noted that more children than usual were admitted with hemolytic uremic syndrome (HUS). This serious health problem may involve renal failure, stroke, or other grave consequences. When the physician coupled the unusual number of children seen in the emergency room for bloody diarrhea with the unusual number of children already hospitalized with HUS, he suspected an outbreak and reported his suspicions to the local health department, which immediately launched an investigation to find the source. Two days later, public health laboratories identified the causative agent as *E. coli* 0157:H7.

An investigation conducted by state public health epidemiologists implicated hamburgers from a chain of fast-food restaurants as the source of infection. While state and local laboratories were confirming new cases of infection, federal laboratories using newly developed techniques documented that the *E. coli* from hamburger samples from the fast-food restaurant chain was the same type isolated from samples from ill persons.

Five days after the initial report, the state health department announced that hamburgers were the probable source of infection, and 250,000 hamburger patties were recalled. A media campaign providing health education and information to an alarmed public helped identify additional infected individuals. Ultimately, more than 600 people were affected, including 45 with acute kidney failure. Three children died.

Nevada had recently had an outbreak of *E. coli* 0157:H7, but it was only recognized after the publicity associated with the Washington outbreak. At least one major difference between the two situations was that Nevada's clinical laboratories were not routinely screening for *E. coli* 0157:H7 despite an earlier outbreak in a day-care center. Without local reporting, the state had no surveillance information, and private physicians were not alerted about a possible outbreak. Of the 58 cases of *E. coli* infection identified in Nevada, none was accurately diagnosed originally or reported to local health departments (Berkelman et al., 1994).

It is estimated that medical care and losses in productivity due to *E. coli* infections cost between $200 million and $600 million each year (Marks et al., 1993). The estimated direct medical costs for the Washington state outbreak alone total $1 million. If the surveillance system had not
identified the outbreak for 10 more days, direct costs could have exceeded $2 million.

The outbreak of *E. coli* infection and public health’s subsequent response led to increased regulations to decrease these organisms in animals and to improve slaughtering and meat-handling procedures and enforcement of cooking temperatures for meat sold to the public. The Food and Drug Administration raised its recommended cooking temperatures for hamburgers. Although Washington state already had a regulation requiring that hamburgers be cooked at a temperature high enough to kill the organism, not all counties were able to regularly inspect restaurants.

Surveillance for this deadly bacterial infection is being strengthened. Recently the Council of State and Territorial Epidemiologists approved a position statement requiring notification of *E. coli* 0157:H7 infection in all states. Many more state public health laboratories are now able to confirm *E. coli* 0157:H7 isolates they receive from clinical laboratories—up from 78% in 1989 to nearly 100% in 1993. In addition, the federal government developed training materials to educate microbiologists at the local level about the types of organisms they should identify and report to public health departments. This collaboration of national, state, and local public health officials continues to provide the basis for successful public health practice. Such partnerships help ease the economic burden of foodborne infection and other health problems in the United States.

**Monitoring the Medical Care System**

In 1990 the New York State Department of Health (NYSDH) began a number of efforts to evaluate outcomes of coronary artery bypass surgery in state hospitals. Coronary bypass surgery is a particularly important area for study because it is one of the most common—approximately 370,000 surgeries are performed annually—and most expensive procedures in the United States.

Health department officials noted large disparities in complication and death rates from coronary artery bypass surgery in the 31 institutions licensed to perform the procedure in New York state. They questioned whether these variations stemmed from discrepancies in the operative risk of patients receiving the surgery or were instead related to institutional quality of care.

The NYSDH maintains data on all open-heart surgery patients including information on patient characteristics such as age, preoperative risk factors, complications, and discharge status. When health department investigators reviewed
death rates from cardiac surgery—taking into account factors that placed some patients at higher risk for death—they noted that rates still varied widely among centers. At one end of the spectrum, fewer than 2% of patients died from surgical complications; at the other end the death rate was five times greater.

In 1991, health department investigators released physician and hospital-specific mortality rates from coronary bypass surgery to hospitals and cardiac surgeons across the state, including information that demonstrated how a particular institution performed in relation to other hospitals caring for patients with similar risk profiles.

Physicians and institutions responded by evaluating their protocols and seeking ways to improve their techniques. One center closed temporarily to improve its program. In an upstate New York hospital, surgeons were able to determine that failure to adequately stabilize persons presenting for emergency cardiac surgery resulted in a poorer outcome in that specific subgroup of patients. Changes in the initial clinical management of these patients resulted in dramatic improvements in their outcomes. On a statewide basis, risk-adjusted death rates from bypass surgery fell from 4.12% to 2.45% over a two-year period (Hannan, personal communication).

Because of national concerns about the overuse of procedures such as coronary artery bypass surgery, the NYSDH looked further to see if the procedure was being performed for appropriate indications in New York’s hospitals. Working with RAND scientists, the state health department was able to establish that fewer than 3% of surgeries were being performed unnecessarily—suggesting that cardiac centers in New York were making appropriate decisions on use of this surgery (Leape et al., 1993).

Approximately 16,000 coronary artery bypass surgeries were performed in New York state in 1993 (Hannan, personal communication). The public is assured that a careful medical care delivery system is appropriately selecting patients who will benefit from this procedure. And the efforts of that state’s health department in monitoring the outcomes of surgery and mobilizing the medical care delivery system resulted in life for an additional 275 people in 1993.

Protecting Against Illness and Injury in the Workplace

Today’s work sites are safer than ever: work-related fatalities declined by 23% between 1980 and 1989, from 7,405 to 5,714 (see Figure 2-2). Still, there are 17 work-related fatalities in the United States each day. Nearly one-quarter of the injuries are related to motor vehicle incidents.

Work-related illnesses are much more difficult to identify and quantify than deaths. Many illnesses have long periods of latency, and by the time they are identified, the association with a workplace incident from several decades earlier is often not recognized. In 1992, an estimated 460,000 cases of nonfatal work-related illness occurred in the United States (Bureau of Labor...
Figure 2-2 Actual and Estimated Annual Occupational Injury Fatalities, 1980–2005

Projecting a conservative rate of decrease from 1980 to 2005, a total of 80,000 deaths from occupational injuries will have been averted. Estimated direct medical costs of the fatalities averted between 1985 and 2005 total $1.5 billion.

Source: PHS and Battelle

Statistics, 1994). The number of cases is likely underreported because employers are not required to record or report all work-related illnesses, a deficit state health departments are filling. The cumulative burden of workplace injuries and illnesses represents a serious and expensive health problem for the nation.

The public health approach to reducing disease, injury, and death in the workplace begins with recognizing the problem through surveillance. The National Institute of Occupational Safety and Health (NIOSH) gathers surveillance data on fatal injuries related to the workplace; surveillance for work-related illness is far less comprehensive. Occupational hazards are also identified by state and local health departments, health care providers, employers, unions, the Occupational Safety and Health Administration, and the workers themselves.

Once a problem in the workplace is

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Motor vehicle-related injuries</td>
<td>23</td>
<td>14,710</td>
</tr>
<tr>
<td>Machine-related injuries</td>
<td>13</td>
<td>8,536</td>
</tr>
<tr>
<td>Homicides</td>
<td>12</td>
<td>7,668</td>
</tr>
<tr>
<td>Falls</td>
<td>10</td>
<td>6,015</td>
</tr>
<tr>
<td>Electrocutions</td>
<td>7</td>
<td>4,491</td>
</tr>
<tr>
<td>Struck by a falling object</td>
<td>7</td>
<td>4,155</td>
</tr>
<tr>
<td>All others</td>
<td>27</td>
<td>18,014</td>
</tr>
</tbody>
</table>

Source: PHS
identified, the next steps are investigating and identifying the causes of illness and developing and applying interventions to remove or control them. A NIOSH Alert reports the problem and recommends ways to reduce it. An Alert often includes an information sheet for employers to post in the workplace to inform employees of risks and ways to minimize them. Such Alerts also stimulate changes that can result in a safer and healthier work environment.

### Tracking Cases of Silicosis

A series of reported cases of silicosis, a condition that impairs breathing, provides an example of how the public health community works to identify and prevent work-related health problems. Silicosis occurs when workers inhale crystalline silica used in abrasive blasting. The lung tissue reacts by developing nodules and scarring around the trapped silica particles. If the nodules grow too large, breathing becomes difficult and death may result. Despite a 1974 NIOSH recommendation that use of silica sand be prohibited as abrasive blasting material, it is still used today. In 1987, 3,000 people were hospitalized for silicosis (NIOSH, 1992); in 1988, 300 people died of this illness.

In 1988, a physician in western Texas reported three cases of sandblaster’s silicosis to the Ector County Health Department. One of the workers, a 34-year-old man, subsequently died as a result of acute silicosis. The county health department and the Texas Department of Health contacted local physicians and identified seven additional sandblasters who had suffered from the disease since 1985. Of the 10 workers identified, nine had worked at the same facility, representing 15% of the total work force.

Investigators from state and county health departments reviewed the personal and occupational history of all workers in the facility, evaluated their chest X-rays, and sampled air from the facility for silica. The air samples had silica levels four to seven times higher than allowed by federal standards (NIOSH, 1992). Supplied-air respirators can protect workers during sandblasting, but they were not in use at the time of the on-site visit at the Texas facility. Instead, workers wore disposable particulate respirators, which do not provide protection against silica.

As a result of this investigation and 89 other reported cases of silicosis, NIOSH published an Alert informing employers and employees of the hazards of crystalline silica and ways to prevent silicosis, and recommending surveillance guidelines for state health departments. The Mine Safety and Health Administration used the recommendations to enhance engineering controls for silica in mines.

In Ector County businesses made important changes, including using new abrasives and containment procedures and increasing the use of suitable respirators. Surveillance continues and workers exposed to silica are followed and treated. The traditional local public health functions—disease recognition, investigation, and reporting—continue to play a vital role in identifying and controlling occupational risks and consequent disease.
Dramatic changes in the health status of Americans have taken place over the past decades—changes that have increased longevity and improved the quality of life of children and adults alike. Most of the leading causes of death today, as listed on death certificates, are chronic diseases—cardiovascular and lung disease, cancer, and diabetes. However, the actual causes of these deaths are high risk behaviors.

Behaviors such as smoking, using illicit drugs, and eating a diet that causes an elevated cholesterol level are modifiable. This means that the underlying causes of many diseases are preventable, and public health interventions can reduce substantially and in some cases prevent these serious health problems.

These case studies highlight critical health concerns—smoking, childhood exposure to lead, communities without fluoride, vaccine preventable diseases, tuberculosis, heart disease and stroke, infant mortality, low birthweight infants, sexually transmitted diseases, AIDS, and unintentional injuries. For each, public health has played a pivotal role in achieving major health gains. Continued public health efforts are needed to build on these past accomplishments.

### Actual Causes of Deaths in the United States, 1990

<table>
<thead>
<tr>
<th>Cause</th>
<th>Estimated Number of Deaths</th>
<th>Percentage of Total Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco</td>
<td>400,000</td>
<td>19</td>
</tr>
<tr>
<td>Diet/activity patterns</td>
<td>300,000</td>
<td>14</td>
</tr>
<tr>
<td>Alcohol</td>
<td>100,000</td>
<td>5</td>
</tr>
<tr>
<td>Microbial agents</td>
<td>90,000</td>
<td>4</td>
</tr>
<tr>
<td>Toxic agents</td>
<td>60,000</td>
<td>3</td>
</tr>
<tr>
<td>Firearms</td>
<td>35,000</td>
<td>1</td>
</tr>
<tr>
<td>Sexual behavior</td>
<td>30,000</td>
<td>1</td>
</tr>
<tr>
<td>Motor vehicles</td>
<td>25,000</td>
<td>1</td>
</tr>
<tr>
<td>Illicit use of drugs</td>
<td>20,000</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Total</td>
<td>1,060,000</td>
<td>50</td>
</tr>
</tbody>
</table>

Source: McGinnis and Foege, 1993
Public health efforts over the past 30 years have successfully reduced the number of Americans who smoke. Since the 1964 US Surgeon General’s Report on Smoking and Health—the first major government publication in which evidence of the link between cigarettes and health hazards was synthesized—the prevalence of smoking by adults has dropped by 38%, from 42% in 1965 to 26% in 1992 (MMWR, 1994a).

Despite this success, 48 million American adults still smoke. Smoking accounts for nearly 20% of all deaths in the United States and is the single largest cause of preventable deaths in the country. It is the major underlying cause of lung cancer, coronary heart disease, chronic bronchitis, and emphysema deaths. The more than 400,000 deaths a year attributed to tobacco use exceed the total number of deaths each year in the United States from AIDS, alcohol, cocaine, heroin, homicide, suicide, motor vehicle crashes, and fires combined (Glynn et al., 1993).

The economic costs of smoking are also high. The estimated total cost of tobacco use in the United States, including increased health care costs and decreased productivity, is more than $80 billion a year. Direct medical costs associated with cigarette smoking alone were $50 billion in 1993, or 7.1% of direct medical expenditures (MMWR, 1994b). The total cost of smoking in 1993 was approximately $102 billion (Battelle, 1994). Each male smoker incurs approximately $11,100 (1994 dollars) more in health care costs over his lifetime than a male who has never smoked; for each female smoker, the excess medical expenses are approximately $13,000 (Battelle, 1994, from Hodgson, 1992) (see Figure CS.1).

Over the years, the Surgeon General’s reports have documented specific health risks associated with smoking—for example, lung and other types of cancer, cardiovascular disease, nicotine addiction, and passive smoking—or have targeted specific at-risk populations such as women and young people. These reports have given prevention guidance to public health and medical professionals throughout the country. The message of these reports is supported by the Surgeon General’s warning about the dangers of cigarette smoking, which has been required on cigarette packages since 1970.

Messages for young people about not smoking are particularly important. Tobacco use usually begins in early adolescence, typically by age 16. Every day, nearly 3,000 children and adolescents begin regular smoking (Pierce et al., 1989), and by age 18 about two-thirds of young people have tried smoking (HHS, 1994). People who do not use tobacco when they are young are much more apt to remain tobacco-free for life. Recognizing the importance of preventing young people from starting to smoke, the Surgeon General released a report in early 1994 titled, Preventing Tobacco Use Among Young People. In addition to the full-length and summary reports designed to guide health educators and policymakers, a special colorful version has been produced for children. SGR 4 Kids is a booklet designed for use in schools, clubs, and other settings in which health education can be used to prevent children from initiating smoking or other tobacco use.

Similarly, antismoking campaigns in communities across the nation reinforce smoking prevention and cessation messages. Smoking advertising has been banned from television, and communities are increasingly enforcing restrictions on tobacco sales to minors. To change a socially acceptable habit, the public health community has forged partnerships with other public and private sector organizations that embrace the population-based approach to smoking prevention. For example, since 1977, the American Cancer Society has sponsored the annual “Great American Smokeout” to foster community-based activities that encourage cigarette smokers to stop smoking for at least 24 hours. As a result of the 1992 Smokeout 7% of smokers reported quitting, and 16% of smokers cut back the number of cigarettes smoked on that day (MMWR, 1993). The overall goal of the Smokeout is to encourage cessation; if smokers can quit for one day, perhaps they can quit for a lifetime.
Complementing these community-wide efforts to reduce the prevalence of smoking are increasingly stringent regulations to protect nonsmokers from tobacco smoke in the environment. Airplanes, office buildings, schools, hospitals, restaurants, hotel rooms, and other public facilities are fast becoming off-limits for smokers. These regulations are mandated at the local, state, and federal levels. Public health professionals often provide the testimony and support needed to pass antismoking legislation or enable employers to establish smoke-free areas.

Other efforts to encourage Americans to stop smoking—or not to start—include increases in federal and state taxes on cigarettes; research on the risks of smoking and means of stopping smoking, including development and introduction of nicotine-replacement aids; legislation barring the sale or distribution of tobacco to people under age 18; and media events to bring health-related tobacco issues to the forefront.

Collectively, these and other public health interventions have made a substantial difference (see Figures CS-2 and CS-3):

- Forty-eight million Americans smoked in 1992, but approximately 42 million more would have smoked without public health interventions.
- From 1964 to 1992, approximately 1.6 million smoking-related deaths were postponed, saving more than 33 million person-years of life, or an average of 21 years of additional life per death postponed.
- Between 1993 and 2015, a projected additional 4.1 million deaths will be postponed as a result of current antismoking activities.

Reducing Children’s Exposure to Lead

Lead affects every system in the body, but it is particularly harmful to a child’s developing nervous system. At high levels of exposure lead can cause seizures, coma, and death. At low levels it is associated with increased behavioral problems and decreased IQ.

In the early 1980s, when the relative impact of exposure to various sources of lead was still being debated, public health surveillance data
California's Tobacco Control Program

California took an aggressive step in 1988 when it passed the Tobacco Tax and Health Protection Act, aimed at decreasing tobacco use among California residents. This act increased the excise tax on cigarettes by $0.25 a pack, and earmarked 20% of these funds for use in antismoking activities. Local health departments are the lead agencies for regional tobacco-control education programs funded by this act, and they have worked with more than 300 community-based organizations to implement tobacco-control interventions. The resulting coalitions have fought tobacco industry sponsorship of sporting and other events designed to attract large numbers of youth and minority populations. Local health departments are also responsible for promoting smoke-free work sites and public places in their communities.

Another activity funded by the public health initiative was a statewide media campaign that stripped the glamour from using tobacco through a combination of dark humor aimed at the tobacco industry and more traditional health messages. An innovative, competitive grants program for projects that target high-risk populations was also established. Funded projects include the Asian American Health Forum, which formed an ethnic network and created a multiple language telephone hotline; Project Trust in San Diego, which targeted 400 stores for merchant education and reduced the number that were selling cigarettes to minors from 73% to 30%; and Fantasy Theatre in Sacramento, whose anti-tobacco plays were seen by nearly 12,000 children.

The program has resulted in numerous successes:
• Smoking prevalence in California decreased by 28% between 1988 and 1993. An estimated 173,000 people credit their decision to quit smoking to the media campaign
• The largest declines occurred among minority populations, which were targeted by the competitive grant program
• In response to actions by local health departments, the proportion of smoke-free workplaces places almost doubled between 1990 and 1993, with exposure of nonsmokers to environmental tobacco smoke decreased by 23%.
• The increase in smoking seen among adolescents in the period 1988-1990 has been halted.

California has set several goals related to smoking, including banning the distribution of tobacco products and tobacco sales from vending machines and establishing tobacco-prevention programs in all public schools. By 1999 the state hopes to reduce the smoking prevalence in California by 75%.

demonstrated that lead from gasoline was a major source of exposure among children. Investigators who analyzed these data found that a decrease in blood-lead levels among children between 1976 and 1980 had coincided almost exactly with the decrease in the use of lead in gasoline production because of the phase in of catalytic converters (see Figure CS-4).

The data on lead in gasoline were so convincing that the Environmental Protection Agency (EPA) withdrew a proposal to allow petroleum manufacturers to increase the amount of lead in gasoline as an inexpensive way to boost octane levels. In addition, EPA accelerated its timetable to phase out all use of leaded gasoline. Now, more than 99.5% of lead has been removed from gasoline, and blood-lead levels of children have been lowered by an additional 70% (Pirkle et al., in press). The health benefits of removing lead from gasoline were accompanied by the economic benefits of reduced car maintenance costs and longer engine life. Lead in paint is the most important

Figure CS-4 Blood-Lead Levels in U.S. Population Relative to the Decline in Lead Used in Gasoline, 1976–1980

Mean blood-lead levels in children and adults obtained from the Second National Health and Nutrition Examination Survey (NHANES II) compared with the amount of lead used in gasoline between 1976 and 1980. The analyses combined data for children and adults to have sufficient sample sizes for each six-month period of the study. Source: Annest et al., 1983
remaining source of lead exposure in the United States. Although it was known since the early 1900s that lead in paint can cause high blood-lead levels among children, it was not until 1977 that the Consumer Product Safety Commission prohibited the addition of lead to paint used for residential purposes. Today, an estimated 57 million residences in the United States still contain leaded paint, and young children live in 3.8 million housing units with deteriorating lead paint (HUD, 1991).

Local public health departments across the nation have taken an active role in combating exposure to lead in paint. Screening programs identify children with high blood-lead levels; follow-up programs provide appropriate medical treatment to children as needed and work to reduce lead paint and dust levels in their homes. In 1993 alone, state and local health departments screened 1.7 million children and identified 70,000 who were at risk of having lead poisoning (Binder, personal communication). At the federal level, the Public Health Service is conducting research to identify low-cost ways of removing lead paint in older buildings and to assess the ability of these methods to reduce blood-lead levels among children.

Public health activities, in combination with the efforts of other public and private organizations, also have successfully reduced children’s exposure to lead from food, water, and point sources. In the 1980s, the Food and Drug Administration worked with food processing manufacturers to develop voluntary regulations to stop the use of lead-soldered cans. The source of lead in cans was minute amounts of splattered solder, which was used to close the cans, but which leached from the seams into the food. Lead-soldered food cans are no longer produced in the United States, but local health agencies in border states are increasing public awareness that glazes used in pottery purchased outside the United States can contain lead and are not safe for preparing or serving food.

Most of the lead in drinking water comes from plumbing connections in older homes, where lead can leach from the solder. Reducing the problem of leached lead involves treating water at the community or district level to make it less corrosive. This intervention also increases the life of the plumbing fixtures, which means that once again the health benefits of reducing lead exposure are accompanied by other economic benefits.

During the 1980s, an estimated 230,000 children lived close enough to an ore smelter to be exposed to lead from that source. In these communities, public health investigators documented the health effects of exposure of children to lead and developed procedures to stop pollution, including adoption of national air-quality standards.

The Lifetime Benefits of Fluoride

Between World War I and World War II, public health professionals became aware that dental decay was so prevalent that practically the entire population suffered from it—no social stratum was exempt, no age group immune, and essentially there were no proven and accepted preventive measures. Even the very young suffered from tooth decay, and many older Americans rightly assumed that they would eventually lose their teeth.

Fluoride’s ability to prevent tooth decay was discovered in the 1930s, but this only benefited those communities that had water supplies with high enough naturally occurring fluoride levels to confer protection. In most communities, the level of naturally occurring fluoride is below the level necessary to prevent dental decay. Studies conducted in the 1940s and 1950s confirmed that small amounts of fluoride added to drinking water can prevent tooth decay.

In 1945 two cities—Grand Rapids, Michigan, and Newburgh, New York—
added fluoride to their public water systems. Today fluoridation is one of the most effective public health interventions in the United States. Largely as a result of fluoridation, more than half of all U.S. children age 5 to 17 are free from dental caries (see Figure CS-5). Children who live in communities without fluoridated water can be expected to have up to 40% more dental caries than children in communities with fluoridated water (MMWR, 1992). The benefits of fluoride extend to adults as well. Studies have shown a reduction in dental caries of 20% to 30% in adults who drink fluoridated water (Gremkowski, 1992).

Approximately 62% (144 million) of the U.S. population that currently uses community water systems drinks fluoridated water. A Year 2000 Objective for the Nation is to have fluoridated water for at least 75% of the population (174 million) who are served by public water systems. Currently 21 states and the District of Columbia have achieved this objective.

Public health initiatives directed at communities that do not currently fluoridate water encourage them to add fluoride to their public water supplies. Increasing the number of communities that have fluoridated water in states such as California, where water fluoridation reaches less than 16% of the eligible population, could result in substantial health care savings, as well as improved oral health. For example, in 1993 approximately $38.7 billion was spent on dental services (White, 1993). Unlike the treatment of many other diseases, restoration of teeth affected by dental caries requires repeated treatment and can later result in substantial costs. Over the lifetime of an individual, the cost of restoring carious teeth may well exceed $1,000 per tooth. In contrast, the per capita expenditures for community water fluoridation for one's lifetime, as little as $0.12 per year in large communities (Garcia, 1989), is less than the cost of one silver filling (MMWR, 1992). Drinking adequately fluoridated water represents one of the most economical preventive values in the nation.

**Strategies for Vaccine Preventable Diseases**

The history of childhood infectious illness in the United States shows the enormous benefits of vaccinations. Diphtheria, which once affected more than 200,000 people each year nationwide, affects less than half a dozen people today. Because of public health leadership, other once-common diseases have also been substantially contained. Moreover, childhood vaccination results in substantial economic savings. Society saves as much as $8.80 in direct medical costs alone for every $1 spent on childhood immunizations (Battelle, 1994).

The primary goal of vaccination is to eradicate a disease. One vaccine preventable disease, smallpox, no longer exists anywhere in the world. Likewise, polio is close to elimination in many places. There have been no cases of polio caused by wild virus strains in the United States since 1979, although a few vaccine-associated cases occur each year (MMWR, 1994c). State and local health departments play a critical role in vaccine programs by providing approximately 50% of all vaccinations in the United States. In addition, they conduct the surveillance necessary to quantify the magnitude of vaccine preventable disease and use the information to develop strategies to reduce further illness.

Experts routinely recommend that children in the United States receive vaccinations against nine diseases:
diphtheria, tetanus, pertussis (DPT); mumps, measles, rubella (MMR); polio; Haemophilus influenzae type b (Hib); and hepatitis B. In 1993, the incidences of most of these diseases were at or near the lowest reported levels ever (MMWR, 1994c). Between 97% and 98% of all school-age children are currently vaccinated against the diseases shown in Figure CS-6, largely as a result of state laws requiring that children be vaccinated before they are allowed to enter school or daycare. Hib, the newest of the childhood vaccines, was introduced in 1988. It prevents the most common cause of bacterial meningitis among children. Its effect is already dramatic: a more than 90% decrease in Hib disease since 1988 (MMWR, 1994c; PHS, 1994).

Despite the excellent record of vaccinating school-age children, some populations of children are still unvaccinated. President Clinton proposed the Childhood Immunization Initiative as a comprehensive national response to undervaccination. Because there are no requirements or formal programs to ensure that children who do not attend school or daycare receive the recommended vaccinations, children under the age of five years are at higher risk of being inadequately vaccinated. This health risk presents a major challenge to public health.

Measles illustrates the successes and challenges associated with combating vaccine preventable infectious diseases. Before the vaccine was approved in 1963, there were an estimated three to four million measles cases annually. About 500,000 of those were reported, and between 400 and 500 people died from complications of measles each year. Of those reported, more than 50% occurred by age six and mortality was greatest in children under the age of five. After the introduction of the vaccine and a national-wide vaccination campaign led by the public health community, the incidence of measles dropped dramatically. By 1983 it had reached a record low of 1,497 cases (see Figure CS-8).

Still, outbreaks of measles occurred in the 1980s among school-age children and college students. Although most of these people had received a single dose of measles vaccine as recommended at the time, between 2% and 5% of children were not fully protected by a single dose of vaccine. Public health authorities realized that a second dose of
measles-mumps-rubella vaccine was necessary to prevent outbreaks and recommended adding a second dose of vaccine.

There was another reason for the continuing number of cases. High vaccination rates among children under age five are critical for decreasing the incidence of measles in a community. The recommended age for the measles-mumps-rubella vaccination is between 12 and 15 months. The 1992 National Health Interview Survey data show that of two-year-olds (19 to 35 months), 55% had received the basic series of immunizations (four DTPs, three polio, and one MMR) (PHS, 1994).

Between 1989 and 1991, more than 55,000 cases of measles were reported. Of these, approximately 11,000 people were hospitalized and 132 died, including 66 children under age five and 20 school-age children (PHS, 1994). This outbreak cost an estimated $150 million in direct medical services, plus the indirect costs associated with absences from work and school. All of this could have been avoided with a vaccine that cost less than $24 a dose (Robinson, 1993).

Children under the age of two need special outreach efforts for several reasons. First is the vaccination schedule itself, which requires four to five clinical visits to receive immunizations before a child is two years old and another visit before the child enters school. These visits are financially prohibitive to many American families. In addition, many parents are not aware of the possible severe consequences of measles and other childhood illnesses. Also, health care providers do not always track children's vaccination status or take the opportunity to check that status when children receive health or medical care for other problems.

To overcome these impediments to the vaccination program, and to reach the Healthy People 2000 objective of 90% coverage with a complete series of all recommended vaccines for all children by the time they are two years old, the National Vaccine Advisory Committee developed a guide for providers on the optimal delivery of vaccinations. This guide includes a recommendation that providers take advantage of every opportunity to vaccinate children before they are two years old—not just during well-baby visits. The recommendations have been endorsed and actively promoted by organizations that represent state and local health departments and professional societies.

State and local health departments and federally sponsored primary care centers also play a critical role in raising levels of vaccine coverage. With federal assistance, local public clinics are vaccinating target population groups that have low coverage rates.

Community-wide initiatives are increasing awareness of the importance of vaccinating preschool children. The Immunization Education and Action Committee, formed by the Surgeon General, Centers for Disease Control and Prevention, and the Healthy Mothers, Healthy Babies Coalition, conducts workshops on vaccination-related issues and serves as a network for more than 100 health professional, government, and volunteer organizations. As a measure of this effort's success, by early 1993 nearly 81% of all children in the United States age 19 to 35 months had been vaccinated for measles.
Tuberculosis: A Case for Continued Vigilance

In some cases, the line between a personal health problem and a public health problem blurs. Tuberculosis is an example. A highly communicable disease, tuberculosis is spread through droplets breathed into the air. Without treatment, an infected person can spread the disease and ultimately infect five or more other people. The disease often has serious, and even fatal, consequences. It is particularly dangerous for young children because of the risk of tuberculosis-related meningitis. Because of its contagiousness and the persistence required if medical treatment is to be successful, tuberculosis poses a substantial public health challenge (see Figure CS-9).

At the beginning of the 20th century, tuberculosis was a common illness and a major threat in the United States. Until the 1940s, it was controlled by isolating infected persons in sanitariums and treating them with bed rest, sunlight, good nutrition, and exercise. People stayed in these specialty hospitals until their disease went into remission or they died.

In the 1940s, antibiotics were developed and drug treatment for tuberculosis became possible. Widespread public health screening for tuberculosis began. Vans were equipped with chest X-ray machines, and people lined up on the streets to be examined. With a staff trained to conduct aggressive case finding, contact tracing, and follow-up treatment with antibiotics, the number of new cases of tuberculosis began to decline.

This was a true public health success story. Throughout the period 1953 to 1984, the incidence of tuberculosis declined at an average rate of approximately 6% each year. Over the 30-year span, the number of cases of tuberculosis dropped a total of 74%—falling from 84,304 cases in 1953 to 22,255 in 1984 (CDC, 1994). Public health professionals looked forward to the day when tuberculosis would be eliminated in the United States.

Today, however, a resurgence of tuberculosis is threatening vulnerable populations in cities across the nation. The disease’s resurgence was first detected in 1985, when the rate at which tuberculosis was declining began to slow. The following year, the number of reported cases of tuberculosis rose. Since that time, the number of cases each year has continued to increase by an average of 3% to 26,673 in 1992. In 1993, however, 25,313 cases were reported, the first sign that renewed vigilance may be paying off (MMWR, 1994d) (see Figures CS-10 and CS-11).

The increase in tuberculosis cases is attributed to a variety of factors, including people whose immune system is compromised by HIV infection, groups of immigrants from countries in which tuberculosis is endemic, and crowded living conditions in prisons and homeless shelters. A decreased emphasis on tuberculosis prevention and control measures within the public health system also contributed to the resurgence of this disease. By the late 1960s, many health departments had closed
Figure CS-10 Estimated Tuberculosis Cases Avoided Because of Public Health Actions, 1955-1985

From 1955 to 1985, 765,000 cases of tuberculosis in the United States were prevented with public health interventions. Projected direct medical care costs of treating this number of patients for tuberculosis would have been at least $8.3 billion. Source: Battelle

Figure CS-11 Observed and Expected Cases of Tuberculosis, 1980-1992

From 1986 to 1992, a reported excess of 52,000 cases of tuberculosis occurred in the United States, over and above the number of cases that would have been expected if the downward trend in the disease had continued. Assuming that public health measures could have prevented 75% of these infections (39,000 cases), the cost of this missed opportunity was estimated to be at least $421 million in direct medical costs. Source: PHS

Their tuberculosis programs or substantially reduced their operating budgets. In the 1970s, as fewer new cases were found, additional prevention and control programs were phased out. As a result, the infrastructure for prevention and control was seriously weakened.

The current resurgence of tuberculosis is complicated by the appearance of virulent strains of the disease that are resistant to antibiotics. In 1991, nearly 14% of people with tuberculosis were infected with multidrug-resistant strains. These individuals are likely to remain infectious for longer periods of time and are more difficult to treat than other patients. There are pockets of high incidence of multidrug-resistant tuberculosis; for example, the incidence in New York City is more than 50 times higher than in the rest of the United States. Public health officials are concerned that outbreaks of multidrug-resistant tuberculosis may become more widespread, more common, and more dangerous in the coming years.

Multidrug-resistant strains generally develop because of inadequate or erratic treatment. When a patient with active tuberculosis stops taking antituberculosis medication, the most resistant bacteria survive. A full course of treatment requires taking drugs for a minimum of six months, and sometimes for considerably longer. More than one in five people with active tuberculosis do not complete a full course of treatment.

State health departments are addressing the tuberculosis problem with innovative programs. One of the most promising is directly observed therapy (DOT), which promotes the effective cure of tuberculosis by ensuring that every person with the disease completes the prescribed treatment. Under DOT the patient with tuberculosis takes the prescribed medication in the presence of a health care worker or other designated individual. This supervision is provided at a home, in the workplace, in a clinic, or in a homeless shelter or other community setting. New York state has approved more than 50 such
Controlling the Spread of Tuberculosis in Monroe County, New York

The Monroe County Health Department (MCHD) in New York works to control tuberculosis by managing active cases of tuberculosis and contacts of infected persons. Every person identified as having had contact with an infected person is given a skin test to see if he or she has the disease. Since it can take as long as three months for the test to detect active tuberculosis, all contacts under six years of age—a group particularly vulnerable to tuberculosis-related meningitis—are given preventive therapy.

One recent case in Monroe County involved a person with tuberculosis who worked in a home-based daycare center. The health department identified 35 children and their families who were possibly exposed to infection. They were invited to a party at which a public health nurse explained the disease, the risks involved, and the necessary interventions. The nurse performed skin tests on everyone at the gathering and followed up to determine who had the disease.

In Monroe County about 80% of the health department's tuberculosis caseload of 20 to 25 people have pulmonary tuberculosis. All of these persons receive directly observed therapy (DOT) to ensure that multidrug-resistant strains do not emerge. A public health nurse goes to each person's house or another convenient site and watches each person take a prescribed group of antituberculosis drugs. This procedure is repeated every day for two months, then twice a week for four months. Directly observed therapy is labor-intensive, but it can take the place of more expensive hospitalization to achieve the same result.

The health department provides leadership to the community by training staff at homeless shelters to test their residents for tuberculosis. The department also provides tuberculosis testing in substance abuse treatment centers and refugee resettlement centers. MCHD uses these opportunities to collaborate with other local agencies in extending the scope of work of public health. The health department's broad outreach into the community is controlling the spread of this highly infectious disease.

sites. For the state health department, DOT offers a cost-effective means of treating patients and preventing the further spread of tuberculosis. The hospital costs of treating a patient with multidrug-resistant tuberculosis may range from $100,000 to $180,000 (Weis et al., 1994).

Public health professionals and researchers are reexamining strategies for preventing and controlling tuberculosis and are placing increased efforts on surveillance, contact tracing, education, community mobilization, and other traditional public health interventions. Work is also underway to improve diagnostic techniques and develop new drugs. More than 60 grassroots organizations have joined the National Coalition for the Elimination of Tuberculosis in an effort to revitalize the national, state, and local public health response to a serious problem.
Reducing Heart Disease and Stroke

One of the great public health and preventive medicine success stories of the past few decades is the dramatic reduction in mortality and morbidity from heart disease and stroke in the United States. From 1972 to 1992, the death rates from heart disease decreased by 51%, and for stroke, by 60% (NCHS, 1993; NHLBI, 1993). The impact of these declines is even more dramatic when they are compared with the 10% drop that occurred in the same period for all noncardiovascular causes of death (see Figure CS-12).

Epidemiologic research has identified modifiable risk factors for cardiovascular disease, these include high blood pressure (hypertension), elevated cholesterol, smoking tobacco, living a sedentary lifestyle, and being overweight. A recent review of studies showed the impact that reducing these risk factors can have. A 1% reduction in a person’s total blood cholesterol level, or a one-millimeter reduction of mercury in the diastolic blood pressure, can result in a 2% to 3% decrease in the risk of heart disease. In addition, smoking cessation can result in a 50% to 70% decrease in heart attacks (Manson, 1992).

Over the years, communities and work sites across the country have tested and implemented programs to reduce risk factors for heart disease and stroke. The National High Blood Pressure Education Program, which began in 1972, is a large-scale community-based intervention that involves 150 national organizations, such as the American Heart Association and the American Stroke Association, public health researchers, health departments in all the states and territories, and more than 2,000 local community organizations in public education efforts to reduce the risk of heart disease.

These efforts have yielded substantial declines in risk factors and increases in knowledge about them. When the program began, only 24% of the American public knew about the relationship among high blood pressure, heart disease, and stroke. Now more than 90% are aware of the relationship. Only 51% of people with high blood pressure were aware of it in 1972; today 84% who are at risk for heart disease are aware. Following these successes in increasing awareness, the public health education campaign shifted toward greater emphasis on taking medication according to instructions, and the percentage of people who have hypertension but whose blood pressure is under control rose from 16% to 55%.

The National Cholesterol Education Program uses a two-pronged educational approach to achieve substantial declines in cholesterol levels. Its efforts demonstrate the complementary roles of clinical medicine and public health. The clinical approach promotes identification and treatment of individuals whose elevated cholesterol places them at a significantly increased risk of having heart disease. The population-based approach seeks to lower average levels of blood cholesterol by encouraging reduced intake of saturated fat, total fat, and cholesterol by the general public, as well as by those at high risk.

One measure of the program’s success is the reduction in serum cholesterol levels nationwide. The proportion of adults with elevated blood cholesterol declined from 26% in 1978 to 20% in 1990, and the proportion of adults who needed dietary therapy for high levels of blood cholesterol declined from 36% to 29% over the same time period. Fat consumption in the American diet declined from 36% of total calories in 1978 to 34% of total calories in 1990. Another measure of success is the increase in the proportion of the population that has been screened for cholesterol—from 35% in 1983 to 65% in 1990.

These programs are only two examples of community-wide public health interventions to reduce the incidence of heart disease and stroke. Others are taking place in schools; at work; in community centers, hospitals, and police and fire stations; and in other central locations in the community. Many employers have instituted health education programs at the work site. In the Michigan automobile industry, for example—where the death rate from heart disease has decreased by 51% over the past two decades—programmatic initiatives have resulted in a decrease of 1% to 3% per year in the death rate from heart disease.

Figure CS-12 Decline in Death Rates from Stroke and Noncardiovascular Disease, 1968-1992

Comparison of the decline in the stroke death rates to the decline in all noncardiovascular disease (non-CVD) death rates. Source: PHS
example, a three-year blood pressure control program demonstrated that employees who had high blood pressure and who participated in extensive monitoring and counseling programs had fewer medical care claims than persons at a control site who did not have such programs. Overall, the prevalence of high blood pressure and high blood cholesterol, as well as the incidence of heart attack and stroke death, has declined significantly because of multiple public health approaches including community monitoring, education, and mobilization of practitioners (see Figure CS-13).

In spite of these successes, heart disease and stroke continue to be the leading causes of death in the United States; they account for more deaths than all other health problems combined. More than 2,500 Americans die each day from these problems—one person every 34 seconds (AHA, 1994). In 1994, the total direct medical care costs of heart disease and stroke are estimated to be $48 billion and $17 billion, respectively (AHA, 1994).

Because of public health interventions, between 1964 and 1992 an estimated 1.6 million deaths (before age 75) from heart disease were prevented, and between 1973 and 1992 an estimated 427,000 deaths (before age 75) from stroke were prevented. Through focused public health activities, it is estimated that during the period 1993 to 2015, 900,000 heart disease deaths and more than 200,000 stroke deaths can be delayed (see Figure CS-14). By 2015, with more and better public health activities, it is estimated that the number of people with heart disease and stroke can be lowered to 4.2 million and 1.7 million, respectively. Without such effective interventions, there may be as many as 12.6 million cases of heart disease and five million cases of stroke in 2015. Reducing heart disease and stroke also saves money. In the Medicare-eligible population alone, people with an average level of cardiovascular risk have 19% higher claims costs than do those with no elevated risk. The higher risk group represents an additional $9.3 billion in Medicare expenditures (Schauffler, 1993).

![Figure CS-13 Actual and Expected Death Rates for Coronary Heart Disease, 1950–1992](image)


![Figure CS-14 Projected Annual Number of Coronary Heart Disease and Stroke Deaths Preventable Because of Public Health Action, 1995–2015](image)

Source: Battelle
Prevention Strategies in the Stroke Belt

The region including Alabama, Arkansas, Georgia, Indiana, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia—known as the "stroke belt." States in the stroke belt have a stroke rate that is more than 10% higher than that of the rest of the country.

State health departments in the stroke belt have developed prevention strategies specifically targeted at African Americans, who are particularly at risk of having a stroke. The principal risk factors for stroke are high blood pressure and smoking.

In Louisiana, the health department is working with churches in two regions in which a majority of the state's stroke deaths occur. Personnel contact a volunteer by calling the support of churches, so the project began by helping parishes and churches to conduct blood pressure screenings and have recruited health professionals to conduct educational sessions on smoking cessation, nutrition, exercise, and other topics related to stroke risk.

Volunteers are also key to the program's success. Mississippi's primary objective is to train volunteers so that they can increase awareness about high blood pressure among their friends, relatives, and neighbors, and in schools, churches, and small businesses. After the first year of the program, Mississippi had trained 46 volunteers in seven locations. These volunteers had contacted 456 people, of whom 93 had elevated blood pressure. Forty-eight of these people, more than 50%, had not previously been aware that they had a problem with high blood pressure.

Preventing Infant Mortality

Infant mortality rates remained level through the 1960s. But with enactment of Medicaid in 1965, millions of women gained new access to medical services, and the infant mortality rate began to decline. Further declines followed the enactment in 1972 of the Special Supplemental Food Program for Women, Infants, and Children (WIC). Advances in high-technology medical care for premature infants largely account for more recent gains in reducing infant mortality.

Beginning in the 1970s, public health agencies took a leadership role in developing regional systems for providing neonatal intensive care. This made the high-technology resources of tertiary care hospitals available to networks of smaller referring hospitals. The result was that a larger population had access to specialized services, with the added benefit of more efficient use of expensive resources.

Overall rates of low birthweight also declined over the past 30 years, but to a lesser degree than infant mortality. The rate of low birthweight among the African American population is more than double that of whites, and low birthweight rates are also somewhat elevated among Hispanics and Native Americans (NCHS, 1993). Among African Americans progress in decreasing low birthweight has begun to erode. Low birthweight rates actually increased beginning in the late 1980s, which may be attributable to a higher incidence of teenage pregnancies, increased smoking among teenage women, and substance abuse. Public health methods hold great promise for changing this situation. Carefully focused interventions that target women at highest risk of having low birthweight babies could result in substantial savings in medical costs as well as improved long-term outcomes for these infants.

Public health improves maternal and infant health in several ways. First, it gathers baseline data—a process that begins at birth with recording the baby's weight on the birth certificate. By linking birth and death certificates, researchers have developed a better understanding of the causes and distribution within the population of low birthweight and infant mortality. Public health interventions are targeted using this information.

Another important public health component is helping enroll at-risk pregnant women in Medicaid. Adequate prenatal care beginning early in pregnancy has been identified as an important factor in reducing low birthweight; good nutrition is also a critical influence on birth outcome. WIC programs are operated mainly by health departments, which provide counseling on diet and vouchers that women may use to purchase specific dairy products, vegetables, and other foods. One of public health's most important contributions is the organization of a service package designed to meet the needs of low-income women. Coordinated WIC and Medicaid programs result in improved birth outcomes and actually reduce Medicaid expenditures.

Progress in reducing infant mortality and the number of low birthweight infants requires expanding the community-based programs that provide maternal and child health services. Insurance coverage alone may not result in improved birth outcomes. Although Medicaid funding increased during the 1980s, there was no parallel increase in such public health programs as case finding, counseling, and transportation, which bring women into the medical care system. This period represents a missed opportunity to reduce the incidence of low birthweight. From the mid-1970s to the mid-1980s, the percentage of low birthweight babies declined steadily, but leveled off in 1984. A conservative estimate of the trend indicates that, had the decline continued, 150,000 fewer low birthweight infants might have been born in the United States between 1985 and 1991 (see Figure CS-15). If Healthy
People 2000 objectives for low birthweight babies are met through expanded programs targeted at high-risk mothers, an estimated $2 billion a year could be saved based on the present value of medical costs (see Figure CS-16).

**Figure CS-15 Rise in Number of Low Birthweight Infants Compared with 1975–1983 Trend**

The expected rate of low birthweight (LBW) infants reflects continuation of the 1975–1983 trend. Source: PHS and Battelle

**Figure CS-16 Projected Medical Expenditures Avoided Through Achievement of Healthy People 2000 Low Birthweight Objectives, 1995–2015**

Projected savings represent the reduction in expected medical expenditures for LBW infants that would occur if the targeted decline in LBW births set forth in Healthy People 2000 is achieved by the year 2000. Source: PHS and Battelle

### Controlling the Spread of Sexually Transmitted Diseases

A major public health challenge of the 20th century has been and continues to be sexually transmitted diseases (STDs). The rate of STDs in the United States is the highest in the industrialized world (Donovan, 1993), with an estimated 12 million persons acquiring a sexually transmitted infection each year.

Left untreated, STDs are spread through sexual intercourse or other intimate contact, from a pregnant woman to her fetus in utero, or by contact of the infant with maternal secretions during birth. The conditions associated with STDs are often long-term and irreversible; some are even fatal. For example, the human Papillomavirus that causes genital warts is linked with cervical cancer—a disease that kills 5,000 women a year. Congenital syphilis may occur in infants born to women with untreated syphilis. For pregnant women with untreated syphilis, the risk of infant death is 40%. Chlamydia, another common STD, can lead to pelvic inflammatory disease (PID), which in turn can lead to infertility, ectopic pregnancy, and chronic pelvic pain. By damaging the genital skin and mucous membranes, STDs also facilitate transmission of HIV.

Public health departments prevent and control the spread of STDs through monitoring, organizing prevention activities, partner notification, developing standards of care, and conducting outreach to encourage individuals to adopt safer sexual behaviors. Prenatal and perinatal care standards are critical to the prevention of congenital syphilis as well as eye and lung infections in newborns due to chlamydia and gonorrhea. Local health departments also improve the quality of screening and treatment by organizing the acquisition and delivery of antibiotics and laboratory testing according to national standards.
Researchers work to improve laboratory tests and to discover new, improved treatment modalities. Health departments work in partnership with health care providers to ensure that sex partners of infected persons are notified of their need for evaluation and treatment, and pregnant women in high-risk areas are encouraged to get prenatal care and screening for syphilis and other STDs. These efforts are designed to target resources efficiently to identify and treat those with STDs in the community, and to identify and educate those who are at high risk of contracting STDs to prevent further transmission of disease.

The recent history of syphilis illustrates the role of public health in prevention and control of STDs. During World War I, 13% of draftees were found to be infected with either syphilis or gonorrhea. Although syphilis rates increased again during World War II, the increase was blunted by an intense public health program that included the distribution of latex condoms and rapid treatment without punitive measures. The introduction of penicillin after World War II, together with screening and partner notification efforts by state and local health departments, resulted in a steep decline in reported cases of syphilis—from an all-time high of 575,600 cases in 1943, to a low of 6,400 cases of primary and secondary (the most infectious stages of the disease) syphilis in 1956 (Brandt, 1988). Subsequent increases in the number of cases led to the reintroduction of federally supported screening and partner notification efforts by health departments. One principal focus of syphilis programs is prevention of congenital syphilis. Congenital syphilis is preventable by reducing syphilis in communities and by screening, especially during prenatal care visits.

As cases of syphilis declined, less funding and attention were paid to STD control efforts, with the exception of occasional campaigns targeted to gonorrhea reduction. Then, in the late 1980s, partially as a result of the nationwide epidemic of crack cocaine use, reported case rates of primary and secondary syphilis increased from 12,131 in 1985 to 50,578 reported cases in 1990, a 40-year high. The combined prevention and treatment efforts of federal, state, and local health departments with medical care providers to interview and counsel individuals testing positive for syphilis and to notify and treat contacts of these patients led to a 48% decline in newly reported cases of primary and secondary syphilis and a 27% decline in congenital syphilis since 1991.

Another STD that is receiving increasing public health attention is chlamydia. With an estimated four million new cases occurring every year, it is three times more common than gonorrhea and 30 times more common than syphilis. Chlamydia affects men and women of all socioeconomic classes and is especially common among adolescents and young adults. Thanks to work by researchers, effective and economical screening tests for chlamydia have become available in recent years, and treatment has improved.

Demonstration projects indicate that chlamydia, whose symptoms are often "silent," is responsive to public health interventions. When case-finding is successful, screening women for chlamydia and treating infected women with single-dose therapy is cost-effective. It costs $2.1 billion a year to treat women for the consequences of a prior untreated chlamydial infection, including ectopic pregnancy, PID, and infertility; screening and preventive treatment costs $175 million a year. The annual savings from prevention: $1.9 billion (DSTD/HIV Prevention, 1994). Without continued support and expansion of the public health role in STD prevention, the numbers of new cases will increase, leading to the increased cost of treating medical complications.

Primary prevention of STDs through behavioral risk reduction is also essential for avoiding the negative consequences and the high costs of these diseases. Prevention activities require behavioral change among those most at risk for STDs, a challenge often impeded by numerous socioeconomic and psychological barriers. For example, many people dependent on drugs acquire STDs through the exchange of sex for drugs. Until they address their drug problem, they will not practice safe sexual behavior. Women who are fearful of physical abuse from their male sexual partners will not be comfortable asking them to use a condom. Innovative, community-based strategies for primary prevention are required to begin to address these and other barriers to behavioral change.

### Estimated Incidence of Selected Sexually Transmitted Diseases in the United States

<table>
<thead>
<tr>
<th>STD</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlamydia</td>
<td>4,000,000</td>
</tr>
<tr>
<td>Gonorrhea</td>
<td>800,000</td>
</tr>
<tr>
<td>Human Papillomavirus</td>
<td>500,000-1,000,000</td>
</tr>
<tr>
<td>Genital Herpes</td>
<td>200,000-500,000</td>
</tr>
<tr>
<td>Syphilis</td>
<td>113,000</td>
</tr>
<tr>
<td>Congenital Syphilis</td>
<td>4,000</td>
</tr>
</tbody>
</table>

Source: PHS
Interventions to Prevent HIV Transmission

When cases of two rare diseases, Pneumocystis carinii pneumonia (PCP) and Kaposi’s sarcoma, began to appear in young gay men in 1981, the public health community (through established networks of information sharing) recognized the increased incidence of these illnesses in a population not previously known to be at risk. A surveillance system was set up through state and local health departments. This system collected data that formed the basis for understanding the distribution of what is now known as AIDS and for developing hypotheses regarding disease transmission. Within 18 months of the first report of the syndrome, all known routes of transmission were identified and reported in a timely manner. The surveillance and epidemiologic data enabled public health workers to issue guidelines for prevention of the infection in 1982 and 1983, before identification of the human immunodeficiency virus (HIV), the virus that causes AIDS, in 1984. It has been estimated that this rapid mobilization of public health systems at the start of the HIV/AIDS epidemic resulted in the prevention of approximately 690,000 cases of HIV, with associated savings in medical costs of approximately $39.4 billion (see Figure CS-17).

HIV can be transmitted through a number of routes: sexual intercourse; transfusion of contaminated blood and blood products; reuse of injecting drug paraphernalia; transmission from mother to infant during the perinatal period; and less commonly, through penetration of the skin with HIV-contaminated sharp objects such as needles or exposure of broken skin or mucous membrane to HIV-infected blood or body fluids, as might occur in health care settings. By 1982, CDC’s surveillance system had collected 1,143 reports of cases of AIDS; by September 1993, 339,250 cases had been reported. It is estimated that there are at least

![Figure CS-17 HIV Cases and Medical Costs Avoided Because of Public Health Mobilization, 1985-2000](image-url)
Keeping the Blood Supply Safe

Each year, about 14 million units of whole blood are donated in the United States (McCullough, 1993). While there have always been risks associated with transfusion of blood products, concerns about the safety of the blood supply increased in the early 1980s.

In 1982, a physician who had treated a patient with hemophilia reported that his patient had just died from Pneumocystis carinii pneumonia (PCP). The physician suspected that the clotting factor his patient had been given might have been the source of his PCP. Clotting factor is a derivative of multiple units of blood. A review of the medical literature showed no previous cases of PCP among people with hemophilia.

However, even though the patient had none of the then known risk factors for AIDS, his symptoms fit the clinical definition of the disease. An active search for other cases of PCP among persons with hemophilia began. By July two more cases had been identified. These patients, too, had symptoms of AIDS but did not have any of the known risk factors. By the end of the summer, two more persons with hemophilia were reported to have AIDS. AIDS cases were also reported among injecting drug users and people who had received transfusions of whole blood.

On the basis of the knowledge that the causative agent of AIDS could be carried in blood, steps were taken to protect the nation’s blood supply. In March 1983, the blood banking community, at the direction of federal health agencies, recommended that persons at risk of having AIDS voluntarily refrain from donating blood because no suitable test for the causative agent was yet available. Self-administered questionnaires were created to screen out high-risk blood donors, and public education campaigns were undertaken to let at-risk people know they should not donate blood.

In the summer of 1984, public health scientists found that applying heat inactivated HIV. Federal guidelines for treating clotting factors, which were adopted in October, greatly reduced the risk of transmission of HIV infection among people with hemophilia. However, more than 9,000 people with hemophilia and their sex partners were already infected with HIV from blood products that contained the virus.

In March 1985, a blood test was licensed to detect the presence of antibodies to HIV. The test has since become a standard part of all blood screening in the United States. As a result, the risk of receiving HIV-infected blood or blood products has been greatly reduced.

The surveillance and laboratory systems already in place as part of the nation’s public health network, and improvements in technology, allowed action to prevent the transmission of HIV to an estimated 43,000 more individuals through transfusion of contaminated blood or blood products between 1985 and 1993 and saved $2.4 billion in direct medical costs (Battelle).

These actions parallel those taken to ensure the safety of the blood supply with respect to other infectious agents. Today, surgical patients, trauma victims, and other blood product recipients in the United States have access to a well-protected blood supply.

<table>
<thead>
<tr>
<th>Agent</th>
<th>Period</th>
<th>Infections Averted</th>
<th>Medical Costs Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV</td>
<td>1985-1993</td>
<td>43,000</td>
<td>$2400 million</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>1971-1993</td>
<td>918,000</td>
<td>145 million</td>
</tr>
<tr>
<td>Hepatitis C</td>
<td>1986-1993</td>
<td>326,000</td>
<td>685 million</td>
</tr>
</tbody>
</table>

Source: Battelle
40,000 new cases of HIV infection in the United States each year. Public health surveillance and analyses of patterns in the distribution of HIV infection and AIDS in the population show that most newly diagnosed cases of AIDS continue to be among homosexual and bisexual men and among injecting drug users. However, the proportion of newly diagnosed cases of HIV infection among heterosexual men, women, and members of minority groups is rising (MMWR, 1994a).

Combating the spread of HIV poses different problems from those associated with other infectious diseases. As no vaccine or cure is available, the transmission of HIV can be halted only by changing behavior. As with substance abuse and other areas focused on by public health, changing behavior to prevent AIDS is extremely difficult. To further these efforts public health institutions are engaging in more socio-behavioral research to develop a better understanding of and techniques for behavior modification.

A critical public health component in the effort to change behaviors and reduce transmission of HIV is education for the general public and specific groups at high risk of having HIV and AIDS. One of the earliest mass educational campaigns took place in 1988, when an eight-page brochure from the U.S. Surgeon General, Understanding AIDS, was mailed to every household. Surveys performed before and after this mailing indicated that the brochure led to substantial changes in knowledge regarding HIV and increases in frequent use of condoms during sexual intercourse (Singer et al., 1991). Other HIV/AIDS-related public health programs that have successfully changed behavior include small-group counseling for high-risk youth, women, and couples; outreach to injecting drug users on the street; and community-wide activities for gay men.

Advances in preventing and controlling HIV and AIDS have occurred rapidly, and additional public health efforts are underway. The CDC continue to take an active role in community intervention and education programs that stress the need for prevention, and the National Institutes of Health continue to develop and test drugs that may substantially delay the onset or progression of AIDS. There are also ongoing efforts to ensure the safety of health care workers and the safety of the public from infected health care workers through development of prevention and treatment recommendations. Joint actions by the public health and medical communities have included formation of behavioral interventions to prevent HIV transmission and development of drugs to treat and prevent AIDS-associated opportunistic infections, such as PCP.

AIDS encompasses multiple epidemics with different patterns in different communities. Therefore, no single public health or medical intervention will be effective in stopping the spread of the disease. Responding to this has required not only a national effort but also activity at the local and state levels. The public health and medical communities continue to confront the AIDS challenge together.

**Partnerships for Reducing Unintentional Injury**

Injury is the third leading cause of death in the United States and the leading cause of death for children and young adults (NCHS, 1993). Each year, injuries result in 4.3 million potential years of life lost prematurely before age 70, compared with fewer than 3 million potential years of life lost each from cancer and heart disease and 400,000 potential years of life lost each from AIDS and stroke.

Nonfatal injuries result in 114 million visits to physicians every year; more than one-quarter of all visits to emergency rooms are for injuries. Injuries are the leading cause of hospital admissions for people under age 45, and this year one in four Americans will have a potentially preventable injury serious enough to require medical attention. Injuries place a tremendous burden on the U.S. economy. The aggregate lifetime cost for persons injured in 1985 was $158 billion. Almost
A Behavioral Approach to Injury Prevention in California

A n injury prevention program operated by the Contra Costa Health Services Department in California took a long-term behavioral approach to reducing motor vehicle injuries among children. State law required that children under four years of age be secured in a child safety seat, but the health department felt that the law alone would not promote safety and behavior change. A coalition including health, traffic, and other local government agencies; health care professionals; private industry; and community-based organizations worked to increase the fine for not having a child in a safety seat and directed a major portion of this fine to the health department to provide education and child-seat subsidies for low-income families. The program will be fully operational in September 1994.

The California legislature amended the original state law to direct local law enforcement agencies to give a portion of the fine to their health departments to implement similar programs (Leahy, personal communication). The state Department of Motor Vehicles also modified its traffic offenders’ course to include a session on child passenger safety.

Three-fourths of these costs were incurred during the first year after injury (Rice et al., 1989).

One obstacle to reducing the incidence of injuries is the widespread belief that injuries are “accidents” that occur by chance and are unavoidable. In fact, most injuries, like many diseases, can be attributed to preventable behavioral and environmental factors. Applying a public health model to the injury problem demonstrates that control programs can work to reduce the incidence and severity of injuries. These programs have in common the application of public health principles of surveillance, risk-factor identification, development of interventions, and evaluation.

Reduction in injuries from motor vehicle crashes illustrates the effectiveness of public health interventions. In 1966, motor vehicle crashes resulted in 50,894 deaths, or 26 deaths for every 100,000 people in the United States. By 1992, crash-related deaths had dropped to 39,235, or 15 deaths for every 100,000 people, the lowest level ever. The dramatic decrease is largely attributable to changes in the environment, vehicles, and personal behavior. A partnership of public health, medical care, and highway safety experts helped increase the use of safety belts, child safety seats, and motorcycle and bicycle helmets; reduce drunk driving; and substantially improve emergency medical services. Highways have become safer as well. This partnership saved thousands of lives and many more injuries each year (see Figures CS-18 and CS-19).

The model used to reduce motor vehicle injuries is applicable to other important types of injury problems, such as burns, drowning, poisoning, and falls. Further reducing all injuries and their associated medical care costs requires continuing public health surveillance and research, building partnerships with public and private organizations and grassroots citizen coalitions, and developing state and local health department strategies and control programs.

Figure CS-19 Observed and Projected Annual Motor Vehicle Fatalities, 1966–2015

Observed and projected annual fatalities with multiple prevention actions such as use of seat belts and child safety seats, changes in minimum drinking age laws, airbags, improved road design, and improved vehicle design.

Source: National Highway Traffic Safety Administration and Battelle
Maryland Aims to Get Helmets on Bicyclists

Each year bicycle crashes cause approximately 900 deaths, 20,000 hospital admissions, and 580,000 visits to emergency rooms. About 80% of deaths and 40% of admissions involve head injury (Baker, 1993). Even though bicycle helmets reduce the risk of head injury by 85%, only 15% of riders wear them. If all bicyclists had worn helmets from 1984 through 1988, as many as 2,500 deaths and 757,000 head injuries could have been prevented (Sacks et al., 1991).

In Maryland public health has promoted helmet use. The initiative began in 1990 in Howard County after two children who were not wearing helmets were killed while bicycling. Following local efforts and testimony by health department staff and others, the county council passed a law requiring that children wear helmets when riding bicycles. The local health department distributed helmets and provided educational programs in the schools. A state and local health department study showed that helmet-use rates rose from 4% before the law was passed to 47% after (Cote, 1992).

In Montgomery County a helmet law was passed in 1991, largely as a result of the local health department's testifying before and presenting data to the county council. Public health collaborated with schools to teach bicycle safety and joined with a local health maintenance organization, the SAFEKIDS coalition, and bicycle shops to promote helmet use. The Allegany County Health Department used the same approach to pass a similar law in 1992.

Leadership to increase helmet use and increase bicycle safety awareness is also taking place on the state level. The Maryland health department is creating awareness of the issue, disseminating surveillance data, bringing together people to address the problem, testifying before state and local legislatures, and continuing to be involved in the governor's statewide bicycle advisory committee.
Many of the problems discussed in this report affect teenagers and young people. STDs and AIDS, unintended pregnancy, tobacco, drug and alcohol problems, and violence are often thought of as independent problems. Because these problems are so often experienced simultaneously by this vulnerable group, multipronged approaches are needed to support adolescents.

Violence, substance abuse, and high-risk sexual behavior among adolescents are not found solely among the poor and disadvantaged. Virtually all young people are at risk because of peer and other social pressures. Evidence suggests that high-risk behavior such as fighting, carrying weapons, using marijuana or cocaine, and engaging in sex with multiple partners is more common among young people age 12 to 19 who drop out of school than it is among adolescents who remain in school (MMWR, 1994).

A Multifaceted Problem

The basis of public health strategies is understanding the problem—where it is located, how it is distributed by age and demographic factors, and what risk factors can form the basis for public health intervention. Epidemiologic studies of substance abuse, high-risk sexual behavior, unintended pregnancy, and violence convey a grim picture of life for adolescents in the United States.

These problems need to be addressed collectively. First, students must stay in school where they can be reached by prevention programs and can build self-esteem through academic achievement. Such programs require cooperation among parents and the education and public health systems. Pregnancy prevention programs among adolescents are likely to fail if participants drop out of school because of boredom or substance abuse. In addition, efforts to prevent substance abuse may fail if parents are absent or abusive. No prevention and intervention programs can succeed for the adolescent who becomes a firearms statistic. With the aid of the public health model, communities can go beyond stopgap approaches to single problems and mount comprehensive programs that address the full range of problems.
during the late 1980s, recent data show that this trend may be reversing. Not only did a recent survey show that marijuana use is increasing among high school students, smaller rises are occurring in use of LSD, prescription stimulants such as amphetamines, and inhalants.

Public health officials have long been concerned about the specific risks to youth of high-risk sexual behavior. Sexual experimentation can lead to diseases such as chlamydia or syphilis, which can cause infertility. Also, of increasing seriousness today is the risk of HIV infection among teenagers. Last, each year more than one million teenagers—12% of all females between age 15 and 19—become pregnant, most unintentionally.

Every day interpersonal violence results in approximately 65 deaths and an additional 6,000

### Defining the Problem: Substance Abuse, High-Risk Sexual Behavior, and Violence Among Youth

#### Substance Abuse
- According to the 1992 Monitoring the Future survey, adolescents age 12 to 17 reported that 14% had used marijuana and 0.3% had used cocaine within the previous month. These figures represented small decreases in marijuana and cocaine use compared with 1988 responses to the same survey. Some 16% of teens had used alcohol in the past month, a decrease of 10% from the 1988 value (SAMHSA, 1993).
- Recently released data from the 1993 Monitoring the Future study indicate that marijuana use is higher among 8th, 10th, and 12th graders in 1993 than in 1992. Although the use of cocaine remained level between 1992 and 1993, fewer students in each grade level felt that using illicit drugs entailed a risk of harm. The 1992 National Household Survey on Drug Abuse indicated that only about 54% of youths age 12 to 17 believe that using cocaine once or twice presents a great risk (SAMHSA, 1993).
- Smoking poses a major health risk to the nation’s youth. Those who start smoking before age 25 have a 10- to 13-fold higher risk of having lung cancer than people who begin smoking when they are older (Hegmann et al., 1993). A 1992 survey reported that 25.4% of 14- to 27-year-olds had smoked cigarettes within a month preceding the survey.

#### High-Risk Sex-Related Behavior
- Among high school students, 61% of males and 48% of females reported having had sexual intercourse at least once. By the time they are seniors, 70% of males and 67% of females reported having had sexual intercourse (MMWR, 1992).
- About 15% of the reported AIDS cases in New York state are among young adults age 20 to 29 years. Since there is an average 8- to 10-year delay between infection and development of AIDS, many of these young adults became infected with HIV while they were teenagers (New York State Department of Health).
- The pregnancy rate for teenagers age 15 to 19 was 117 per 1,000 women in 1990, a 23% increase since 1972. An estimated 85% of these pregnancies were unintended. About 83% of these unintended pregnancies end in abortion (Alan Guttmacher Institute, 1994).

#### Violence and Suicide
- A national survey of high school students showed that nearly 20% had carried a weapon to school at least once in the preceding month. One-fifth of those who had carried a weapon had carried a firearm (MMWR, 1991a).
- More than 8% of high school students reported making at least one attempt at suicide in the preceding 12 months. Two percent of students made attempts that were serious enough to require medical attention (MMWR, 1991b).
injuries (NCHS, 1992). Violence is most often perpetrated by and directed at adolescents and young adults. Arrest rates for homicide, rape, robbery, and aggravated assault in the United States peak among older adolescents and young adults. Based on interviews with assault victims, persons age 12 to 24 committed almost half of the estimated 6.4 million nonfatal crimes of violence in 1991. Homicide rates among young American men are higher than in any other Western industrialized nation and persons age 12 to 24 face the highest rate of nonfatal assault of any age group in the United States.

Children are at particularly high risk of violence. An estimated 1,000 to 2,000 children died from abuse and neglect in the United States in 1988 (McClain et al., 1993), and at least 1.6 million children experienced nonfatal abuse and neglect in 1986 (Westat, 1988). Long-term consequences of this abuse include depression, poor self-esteem, alcohol and substance abuse, self-destructive behavior, and aggression. These problems may persist into adulthood resulting in child and partner abuse and other types of violent crime.

Violent acts in the United States appear to be increasing in frequency and severity (Mercy et al., 1993). During the 1980s, acts of violence accounted for more than 215,000 deaths and 20 million nonfatal injuries. Violence involving firearms is the second leading cause of fatal injury in the United States, accounting for nearly 20,000 deaths in 1990. If current trends continue, cumulative firearms-related deaths among people age 10 to 34 are projected to exceed 700,000 between 1994 and 2015. The direct annual medical costs from these fatal and nonfatal gunshot wounds are projected at $34 billion in 2015 (see Figures 3-1 and 3-2). Adequate support for population-based prevention strategies could help interrupt this trend. Decreasing firearms-related deaths by 50% between 1993 and 2015 would save more than 350,000 lives (Battelle).
Intervening to Protect Teenagers

Public health interventions try to reduce the consequences of substance abuse, high-risk sexual behavior, and violence to adolescents by providing them with tools to resist these behaviors and move successfully into adulthood. Most interventions aimed at adolescents are similar in content whether they address smoking, unintended pregnancy, or violence in school. They:

- Provide teens with an opportunity to build self-esteem by demonstrating competence in school, work, sports, drama, or community activity.
- Promote alternatives to high-risk behaviors by means of peer counselors, community role models, and public figures.
- Teach skills needed by teens to remove themselves from risky situations and to resist unhealthy peer influences.
- Help teens build relationships with caring adults by involving parents, teachers, and other adults in the problem-solving process.
- Help teens to access health care, social services, and other resources needed to establish and maintain new patterns of behavior.

Preventing the use of "gateway drugs"—marijuana, alcohol, and tobacco—can break the cycle of incomplete education, unemployment, family disruption, and addiction. Approaches to preventing adolescent substance abuse are geared toward shrinking the supply of drugs—by means of laws and ordinances against drug trafficking and use—and reducing demand. Public health strategies seek to prevent substance abuse through school and community-based programs that reduce demand by giving teens tools to resist environmental and social pressure to experiment with drugs.

Community coalitions, such as Mothers Against Drunk Driving, are mobilizing across the country to fight substance abuse. Joining forces in this effort are national, state, and local public health agencies. Inner-city and rural communities alike have been building coalitions and partnerships among community leaders and health care providers through the Community Partnership Demonstration Grant Program and other initiatives. These grassroots efforts provide an opportunity for communities to design programs that simultaneously address substance abuse, teen pregnancy, and intentional and unintentional injuries.

Also using a public health model, schools and community groups are reaching out to educate teens about sexuality, contraception, and changing attitudes and behavior toward early sexual activity. A new trend in these programs is to provide teens with alternatives to early sexual involvement. One promising program, developed at Grady Hospital in Atlanta, Georgia, uses high school teen leaders to help 13- and 14-year-old girls resist pressure to become sexually active. Early statistics show that Atlanta teenagers participating in the "Postponing Sexual Involvement" program are one-third less likely to become pregnant before graduation (Howard et al., 1990). A similar initiative, ENABL (Education Now and Babies Later), has been implemented in California (Brindis, personal communication). The benefits of such well-designed, multistrategy pregnancy prevention programs exceed their costs (Battelle, 1994).

In addition to being a law enforcement problem, violence is now recognized as a public health issue. Application of public health strategies and interventions to decrease and prevent additional violence in the community is relatively new. The public health community is mobilizing resources by expanding surveillance of violence, including tracking firearms-related deaths and
Reducing Unintended Teen Pregnancy in Rural South Carolina

Bamford County, South Carolina, began a community-wide public health project in 1982 using multiple interventions to reduce pregnancy among teenagers. Public health professionals coordinated a public-private initiative to tackle this social problem. The strategies focused on health education and information as well as enabling responsible sexual behavior. Teens and younger children learned about human reproduction as part of the school curriculum. Parent, clergy, and other community leaders were offered mini-courses and lectures on parenting skills and serving as role models. Continuing education classes were made available at a nearby university for teachers and school administrators. In addition, the school nurse provided condoms on request and arranged for transportation to county family planning clinics.

Researchers in the School of Public Health at the University of South Carolina found that the rate of pregnancy for 14- to 17-year-old girls in the program declined substantially—from 67 pregnancies per 1,000 adolescents to approximately 20 pregnancies per 1,000 adolescents after three years. Three control counties that did not apply the multiple intervention strategies did not show similar declines in pregnancy rates.

During the fourth year of the study, however, the program lost momentum when the program lost funding for some of its elements, including the school nurse. Without the nurse it became much more difficult for the teenagers to obtain access to family planning services. Further, many of the trained teachers left the school system, decreasing the impact of the school-based education program. The next year, the pregnancy rate for teenage girls in Bamford County rose to a level roughly similar to those in the comparison counties—approximately 40 pregnancies per 1,000 adolescents (Vincent, 1991) (see Figure 3-3). The unhappy ending to an almost success story underscores the need to maintain momentum on all fronts, including adequate program funding and strong coordination by the public health community.

**Figure 3-3 Effects of a Program to Reduce Teen Pregnancy in Intervention and Comparison Counties**

Teen pregnancy rates in a portion of Bamford County, South Carolina, where a program to reduce teen pregnancy was active starting with the beginning of the 1982 school year and decreased in 1986, compared to other counties. Rates are for females between 14 and 17 years of age. Estimated pregnancy rate (EPR) = (livbirths + fetal deaths + induced abortions)/female population) x 1000.

Source: Vincent et al., 1991
Public health often acts as the catalyst in local and state efforts to develop prevention and intervention programs. Violence prevention initiatives in Seattle-King County illustrate how the public health system can provide the coordination and resources necessary to improve the health and well-being of the community.

In the Seattle-King County area of Washington state, the level of violent crime (including homicide, rape, robbery, and aggravated assault) rose by 12% between 1988 and 1992. The homicide rate among young people age 15 to 24 doubled from 1988 to 1992; more than 80% of all homicides involved a gun. Wounds from firearms were the leading cause of death for this age group.

A strong coalition of community groups applied a public health approach to reducing violence in the community through:

- Prevention programs and treatment for persons involved in domestic violence;
- Parenting and family support programs to prevent child abuse;
- Therapeutic daycare to treat abused children;
- Substance abuse treatment for parents and
- General social and family support, including jobs and low-cost housing.

Led by public health professionals, the community-wide effort developed a policy agenda for reducing family violence and recommended a ban on handguns by the year 2000. Supportive services for children and young people were expanded. Town meetings educated the public about the seriousness of the violence problem and the importance of taking preventive measures. Legislation was enacted to raise the minimum age for possessing a handgun from 14 to 18 years. Public health agencies are currently evaluating these efforts to assess effectiveness and impact.

Injuries; identifying causes and potential interventions; developing and field-testing public information and educational campaigns on violence; training health professionals to identify victims of family violence; assisting community groups in organizing campaigns against violence and to control firearms; and working with legislators to pass stringent laws to restrain the presence of firearms in schools, homes, workplaces, and on the street.

Into the Future

The changing nature of America's health threats requires public health to apply its methods in new ways. The public health infrastructure provides the skills and leadership to affect the vexing behavioral problems of our youth. Data collection and analysis supply information on the magnitude of the problems and permit resources to be targeted to appropriate populations. Epidemiologic and behavioral research identify risk factors and approaches to their control. Information dissemination educates communities and provides direction for mobilization to contain and prevent further behaviorally mediated health problems. Public health professionals and researchers working with law enforcement, social services, and education professionals craft programs to reach out to adolescents. Working with the media, public health shapes social marketing campaigns designed to change community attitudes. Evaluation of the effectiveness and the cost-effectiveness of new programs allows decision-makers at local and national levels to make informed judgments about the wider applicability of demonstration projects.
Over the past century, the profile of disease, injury, and death has changed dramatically. While new infectious killers such as AIDS have arisen, hazards to health and life from others have diminished because of advances in medical therapies, improvements in housing, and protection of food and water. The average lifespan of Americans has been extended by more than 30 years since 1900. Now death is most often due to the chronic illnesses of coronary artery disease, stroke, and cancer.

This change in the pattern of illness and death has altered our perceptions of health threats and health care. Infectious diseases generally are viewed as relatively minor threats to collective well-being; the safety of food and water supplies is largely assumed. Americans see medical technology and pharmacology as the primary means to maintain health and save lives. These beliefs are bolstered by government and business decisions that have steadily supported a rapidly growing medical care budget. Illness, injury, and death from substance abuse, violence, and other risk-taking behaviors are considered social rather than health problems, and preventive solutions are sought principally in the social services and law enforcement sectors with treatment by the medical care system.

These perceptions are only partly accurate. New infectious organisms are emerging and old agents are developing resistance to currently available therapeutic drugs. Most preventable disability and premature death are caused by conditions that are not amenable to medical intervention. Many threats to health that are deemed social in origin require public health approaches. Environmental and behavioral risks to health call for prevention-oriented public health strategies. Monitoring, surveillance of health status and disease burden, research, education, regulation, and community mobilization all make contributions to the effort to understand and control public health problems.

As the health needs of the country have changed, public health has shifted its focus and adapted its tools to meet current problems. Activities such as monitoring deaths and injuries related to the use of firearms and motor vehicles, charting patterns of infectious and chronic disease, and identifying associations between environmental toxins and illness are ways in which public health remains alert to threats to the nation’s well-being.

Public health actions at local levels have stimulated coalitions among business, community, medical care facilities, and voluntary health
organizations to allow more comprehensive responses to health challenges. And increasingly in state and national arenas, the multifaceted medical care delivery system is assisted in monitoring and ensuring the quality of its care by public health agencies. The need continues for the visionary and practical action that is characteristic of public health.

Divestments and Investments in Public Health

In 1992, an estimated $34 per person was spent on public health functions in this country (Public Health Foundation, 1994) in contrast to $3,007 per person for medical care services (Burner et al., 1992). The development of a powerful and expensive curative-care system has diverted public attention and resources from support for an increasingly fragile public health system. As the medical care budget has grown, decision-makers have increasingly looked to public health programs to support personal care services for the uninsured. This diversion of resources has resulted in decreased capacity to perform core public health functions in public health agencies throughout the country.

Reduced support for public health not only diminishes a community’s ability to respond to public health emergencies; it also detracts from proactive efforts to maintain the well-being of the public. Failure to support the development of innovative strategies and interventions for preventing health problems at the community level results in increased pressure on the medical care delivery system.

By the year 2000, nearly one dollar of every nine spent on medical care for six of the conditions detailed in the case studies—low birthweight, firearms injuries, coronary heart disease, stroke, occupational injuries, and motor vehicle injuries—could be averted by a strong public health system (Battelle). Because there is a lag between investments in prevention and improvements in health outcomes, public health initiatives generate medical care savings at an accelerating rate. Efforts to address the problem of low birthweight, for example, would show relatively nominal effects in 1994 and 1995, but by the year 2000 would avert total costs of $2.7 billion (see Figure 4-1).

The resurgences of infectious diseases, failures to improve infant mortality rates, and increases in teenage pregnancy described in this report have all occurred when public health resources are inadequate. Neglect of the public health system will create greater burdens of disease and injury, at still higher cost to the medical care system.

**Figure 4-1 Percent of Medical Care Expenditures Potentially Averted for Six Selected Conditions, 1994-2000**

[Diagram showing percent of direct medical care costs potentially averted for six selected conditions, 1994-2000]

Foregone medical service costs arising from investments in public health for injuries and deaths for six conditions: motor vehicle-related (MVINJ), occupational-related (OCCINJ), stroke (STROKE), coronary heart disease (CHD), firearms-related (FIREARMS), and low birthweight babies (LBW-BABIES). The percentage of direct medical care costs that can be averted for these six conditions as a result of public health efforts increases from 4% in 1994 to nearly 11% in the year 2000.

Source: Battelle
A Leadership Role for Public Health

The changes in the medical care delivery system resulting from health care reform will have important implications for the accessibility, quality, and organization of personal care services. Universal insurance will provide currently uninsured Americans with the opportunity for more timely use of personal health services. The growth of managed care and capitated plans will increase attention on improving the outcomes of service and the satisfaction of plan members. If people can stay with their insurers when switching jobs, managed care organizations will have further incentive to maintain the health of their patients on a long-term basis. Clinical preventive services—such as mammography, immunizations, and cholesterol screening—will then see greater promotion by plans and insurers. Managed care organizations that use population-based strategies for disease prevention and health promotion will register improvements in health status and patient satisfaction, providing financial stability to their plans.

But the medical care delivery system alone cannot improve the health of the nation. Universal insurance for medical care will not ensure that access to services will improve for groups with historical difficulties entering the medical system, such as the frail, the uneducated, and the foreign-born. Adequate linkages to medical care need to be monitored, and in some cases provided, by a strong public health system. Even if incentives increase for medical care plans to take broader perspectives in health, those perspectives will be targeted toward their membership. Public health data systems will need to monitor the health of diverse peoples belonging to diverse systems of care to ensure that differences in health status and risks are noted and addressed.

Finally, the majority of conditions responsible for premature death and disability in the United States are simply inappropriate for medical care delivery system action. They require response on the wider fronts of monitoring, research, education, and community protection and mobilization where public health operates. The tools of public health allow state, local, and national public health agencies to take the broad and long view of the health of their communities.

Public health must retain its leadership role in protecting and promoting the health of the American public. Substantial improvements in the level of health in the United States continue to be the responsibility of the public health system. Wise health care reform will direct sufficient resources to support and strengthen the capacities of the public health system into the future.
COST PRODUCTION AND DISCOUNTING METHODS

All cost projections in this document—both future and retrospective—were developed using a consistent method for adjusting for price changes occurring over time. The basic approach matches that of the Cost of Injury report and Max and Rice (1993). For projecting the direct costs of medical care, Max and Rice proposed using the reported increase in personal health care expenditures as published by HCFA for the National Health Accounts. HCFA's method combines the joint effects of health care inflation and changes in the average intensity of treatments.

HCFA's methods were adopted in both adjusting past medical care costs and projecting future costs. Future cost projections used a series of HCFA National Health Projections for expenditures through 2030 (Burner et al., 1992). Implicit in these projections is an increase in personal health care expenditures of nearly 8.5% per year in nominal terms from 1993 to 2020. Interpolations were used to estimate specific years between 1994 and 2015 not reported in Burner et al.

Estimates of the present value (in 1994 dollars) of both future and past costs of illness (or costs of avoided illness) use 6% discount rate. This rate was used in both the Cost of Injury report and Max and Rice (1994). For example, medical services projected to cost $100 dollars in 2004 would have a present value of $55.84 in 1994 dollars. It was not possible to recalculate published estimates of illness costs that may have used different assumptions about future prices. Those costs were accepted as given for the year or years of the original analyses and recalibrated to represent their value in 1994 dollars. Future costs were discounted to compute their present value in 1994 dollars.


Chapter 1

Figure 1-1. MMWR, Summary of Notifiable Diseases, October 29, 1993.

Figure 1-2. Battelle, Cost Benefit Analysis of the Oral Poliomyelitis Vaccine, 1994. Preventable fraction estimated to be 50% of expected cases in absence of public and private vaccine program, based on expert opinion. Future model assumes 1992 rate of cases projected to successive future birth cohorts; the same preventable fraction of 50% is used to estimate preventable cases due to public health.

Figure 1-4. Source: Public Health Foundation.

Chapter 2

Figure 2-1. MMWR, April 16, 1993.


Table: Leading Causes of Occupational Injury and Death; NIOSH, 1993 and unpublished data.


Case Studies

Figure CS-1. Hodgson TA. Milbank Q 1992: 70:81-125. Costs are based on lifetime medical expenditures from age 17, discounted by 3% annually. Costs are in 1994 dollars.

Figures CS-2 and CS-3. Wamer KE. Am J Public Health 1989; 79:144-151 and Battelle. Reported prevalence for 1950-1990 is based on annual National Health Interview Survey data; projected prevalence for 2000 and 2010 was estimated by extrapolating smoking rates for these cohorts from earlier years. Expected prevalence in the absence of anti-smoking activities is based on age and gender-matched smoking prevalence rates before 1964 and on extrapolations of these values.


Figure CS-5. MMWR, May 29, 1992. Estimated expenditures derived by applying the discounted cost for a silver filling to the estimated total number of decayed, filled, or missing teeth for each age group in each time period. (Battelle).

Figure CS-6. PHS. Disease Prevention Through Vaccine Development and Immunization. The U.S. National Vaccine Plan, 1994; and MMWR, February 4, 1994.

Figure CS-7. Battelle, Cost benefit analysis of the DTP Vaccine, 1994; Cost benefit analysis of MMR, 1994. Historic cases adjusted for underreporting. Public health preventable fraction estimated to be 50% of total expected cases in absence of public and private vaccine program, based on expert opinion. Future model assumes 1992 rate of cases projected to successive future birth cohorts; the same fraction of 50% was used to estimate cases prevented as a result of public health.

Figure CS-8. MMWR, December 10, 1993.

Figure CS-9. PHS. The number of cases shown in the model are based on 1987 data. Model originally developed by Ferebee in 1967.

Figure CS-10. Historic cases based on CDC surveillance data. Expected cases based on average annual 5.8% decline observed from 1953 to 1985 and adjusted to show 25% of the decline as not related to public health activities. With public health 75% (765,000) of expected cases did not occur.

Figure CS-11. MMWR, Sept 17, 1993. Expected cases based on the 1980-1984 trend of decline in cases. Observed cases as reported to CDC. To estimate the number of TB excess cases attributed to declines in public health activities, the same preventable fraction (75%) was applied to the total number of excess TB cases that occurred up to 1992, for a total of 39,000 cases.

Figure CS-12. Prepared by NHLBI; data from Vital Statistics of the U.S., NCHS, 1993.

Figure CS-14. Battelle. Projections of deaths derived from 1992 age-specific mortality rates applied to projected age distribution to year 2015. Assumes that with biomedical and public health activities, mortality will decrease by two-thirds by the year 2015. Annual deaths between 1993 and 2015 were interpolated from the 2015 number. Of this decline, the fraction attributed to public health action is 50%.


Figure CS-16. Savings based on difference between projected numbers of LBW births with 1989–1991 rate compared with a lower rate representing attainment of Healthy People 2000 objectives assuming a linear decrease in rate from 1995 to 2000 and no subsequent decrease. Rates applied to projected births from Bureau of the Census Population Projections 1993–2050. Costs based on Institute of Medicine “Preventing Low Birthweight” estimate of direct medical costs adjusted to 1994 price levels.

Figure CS-17. CDC surveillance data and Harris and Rattner, 1992. Estimates of annual HIV incidence were derived from CDC published reports of annual AIDS cases using a back-calculation model (Harris CV, Rattner E. Computers Ops Res 1992;19:79–93). The impact of a one-year delayed mobilization of public health systems on HIV incidence was estimated by taking the rate of increase in new HIV cases (the infection multiplier) from 1983 to 1984 and extrapolating this factor to the 1984–1985 period. Rates of increase of new HIV cases for all subsequent years were the same as in the base model delayed by one year. Medical care costs for HIV were taken from Guinan ME et al., Am J Prev Med 1994;10:1–4.


Figure CS-19. Deaths from 1966 to 1974 derived from NCHS data; deaths from 1975 to 1992 derived from National Highway Traffic Safety Administration Fatal Accident Reporting System. Projected deaths in absence of interventions based on constant 1966 rate (26.02/100,000 population). Projected deaths in presence of intervention based on 1% per year decrease, 1993–1995; 0.5% per year decrease, 1996–2000; and 0.4% per year decrease, 2001–2015.

Table: Protecting the Blood Supply from Infectious Agents: Battelle from multiple sources. As 80% of individuals infected with hepatitis B do not develop symptoms requiring medical treatment, and 75% of those who do seek medical care receive only outpatient treatment, the cost per case of hepatitis B infection is much lower than the cost of HIV infection.

Table: Estimated Incidence of Selected Sexually Transmitted Diseases in the U.S: CDC, DSTD/HIV Prevention.

Chapter 3

Figure 3-1. Firearms deaths were calculated by applying estimated firearms death rates to census-projected population totals by age, race, and gender. Firearms deaths include homicides, suicides, and unintentional injuries. Data on firearms mortality trends from Fingerhut LA. Firearm mortality among children, youth, and young adults 1–34 years of age, trends and current status: U.S. 1985–1990. *Advance Data from Vital and Health Statistics* 231, Hyattsville, MD; NCHS, March 23, 1993. Trends observed in these data were extrapolated by Battelle to the year 2015.

Figure 3-2. There are no data on the number of nonfatal firearms injuries. Experts estimate from 2.5 times to 20 times more injuries than deaths. This analysis used conservative estimates. The low estimate assumes three times more nonfatal injuries as deaths and the high estimate assumes six times as many. The costs of direct medical care for nonfatal gunshot injuries were derived from the *Cost of Injury Report*.

Figure 3-3. Program data are from Vincent et al., 1991. Data on pregnancy rates are from the South Carolina Department of Health and Environmental Control.


Chapter 4

Figure 4-1. Battelle models. Potential averted direct medical care costs were estimated using condition-specific projections for each of the six conditions. Each of these projections produced estimates of both averted cases and the number of cases that could be expected in the absence of public health efforts. Costs per case were calibrated to represent their 1994 present values. Total costs averted were summed over the six conditions and compared to the total direct cost that otherwise would be expended for those treatments. This was 4% of such costs for 1994 and nearly 11% for the year 2000. The direct costs averted for each condition were then expressed as a percentage of the sum of costs averted across the six conditions. For example, the projected costs averted for coronary heart disease for the year 2000, $5.8 billion, represent 35% of total averted costs for the six conditions for that year, or nearly 4% of direct costs that otherwise would be expended.

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