

## **TEN GREAT PUBLIC HEALTH ACHIEVEMENTS -- UNITED STATES, 1900-1999<sup>1</sup>**

During the 20th century, the health and life expectancy of persons residing in the United States improved dramatically. Since 1900, the average lifespan of persons has lengthened by greater than 30 years; 25 years of this gain are attributable to advances in public health. To highlight these advances, New Hanover County Health Department will profile ten public health achievements in a series of monthly reports.

Many notable public health achievements have occurred during the 1900s, and other accomplishments could have been selected for the list. The choices for topics were based on the opportunity for prevention and the impact on death, illness, and disability and are not ranked by order of importance.

Future reports that will appear throughout the remainder of 2000 will focus on ten achievements:

- Vaccination,
- Motor-vehicle safety,
- Safer workplaces ,
- Control of infectious diseases,
- Decline in deaths from coronary heart disease and stroke,
- Safer and healthier foods,
- Healthier mothers and babies,
- Family planning,
- Fluoridation of drinking water, and
- Recognition of tobacco use as a health hazard.

<sup>1</sup> Morbidity and Mortality Weekly Report, Centers for Disease Control and Prevention

## VACCINATIONS

The first report in this series focuses on vaccination, which has resulted in the eradication of smallpox; elimination of poliomyelitis in the Americas; and control of measles, rubella, tetanus, diphtheria, Haemophilus influenzae type b, and other infectious diseases in the United States and other parts of the world. At the beginning of the 20th century, infectious diseases were widely prevalent in the United States and exacted an enormous toll on the population. In 1900, few effective treatment and preventive measures existed to prevent infectious diseases. Although the first vaccine against smallpox was developed in 1796, greater than 100 years later its use had not been widespread enough to fully control the disease. Four other vaccines -- against rabies, typhoid, cholera, and plague -- had been developed late in the 19th century but were not used widely by 1900. Since 1900, vaccines have been developed or licensed against 21 other diseases.

During the 20th century, substantial achievements have been made in the control of many vaccine-preventable diseases. National efforts to promote vaccine use among all children began with the appropriation of federal funds for polio vaccination after introduction of the vaccine in 1955. Since then, federal, state, and local governments and public and private health-care providers have collaborated to develop and maintain the vaccine-delivery system in the United States.

Dramatic declines in morbidity have been reported for the nine vaccine-preventable diseases (Smallpox, pertussis, tetanus, poliomyelitis (paralytic), measles, mumps, rubella, congenital rubella, and haemophilus influenzae type b) for which vaccination was universally recommended for use in children before 1990. Smallpox is the only disease that has been eradicated. The last documented indigenous transmission of wild poliovirus in the United States occurred in 1979. Since then, reported cases have been either vaccine-associated or imported. Measles vaccine was licensed in the United States in 1963. The first Haemophilus influenzae type b vaccines (Hib) were licensed in 1985. In less than a decade, the use of the Hib vaccines nearly eliminated Hib invasive disease among children.

Vaccines are one of the greatest achievements of biomedical science and public health. Despite remarkable progress, several challenges face the U.S. vaccine-delivery system. The infrastructure of the system must be capable of successfully implementing an increasingly complex vaccination schedule. In addition, licensure of new vaccines is anticipated against infections and against chronic diseases.

Despite the dramatic declines in vaccine-preventable diseases, such diseases persist, particularly in developing countries. Efforts are needed to expand the use

of existing vaccines in routine childhood vaccination programs worldwide and to successfully introduce new vaccines as they are developed. Such efforts can benefit the United States and other countries.

## **MOTOR VEHICLE SAFETY**

Improvements in motor-vehicle safety have resulted from engineering efforts to make both vehicles and highways safer and from successful efforts to change personal behavior (e.g., increased use of safety belts, child safety seats, and motorcycle helmets and decreased drinking and driving). These efforts have contributed to large reductions in motor-vehicle-related death.

The reduction of the rate of death attributable to motor-vehicle crashes represents the successful public health response to a great technologic advance of the 20th century--the motorization of America. Six times as many people drive today as in 1925, and the number of motor vehicles in the country has increased 11-fold.

Annual motor vehicle crash related fatalities involving alcohol has decreased 39% since 1982. Factors that may have contributed to this decline include increased public awareness of the dangers of drinking and driving; new and tougher state laws; stricter law enforcement; an increase in the minimum legal drinking age; prevention programs that offer alternatives such as safe rides, designated drivers, and responsible alcohol-serving practices; and a decrease in per capita alcohol consumption.

Since 1975, the motor-vehicle-related fatality rate has decreased 27% for young motor-vehicle occupants (ages 16-20 years). Strategies that have contributed to improved motor-vehicle safety among young drivers include laws restricting purchase of alcohol among under-aged youths and some aspects of graduated licensing systems.

From 1975 to 1997, pedestrian fatality rates decreased 41%, but still account for 13% of motor-vehicle-related deaths. Factors that may have reduced pedestrian fatalities include more and better sidewalks, pedestrian paths, and playgrounds away from streets, one-way traffic flow, and restricted on-street parking.

In response to legislation, highly visible law enforcement, and public education, rates of safety belt use nationwide have increased from approximately 11% in 1981 to 68% in 1997. Safety belt use began to increase following enactment of the first state mandatory-use laws in 1984. All states have passed child passenger protection laws.

Despite the great success in reducing motor-vehicle-related death rates, motor-vehicle crashes remain the leading cause of injury-related deaths in the United States. Furthermore, motor-vehicle-related injuries led all causes for deaths among persons aged 1-24 years. The challenge for the 21st century is to sustain and improve motor-vehicle safety. Future success will require augmentation of the public health approach to 1) expand surveillance to better monitor nonfatal

injuries, detect new problems, and set priorities; 2) direct research to emerging and priority problems; 3) implement the most effective programs and policies; and 4) strengthen interagency, multidisciplinary partnerships.

## **IMPROVEMENTS IN WORKPLACE SAFETY**

At the beginning of this century, workers in the United States faced remarkably high health and safety risks on the job. Through efforts by individual workers, unions, employers, government agencies, scientists, and others, considerable progress has been made in improving these conditions. Despite these successes, much work remains, with the goal for all workers being a productive and safe working life and a retirement free from long-term consequences of occupational disease and injury.

Data from multiple sources reflect the large decreases in work-related deaths from the high rates and numbers of deaths among workers during the early 20th century. The decline in occupational fatalities in mining and other industries reflects the progress made in all workplaces since the beginning of the century in identifying and correcting the factors that contribute to occupational health risks. The declines can be attributed to multiple, interrelated factors, including efforts by labor and management to improve worker safety and by academic researchers. Other efforts to improve safety were developed by state labor and health authorities and through the research, education, and regulatory activities undertaken by government agencies. Efforts by these groups led to physical changes in the workplace, such as improved ventilation; safer equipment; development and introduction of safer work practices; and improved training of health and safety professionals and of workers. The reduction in workplace deaths has occurred in the context of extensive changes in economic activity, the industrial mix, and workforce demographics.

Despite the accomplishments, workers continue to die from preventable injuries sustained on the job. Increased attention to other areas, such as intervention effectiveness research, surveillance research methods, and organization of work, should guide continued efforts to reduce both occupational illnesses and injuries in the next century.

## **CONTROL OF INFECTIOUS DISEASES**

Control of infectious diseases has resulted from clean water and improved sanitation. Infections such as typhoid and cholera transmitted by contaminated water, a major cause of illness and death early in the 20th century have been reduced dramatically by improved sanitation. In addition, the discovery of antimicrobial therapy has been critical to successful public health efforts to control infections such as tuberculosis and sexually transmitted diseases.

Deaths from infectious diseases have declined markedly in the United States during the 20th century. This decline contributed to a sharp drop in infant and child mortality and to the increase in life expectancy. In 1900, the three leading causes of death were pneumonia, tuberculosis, and diarrhea and enteritis, which (together with diphtheria) caused one third of all deaths. Of these deaths, 40% were among children aged less than 5 years. In 1997, heart disease and cancers accounted for 54.7% of all deaths.

Public health action to control infectious diseases is based on the discovery of microorganisms as the cause of many serious diseases. Disease control resulted from improvements in sanitation and hygiene, the discovery of antibiotics, and the implementation of universal childhood vaccination programs. Scientific and technologic advances played a major role in each of these areas and are the foundation for today's disease surveillance and control systems.

Success in reducing morbidity and mortality from infectious diseases during the first three-quarters of the 20th century led to complacency about the need for continued research into treatment and control of infectious diseases. However, the appearance of AIDS, the re-emergence of tuberculosis, and an overall increase in infectious disease mortality during the 1980s and early 1990s provide additional evidence that as long as microbes can evolve, new diseases will appear. The emergence of new diseases underscores the importance of disease prevention through continual monitoring of underlying factors.

For continued success in controlling infectious diseases, the public health system must prepare to address diverse challenges, including the emergence of new infectious diseases, the re-emergence of old diseases, large foodborne outbreaks, and acts of bioterrorism. Ongoing research on the possible role of infectious agents is imperative. Continued protection of health requires improved capacity for disease surveillance and outbreak response at the local, state, federal, and global levels; the development and dissemination of new laboratory and epidemiological methods; continued antimicrobial and vaccine development; and ongoing research into environmental factors.

## **DECLINE IN DEATHS FROM HEART DISEASE AND STROKE**

Decline in deaths from coronary heart disease and stroke have resulted from risk-factor modification, such as smoking cessation and blood pressure control coupled with improved access to early detection and better treatment. Since 1972, death rates in the United States for coronary heart disease have decreased 51%. Heart disease has been the leading cause of death in the United States since 1921, and stroke has been the third leading cause since 1938; together they account for approximately 40% of all deaths.

Prevention efforts and improvements in early detection, treatment, and care have resulted in a number of beneficial trends, which may have contributed to declines in heart disease and stroke. These trends include:

- A decline in cigarette smoking among adults.
- A decrease in blood pressure levels.
- An increase in the percentage of persons with hypertension who have the condition treated and controlled.
- A decrease in blood cholesterol levels.
- Changes in the diet.
- Improvements in medical care, including advances in diagnosing and treating heart disease and stroke, development of effective medications for treatment of hypertension and hypercholesterolemia, greater numbers of specialists and health-care providers, an increase in emergency medical services for heart attack and stroke, and an increase in coronary-care units.

Despite remarkable progress, heart disease and stroke remain leading causes of disability and death. In addition, the overall declines in heart disease and stroke mortality mask important differences in rates of decline by race/ethnicity, sex, socioeconomic status, and geographic region.

Major public health challenges for the 21st century include:

- Reducing risk factor levels and preventing the development of adverse risk factors.
- Reducing the racial/ethnic disparities in heart disease and stroke mortality.
- Increasing the ability to reach underserved groups with appropriate and effective public health messages.
- Promoting policy and environmental strategies that enhance healthy behavior.
- Determining the relation between genetics and disease.
- Identifying new or emerging risk factors and determining their potential for public health intervention.

## **SAFER AND HEALTHIER FOODS**

Since 1900, safer and healthier foods have resulted from decreases in microbial contamination and increases in nutritional content. During the early 20th century, contaminated food, milk, and water caused many foodborne infections. Once the sources and characteristics of foodborne diseases were identified--long before vaccines or antibiotics--handwashing, sanitation, refrigeration, pasteurization, and pesticide application could control them. Healthier care, feeding and processing of animals also improved food supply safety.

### **Food Safety**

Perishable foods contain nutrients that pathogenic microorganisms require to reproduce. Prompt refrigeration slowed bacterial growth and kept food fresh and edible.

Another process that reduced the incidence of disease was pasteurization. Along with improved crop varieties, insecticides and herbicides have increased crop yields, decreased food costs, and enhanced the appearance of food. Without proper controls, however, the residues of some pesticides that remain on foods can create potential health risks.

Newly recognized foodborne pathogens have emerged in the United States since the late 1970s. Contributing factors include changes in agricultural practices and food processing operations, and the globalization of the food supply. Seemingly healthy food animals can be reservoirs of human pathogens. Improved surveillance, applied research, and outbreak investigations have explained the mechanisms of contamination that are leading to new control measures for foodborne pathogens.

New diagnostic techniques and the rapid exchange of information through use of electronic networks and the Internet will accelerate any 21st century improvement. CDC, the Food and Drug Administration, the U.S. Department of Agriculture (USDA), other federal agencies, and private organizations are enhancing food safety by collaborating in education, training, research, technology, and transfer of information and by considering food safety as a whole--from farm to table.

### **Nutrition**

The discovery of essential nutrients and their roles in disease prevention has been instrumental in almost eliminating nutritional deficiency diseases such as goiter, rickets, and pellagra in the United States. Because of food restrictions and shortages during the first world war, scientific discoveries in nutrition were translated quickly into public health policy; in 1917, USDA issued the first dietary recommendations based on five food groups; in 1924, iodine was added to salt to prevent goiter. While the first half of the twentieth century was devoted to preventing and controlling nutritional deficiency disease, the focus of the second half has been on preventing chronic disease. The Framingham Heart Study in

1949 identified the contribution of diet and sedentary lifestyles to the development of cardiovascular disease, and the effect of elevated serum cholesterol on the risk for coronary heart disease. With increased awareness, public health nutrition programs have sought strategies to improve diets. By the 1970s, food and nutrition labeling and other consumer information programs stimulated the development of products low in fat, saturated fat, and cholesterol.

The most urgent challenge to nutritional health during the 21st century will be obesity. In the United States, with an abundant, inexpensive food supply and a largely sedentary population, overnutrition has become an important contributor to morbidity and mortality in adults.

## **HEALTHIER MOTHERS AND BABIES**

At the beginning of the 20th century, for every 1000 live births, six to nine women in the United States died of pregnancy-related complications, and approximately 100 infants died before age 1 year. From 1915 through 1997, the infant mortality rate declined greater than 90% and the maternal mortality rate declined almost 99%. Environmental interventions, improvements in nutrition, advances in clinical medicine, improvements in access to health care, improvements in surveillance and monitoring of disease, increases in education levels, and improvements in standards of living contributed to this remarkable decline. Despite these improvements in maternal and infant mortality rates, significant disparities by race and ethnicity persist.

### **Infant Mortality**

Healthier mothers and babies have resulted from better hygiene and nutrition, availability of antibiotics, greater access to health care, and technologic advances in maternal and neonatal medicine. The decline in infant mortality is unparalleled by other mortality reduction this century.

Environmental interventions (e.g., sewage and refuse disposal and safe drinking water) played key roles in reducing infant mortality. Rising standards of living, including improvements in economic and education levels of families, helped to promote health. Declining fertility rates also contributed to reductions in infant mortality through longer spacing of children, smaller family size, and better nutritional status of mothers and infants.

Inadequate programs during the 1950s-1960s to reduce deaths among high-risk neonates led to renewed efforts to improve access to prenatal care, especially for the poor, and to a concentrated effort to establish neonatal intensive-care units and to promote research in maternal and infant health. During the late 1960s, after Medicaid and other federal programs were implemented, infant mortality declined substantially.

The reduction in vaccine-preventable diseases (e.g., diphtheria, tetanus, measles, poliomyelitis, and *Haemophilus influenzae* type b meningitis) has reduced infant morbidity and has had a modest effect on infant mortality. Advances in prenatal diagnosis of severe central nervous system defects, selective termination of affected pregnancies, and improved surgical treatment and management of other structural anomalies have helped reduce infant mortality. National efforts to encourage reproductive-aged women to consume foods or supplements containing folic acid could reduce the incidence of neural tube defects by half.

### **Maternal Mortality**

During the first half of the 20<sup>th</sup> Century, poor obstetric education and delivery practices were mainly responsible for the high numbers of maternal deaths. Most

births occurred at home with the assistance of midwives or general practitioners. Inappropriate and excessive surgical and obstetric interventions (e.g., induction of labor, use of forceps, and cesarean deliveries) were common. Deliveries, including some surgical interventions, were performed without following the principles of asepsis.

Since 1982, maternal mortality has not declined. However, more than half of maternal deaths can be prevented with existing interventions. The leading causes of maternal death are hemorrhage, pregnancy-induced hypertension (toxemia), and embolism.

### **Challenges for the 21st Century**

Despite the dramatic decline in infant and maternal mortality during the 20th century, challenges remain. Perhaps the greatest is the persistent difference in maternal and infant health among various racial/ethnic groups.

The increased use of assisted reproductive technology has led to an increase in multiple gestations and a concurrent increase in the pre-term delivery and low birth weight rates. Therefore, in the coming decades, public health programs will need to address the leading causes of infant mortality: deaths related to low birth weight and pre-term births and congenital anomalies. Effective strategies to reduce unintended pregnancy, to eliminate exposure to unhealthy lifestyle factors, and to ensure that all women begin prenatal care early are important challenges for the next century.

A thorough review of the quality of health care and access to care for all women and infants is needed to avoid preventable mortality and morbidity and to develop public health programs that can eliminate racial/ethnic disparities in health. Preconception health services for all women of childbearing age, including healthy women who intend to become pregnant, and quality care during pregnancy, delivery, and the postpartum period are critical elements needed to improve maternal and infant outcomes.

## **FAMILY PLANNING**

During the 20th century, the hallmark of family planning in the United States has been the ability to achieve desired birth spacing and family size. Fertility decreased as couples chose to have fewer children; concurrently, child mortality declined, people moved from farms to cities, and the age at marriage increased. Smaller families and longer birth intervals have contributed to the better health of infants, children, and women, and have improved the social and economic role of women. Despite high failure rates, traditional methods of fertility control contributed to the decline in family size. Modern contraception and reproductive health care systems that became available later in the century further improved couples' ability to plan their families. Publicly supported family planning services prevent an estimated 1.3 million unintended pregnancies annually.

### **Challenges for the 21st Century**

In the United States, unintended pregnancy remains a problem; 49% of pregnancies are unintended and 54% of these end in abortion. These rates remain significantly higher than rates of many other industrialized countries. Although pregnancy and childbearing rates for adolescent women have declined since 1991, the proportion of adolescent women who are unmarried at the time of giving birth has increased.

Access to high quality contraceptive services will continue to be an important factor in promoting healthy pregnancies and preventing unintended pregnancy in this country.

During the 20th century, restrictive policies and laws affecting family planning were largely replaced by legislative and funding support for family planning services by physicians and specialized reproductive health-care providers. Marshaling public support for efforts needed to reduce the high rate of unintended pregnancy and to provide the full array of reproductive health-care services remains a challenge.

## **FLUORIDATION OF DRINKING WATER TO PREVENT DENTAL CARIES**

Fluoridation of drinking water began in 1945 and today it reaches an estimated 144 million persons in the United States. Fluoridation safely and inexpensively benefits both children and adults by effectively preventing tooth decay, regardless of socioeconomic status or access to care. Fluoridation has played an important role in the reductions in tooth decay in children and of tooth loss in adults. Although other fluoride-containing products are available, water fluoridation remains the most equitable and cost-effective method of delivering fluoride to all members of most communities, regardless of age, educational attainment, or income level.

Despite the substantial decline in the prevalence and severity of tooth decay during the 20th century, this largely preventable disease is still common. National data indicate that 67% of persons aged 12-17 years and 94% of persons aged greater than or equal to 18 years have experienced caries in their permanent teeth. Among the most striking results of water fluoridation is the change in public attitudes and expectations regarding dental health. Tooth loss is no longer considered inevitable, and increasingly adults in the United States are retaining most of their teeth for a lifetime. Thus, more teeth than ever will be at risk for caries among persons aged greater than or equal to 60 years. In the next century, water fluoridation will continue to help prevent caries among these older persons in the United States. To overcome the challenges facing this preventive measure, public health professionals at the national, state, and local level will need to enhance their promotion of fluoridation and commit the necessary resources to improve dental health in our communities.

## **TOBACCO USE**

Recognition of tobacco use as a health hazard and subsequent public health anti-smoking campaigns have resulted in changes in social norms to prevent initiation of tobacco use, promote cessation of use, and reduce exposure to environmental tobacco smoke. Since the 1964 Surgeon General's report on the health risks of smoking, the prevalence of smoking among adults has decreased, and millions of smoking-related deaths have been prevented.

Smoking--once a socially accepted behavior--is the leading preventable cause of death and disability in the United States. During the first decades of the 20th century, lung cancer was rare; however, as cigarette smoking became increasingly popular, the incidence of lung cancer became epidemic. Other diseases and conditions caused by tobacco use include heart disease, vascular disease, laryngeal cancer, oral cancer, esophageal cancer, chronic obstructive pulmonary disease, intrauterine growth retardation, and low birthweight. During the latter part of the 20th century, the adverse health effects from exposure to environmental tobacco smoke also were documented. These include lung cancer, asthma, respiratory infections, and decreased pulmonary function

Much remains to be done despite the public health achievements in reducing tobacco use in the 20th century. Commensurate with the cost of the harm caused by tobacco, resources must be expended, including programs preventing adolescents from starting to smoke, getting adults and young people to quit smoking, and eliminating exposure to environmental tobacco smoke and disparities among population groups.

## **CHANGES IN THE PUBLIC HEALTH SYSTEM**

A final report in this series will review the public health system whose activities on research, epidemiology, health education, and program implementation have made these achievements possible. The 10 public health achievements highlighted in this *MMWR* series reflect the successful response of public health to the major causes of morbidity and mortality of the 20th century. In addition, these achievements demonstrate the ability of public health to meet an increasingly diverse array of public health challenges. This report highlights critical changes in the public health system this century.

In the early 1900s, many major health threats were infectious diseases associated with poor hygiene and poor sanitation, diseases associated with poor nutrition, poor maternal and infant health, and diseases or injuries associated with unsafe workplaces or hazardous occupations. However, as the incidence of these diseases decreased, chronic diseases increased. In the last half of the century, public health identified the risk factors for many chronic diseases and intervened to reduce mortality. While continuing to develop and refine interventions, enhanced morbidity and mortality surveillance helped to maintain these earlier successes. The shift in focus led to improved capacity of epidemiology and to changes in public health training and programs. Epidemiology, the population-based study of disease and an important part of the scientific foundation of public health, acquired greater capacity during the 20th century.

At the beginning of the century, many public health initiatives were started and supported by nongovernmental organizations. However, as federal, state, and local public health infrastructure expanded, governments' role increased and assumed more responsibility. Today, public health represents the work of both government and nongovernmental organizations