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Achievements in Public Health, 1900-1999: Changes in the Public Health System

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The 10 public health achievements highlighted in this *MMWR* series (see [box](#)) reflect the successful response of public health to the major causes of morbidity and mortality of the 20th century (1-11). 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 U.S. public health system this century.

In the early 1900s in the United States, many major health threats were infectious diseases associated with poor hygiene and poor sanitation (e.g., typhoid), diseases associated with poor nutrition (e.g., pellagra and goiter), poor maternal and infant health, and diseases or injuries associated with unsafe workplaces or hazardous occupations (4,5,7,8). The success of the early public health system to incorporate biomedical advances (e.g., vaccinations and antibiotics) and to develop interventions such as health education programs resulted in decreases in the impact in these diseases. However, as the incidence of these diseases decreased, chronic diseases (e.g., cardiovascular disease and cancer) increased (6,10). In the last half of the century, public health identified the risk factors for many chronic diseases and intervened to reduce mortality. Public efforts also led to reduced deaths attributed to a new technology, the motor vehicle (3). These successes demonstrated the value of community action to address public health issues and have fostered public support for the growth of institutions that are components of the public health infrastructure*. The focus of public health research and programs shifted to respond to the effects of chronic diseases on the public's health (12-17). 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.

Quantitative Analytic Techniques

Epidemiology, the population-based study of disease and an important part of the scientific foundation of public health, acquired greater quantitative capacity during the 20th century. Improvements occurred

in both study design and periodic standardized health surveys (12,18-21). Methods of data collection evolved from simple measures of disease prevalence (e.g., field surveys) to complex studies of precise analyses (e.g., cohort studies, case-control studies, and randomized clinical trials) (12). The first well-developed, longitudinal cohort study was conducted in 1947 among the 28,000 residents of Framingham, Massachusetts, many of whom volunteered to be followed over time to determine incidence of heart disease (12). The Framingham Heart Study served as the model for other longitudinal cohort studies and for the concept that biologic, environmental, and behavioral risk factors exist for disease (6,12).

In 1948, modern clinical trials began with publication of a clinical trial of streptomycin therapy for tuberculosis, which employed randomization, selection criteria, pre-determined evaluation criteria, and ethical considerations (19,21). In 1950, the case-control study gained prominence when this method provided the first solidly scientific evidence of an association between lung cancer and cigarette smoking (22). Subsequently, high-powered statistical tests and analytic computer programs enabled multiple variables collected in large-scale studies to be measured and to the development of tools for mathematical modeling. Advances in epidemiology permitted elucidation of risk factors for heart disease and other chronic diseases and the development of effective interventions.

Periodic Standardized Health Surveys

In 1921, periodic standardized health surveys began in Hagerstown, Maryland (12). In 1935, the first national health survey was conducted among U.S. residents (12,23). In 1956, these efforts resulted in the National Health Survey, a population-based survey that evolved from focusing on chronic disease to estimating disease prevalence for major causes of death, measuring the burden of infectious diseases, assessing exposure to environmental toxicants, and measuring the population's vaccination coverage. Other population-based surveys (e.g., Behavioral Risk Factor Surveillance System, Youth Risk Behavior Survey, and the National Survey of Family Growth) were developed to assess risk factors for chronic diseases and other conditions (24-26). Methods developed by social scientists and statisticians to address issues such as sampling and interviewing techniques have enhanced survey methods used in epidemiologic studies (12).

Morbidity and Mortality Surveillance

National disease monitoring was first conducted in the United States in 1850, when mortality statistics based on death registrations were first published by the federal government (23,27). During 1878-1902, Congress authorized the collection of morbidity reports on cholera, smallpox, plague, and yellow fever for use in quarantine measures, to provide funds to collect and disseminate these data, to expand authority for weekly reporting from states and municipal authorities, and to provide forms for collecting data and publishing reports (15,23,27). The first annual summary of *The Notifiable Diseases* in 1912 included reports of 10 diseases from 19 states, the District of Columbia, and Hawaii. By 1928, all states, the District of Columbia, Hawaii, and Puerto Rico were participating in the national reporting of 29 diseases. In 1950, state and territorial health officers authorized the Council of State and Territorial Epidemiologists (CSTE) to determine which diseases should be reported to the U.S. Public Health Service (PHS) (27). In 1961, the Centers for Disease Control and Prevention (CDC) assumed responsibility for collecting and publishing nationally notifiable diseases data. As of January 1, 1998, 52 infectious diseases were notifiable at the national level.

In the early 1900s, efforts at surveillance focused on tracking persons with disease; by mid-century, the

focus had changed to tracking trends in disease occurrence (28,29). In 1947, Alexander Langmuir at the newly formed Communicable Disease Center, the early name for CDC, began the first disease surveillance system (27). In 1955, surveillance data helped to determine the cause of poliomyelitis among children recently vaccinated with an inactivated vaccine (28). After the first polio cases were recognized, data from the national polio surveillance program confirmed that the cases were linked to one brand of vaccine contaminated with live wild poliovirus. The national vaccine program continued by using supplies from other polio vaccine manufacturers (28). Since these initial disease surveillance efforts, morbidity tracking has become a standard feature of public health infectious disease control (29).

Public Health Training

In 1916, with the support of the Rockefeller Foundation, the Johns Hopkins School of Hygiene and Public Health was started (30,31). By 1922, Columbia, Harvard, and Yale universities had established schools of public health. In 1969, the number of schools of public health had increased to 12, and in 1999, 29 accredited schools of public health enrolled approximately 15,000 students (31,32). Besides the increase in the number of schools and students, the types of student in public health schools changed. Traditionally, students in public health training already had obtained a medical degree. However, increasing numbers of students entered public health training to obtain a primary postgraduate degree. In 1978, 3753 (69%) public health students enrolled with only baccalaureates. The proportion of students who were physicians declined from 35% in 1944-1945 to 11% in 1978 (28,31). Thus, public health training evolved from a second degree for medical professionals to a primary health discipline (33). Schools of public health initially emphasized the study of hygiene and sanitation; subsequently, the study of public health has expanded into five core disciplines: biostatistics, epidemiology, health services administration, health education/ behavioral science, and environmental science (30,34).

Programs also were started to provide field training in epidemiology and public health. In 1948, a board was established to certify training of physicians in public health administration, and by 1951, approximately 40 local health departments had accredited preventive medicine and public residency programs. In 1951, CDC developed the Epidemic Intelligence Service (EIS) to guard against domestic acts of biologic warfare during the Korean conflict and to address common public health threats. Since 1951, more than 2000 EIS officers have responded to requests for epidemiologic assistance within the United States and throughout the world. In 1999, 149 EIS officers are on duty.

Nongovernment and Government Organizations

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

Nongovernment organizations. The Rockefeller Sanitary Committee's Hookworm Eradication Project conducted during 1910-1920 was one of the earliest voluntary efforts to engage in a campaign for a specific disease (35). During 1914-1933, the Rockefeller Foundation also provided \$2.6 million to support county health departments and sponsored medical education reform. Other early efforts to promote community health include the National Tuberculosis Association work for TB treatment and

prevention, the National Consumers League's support of maternal and infant health in the 1920s, the American Red Cross' sponsorship of nutrition programs in the 1930s, and the March of Dimes' support of research in the 1940s and 1950s that led to a successful polio vaccine. Mothers Against Drunk Driving started in 1980 by a group of women in California after a girl was killed by an intoxicated driver and grew into a national campaign for stronger laws against drunk driving.

Professional organizations and labor unions also worked to promote public health. The American Medical Association advocated better vital statistics and safer foods and drugs (17). The American Dental Association endorsed water fluoridation despite the economic consequences to its members (9). Labor organizations worked for safer workplaces in industry (4). In the 1990s, nongovernment organizations sponsor diverse public health research projects and programs (e.g., family planning, human immunodeficiency virus prevention, vaccine development, and heart disease and cancer prevention).

State health departments. The 1850 Report of the Sanitary Commission of Massachusetts, authored by Lemuel Shattuck (13,14), outlined many elements of the modern public health infrastructure including a recommendation for establishing state and local health boards. Massachusetts formed the first state health department in 1889. By 1900, 40 states had health departments that made advances in sanitation and microbial sciences available to the public. Later, states also provided other public health interventions: personal health services (e.g., disabled children and maternal and child health care, and sexually transmitted disease treatment), environmental health (e.g., waste management and radiation control), and health resources (e.g., health planning, regulation of health care and emergency services, and health statistics). All states have public health laboratories that provide direct services and oversight functions (36).

County health departments. Although some cities had local public health boards in the early 1900s, no county health departments existed (33). During 1910-1911, the success of a county sanitation campaign to control a severe typhoid epidemic in Yakima County, Washington, created public support for a permanent health service, and a local health department was organized on July 1, 1911 (33). Concurrently, the Rockefeller Sanitary Commission began supporting county hookworm eradication efforts (17,35). By 1920, 131 county health departments had been established; by 1931, 599 county health departments were providing services to one fifth of the U.S. population (33); in 1950, 86% of the U.S. population was served by a local health department, and 34,895 persons were employed full-time in public health agencies (37).

Local health departments. In 1945, the American Public Health Association proposed six minimum functions of local health departments (38). In 1988, the Institute of Medicine defined these functions as assessment, policy development, and assurance, and PHS has proposed 10 organizational practices to implement the three core functions (39,40). The national health objectives for 2000, released in 1990, provided a framework to monitor the progress of local health departments (41). In 1993, 2888 local health departments**, representing county, city, and district health organizations operated in 3042 U.S. counties. Of the 2079 local health departments surveyed in 1993, nearly all provided vaccination services (96%) and tuberculosis treatment (86%); fewer provided family planning (68%) and cancer prevention programs (54%) (42).

Federal government. In 1798, the federal government established the Marine Hospital Service to provide health services to seamen (15). To recognize its expanding quarantine duties, in 1902, Congress changed the service's name to the Public Health and Marine Hospital Service and, in 1912, to

the Public Health Service. In 1917, PHS' support of state and local public health activities began with a small grant to study rural health (35). During World War I, PHS received resources from Congress to assist states in treating venereal diseases. The Social Security Act of 1935, which authorized health grants to states, and a second Federal Venereal Diseases Control Act in 1938 (13,14), expanded the federal government's role in public health (15,35). In 1939, PHS and other health, education, and welfare agencies were combined in the Federal Security Agency, forerunner of the Department of Health and Human Services. In the 1930s, the federal government began to provide resources for specific conditions, beginning with care for crippled children. After World War II, the federal role in public health continued to expand with the Hospital Services and Construction Act (Hill-Burton) of 1946*** (15). In 1930, Congress established the National Institutes of Health [formerly the Hygiene Laboratories of the Public Health Service] and the Food and Drug Administration. CDC was established in 1946 (29). Legislation to form Medicare and Medicaid was enacted in 1965, and the Occupational Safety and Health Administration and the Environmental Protection Agency were organized in 1970.

Although federal, state, and local health agencies and services have increased throughout the century, public health resources represent a small proportion of overall health-care costs. In 1993, federal, state, and local health agencies spent an estimated \$14.4 billion on core public health functions, 1%-2% of the \$903 billion in total health-care expenditure (43).

Conclusion

The public health infrastructure changed to provide the elements necessary for successful public health interventions: organized and systematic observations through morbidity and mortality surveillance, well-designed epidemiologic studies and other data to facilitate the decision-making process, and individuals and organizations to advocate for resources and to ensure that effective policies and programs were implemented and conducted properly. In 1999, public health is a complex partnership among federal agencies, state and local governments, nongovernment organizations, academia, and community members. In the 21st century, the success of the U.S. public health system will depend on its ability to change to meet new threats to the public's health.

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* The government, community, professional, voluntary, and academic institutions and organizations that support or conduct public health research or programs.

** A local health department is an administrative or service unit of local or state government responsible for the health of a jurisdiction smaller than the state.

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