Trends and Disparities in Coronary Heart Disease, Stroke, and Other Cardiovascular Diseases in the United States
Findings of the National Conference on Cardiovascular Disease Prevention

Richard Cooper, MD; Jeffrey Cutler, MD; Patrice Desvigne-Nickens, MD; Stephen P. Fortmann, MD; Lawrence Friedman, MD; Richard Havlik, MD, MPH; Gary Hogelin, MPA; John Marler, MD; Paul McGovern, PhD; Gregory Morosco, PhD, MPH; Lori Mosca, MD, PhD, MPH; Thomas Pearson, MD, PhD, MPH; Jeremiah Stamler, MD; Daniel Stryer, MD; Thomas Thom, BA

Abstract—A workshop was held September 27 through 29, 1999, to address issues relating to national trends in mortality and morbidity from cardiovascular diseases; the apparent slowing of declines in mortality from cardiovascular diseases; levels and trends in risk factors for cardiovascular diseases; disparities in cardiovascular diseases by race/ethnicity, socioeconomic status, and geography; trends in cardiovascular disease preventive and treatment services; and strategies for efforts to reduce cardiovascular diseases overall and to reduce disparities among subpopulations. The conference concluded that coronary heart disease mortality is still declining in the United States as a whole, although perhaps at a slower rate than in the 1980s; that stroke mortality rates have declined little, if at all, since 1990; and that there are striking differences in cardiovascular death rates by race/ethnicity, socioeconomic status, and geography. Trends in risk factors are consistent with a slowing of the decline in mortality; there has been little recent progress in risk factors such as smoking, physical inactivity, and hypertension control. There are increasing levels of obesity and type 2 diabetes, with major differences among subpopulations. There is considerable activity in population-wide prevention, primary prevention for higher risk people, and secondary prevention, but wide disparities exist among groups on the basis of socioeconomic status and geography, pointing to major gaps in efforts to use available, proven approaches to control cardiovascular diseases. Recommendations for strategies to attain the year 2010 health objectives were made. (Circulation. 2000;102:3137-3147.)

Key Words: cardiovascular diseases ■ epidemiology ■ prevention

The 20th century witnessed dynamic, worldwide changes in cardiovascular disease (CVD) mortality, including death from coronary heart disease (CHD), stroke, and other CVDs. Many Western countries documented a rise in mortality from CVD until the 1960s and 1970s, with substantial declines since those peaks. Other parts of the world have shown different patterns, including high rates of CVD mortality in Eastern Europe that continue to rise and an ominous epidemic of CHD and stroke emerging in developing countries.1 In the United States, recent evidence has suggested that the decline in CHD mortality since the late 1960s has slowed. This may be especially true in specific subgroups (defined by socioeconomic status, race or ethnicity, and region), whose declines have lagged. This has led to relatively higher CVD rates, which constitute a major challenge to reaching the Healthy People 2010 Objectives set for the American people.2 The causes of these disparities in CVD burden are primarily environmental and likely include differences in CVD risk factors, lifestyle, and the availability and use of primary and secondary preventive services.

The National Conference on CVD Prevention was a transagency conference convened at the encouragement of the US Congress3 from September 27 through 29, 1999, in Bethesda, Maryland to assess the magnitude and causes of trends in CHD, stroke, and other CVDs; to examine various explanations for increasing health disparities across socioeconomic status, race/ethnicity, and region; and to explore opportunities to rectify these disparities. The Conference had the following 5 objectives.

1. To examine trends in levels of CVD mortality (and morbidity, if possible) in the US population as a whole and in selected subpopulations.
2. To describe trends in levels of CVD risk factors by both behavior (eg, diet, exercise, and tobacco use) and
physiology (eg, serum lipids, blood pressure, obesity, and diabetes) in the US population as a whole and in selected subpopulations in parallel to CVD mortality trends as a way to better understand observed disparities in CVD mortality.

3. To estimate trends in levels of cardiovascular health services, including primary prevention, secondary prevention, and rehabilitation, in parallel to CVD mortality trends as a way to understand the influence of disparities in health care and disparities in CVD mortality trends.

4. To identify areas where new or better data are needed to attain the Year 2010 Health Objectives for the Nation so as to target those areas as part of the strategic research agenda for the 21st century.

5. To develop a more effective strategic agenda for CVD prevention programs and policies to reduce disparities among subpopulations in CVD mortality, morbidity, risk factors, and healthcare services as a means to reduce CVD mortality in the US population as a whole and to meet 2010 Health Objectives.

The Conference had roots in 3 previous conferences that endeavored to describe and explain changes in CVD mortality in the last quarter of the 20th century. The first, “The Conference on the Decline in Coronary Heart Disease Mortality,”4 was convened in 1978 and verified the newly described downward trend in CVD mortality but was unable to identify precisely the causes for these declines. The second, “Trends and Determinants of Coronary Heart Disease Mortality: The Influence of Medical Care,”5 was held in 1986 to examine the contributions of preventive and therapeutic patient management; it concluded that some of the decline in CVD mortality could indeed be attributed to preventive and early medical care. The third, “Trends and Determinants of Coronary Artery Disease Mortality: International Comparisons,”6 was convened in 1988 to make international comparisons of CHD mortality, morbidity, risk factors, and medical care and to seek explanations for worldwide variations in CHD incidence, prevalence, mortality, case fatality rates, and trends.

This report summarizes the findings of the 1999 Conference on CVD Prevention. It aims to provide a better picture of the cardiovascular health of the United States and to create policies and programs that will more effectively prioritize and implement CVD control efforts over the next decade.

**Recent Trends in CVD Mortality in the United States**

CVD has been recognized as the dominant cause of death in the United States for at least 50 years, with heart disease ranking first and stroke ranking third as specific causes of death. CVD accounts for >900,000 deaths annually in the United States7; 12 million Americans have CHD, and another 4 million have had a stroke.8,9 Despite the enormous magnitude of the current CVD burden, the United States has been the beneficiary of substantial declines in both CHD and stroke mortality (Figure 1).8–11 CHD mortality declines began in the 1960s. In contrast, stroke rates have generally declined from about 1920 to 1990, with more pronounced declines from 1970 to 1990.

An impetus for the National Conference on CVD Prevention was the perception that the declines in CHD and stroke rates since 1990 had slowed (Table 1). Age-adjusted CHD mortality rates decreased at >3% per year for the 20-year period between 1970 and 1990. However, for the 7-year period between 1990 and 1997, CHD mortality declined at a rate of 2.7% (Table 1). Perhaps more striking were the findings for stroke mortality, which had sizable reductions in both the 1970s and 1980s but much more modest reductions since 1990. Others have documented this flattening of the stroke trend.12–14 These trends have generally been observed for both men and women and in both middle-aged and older Americans (data not shown).

**TABLE 1. Annual Percent Change in Death Rates for CHD and Stroke in the United States by Decade from 1950 to 1997**

<table>
<thead>
<tr>
<th>Decade</th>
<th>CHD</th>
<th>Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950–60</td>
<td>2.1</td>
<td>0.2</td>
</tr>
<tr>
<td>1960–70</td>
<td>2.0</td>
<td>1.2</td>
</tr>
<tr>
<td>1970–80</td>
<td>1.9</td>
<td>2.1</td>
</tr>
<tr>
<td>1980–90</td>
<td>2.0</td>
<td>3.5</td>
</tr>
<tr>
<td>1990–97</td>
<td>2.7</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Data are from Reference 10 and are based on rates age-adjusted to the 2000 standard.

*Two different time periods for CHD, 1960–1967 and 1970–1978 were used to stay within coding revisions.
Another important cause of CVD death is congestive heart failure. This disease serves as a fatal sequela of several CVDs, including CHD, hypertension, valvular heart disease, and idiopathic cardiomyopathy. Currently 4.6 million Americans have congestive heart failure, and there are 550,000 new cases annually.8,9 It is the only category of CVD in which prevalence, incidence, and mortality seem to have increased in most years over the past 25 years. With the aging of the population and declines in mortality from other forms of CVD, it is likely that congestive heart failure will continue to increase in public health importance.15

### Recent Trends in CVD Mortality by Race and Ethnicity

CHD and stroke mortality rates differ among the major ethnic groups in the United States (Table 2) (National Center for Health Statistics, personal communication, August 2000).11 Blacks have the highest rates of CHD, and non-Hispanic whites also have relatively high CHD mortality. Native Americans, Asians, and Hispanics have lower rates. CHD mortality rates are especially high in middle-aged black men relative to other race/sex groups, and stroke mortality rates are strikingly higher in blacks in general. Native Americans and Hispanics have the lowest stroke rates.

Early in the decline of CHD and stroke, CVD death rates in all major demographic groups declined in parallel. However, since the mid-1980s, the documented trends in CHD have diverged across race/sex subgroups (Figure 2).10,16-18 The rates of CHD mortality have declined more slowly in black men than in white men. Although white men at one time had higher age-adjusted (to the year 2000 standard) rates than black men, the rates are now almost identical. The declines in CHD mortality rates among black women have also been somewhat slower than among white women; black women have had higher rates since the mid-1980s (Figure 2).

### Recent Trends in CVD Mortality by Socioeconomic Group

Steep gradients in CVD mortality are observed across socioeconomic status, as measured by education, income, or occupation.19,20 Socioeconomic status stratum-specific trends in CVD have been more difficult to ascertain because of limitations in national data. There is evidence that the CVD mortality decline began later in women with a lower socioeconomic status than in those with a higher socioeconomic status.21 Data from US metropolitan areas show a graded relationship between income inequality (a measure of maldistribution of wealth across a population) and heart disease mortality.22 There is also strong documentation for trends in total mortality, to which CVD is a substantial contributor, showing that the gap between lower and higher socioeconomic status has widened.23,24 Overall, the available data suggest that the gap in CVD mortality between the poor and undereducated versus the wealthy and well-educated has not lessened and may be widening.

### Recent Trends in CVD Mortality by Geography

CVD mortality rates vary markedly by region in the United States, with age-adjusted CHD rates varying >2-fold between the states with the highest and lowest rates. However, state-level mapping of CVD mortality provides only a crude measure of disease distribution; finer geographic or economic units are needed to refine the patterns. Maps of CVD based on areas smaller than states have been available since the 1960s; they describe the decline in CVD as a function of geography.22 CVD mortality first began declining in the Northeast United States as early as 1962, with areas of the South showing no decline until 1970. Relative to the United States as a whole, many areas of Appalachia experienced low levels of CVD mortality in the 1950s, whereas by 1968 to 1978, their rates were among the highest. Similarly, relatively high rates in areas of the Western United States declined to the midrange, leaving a strong positive west-to-east gradient in CVD mortality.

Recently, new maps of CHD mortality by county for US women were published.25 These age-adjusted data again show striking variation by geographic region; the differences in CHD mortality between the counties with the lowest and highest rates are >3-fold. Again, a west-to-east gradient is observed, with a strong clustering of high CHD rates in the Mississippi Delta, in Appalachia and the Ohio River Valley, and in the Piedmont areas of Georgia, South Carolina, and North Carolina. Some areas, such as Mississippi, may actually have experienced increasing CHD mortality rates since the late 1980s. Those areas currently left with high CHD mortality are frequently characterized as rural and poor.

### Table 2. CHD and Stroke Mortality Rates by Race and Ethnicity in the United States in 1997

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>CHD Mortality Rate</th>
<th>Stroke Mortality Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Hispanic white</td>
<td>182.8</td>
<td>60.3</td>
</tr>
<tr>
<td>Black</td>
<td>186.8</td>
<td>81.6</td>
</tr>
<tr>
<td>Native American</td>
<td>112.7</td>
<td>39.2</td>
</tr>
<tr>
<td>Asian</td>
<td>100.1</td>
<td>54.6</td>
</tr>
<tr>
<td>Hispanic</td>
<td>124.2</td>
<td>40.0</td>
</tr>
</tbody>
</table>

Data are expressed as mortality per 100,000 population and are based on rates age-adjusted to the 2000 standard; they are from the National Center for Health Statistics (personal communication, August 2000).

### Figure 2. Death rates for coronary heart disease by sex and race in the United States from 1980 to 1997. Rates are age-adjusted to 2000 standard.
A more dynamic picture is available for trends in stroke. Howard et al. calculated age-adjusted stroke mortality rates by race and ethnicity at the county level between 1968 and 1996. From these data, the percent decline in stroke mortality between 1968 and 1996 was determined. Statistical modeling of these data produced a calculated “floor” for stroke mortality rates and the distance to go to that floor. The results of these analyses yielded race/sex specific maps of stroke mortality for 1968, 1982, and 1996. These suggest that some states in the Southeast (e.g., Georgia and Alabama) are no longer among those with the highest stroke mortality. Areas that now have high (compared with the rest of the United States) stroke mortality rates include Arkansas and Oregon/Washington. This splitting of the “stroke belt” and its movement to the South Central and Northwest regions of the United States demonstrates the dynamic changes in stroke mortality by region within only 3 decades.

Summary
For the United States as a whole, the CHD mortality rate still seems to be declining, but at a slower rate than from 1970 to 1990. Stroke mortality rates have changed little in most areas since 1990. However, there are striking differences in levels and trends of CVD rates by race/ethnicity, socioeconomic status, and geography.

Recent Trends in Levels of CVD Risk Factors in the United States
Changes in factors causally related to atherosclerotic CVD may explain these recent trends in mortality. This section explores recent trends in the major CVD risk factors, including cigarette smoking, dietary patterns, physical inactivity, obesity, blood pressure, serum lipids and lipoproteins, and diabetes. Trends are described in the US population as a whole and for population subgroups, especially race/ethnic groups, socioeconomic status levels, and children (when data are available).

Trends in Tobacco Use
Cigarette consumption on a per-capita basis declined from 1964, the date of the issue of the First Surgeon General’s Report on Smoking, when >40% of adults smoked, until ~1990. Nonetheless, nearly 180,000 deaths from CVD were attributed to tobacco use in 1990. Trends since 1990 suggest that smoking prevalence has reached an asymptote, at which ~25% of the US population continues to smoke on a daily basis. Trends by socioeconomic status, as measured by educational attainment, indicate a greater reduction in smoking prevalence among those with some college or a college degree, resulting in a substantial widening of the gradient across educational strata since 1974. However, a lack of further reduction in smoking prevalence seems to be present across all educational strata. Smoking trends by race/ethnic groups parallel those of the US population as a whole, but smoking prevalence rates vary markedly by race/ethnic group and sex. Native American men and women seem to have the highest prevalence rates. The rates of smoking remain higher in men than in women. The lowest rates of smoking are found in Hispanic and Asian women. For most groups, however, there seems to be a flattening in the decline of smoking rates since 1990.

Trends in children are especially informative, because most dependent smokers begin smoking regularly before graduating from high school. Adolescent smoking prevalence, therefore, may serve as a predictor of future patterns of adult smoking. Smoking prevalence in 9th and 10th graders, in both boys and girls, increased from 1993 to 1997. By 12th grade, there is little difference in the rates of smoking between boys and girls, with a prevalence of 20% for both sexes.

Recent Dietary Trends
Dietary patterns in the United States over the past 30 years have been estimated using National Health and Nutrition Examination Surveys (NHANES I, II, III), by US Department of Agriculture Nationwide Food Consumption Surveys and Continuing Survey of Food Intakes by Individuals, and by special surveys of local populations. Continued changes to improve dietary intake methodology make it difficult to estimate trends in nutrient intake with confidence. Nevertheless, these data, taken in aggregate, suggest that total fat consumption in grams per day between the 1970s and 1990s has been stable or somewhat higher, with a decrease as a percent of calories. Estimated carbohydrate intake has increased in parallel with the decrease in percent of calories as total fat. Saturated fat consumption over this period has fallen as a proportion of calorie intake, and dietary cholesterol has been reduced by a fifth. These data are consistent with decreased serum cholesterol levels over the same period.

Evaluation of trends of specific foods in the food supply shows that estimated intake of beer and wine has increased. Other shifts in food intake have occurred. There were reductions in the consumption of red meat, eggs, and whole milk between 1970 and 1997 and increases in the consumption of soda, grains, sweeteners, cheese, and fats and oils. Some of these changes may reflect changes in the way dietary data are collected. However, changes in nutrient and food intake may reflect the fact that consumers are not controlling the preparation of their meals. An increasing proportion of foods are prepared away from home; the proportion increased from 16% in 1977 through 1978 to 29% in 1995.

Recent Trends in Levels of Leisure Time Physical Activity
Participation in regular leisure time physical activity in the United States can be estimated from 3 national surveys of adults (National Health Interview Survey, NHANES, and the Behavioral Risk Factor Surveillance System). Data from 1996 suggest that only 28% of adults meet the recommended levels of moderate or vigorous leisure time physical activity, and 29% report no regular physical activity outside their work. The prevalence of physical inactivity increases with age, is higher in women than men, and is highest in black and Hispanic groups. There is a striking gradient of physical inactivity by education; the prevalence of physical inactivity in persons not graduating from high school is 2.5 times greater than that of college graduates. Physical inactivity is highest in rural areas, especially those in the South and West.
Over the past 15 years, there have been only minor changes in leisure time physical activity reported, although national surveillance data do not include all types of physical activity (eg, occupational, transportation) to verify population trends in total physical activity.

As assessed by the Youth Risk Behavior Survey, 72% of high school boys and 54% of high school girls reported vigorous physical activity for at least 20 minutes 3 or more days per week. Attendance at daily physical education classes fell between 1991 and 1997 from 41% to 28%. White adolescents had higher rates of vigorous physical activity than black or Hispanic adolescents (67% versus 54% and 60%, respectively).

Recent Trends in the Prevalence of Overweight and Obesity

Overweight and obesity are currently defined by body mass index [weight in kilograms/(height in meters)]². A body mass index of 25 to 29.9 defines overweight, and one ≥30 defines obesity. Current estimates from NHANES III for US adults aged 20 to 74 years identify ~60% of men and ~50% of women as being overweight, with 20% of men and 25% of women being obese. The prevalence of overweight and obesity is higher in Hispanic men than in non-Hispanic white or black men and is higher in both black women and Hispanic women than in non-Hispanic white women. The prevalence of overweight is inversely related to education or income in women of all ethnic groups. For men, however, the pattern is opposite, with greater obesity at higher levels of income. The prevalence of overweight is 13% to 15% in children 6 to 12 years of age and 11% to 12% in those aged 12 to 17 years. Mexican-American boys have a higher prevalence of overweight than black or white boys, and Mexican-American and black girls have a higher prevalence of overweight than white girls.

The trend in obesity increased strikingly from 1980 to 1994. Although the prevalence of overweight increased slightly between 1960 and 1994, a large increase in the prevalence of obesity in both men and women has been observed in the most recent data available from 1994. Parallel trends are seen in children (both in those aged 6 to 11 years and those aged 12 to 17 years). Although the prevalence of overweight increased with each year between 1963 and 1994, the large increase, especially in those aged 12 to 17 years, occurred between 1980 and 1994. The prevalence of overweight and obesity seems to have increased in all educational strata over this period of time.

Trends in Blood Pressure and Hypertension

Hypertension remains a common condition in the United States; it affects >43 million Americans and has an estimated age-adjusted prevalence of 26% in adult males and of 22% in adult females. Blacks have long been known to have the highest prevalence. Of the 43 million estimated hypertensives in the United States, >20 million are not treated. Of the remaining 23 million treated hypertensives, an estimated 12 million are thought not to be controlled (systolic blood pressure <140 mm Hg and diastolic blood pressure <90 mm Hg); thus, only 11 million of 43 million hypertensives are both treated and controlled.

Although good progress was made in reducing the prevalence of high blood pressure in the 1970s and 1980s, the levels of awareness, treatment, and control apparently reached a plateau around 1990.

Trends in Serum Lipids

Measurements of serum total cholesterol from representative samples of the US population are available from NHANES I, II, and III (Table 3). These show considerable progress until around 1994 in reaching Year 2000 objectives of a serum total cholesterol ≤200 mg/dL and ≤20% of the adult

### TABLE 3. Age-Adjusted Mean Serum Total Cholesterol Levels* (mg/dL)

<table>
<thead>
<tr>
<th>Ethnic Group</th>
<th>Educational Level</th>
<th>Survey Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black men</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–8</td>
<td>205</td>
<td>209</td>
</tr>
<tr>
<td>9–12</td>
<td>212</td>
<td>210</td>
</tr>
<tr>
<td>13+</td>
<td>*</td>
<td>217</td>
</tr>
<tr>
<td>Black women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–8</td>
<td>215</td>
<td>223</td>
</tr>
<tr>
<td>9–12</td>
<td>220</td>
<td>216</td>
</tr>
<tr>
<td>13+</td>
<td>*</td>
<td>221</td>
</tr>
<tr>
<td>White men</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–8</td>
<td>215</td>
<td>208</td>
</tr>
<tr>
<td>9–12</td>
<td>219</td>
<td>214</td>
</tr>
<tr>
<td>13+</td>
<td>222</td>
<td>213</td>
</tr>
<tr>
<td>White women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–8</td>
<td>225</td>
<td>218</td>
</tr>
<tr>
<td>9–12</td>
<td>223</td>
<td>216</td>
</tr>
<tr>
<td>13+</td>
<td>224</td>
<td>212</td>
</tr>
</tbody>
</table>

*Insufficient sample size.

Data are from subjects aged 20 to 74 years and are expressed in mg/dL. The sources of this information include the following: National Health Examination Survey I, 1960–1962; NHANES I, 1971–1974; NHANES II, 1976–1980; and NHANES III (phase I), 1988–1991.

<table>
<thead>
<tr>
<th>Ethnic group</th>
<th>Prevalence, %</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1995</td>
<td>1998</td>
</tr>
<tr>
<td>White</td>
<td>4.2</td>
<td>4.8</td>
</tr>
<tr>
<td>Black</td>
<td>6.5</td>
<td>8.3</td>
</tr>
<tr>
<td>Hispanic</td>
<td>4.1</td>
<td>5.1</td>
</tr>
<tr>
<td>Educational level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than high school</td>
<td>8.4</td>
<td>10.3</td>
</tr>
<tr>
<td>High school</td>
<td>4.6</td>
<td>5.3</td>
</tr>
<tr>
<td>Some college</td>
<td>3.5</td>
<td>4.4</td>
</tr>
<tr>
<td>College +</td>
<td>2.6</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Data are from Reference 45.
*Diabetes was self-reported.

population with a total cholesterol ≥240 mg/dL. Progress can be seen in all race/sex groups and in all educational strata, suggesting a change in population determinants of serum cholesterol, such as the saturated fat and cholesterol content of the US diet, despite the increase in the prevalence of overweight.30,43 Although Asians, Native Americans, and Hispanics have lower total cholesterol levels than non-Hispanic whites, there are clear gaps in national data for all racial and ethnic groups, as well as for geographic areas.

Trends in Type-2 Diabetes

Type-2 diabetes is a major contributor to CVD morbidity and mortality in the United States.44 Even before the new, lower threshold of fasting blood glucose for the diagnosis of diabetes, there was evidence that the prevalence of diagnosed cases of type-2 diabetes had increased in recent years; it may now approach 7% of US adults. The Behavioral Risk Factor Surveillance System45 collected self-reported data on physician-diagnosed diabetes. Age-adjusted prevalence rates seem to have increased strikingly from 1995 to 1998 in all race/ethnic groups, with increases ranging from 14% to 28% (Table 4). A strong, inverse gradient by education was observed, but large increases in diabetes prevalence seem to have occurred in college-educated strata. In addition, it is estimated that a large proportion (up to half) of cases of type-2 diabetes have not been diagnosed, making these trends even more ominous. These sharply rising prevalence rates are consistent with local serial surveys in Rochester, Minnesota46 and San Antonio, Texas47 between 1945 and 1990. The increase in the prevalence in diabetes does not seem to be due to increased survival; rather, an increase in incidence largely accounts for the increased prevalence. The incidence in both Mexican Americans and non-Hispanic whites in San Antonio tripled from 1987 to 1996.47

Summary

Trends in levels of CVD risk factors are, to a great extent, consistent with a slowing of the decline in population risk. Prevalence rates of many risk factors, such as smoking, dietary saturated fat and cholesterol, serum cholesterol, and hypertension, fell until 1990; however, since then, there has been little or no progress, at least in smoking prevalence, physical inactivity, and hypertension control. Moreover, there are several trends suggesting an increase in population risk, including greater dietary intake of calories, a rapid rise in obesity prevalence, and a striking increase in the prevalence of type-2 diabetes. Taken in aggregate, trends in risk factors since 1990 do not seem to be heading toward a reduced risk of CVD for Americans.

Recent Trends in CVD Preventive Services in the United States

Trends in Population-Wide Interventions to Promote Healthy Lifestyles

The realization that widespread dietary habits, physical inactivity patterns, and tobacco use were associated with population-wide CVD began in the 1950s and was confirmed by studies such as the Seven Countries Study.48 This led to the concept that CVD prevention should be implemented at the population level. National efforts to make the US population aware of CVD and to educate health professionals about CVD prevention were initiated in the 1950s and 1960s with the issuance of formal statements and reports, such as the 1961 American Heart Association Diet Report, the 1964 Surgeon General’s report on smoking, and the 1970 Report of the Inter-Society Commission for Heart Disease Resources.49

Studies of community-wide interventions for CVD control were initiated in Finland50 and the United States51 in the early 1970s. These have been expanded to include schools, religious organizations, and worksites.52 An increasing number of public and private efforts have addressed CVD prevention issues on a national, regional, or local basis since the mid-1980s. As an example of efforts in the voluntary health sector, the American Heart Association developed an extensive series of materials and programs directed at population groups at worksites and schools, at consumers, and at subgroups such as women. At the federal level, the National High Blood Pressure Education Program, the National Cholesterol Education Program, the Obesity Education Initiative, and other programs have sought, through education and mass media, to increase awareness, treatment, and control for major CVD risk factors and to promote population-wide adoption of healthful lifestyles.

Since the early 1980s, public health agencies at the state level have received funding for CVD control through the Preventive Health and Health Services block grants. About 75% of block grant funding goes for chronic disease control, and all states currently receive block grant funds for CVD prevention. However, state funding for CVD control is not comparable to CVD’s burden on the population. For example, a survey of state health departments in 1989 revealed only 3% of total spending for health programs was devoted to all chronic diseases, violence, and injury prevention. In November 1998, the US Congress allocated funds to create a national CVD prevention program at the Centers for Disease Control and Prevention. This allocation currently stands at $16 million and funds programs in 11 states. The Centers for
Trends in the Usage of Clinical Interventions for Primary Prevention

Primary care physicians can play a central role in the detection and management of CVD risk factors, including adverse eating, drinking, and activity habits; smoking; hyperlipidemia; hypertension; diabetes; and atrial fibrillation (a risk factor for thromboembolic stroke). Surveys about physician attitudes, practice behaviors, and patient-centered outcomes have been published over the past 30 years.

For cigarette smoking, >80% of physicians recognize the importance of smoking cessation counseling and have done so for >20 years. However, various studies have shown that less than half routinely counseled their patients during the 1980s and 1990s. Physicians acknowledge that hyperlipidemia is an important CVD risk factor, and screening for this condition has increased considerably; however, less than half of patients are treated. Similarly, physicians demonstrate an increase in their knowledge of high blood pressure as a major CVD risk factor, and screening for high blood pressure increased in the 1980s to >80% of adults. Treatment has also increased, but in the 1990s, only half of hypertensive patients received treatment from their physicians. Screening for diabetes also lagged in the 1980s and 1990s, with fewer than 50% of physicians routinely screening for this illness. Finally, despite numerous trials demonstrating the efficacy of anticoagulation to prevent stroke in patients with atrial fibrillation, less than half of patients were so treated.

Trends in Clinical Intervention for Secondary Prevention

Patients with established CVD constitute one of the highest risk groups. Secondary prevention involves identifying, treating, and rehabilitating these patients to reduce their risks of recurrence, decrease their need for interventional procedures, improve their quality of life, and extend their overall survival. The American Heart Association has identified the secondary preventive measures generally accepted as efficacious.

The Health Care Financing Administration Cooperative Cardiovascular Project has examined the use of aspirin, β-blockers, ACE inhibitors, and smoking advice in Medicare patients admitted with myocardial infarction nationwide. Remarkable heterogeneity is observed in the prescription rates of these proven secondary prevention strategies. For example, β-blocker prescription rates vary by region, from <20% to >80% of patients with a myocardial infarction leaving the hospital with a β-blocker prescribed. Areas in the Northeast and Midwest seem to have the highest rates of use, and the Southeast and South Central areas of the country have the lowest rates of β-blocker use.

Another nationwide concern is the severe underuse of cardiac rehabilitation, despite its association with a 20% reduction in mortality. Approximately 15% to 30% of acute myocardial infarction patients receive cardiac rehabilitation. Reasons cited for nonparticipation include a lack of physician referral, poor patient motivation, and logistical or financial constraints.

Patients with CHD also infrequently receive the recommended levels of treatment for hyperlipidemia. An audit of 48,586 medical records of patients with CHD in 140 practices found only 44% had an LDL cholesterol measurement and only 25% had an LDL cholesterol level <100 mg/dL. Similarly, a study of 619 practices identified only 17% of CHD patients with an LDL cholesterol level <100 mg/dL.

Revascularization procedures have increased annually for the past 15 years. However, several studies have identified disparities by race and sex in rates of cardiac catheterization, coronary bypass graft surgery, and percutaneous transluminal coronary artery interventions. Angioplasty and bypass surgery rates correlate with catheterization rates. Large geographic variations in the rates of these services exist, suggesting that factors other than disease incidence account for this variation.

Finally, congestive heart failure continues to be a major disease burden; it is the most common cause for hospital admission under the Medicare program. Rates of readmission in the 30 days after discharge are estimated at 18% to 25%. Guidelines for treatment, including use of diuretics and ACE inhibitors, have been established. Despite this, there is abundant evidence for undertreatment. For example, 5 studies have demonstrated only 10% to 50% of patients receive the recommended doses of ACE inhibitors.

Summary

There is evidence for considerable activity in population-wide prevention, primary prevention for higher risk people, and secondary prevention. Given the magnitude of CVD as a health problem, more can and should be done for population-based primary prevention. Within the healthcare sector, fewer than 50% of patients will reliably have their risk factors assessed, treated, or controlled. Similar disparities are observed in secondary prevention, despite widely accepted guidelines, numerous clinical trials, and favorable cost-effectiveness studies. These data point to numerous gaps in our efforts to use available, proven interventions to control CVD. Few data are available on trends in these measures or...
Areas Where New or Better Data Are Needed to Attain the Year 2010 Health Objectives, as Part of a Strategic Research Agenda for the 21st Century

On the basis of the review of trends in CVD mortality, risk factors, and deleterious health behaviors and the provision of preventive services, 8 recommendations for new areas of research and development were put forth by the National Conference on CVD Prevention.

1. Apply established theory and prior experience in community studies and test interventions involving modern forms of health communication, environmental change, and policy.
2. Explore opportunities afforded by managed care and other computerized medical record linkage systems for monitoring trends in mortality, morbidity, risk factors, and preventive services.
3. Design community interventions with shorter durations and intermediate end points for widespread implementation; these should include smaller, high-risk population subgroups, as defined by race/ethnicity, socioeconomic status, or geography.
4. Establish a national surveillance system for CVD that will:
   a. Provide adequate data to monitor levels and trends in population subgroups, as defined by race/ethnicity, socioeconomic status, and geography.
   b. Allow differences within the population in mortality, morbidity (including congestive heart failure), incidence, and risk factor levels to be better understood.
5. Design research to improve risk-factor detection and management in primary care settings based on a better understanding of the behavior at the patient, provider, and organizational levels and, specifically, acquire knowledge about the intensity of interventions required to activate behavior change, better measures of outcomes to monitor these behavior changes, and means to maintain beneficial behavior changes.
6. Design research in healthcare organizations to understand better the role of incentives in preventive care delivery, the opportunities in managed care and other “systems approaches,” the potential role of multidisciplinary teams, and the promise of technological advances to improve data collection, service delivery, and cost effectiveness.
7. Seek greater understanding of physician and patient factors that affect adherence to prevention guidelines, and expand secondary prevention with risk factor management that is pathophysiologically grounded, evidence-based, and cost-effective.
8. Expand the identification of susceptible individuals using new measures of premorbid disease.

A More Effective Strategic Agenda for CVD Prevention Programs and Policies as a Means to Achieve the Healthy People 2010 Objectives

Although research will provide improved tools and strategies for application to the problem of CVD, the existing wealth of knowledge is being applied with limited effectiveness. To address this, 7 recommendations were put forth by the National Conference on CVD Prevention as a way to meet the challenges raised by the current trends in CVD.

1. Clearly define and fully coordinate the leadership of the CVD control efforts at the population, primary care, and secondary prevention/rehabilitation levels.
2. Cultivate enhanced collaborations and partnerships for population-based programs (eg, state and local health departments, academia, voluntary health organizations, public advocacy groups, employers, unions, religious organizations, schools, various industries, etc), in primary care (eg, physicians, nurses, dietitians and nutritionists, physiatrists, health educators, other health professionals, voluntary health organizations, pharmaceutical industries, third-party payers, and managed care organizations), and in secondary prevention/rehabilitation (eg, specialty professional organizations, voluntary health organizations,
pharmaceutical and device manufacturers, hospitals, and third-party payers).
3. Expand the work force trained in CVD prevention at the community, primary care, and secondary prevention/rehabilitation levels.
4. Implement new strategies to reduce the risks of populations and individuals through policy and environmental changes at the population level (eg, nutrition, physical activity, and tobacco control), in primary care systems (eg, reorganization of care teams and use of nonphysician professionals and self-help programs), and by secondary prevention/rehabilitation providers (eg, inpatient care protocols, nurse case managers, and more accessible rehabilitation programs).
5. Develop a national CVD surveillance system, which includes measures of incidence, morbidity/disability, and use of preventive services in addition to current mortality and risk-factor prevalence data, with the capability to identify trends in subgroups, including higher risk subgroups, as defined by race/ethnicity, socioeconomic status, and geography, for use in planning and evaluation (note: this is similar to the first recommendation for research and development).
6. Explore new systems to evaluate the performance of preventive services at the population, primary care, and secondary prevention levels for the purposes of program planning and evaluation, accountability of responsible providers, and motivation of populations and individuals.
7. Create new mechanisms to support existing prevention programs and to provide resources for new initiatives and incentives for system, provider, and individual behavior change to create a community and healthcare system more balanced toward prevention.

Discussion
This report intends to provide a current picture of cardiovascular health in the United States at the end of the 20th century. The striking declines in CHD since 1960 and in stroke since 1920 have led some to conclude that the CVD epidemic will disappear, possibly without further investment of effort or resources or without the development of enhanced prevention and treatment strategies. At the very least, recent trends suggest that CVD patterns in the United States are much more complex than previously appreciated. Mortality declines do not necessarily equate with reduced incidence; on the contrary, some population-based studies suggest that incidence has not changed since the late 1980s. The resulting increase in prevalence due to reduced case-fatality rates has resulted in higher levels of disability and healthcare cost from CVD. A more pessimistic view would predict an actual increase in incidence on the basis of deleterious risk factor trends and continued high levels of mortality as many CVD patients eventually die of heart failure and the long-term sequelae of stroke.

The core strategy implied in the research and programmatic recommendations of the National Conference on CVD is to target incidence reduction as the key to CVD control through the prevention of risk factors and prompt, sustained, and effective treatment of risk factors once they develop. Trends in risk behaviors suggest that we still have large deficits in our knowledge of determinants of population behavior. Gaps in the implementation of widely accepted treatment guidelines suggest that improvement in healthcare provider behaviors remains an elusive target. Although significant questions need exploration, a number of programs can be advocated on the basis of what is already known. The allocation of resources for such programs is a key issue, especially for a disease that is already a leading cost of direct and indirect health expenditures.

Not to be forgotten in these discussions is one fundamental reason for disappointing trends in mortality, risk factors, and preventive services: the disparities existing in the United States between the affluent and the poor. An examination of mortality, risk-factor prevalence, and use of preventive services identifies room for improvement even in the affluent. However, it may be difficult or impossible to achieve national goals for CVD control by efforts that simply widen the gap between groups defined by race/ethnicity, socioeconomic status, or geography. Therefore, any research or programmatic strategies must involve all segments of the US population, with enhanced efforts to remove differences in risk behaviors, preventive care, and morbidity and mortality in the disadvantaged.

Acknowledgments
The authors thank Debra Graham and Kecia Brown for coordinating the National Conference on CVD Prevention and Kathy Bohn for assistance in manuscript preparation.

References
24. Pappas G, Queen S, Hadden W, et al. The increasing disparity in mor-
27. Byers T, Anda R, McQueen D, et al. The correspondence between
variation in the onset of decline of coronary heart disease mortality in
29. Byers T, Anda R, McQueen D, et al. The correspondence between
variation in the onset of decline of coronary heart disease mortality in
41. Sempos CT, Carroll MD. Recent US, trends in serum lipids; a minority health focus. Paper presented at: National Conference on CVD Pre-
vention; September 27–29, 1999; Bethesda, Md.
49. Report of the Inter-Society Commission for Heart Disease Resources: Prevention of cardiovascular disease: primary prevention of the athero-
60. Streja DA, Rabkin SW. Factors associated with implementation of pre-


72. Packer M, Cohn JN, eds, on behalf of the membership of the Advisory Council to Improve Outcomes Nationwide in Heart Failure. Consensus recommendations for the management of chronic heart failure. *Am J Cardiol*. 1999;83(suppl 2A):1A–38A.


Trends and Disparities in Coronary Heart Disease, Stroke, and Other Cardiovascular Diseases in the United States: Findings of the National Conference on Cardiovascular Disease Prevention
Richard Cooper, Jeffrey Cutler, Patrice Desvigne-Nickens, Stephen P. Fortmann, Lawrence Friedman, Richard Havlik, Gary Hogelin, John Marler, Paul McGovern, Gregory Morosco, Lori Mosca, Thomas Pearson, Jeremiah Stamler, Daniel Stryer and Thomas Thom

Circulation. 2000;102:3137-3147
doi: 10.1161/01.CIR.102.25.3137

Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2000 American Heart Association, Inc. All rights reserved.
Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circ.ahajournals.org/content/102/25/3137

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation is online at:
http://circ.ahajournals.org/subscriptions/