Decline in Deaths From Heart Disease and Stroke—United States, 1900-1999

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**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. Since 1950, age-adjusted death rates from cardiovascular disease (CVD) have declined 60%, representing one of the most important public health achievements of the 20th century. This report summarizes the temporal trends in CVD, advances in the understanding of risk factors for CVD, development of prevention interventions to reduce these risks, and improvements in therapy for persons who develop CVD.**

**Decline in CVD Death Rates**

Age-adjusted death rates per 100,000 persons (standardized to the 1940 U.S. population) for diseases of the heart (i.e., coronary heart disease, hypertensive heart disease, and rheumatic heart disease) have decreased from a peak of 307.4 in 1950 to 134.6 in 1996, an overall decline of 56%. Age-adjusted death rates for coronary heart disease (the major form of CVD contributing to mortality) continued to increase into the 1960s, then declined. In 1996, 621,000 fewer deaths occurred from coronary heart disease than would have been expected had the rate remained at its 1963 peak.

Age-adjusted death rates for stroke have declined steadily since the beginning of the century. Since 1950, stroke rates have declined 70%, from 88.8 in 1950 to 26.5 in 1996. Total age-adjusted CVD death rates have declined 60% since 1950 and accounted for approximately 73% of the decline in all causes of deaths during the same period.\(^1\)

**Disease Epidemiology**

Intensive investigation into the CVD epidemic largely began in the 1940s following World War II, although causal hypotheses about CVD and recognition of geographic differences in disease occurred earlier.\(^2,4\) Landmark epidemiologic investigations, including the cross-country comparisons of Ancel Keys\(^5\) (see box) and the Framingham Heart Study,\(^6\) established the major risk factors of high blood cholesterol, high blood pressure, and smoking and dietary factors (particularly dietary cholesterol, fat, and sodium). The risk factor concept—that particular biologic, lifestyle, and social conditions were associated with increased risk for disease—developed out of CVD epidemiology.\(^3,4\) In addition to the major risk factors (i.e., high blood pressure, high blood cholesterol, and smoking), other important factors include socioeconomic status, obesity, and physical inactivity.\(^7\) Striking regional differences were noted particularly for stroke mortality, with the highest rates observed in the southeastern United States.\(^1\) Cross-national and cross-cultural studies highlighted the importance of social, cultural, and environmental factors in the development of CVD.

Coronary heart disease and stroke, the two major causes of CVD-related mortality, are not influenced to the same degree by the recognized risk factors. For example, elevated blood cholesterol is a major risk factor for coronary heart disease, and hypertension is the major risk factor for stroke. Physical activity, smoking cessation, and a healthy diet, which can lower the risk for heart disease, also can help lower the risk for stroke.\(^8\)

**Advances in Prevention**

Early intervention studies in the 1960s sought to establish whether lowering risk factor levels would reduce risk for CVD.\(^2,4\) During the 1970s and 1980s, along with numerous clinical trials demonstrating the efficacy of antihypertensive and lipid-lowering drugs, community trials sought to reduce risk at the community level.\(^9\) Public health interventions to reduce CVD have benefitted from a combination of the “high risk” approach—aimed at persons with increased risk for CVD—and the population-wide approach—aimed at lowering risk for the entire community.\(^10\) National programs that combine these complementary approaches and that are aimed at health-care providers, patients, and the general public include the National High Blood Pressure Education Program,\(^11\) initiated in 1972, and the National Cholesterol Education Program,\(^12\) initiated in 1985.\(^13\) Although earlier CDC community demonstration projects focused on cardiovascular health,\(^9\) CDC established its National Center for Chronic Disease Prevention and Health Promotion in 1989, with a high priority of promoting cardiovascular health.

**Factors Contributing to the Decline in CVD Deaths**

Reasons for the declines in heart disease and stroke may vary by period and across region or socioeconomic groups (e.g., age, sex, and racial/ethnic groups). 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 aged ≥18 years from approximately 42% in 1965 to 25% in 1993.\(^13\) Substantial public health efforts to reduce tobacco use began soon after recognition of the association between smoking and CVD and between...
smoking and cancer and the first Surgeon General’s report on smoking and health published in 1964.

- A decrease in mean blood pressure levels in the U.S. population,

- An increase in the percentage of persons with hypertension who have the condition treated and controlled,

- A decrease in mean blood cholesterol levels.

Changes in the U.S. diet. Data based on surveys of food supply suggest that consumption of saturated fat and cholesterol has decreased since 1909.15 Data from the National Health and Nutrition Examination surveys suggest that decreases in the percentage of calories from dietary fat and the levels of dietary cholesterol coincide with decreases in blood cholesterol levels.

- 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 focusing on CVD, an increase in emergency medical services for heart attack and stroke, and an increase in coronary-care units.13,17 These developments have contributed to lower case-fatality rates, lengthened survival times, and shorter hospital stays for persons with CVD.14

Challenges for the 21st Century
Despite remarkable progress, heart disease and stroke remain leading causes of disability and death. Estimated costs for morbidity and mortality from CVD, including health expenditures and lost productivity, are expected to be $286.5 billion in 1999.18 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. During 1985-1996, for example, heart disease age-adjusted mortality declined 29% among white men, but only 10% among American Indian/Alaskan Native women.13 Persons of lower socioeconomic status have higher mortality, morbidity, and risk factor levels for heart disease and stroke than persons of higher socioeconomic status.13,19 In addition, the social class gap in heart disease deaths may be increasing as the rates of heart disease decline faster among higher social classes.19 Geographically, declines in heart disease deaths did not occur at the same time for all communities. Areas with poorer socioeconomic profiles were more likely to experience a later onset of the decline of heart disease.19

Public health programs at the state level for heart disease and stroke have been limited. In fiscal year 1999, through a new program, CDC funded 11 states with the highest CVD mortality rates to plan, develop, and implement state-based efforts for CVD prevention. In addition to activities such as surveillance, these programs will emphasize policy and environmental in-
interventions, both social and physical, aimed at sustaining positive health behavior change. Although many trends have been positive, trends for some important indicators have not improved substantially, have leveled off, or are reversing. For example, approximately 70% of persons with hypertension do not have the condition controlled at levels below 140/90 mm Hg, and death rates for stroke have not declined in recent years. Heart failure has emerged as a health concern for older adults, and adults who survive a myocardial infarction or other hypertension-related diseases remain at increased risk for heart failure. In addition, the prevalence of obesity has increased among both children and adults in the United States. Major public health challenges for the 21st century include:

- reducing risk factor levels and preventing the development of adverse risk factors. Continued research is needed to understand the determinants (social, psychological, environmental, physiologic, and genetic) of CVD 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 relationship between genetics and disease. The associations of genetic variants with CVD, and especially the interplay between genetic and environmental factors, may play increasingly important roles in the nation’s efforts to prevent CVD.
- identifying new or emerging risk factors and determining their potential for public health intervention. New or emerging risk factors that have been associated with CVD include elevated levels of total homocyst(e)ine, fibrinogen, and C-reactive protein, and infectious agents such as *Helicobacter pylori* and *Chlamydia pneumoniae.*
- focusing on secondary prevention and disability. An aging U.S. population and an increasing number of persons surviving life-threatening cardiovascular conditions requires public health programs to focus on issues such as disability and quality of life. Persons with existing cardiovascular conditions are at increased risk for future life-threatening events related to those conditions.
- addressing the needs of the global community. Although CVD death rates are higher in developed nations, most cases occur in developing nations. Developing countries may face a double burden of infectious and chronic diseases. International collaboration to improve cardiovascular health will need to continue to reduce the burden of CVD worldwide.

Reported by: Cardiovascular Health Br, Div of Adult and Community Health, National Center for Chronic Disease Prevention and Health Promotion, CDC.

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Outbreak of *Salmonella* Serotype Muenchen Infections Associated With Unpasteurized Orange Juice—United States and Canada, June 1999

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DURING JUNE 1999, PUBLIC HEALTH-Seattle and King County (PHSKC) and the Washington state health department and the Oregon Health Division independently investigated clusters of diarrheal illness attributed to *Salmonella* serotype Muenchen infections in each state. Both clusters were associated with a commercially distributed unpasteurized orange juice traced to a single processor, which distributes widely in the United States. As of July 13, 207 confirmed cases associated with this outbreak have been reported by 15 states and two Canadian provinces; an

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additional 91 cases of S. Muenchen infection reported since June 1 are under investigation. This report summarizes the two state-based investigations and presents preliminary information about the outbreak in the other states and Canada.

Washington
On June 19, state health officials were notified of three cases of *Salmonella* serogroup C2 infection, which were confirmed subsequently as S. Muenchen. Interviews of the ill persons revealed one common feature: drinking a fruit smoothie containing unpasteurized orange juice from different outlets of restaurant chain A. PHSKC and the Washington State Department of Health initiated an investigation. A case was defined as illness with onset after June 9, with isolation of S. Muenchen from stool or blood or isolation of *Salmonella* serogroup C2 with a pulsed-field gel electrophoresis (PFGE) or restriction fragment length polymorphism pattern that was indistinguishable from the outbreak strain.

In a case-control study by PHSKC of nine ill and 29 well restaurant A patrons, illness was significantly associated with drinking smoothies containing orange juice (100% of cases exposed compared with 14% of controls; odds ratio = undefined, p<0.001). By July 12, 57 persons with S. Muenchen infection with onset of illness during June 14-29 were identified in Oregon. The median age was 36 years (range: 9 months-95 years), and 54% were female. Forty-four patients were known to have drank unpasteurized orange juice before illness onset. Among the 39 patients for whom information was available, the predominant symptoms were diarrhea (100%), fever (89%), abdominal cramps (85%), chills (82%), and bloody diarrhea (59%). Seven persons were hospitalized; no patients died.

Recall of Orange Juice
On June 25, on the basis of the epimiologic information from the investigations in Washington and Oregon and discussions with the Food and Drug Administration (FDA), Sun Orchard voluntarily issued a recall. Unpasteurized orange juice produced by Sun Orchard was distributed to Arizona, California, Colorado, Nevada, New Mexico, Oregon, Texas, Utah, Washington, Wisconsin, and the Canadian provinces of Alberta and British Columbia under the brand names Aloha, Earls and Joeys Tomato’s, Markon, Sysco, Trader Joe’s, Voila, and Zupan. Other states and provinces received these products through secondary distribution. The juice was distributed to hotels, restaurants, and supermarkets, and was served in individual glasses as “fresh-squeezed” juice in hotels and restaurants. In addition, a frozen form of the unpasteurized juice was sold under the brand name Vareva for use in restaurants and institutions.

Other States and Canada
An outbreak-related case was defined as S. Muenchen infection after June 1 in a person who drank unpasteurized orange juice or whose isolate had a PFGE pattern with no more than one band difference from the Washington outbreak strain. In addition to the Washington and Oregon cases, 66 cases were reported in persons in 13 other states: Arizona (four), California (21), Connecticut (one), Florida (one), Illinois (one), Iowa (two), Massachusetts (seven), Michigan (three), Minnesota (six), New Mexico (10), Texas (five), Utah (four), and Wisconsin (one). Cases also were reported from the Canadian provinces of Alberta (four) and British Columbia (eight). Among the 66 patients for whom information was available, the median age was 32 years (range: 6 months-66 years), and 58% were female. Six persons were hospitalized. An additional 78 cases of S. Muenchen infection occurring after June 1 reported by nine other states and the two Canadian provinces are under investigation.
Escherichia coli breaks in the United States in this vehicular transmission in at least 15 outbreaks less than 10 per year. Less than 6 isolates per year and Washington-deaths.1

Treatments result in approximately 500 800,000-4 million osteomyelitis, and abscesses also can occur.

Dehydration. Bacteremia, meningitis, diarrhea, abdominal cramps, fever, and vomiting cause gastroenteritis characterized by nausea, vomiting, and bloody diarrhea. Salmonella infection typically causes gastroenteritis characterized by diarrhea, abdominal cramps, fever, and dehydration. Bacteremia, meningitis, osteomyelitis, and abscesses also can occur. Each year in the United States, 800,000-4 million Salmonella infections result in approximately 500 deaths. S. Muenchen is an infrequently isolated serotype, accounting for approximately 1.6% of human Salmonella isolates reported in 1997 to the Public Health Laboratory Information System.2,3 Oregon typically reports less than 6 isolates per year and Washington less than 10 per year.

Juice has been implicated as the vehicle of transmission in at least 13 outbreaks in the United States in this century involving pathogens, including Escherichia coli O157:H7, Cryptosporidium parvum, and other Salmonella serotypes (e.g., S. Typhi and S. Hartford). In an outbreak of E. coli O157:H7 infections attributed to unpasteurized apple juice, one child died, and 14 children developed hemolytic uremic syndrome. The outbreak described in this report is the second and largest Salmonella outbreak associated with unpasteurized orange juice. The acidic nature of orange juice (pH of 3.4-4.0) previously was believed to inhibit bacterial growth and protect against foodborne illness; however, recent outbreaks and laboratory investigations have demonstrated otherwise. Salmonella serotypes Gaminara, Hartford, Rubislaw, and Typhimurium have survived in orange juice for up to 27 days at pH 3.5 and 60 days at pH 4.1.7

In 1998, FDA proposed Hazard Analysis and Critical Control Point (HACCP) and labeling regulations to improve the safety of juice products.8 The proposed HACCP regulation requires juice to be produced using methods such as pasteurization or an equivalent process to ensure that pathogenic microorganisms are destroyed. In the outbreak described in this report, the implicated company had a HACCP plan. Investigations are under way to determine where these control measures failed and how the juice became contaminated. FDA published a final rule for the labeling of fruit and vegetable juices that includes a warning statement to advise consumers of the risks associated with drinking unpasteurized juices.9 However, the labeling requirements do not apply to juice or products containing juice that are not packaged (i.e., sold by the glass) in retail establishments, such as the product implicated in this outbreak. In Washington, some consumers were unaware that they were drinking unpasteurized commercial orange juice in their fruit smoothies.

Because the source of contamination of the orange juice is unknown and to facilitate outbreak investigation, local and state health departments are encouraged to investigate all cases of S. Muenchen infections occurring since June 1 using a questionnaire from CDC’s Foodborne and Diarrheal Diseases Branch, Division of Bacterial and Mycotic Diseases, National Center for Infectious Diseases, telephone (404) 639-2206, and to consider referring isolates for PFGE with the standardized PulseNet Salmonella protocol by the Washington State Public Health Laboratory or by another PulseNet laboratory. Health departments also should consider investigating cases of S. Alamo, S. Gaminara, S. Hidalgo, and S. Javi-ana in which illness onset occurred after June 1.

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