

SECTION 1.

HEART DISEASE AND STROKE PREVENTION: TIME FOR ACTION

Summary

The continuing epidemic of cardiovascular diseases (CVD) in the United States and globally calls for renewed and intensified public health action to prevent heart disease and stroke. Public health agencies at national, state, and local levels (including CDC in partnership with NIH) bear a special responsibility to meet this call, along with tribal organizations and all other interested partners. The widespread occurrence and silent progression of atherosclerosis and high blood pressure (the dominant conditions underlying heart disease and stroke) has created a CVD burden that is massive in terms of its attendant death, disability, and social and economic costs. This burden is projected to increase sharply by 2020 because of the changing age structure of the U.S. population and other factors, including the rising prevalence of obesity and diabetes. Several popular myths and misconceptions have obscured this reality, and these must be dispelled through effective communication with the public at large and with policy makers.

More than a half-century of research and experience has provided a strong scientific basis for preventing heart disease and stroke. Policy statements and guidelines for prevention have been available for more than four decades and have increased in breadth, depth, and number to guide both public health action and clinical practice. National public health goals have been updated to 2010 and include a specific call to prevent heart disease and stroke. Achieving this goal would greatly accelerate progress toward achieving the nation's two overarching health goals—increasing quality and years of healthy life and eliminating health disparities. CVD is a major contributor to early death (measured as years of life lost) and to differences in life expectancy among racial and ethnic groups.

An unprecedented opportunity exists today to develop and implement an effective public health strategy to prevent heart disease and stroke. Three major factors have contributed to this opportunity:

- More cumulative knowledge and experience in CVD prevention exists today than ever before.
- Major national partnerships have been established to support heart disease and stroke prevention.
- Health professionals increasingly recognize the continuing CVD epidemic, unfavorable recent trends, and forecasts of a mounting burden of heart disease and stroke, nationally and worldwide. This recognition has increased their awareness of the need for immediate action.

Despite this opportunity, the public health investment in preventing heart disease and stroke remains far below what is needed for fully effective intervention. Serious shortcomings also exist in the delivery of

established treatments for these conditions in clinical practice. These facts demonstrate that the vast body of current knowledge and experience in CVD prevention has yet to be adequately applied to realize the full potential benefit to the public's health. The most critical need today is for public health action that is guided by the knowledge and experience already at hand.

Introduction: Planning for the Prevention of Heart Disease and Stroke

Heart disease and stroke together exact a greater toll on America's health than any other condition.¹ Early death, disability, personal and family disruption, loss of income (more than \$142 billion for 2003), and medical care expenditures (more than \$209 billion) are some indicators of this toll. Young and old, women and men, rich and poor, and all racial and ethnic groups share this burden. Moreover, we can expect even greater numbers of heart attacks and strokes, increasing dependency (especially among the expanding population of older Americans), and mounting costs of care for victims and their families unless we as a nation renew and greatly intensify our public health effort to prevent these conditions.

Heart attacks and strokes can be prevented or delayed if the knowledge we already have is put into action now. In fact, a broad coalition of national organizations and federal health agencies have already adopted a comprehensive goal for preventing heart disease and stroke as part of the *Healthy People 2010* national health goals.² But having goals is only a beginning. Attaining these goals requires a plan with specific recommendations and action steps for implementing them. Today, we can build such an action plan on a solid knowledge base resulting from decades of research on the causes and prevention of heart disease and stroke, especially because of the support of NIH and the American Heart Association.

For CDC, developing an action plan for cardiovascular health (CVH) is critical for two compelling reasons. First, CDC and NIH have been assigned responsibility as co-lead agencies to head the nation's effort to attain the *Healthy People 2010* goal for preventing heart disease and stroke.² Second, Congress charged CDC in 1998 to develop and implement state-based cardiovascular disease prevention programs in every state and U.S. territory. These recent mandates create a need and responsibility to formulate a long-range strategy to guide the public health community in preventing heart disease and stroke. Accordingly, in December 2001, CDC initiated a planning process that included an intensive series of expert consultations as the basis for developing this *Action Plan*.

Heart Disease and Stroke: Scope, Burden, Disparities, and a Forecast

The Scope of "Heart Disease and Stroke"

Disorders of the circulation that affect the heart, brain, and other organs may be described in various terms, sometimes with specific technical

meaning.^{1,3} For clarity, the most important terms used in this plan are defined either in the text or in the glossary (see Appendix A). Some of the more common terms are defined in this section.

“Heart disease and stroke” refers to the two major classes of circulatory conditions that are the main focus of the *Action Plan*. This usage, which was chosen for the title of the plan, corresponds with the terminology of Chapter 12, Heart Disease and Stroke of *Healthy People 2010*.² “Heart disease” most often refers to coronary heart disease (including heart attack and other effects of restricted blood flow through the arteries that supply the heart muscle) or to heart failure. Other times, this term refers to several conditions or all diseases affecting the heart (e.g., “heart disease deaths”). “Stroke” refers to a sudden impairment of brain function, sometimes termed “brain attack,” that results from interruption of circulation to one or another part of the brain following either occlusion or hemorrhage of an artery supplying that area.

“Cardiovascular health” (CVH) refers broadly to a combination of favorable health habits and conditions that protects against the development of cardiovascular diseases. “CVH promotion” is support and dissemination of these favorable habits and conditions. “Cardiovascular disease or diseases” (CVD), in turn, refers in principle to any or all of the many disorders that can affect the circulatory system. Here, CVD most often means coronary heart disease (CHD), heart failure, and stroke, taken together, which are the circulatory system disorders of the greatest public health concern in the United States today. However, CVD can also mean cerebrovascular disease, or disease of brain circulation. Throughout this plan, which is intended to address heart disease and stroke together, use of either CVH or CVD means both cardiovascular and cerebrovascular disease. More often, if less conveniently, the phrase “heart disease and stroke” means explicitly that both are included.

Heart disease and stroke are mainly consequences of atherosclerosis and high blood pressure (hypertension).³ They are sometimes included in the broader category of atherosclerotic and hypertensive diseases (see The Knowledge Base for Intervention later in this section). Risk factors for heart disease and stroke have been well established for many years. Distinct from age, family history, and possible genetic determinants are modifiable risk factors that cause heart attacks and strokes, including high blood cholesterol, high blood pressure, smoking, and diabetes. Behaviors that contribute to development of risk factors, partly by causing obesity, include adverse dietary patterns and physical inactivity. Social and environmental conditions that may determine such behavioral patterns, in turn, include education and income, cultural influences, family and personal habits, and opportunities to make favorable choices. Policies—especially in the form of laws, regulations, standards, or guidelines—contribute to setting these and other social and environmental conditions. For example, dietary patterns result from the influences of food production policies, marketing practices, product availability, cost, convenience, knowledge, choices that affect health, and preferences that are often based on early-life habits. Because many aspects of behavior are clearly beyond the control of the individual, the scope of heart disease

and stroke prevention, from the public health perspective, extends far beyond the individual or the patient. Thus, a comprehensive public health strategy for prevention must address the broader determinants of risk and disease burden as they affect both the population as a whole and particular groups of special concern, including those determinants that make healthier choices more likely.

The Nation's CVD Burden

The nation's CVD burden can be described in many ways. Examples include the number and rate of deaths by age, sex, race or ethnicity, or place of residence; the number and percentage of the population with a specific CVD condition or risk factor; and estimates of economic costs, including direct health care expenditures and loss of income from early death or disability. Several federal agencies contribute data on these aspects of the burden, including CDC and its National Center for Health Statistics and NIH's National Heart, Lung, and Blood Institute and National Institute of Neurological Disorders and Stroke. Table 1 illustrates several measures of the CVD burden in the U.S. population as reported by the American Heart Association on the basis of these data sources.¹

The dominant change in CVD mortality in the United States in recent decades was a major decline in the annual rates of death for the population as a whole (i.e., age-adjusted death rates) for both CHD and stroke. These declines resulted in a substantial reduction in the numbers of deaths from these conditions that would have occurred for any particular age group (e.g., 45–54 years) under the previously higher rates. Despite these declines in rates, actual numbers of deaths from heart disease have changed little in 30 years and have actually increased within the past decade, especially for stroke.¹ This is mainly because more people are living longer, and rates are higher among successively older age groups.

As a consequence, heart disease remains the nation's leading cause of death.¹ Stroke is the third leading cause of death, and both conditions are major causes of adult disability. The decline in rates of coronary heart disease mortality slowed from -3.3% a year in the 1980s to -2.7% a year in the 1990s, and the decline in overall rates of stroke mortality slowed markedly in contrast to the 1970s and 1980s.⁴ Meanwhile, the frequency of heart failure increased steadily during the last 25 years.³ Peripheral arterial disease continues to be a major predictor of CVD death.^{1,3} In addition, the previous favorable trends were not uniform among racial and ethnic groups. For example, heart disease rates declined more slowly among blacks than whites.¹ These shifting trends are consistent with forecasts of the global burden of CVD over the next two decades and support the prediction that heart disease and stroke will persist as the leading causes of death and disability worldwide unless effective public health action is taken to prevent them.^{5,6}

Two other points should be emphasized. First, sudden deaths from coronary heart disease that occur without hospitalization or in the absence of any previous medical history of coronary heart disease

Table 1. Selected indicators of the cardiovascular disease (CVD) burden, United States**Number of Deaths in 2000**

- 2,600 CVD deaths occur every day—that's one every 33 seconds.
- 150,000 CVD deaths occur each year among people younger than age 65.
- 250,000 coronary heart disease (CHD) deaths occur each year without hospitalization.
- 50% of men and 63% of women who suffered a sudden CHD death lacked any previous CHD history.
- 40,429 deaths occurred in 2000 from peripheral vascular disease, aortic aneurysm, and other diseases of the arteries.
- During 1990–2000, the number of CVD deaths increased 2.5%, although the death rate decreased 17.0%.

Survivors in 2000

- 450,000 people had survived a first heart attack for more than 1 year.
- 450,000 people had survived with heart failure for more than 1 year.
- 375,000 people had survived a first stroke for more than 1 year.

Prevalence in 2000

- 12.9 million people were living with coronary heart disease.
- 4.9 million people were living with heart failure.
- 4.7 million people were living with stroke.

Risk Factors in 2000

- 105 million people had high total cholesterol (≥ 200 mg/dl).
- 50 million people had high blood pressure (systolic ≥ 140 mm Hg, diastolic ≥ 90 mm Hg) or were taking antihypertensive medication.
- Nearly 48.7 million people age ≥ 18 were current smokers.
- More than 44 million people were obese (body mass index ≥ 30.0 kg/m²).
- 10.9 million people had physician-diagnosed diabetes.

Projected Costs in 2003

\$209.3 billion in direct costs and \$142.5 billion in indirect costs, for a total of \$351.8 billion.

Note: Death rates and prevalence per 100,000 were age-adjusted to the 2000 U.S. standard population.

Source: Based on data compiled and reported by the American Heart Association. *Heart and Stroke Statistics—2003 Update*.

(250,000 each year) make the strongest case for prevention.¹ For some victims, no opportunity exists for treatment because their death is the first sign of CVD. Second, the annual cost of CVD to the nation is projected to exceed \$351 billion in 2003.¹ This total includes direct health care costs (for hospital and nursing home care, physicians and other professionals, drugs and other medical durables, and home health care) and indirect costs (due to lost productivity from disability and death). This cost substantially exceeds comparable costs for all cancers (\$202 billion) and for human immunodeficiency virus (HIV) infections (\$28.9 billion) reported for 2002.¹

Such data confirm that the CVD epidemic is continuing in the United States and that it is a major component of our health care costs. Yet they do not convey the full impact of CVD. For example, cognitive impairment and dementia caused by underlying vascular disease of the brain (vascular cognitive impairment [VCI]) may occur in as many as 30% of stroke survivors, as well as in people without a clear history of stroke.⁷ These observations also apply to people with or without Alzheimer's disease. Such findings suggest that VCI is part of the CVD spectrum and should be included in estimates of both the CVD burden and the potential health and economic impact of prevention. These factors reinforce concerns that the aging of the U.S. population will make CVD an even greater burden than previously estimated in the next two decades.

The CVD burden can also be expressed in the personal stories of how it affects people and their families. Just one example is the sudden death from heart attack in June 2002 of the St. Louis Cardinals' star pitcher, Darryl Kile. Kile was 33 years old and is survived by his widow and three young children.⁸ This is a striking example of the increased number of victims of sudden cardiac death younger than age 35 in the past decade.¹ With an estimated 12.9 million Americans living with heart disease and 4.7 million living with stroke, many people can recount the impact on their lives of becoming a victim of CVD. For millions of others who did not survive their first encounter with heart disease or stroke, only the family members or friends left behind can tell their stories.

Disparities

Health disparities have long been a special concern in setting national objectives, and *Healthy People 2010* calls for the elimination of such disparities as one of its two overarching goals.² Disparities can exist among certain populations defined by sex, race or ethnicity, education or income, disability, place of residence, or sexual orientation. Sex-specific data are commonly available for CVD. In contrast to previous beliefs, CVD is clearly not an affliction primarily of men. In fact, it causes more deaths among women. In 2000, CVD was responsible for 505,661 deaths among U.S. women and 440,175 deaths among U.S. men. The higher numbers among women are partially due to the greater numbers of women in the oldest age groups, where CVD mortality is highest.¹

Major disparities in the burden of heart disease and stroke and their risk factors among different racial and ethnic groups are widely recognized. However, relevant data for some groups are scant or nonexistent because data have not been collected to address this concern adequately. To improve data collection, the federal government has promulgated standards for classifying race and ethnicity in federal data systems.⁹

Researchers have also explored and published data on the geographic variations in the burden of heart disease death—by state and by county—for both women and men in the five major racial and ethnic categories.^{10,11} These publications include information on local economic resources and medical care resources in the different areas examined. Data on the geographic variations in stroke deaths were published in 2003.¹²

Table 2 summarizes heart disease mortality differences by race and ethnicity in the United States. Table 3 presents similar data for stroke deaths for the most recent years available, 1999–2000.*¹² Both tables illustrate striking disparities in the excess mortality among blacks (for both women and men) compared with all other groups.

* In Tables 2 and 3, data for Hispanics are presented twice—once under the category of “Hispanic,” which includes Hispanics of all racial identities (e.g., Hispanic blacks, Hispanic whites), and again under any of the four racial categories according to a person’s racial identity. Consequently, data for the five groups are not mutually exclusive because “Hispanic” is considered a designation of ethnicity, not race.

Table 2. Heart disease death rates for people aged ≥35 years, United States, 1991–1995*

Sex	Race or Ethnicity				
	American Indian or Alaskan Native	Asian or Pacific Islander	Black	Hispanic	White
Women	259	221	553	265	388
Men	465	372	841	432	666

* Rates per 100,000 are age-adjusted using the 1970 U.S. standard population.

Source: CDC. References 10 and 11.

Disparities in other areas have been published in *Health, United States, 2002*, an annual report on national trends in health statistics.¹³ This report also examines differences in health outcomes and risk factors for major racial and ethnic groups in the United States. Table 4 (page 20) presents examples of these disparities, some of which relate specifically to heart disease and stroke, whereas others relate to overall health. Several key points about health disparities among different groups are evident in this table. First, the extent to which data are lacking for major population groups is evident. Second, for populations with adequate data, disparities are striking—particularly among African Americans—in terms of years of life lost to death from heart disease and cerebrovascular disease, prevalence of hypertension and obesity (women only), and poverty. Other noteworthy points are the low values of several indicators for Asians (including Native Hawaiians and Other Pacific Islanders); the excess years of life lost because of deaths from cerebrovascular disease and diabetes among American Indians or Alaska Natives; and the high prevalence in the Hispanic or Latino population of poverty, lack of health coverage, and obesity. The table also indicates that a substantial proportion of these three minority groups live in poverty or without health care coverage.

Table 3. Stroke death rates for people aged ≥35 years, United States, 1991–1998*

Sex	Race or Ethnicity				
	American Indian or Alaskan Native	Asian or Pacific Islander	Black	Hispanic	White
Women	77	96	153	72	113
Men	80	118	182	88	121

* Rates per 100,000 are age-adjusted using the 2000 U.S. standard population.

Source: CDC. Reference 12.

Although other data sources are available for some of these populations, they suffer several limitations. Some of these were outlined in a 1999 report that illustrated the insufficiencies of data on Asian American and Pacific Islander populations.¹⁴ These include a lack of data for subgroups with heterogeneous health characteristics, relatively small sample sizes, a lack of systematic data collection, a lack of longitudinal studies, a lack of population-based CVD data, and self-selection bias in sampling methods. Eliminating disparities requires adequate CVD data to establish the nature and extent of the disparities and to monitor changes. Clearly, data

systems must be strengthened if disparities are to be addressed effectively. What we do know about existing disparities indicates that interventions must affect disadvantaged groups more than they do the population as a whole. The population-based health objectives for heart disease and stroke presented in *Healthy People 2010* that could be improved in the short term have targets that are predominantly based on the criterion “better than the best”—that is, all groups are expected to achieve a better

Table 4. Disparities in selected health indicators by race/ethnicity, United States

Health Indicators	American Indian or Alaska Native	Asian*	Black or African American	Native Hawaiian or Other Pacific Islander	White, Non-Hispanic	Hispanic or Latino
Years of potential life lost before age 75 [†] from heart disease [‡] (1999 data)	1238.9	617.5	2398.9	— [§]	1222.9	869.8
Years of potential life lost before age 75 [†] from CVD (1999 data)	243.3	214.4	508.2	—	180.8	207.5
Years of potential life lost before age 75 [†] from diabetes mellitus [¶] (1999 data)	41.4	84.6	402.5	—	155.6	214.2
Tobacco use (cigarettes) during the past month among persons aged >12 (2000 data)	42.3%	16.5%	23.3%	—	25.9%	20.7%
Hypertension** among men aged 20–74 (1988–1994 data)	—	—	36.4%	—	25.5%	25.9%
Hypertension among women aged 20–74 ^{††} (1988–1994 data)	—	—	35.9%	—	19.7%	22.3%
Total cholesterol ≥240 mg/dl among men (1988–1994 data)	—	—	16.4%	—	19.1%	18.7%
Total cholesterol ≥240 mg/dl among women (1988–1994 data)	—	—	19.5%	—	20.7%	17.7%
Body mass index ≥30 kg/m ² among men aged ≥20 (1988–1994 data)	—	—	21.1%	—	20.7%	24.4%
Body mass index ≥30 kg/m ² among women ^{††} aged ≥20 (1988–1994 data)	—	—	39.0%	—	23.3%	36.1%
No health care coverage among persons aged <65 (2000 data) [#]	38.2%	17.3%	20.0%	—	15.2%	35.4%
Poverty, all ^{§§} (2000 data)	—	10.7%	22.0%	—	7.5%	21.2%
Poverty, aged <18, female head, no spouse (2000 data)	—	32.3%	49.4%	—	27.9%	48.3%

* Includes data for Native Hawaiians or other Pacific Islanders except for tobacco use.

† Rates per 100,000 are age-adjusted using the 2000 U.S. standard population.

‡ Includes all heart disease deaths coded according to the *International Statistical Classification of Diseases and Related Health Problems (ICD-10)* (Geneva, Switzerland: World Health Organization; 1992).

§ Data do not meet the criteria for statistical reliability, data quality, or confidentiality.

|| Includes all cerebrovascular disease deaths coded according to the *ICD-10*.

¶ Includes all diabetes deaths coded according to the *ICD-10*.

** Defined as a person having blood pressure ≥140/90 mm Hg or reporting current antihypertensive therapy.

†† Excludes pregnant women.

Percentages are age-adjusted using the 2000 U.S. standard population.

§§ Defined as all persons living in a household with income below the poverty level.

||| Defined as all related children aged <18 years living in a household with income below the poverty level and headed by a female with no spouse present.

Note: Data on hypertension, total cholesterol, and body mass index (BMI) that are labeled “Hispanic or Latino” are for the Mexican population. Data labeled as “Black or African American” are for non-Hispanic blacks. Percentages are age-adjusted using the 2000 U.S. standard population.

Sources: CDC, NCHS, National Vital Statistics System: estimates of years of potential life lost. Substance Abuse and Mental Health Services Administration, National Household Survey on Drug Abuse: estimates of tobacco use. CDC, NCHS, National Health and Nutrition Examination Survey: estimates of hypertension, total cholesterol, and body mass index. CDC, NCHS, National Health Interview Survey: estimates of no health care coverage. U.S. Bureau of the Census, Current Population Survey: poverty.

measure of health status by 2010 than that of the most favorable group at the baseline.² This implies that we should attain health improvements for all groups within the population, but that groups with poorer baseline status need to experience accelerated improvement, so that all groups will reach the same measures of better health by 2010. Attaining the targets for these objectives will require that the most effective programs, including those aimed at reducing the prevalence of CVD risk factors, reach the groups with the greatest CVD burden.

A Forecast

Over the next two decades, the number of Americans older than age 65 will increase dramatically, from approximately 34.7 million in 2000 to more than 53.2 million in 2020.¹⁵ By 2020, a total of 16.5% of Americans will be aged 65 or older, compared with 12.6% in 2000—an increase of nearly one-third. Proportions of minorities in the overall population are expected to increase from 12.9% to 14.0% for blacks, 4.1% to 6.1% for Asians, 0.9% to 1.0% for American Indians, and 11.4% to 16.3% for Hispanics. Heart disease deaths are projected to increase sharply between 2010 and 2030, and the population of heart disease survivors is expected to grow at a much faster rate than the U.S. population as a whole. Marked increases in numbers of stroke deaths are also predicted.¹⁶ These changes together will constitute a major increase in the nation's CVD burden, accompanied by increasing demands for related health care services, as well as increases in health care expenditures; lost income and productivity; and prevalence of disease, disability, and dependency. This forecast suggests that instead of increasing quality and years of healthy life, we may lose ground. Moreover, if recent trends continue, disparities may widen rather than be eliminated.⁴ The need for prevention has never been as great as it is today.

Myths and Misconceptions

Although data show us the hard facts, the disease burden also can be expressed in more visual ways to dramatize its magnitude. For example, the number of annual deaths from heart attacks alone exceeds the number of deaths that would occur if two fully occupied 747 aircraft crashed every day of the year with no survivors. Yet, CVD has not aroused a level of public concern commensurate with its relative importance.¹ Why?

Among the reasons are several myths or misconceptions about heart disease and stroke that must be addressed as this plan gains the needed support of the public and policy makers. These include the beliefs that heart attacks only affect the elderly, that heart attack death is quick and easy ("the best way to go"), that a heart attack can be "fixed" with modern medical and surgical technology, and that heart attacks and strokes occur when "your time has come."

The truth is very different. Of the 945,836 people who died of CVD in 2000, 32% were younger than age 75.¹ Currently, the average expected age at death in the United States is 76.9 years.¹⁷ As noted previously,

250,000 coronary heart disease deaths occur each year without the victim reaching a hospital. For one-half to two-thirds of those who die suddenly of CHD, there was no previous recognition of the disease.¹ Many people who died under these conditions had no opportunity for treatment and could only have been saved by preventive measures that reach the population as a whole. The more common outcome, however, is to survive for days, weeks, months, or years. Those who survive may experience disability, job loss, or dependency, often with long-term consequences. Survivors also have a greatly increased risk of having another heart attack or stroke. Modern medicine and surgery can offer great benefit to those who survive long enough to receive treatment, but are no help to those who die suddenly following their first CVD event. There is no complete “cure” once a heart attack or stroke has occurred, as survivors continue to be at increased risk for another attack.¹ Finally, “your time” has not yet come if readily available preventive measures can still increase quality and years of healthy life.

These and other myths about heart disease and stroke must be dispelled through effective communication and education. They are significant barriers to understanding the urgency of the CVD epidemic and the potential for preventing these conditions.

The Knowledge Base for Intervention

The CVD epidemic in the United States and other Western industrialized countries was first recognized around the middle of the twentieth century.³ In response, extensive research programs involving laboratory, clinical, and population-based investigations were undertaken to identify the causes and the means of preventing coronary heart disease and stroke. The result of this research has been a major growth in knowledge and understanding of the causes of CVD, especially because of the work of NIH and the American Heart Association.

Statistical research has shown that death rates from heart disease and stroke vary among populations and over only a few years' time in ways that cannot be explained by differences or changes in genetic factors. Such findings demonstrate clearly that environmental factors, in the broadest sense, play a major role in the occurrence of heart disease and stroke and can do so over a relatively short term. Thus, controlling these factors offers opportunities for prevention. Major epidemiologic studies revealed that incidence rates (measures of the occurrence of new cases of CVD, whether fatal or not) could be predicted by blood cholesterol level, blood pressure level, smoking, diabetes, and certain other potentially modifiable characteristics. These characteristics, recognized as “risk factors” since the 1960s, were ultimately established as the major causes of CVD.

How do these factors cause CVD? The principal pathway to a heart attack or stroke is through the gradual, years-long development of atherosclerosis and high blood pressure. Atherosclerosis is a disease of the medium-sized and larger arteries, such as those that supply the heart (the coronary arteries), the brain (the carotid and cerebral arteries), and

the lower extremities (the peripheral arteries), as well as the aorta. Atherosclerosis consists of concentrated areas of mushy material (atheromas) within the arterial wall that are often encrusted or hardened (sclerosed) by deposited calcium. The resulting abnormality is a plaque that weakens the arterial wall and may intrude into the lumen or channel of the artery to limit blood flow or obstruct it completely. A plaque may suddenly rupture, leading to blockage of the artery and precipitating a heart attack or stroke.

High blood pressure (or hypertension) also can cause heart disease or stroke by exacerbating the effects of other risk factors in accelerating progression of atherosclerosis by placing a continuous, excess workload on the heart (hypertensive heart disease). It can also cause a cerebral artery to rupture (cerebral hemorrhage).

Atherosclerosis begins to develop in childhood and progresses into the adult years, under strong influence of the risk factors noted previously. Autopsy studies of young American men who died in the Korean War and in Vietnam confirmed that people in their 20s can have moderate and sometimes severe atherosclerosis despite a lack of any medical history to suggest it.^{18,19} More recent studies of children, adolescents, and young adults (younger than 35) have demonstrated the close link of blood cholesterol level, blood pressure level, smoking, and obesity with the extent and severity of atherosclerosis among people well below age 20.^{20,21} High blood pressure also develops progressively throughout life, undergoing major increases in adolescence and late adulthood. These findings underscore the opportunities for preventing CVD during childhood and adolescence, as well as the lifelong importance of prevention.

Establishing a way to prevent risk factors requires knowledge about the risk factors themselves. That is, can they be changed? Can heart attacks and strokes be prevented as a result? How prevalent are these risk factors? If their frequency is reduced in the population as a whole, what will the impact be on rates of heart disease and stroke nationwide? An impressive body of evidence amassed over the last 30 years has established that blood cholesterol levels, blood pressure levels, and smoking habits can be modified and that diabetes can be prevented and controlled by behavioral change as well as by medication, all with favorable impact on CVD risk. Population studies have monitored the continuing high prevalence of these risk factors in the United States since the early 1960s.

In the mid-1980s, researchers projected how the CVD burden would be affected if the major risk factors were reduced.²² These projections suggested that CVD death rates could be reduced by 70% by reducing the population's mean level of blood cholesterol to 190 mg/dl and the mean level of diastolic blood pressure to 80 mm Hg. Because this estimate did not consider the added impact of reducing the prevalence of smoking, it probably underestimated how much CVD death rates could be reduced. Current estimates indicate that these major risk factors account for 75% of the difference in risk for CHD within populations.²³ If these projections were systematically updated, we could estimate how

much the CVD burden might be reduced over the next two decades. This estimate might be substantially greater than the *Healthy People 2010* target of reducing heart disease and stroke deaths by 20%. As indicated previously, a greater reduction is needed if the projected increase in CVD burden is to be offset.

Finland's experiences during 1970–1990 are a good example of the healthy changes that can be achieved by reducing major risk factors for heart disease.²⁴ Improvements in blood cholesterol levels, blood pressure levels, and smoking rates for both women and men closely predicted the actual declines in heart disease deaths that were observed over 20 years. Deaths declined more than 60% for women and more than 50% for men. Although community intervention studies in the United States also have demonstrated positive changes, these interventions have generally lacked the intensity and duration (i.e., the "preventive dose") needed to demonstrate that they actually reduced CVD deaths beyond the influence of favorable changes taking place in society at large.²⁵

What knowledge constitutes a sufficient basis for public health action? Both formal research and relevant practical experience are important. Like evidence-based medicine, evidence-based public health needs established criteria for systematically evaluating available evidence. Continuous evaluation can guide current and future programs and advance policies as new knowledge is acquired.

In contrast to evidence-based medicine, evidence-based public health depends on different types of evidence. For example, randomized controlled trials are considered essential to evidence-based medicine but are often lacking in the public health arena. On the other hand, population-based observations that are often unavailable in clinical decision making are included in the evidence base for public health decisions. The context of public health practice is the world at large, where many influences on health are continually at play. Therefore, the central question for evidence-based public health is not whether to take a particular action or no action, but whether the status quo, with its prevailing influences on the population's health, is best. By asking what evidence supports the status quo, as well as what supports a proposed alternative policy or program, evidence-based public health can help establish the relative merits of proposed interventions.

Clearly, the CVD burden of this nation will not improve under the status quo. We have the knowledge needed to launch a comprehensive public health strategy to change this situation. In fact, only by putting current knowledge into action now can we strengthen the body of knowledge substantially, as new and expanded programs and policy frameworks are implemented and rigorously evaluated.

Evolution of Prevention Policy

As our knowledge about CVD has grown during the past half-century, our policies for preventing heart disease and stroke have also advanced.³ The first recommendations appeared in 1959 in *A Statement on*

Arteriosclerosis: Main Cause of “Heart Attacks” and “Strokes,” which was signed by five past presidents of the American Heart Association.²⁶ Citing studies published in the 1950s, this report identified most of the same risk factors discussed here as the focus for preventive measures to be taken by patients and their physicians.

A wealth of recommendations has appeared subsequently. For example, the 1972 report from the Inter-Society Commission for Heart Disease Resources, *Primary Prevention of the Atherosclerotic Diseases*, recommended “a strategy of primary prevention of premature atherosclerotic diseases be adopted as long-term national policy for the United States and to implement this strategy that adequate resources of money and manpower be committed to accomplish: changes in diet to prevent or control hyperlipidemia, obesity, hypertension and diabetes; elimination of cigarette smoking; [and] pharmacologic control of elevated blood pressure.”²⁷

The Cardiovascular Disease Unit of the World Health Organization and the International Heart Health Conferences also have issued recommendations, usually addressing international and global concerns.^{3,28} Recommendations have been published by the American Heart Association/American Stroke Association, the American College of Cardiology, and the National Heart, Lung, and Blood Institute, including clinical practice guidelines for detecting and treating risk factors and preventing heart disease and stroke.³

In 1994, an important predecessor to the present plan was published by the CVD Plan Steering Committee,* *Preventing Death and Disability from Cardiovascular Diseases: A State-Based Plan for Action.*²⁹ This document was a call to the states to expand their capacity and obtain additional resources so they could develop the infrastructure needed to achieve the year 2000 objectives for CVD prevention and control. By outlining basic functions for CVD programs and strategies for building capacity, this report contributed directly to implementation of CDC’s state heart disease and stroke prevention program in 1998. It also indicated the value of partnership and collaborative in producing a policy document with broad support, based on the contributions of participating members.

In this extensive body of policy documents, what is advised for preventing heart disease and stroke? Two main approaches have been recommended—interventions addressing individuals and interventions addressing whole populations.³⁰ The individual or “high-risk” approach centers either on people with CVD risk factors but no evident disease or on those with CVD, including survivors of CVD events. For people with risk factors but no recognized disease, “primary prevention” is intended to prevent a first heart attack or stroke by detecting and treating risk factors. For people with known CVD, “secondary prevention” is

* Members represented the American Heart Association/American Stroke Association, the Association of State and Territorial Directors of Health Promotion and Public Health Education, the Association of State and Territorial Public Health Nutrition Directors, CDC, the Chronic Disease Directors, and the National Heart, Lung, and Blood Institute.

intended to reduce the risk for subsequent heart attacks or strokes by treating CVD and the risk factors. Both aspects focus on individual risk. The “population-wide” approach, which focuses on a whole population or community, recognizes that the excess risk for heart disease and stroke is widely distributed in the population, with most victims having moderate, rather than extreme, risk. Therefore, even modest change in average risk in the whole population, achievable through means such as public education, can markedly reduce the risk for CVD events.

A third approach aims to prevent CVD risk factors in the first place. Sometimes called “primordial prevention,” this plan uses the term “CVH promotion.”³¹ This approach is most widely applicable in populations where social and economic development has yet to progress to the point of fostering epidemic occurrence of the major risk factors. CVH promotion also encompasses interventions aimed at individuals at any age who have not yet developed treatable levels of CVD risk factors because the interventions occur before the risk factors begin to cause or accelerate atherosclerosis. Such intervention should occur in childhood or even, as recent research suggests, during gestation (to improve the fetal environment).³² These interventions should continue throughout adulthood to prevent risk factors from ever developing.

Despite the many policy recommendations made since the 1950s, practice has lagged far behind. Assessments in recent years have consistently shown that doctors and patients have not adhered well to treatment guidelines for secondary prevention.³³ Although well-supported and detailed policies for preventing heart disease and stroke have long been available, the actions recommended in these policies have, to a large degree, not been followed. Action is needed to support their effective implementation.

Healthy People 2010 Goals and Objectives

Published in January 2000, *Healthy People 2010* is the latest in a series of documents initiated in 1979 to present national health objectives.² This new volume makes an important advance over *Healthy People 2000* in presenting a goal and related objectives for preventing heart disease and stroke. The Healthy People 2010 Heart and Stroke Partnership* divided this goal into four separate goals based on the different intervention approaches that would be needed to achieve them. These four goals are prevention of risk factors, detection and treatment of risk factors, early identification and treatment of heart attacks and strokes, and prevention of recurrent cardiovascular events. Objectives outline specific measures of progress that should be attained by the year 2010. A total of 16 objectives specifically address coronary heart disease, heart

* Current partners include the American Heart Association/American Stroke Association; National Center for Chronic Disease Prevention and Health Promotion (NCCDPHP), CDC; Centers for Medicare & Medicaid Services; Indian Health Service; National Heart, Lung, and Blood Institute and National Institute of Neurological Disorders and Stroke, NIH; and Office of Disease Prevention and Health Promotion, Office of Public Health and Science, U.S. Department of Health and Human Services.

failure, stroke, blood pressure, and total blood cholesterol levels. In addition, 48 related objectives address chronic kidney disease, diabetes, nutrition and overweight, physical activity and fitness, tobacco use, access to quality health services, and public health infrastructure. Several other objectives relate indirectly to CVH. All of the related objectives are tabulated in Appendix B.

When the 2010 goal and its objectives were adopted, CDC was designated to join NIH as the co-lead federal health agency responsible for heart disease and stroke prevention. CDC and NIH share responsibility “for undertaking activities to move the nation toward achieving the year 2010 goals and for reporting progress . . . over the course of the decade.”² The activities of these two co-lead agencies in heart disease and stroke prevention are highlighted in Appendix C. Publishing these goals and objectives alone will not assure that they are attained. When progress toward meeting the *Healthy People 2000* objectives was reviewed, three of the 17 objectives were met, some progress had been made for another 12 objectives, and health status had worsened for the remaining two.³⁴ Among the 9 objectives for which positive percentage changes could be calculated, only 5 reached more than 50% of the target.

Unless we make substantial progress toward meeting the 2010 goal for preventing heart disease and stroke, we will see increasing numbers of people with CVD risk factors, increasing numbers of first and recurrent heart attack and stroke victims, and increasing numbers of people who die of CVD. Further, costs will increase because of the larger numbers of people needing CVD treatment and the higher cost for each CVD event (if the trend of increasing costs for health services continues as expected). In contrast, success in meeting this goal can reverse the unfavorable trends of the past decade. We must build on the promise of knowledge and experience that awaits widespread translation into public health practice.

The Present Opportunity

To be effective, public health action must have a solid knowledge base that is built on science and practical experience and sound policies that are founded on this knowledge. Over the past 30 years, such support for heart disease and stroke prevention has been greatly strengthened. But this support has not been sufficient to establish and sustain the needed public health effort. Until the early 1970s, the Bureau of State Services in the former U.S. Department of Health, Education, and Welfare supported state health departments through its Heart Disease and Stroke Control Program, but that program was discontinued. And although the Inter-Society Commission on Heart Disease Resources called for a national commitment to prevent atherosclerosis in the early 1970s, public health efforts to address these problems have remained too limited to offer the full potential benefit of existing knowledge.²⁷

What is different now from those early transient efforts? What new and unprecedented opportunities exist for heart disease and stroke

prevention? This *Action Plan* describes the current opportunities for action and the potential for success in the immediate future. Recent trends in the CVD burden in the United States and projections of the continuing predominance of heart disease and stroke as causes of death and disability worldwide have motivated concerned health professionals to consider a new level of concerted action to prevent CVD.^{4,5} Clearly, treating victims of heart disease and stroke cannot alone solve the problem. Prevention is preferable in principle and necessary as a matter of national policy if we are to attain our goals of increasing quality and years of healthy life and eliminating health disparities. This perspective has recently been strongly reinforced by *Steps to a HealthierUS*, a bold new initiative by Secretary of Health and Human Services Tommy G. Thompson. The *Steps* initiative is designed to address this nation's health care crisis and the need to prevent the chronic diseases and conditions, including heart disease and stroke, that represent 75% of our health care expenditures. The Secretary's initiative is a response to President George W. Bush's *HealthierUS* initiative, which directs key departments of the federal government to develop plans to better promote fitness and health for all Americans.

To implement *Steps to a HealthierUS*, the U.S. Department of Health and Human Services (HHS) is marshalling all available resources within the department and calling on other federal agencies and the private sector (e.g., the fast food and soft drink industries) to take steps to improve our nation's health. At the personal level, all Americans are challenged to take the first step by walking 30 minutes a day. At the societal level, policy makers are asked to take their first step by embracing prevention as the long-term solution for our health care crisis. The *Steps* initiative thus constitutes a significant impetus toward prevention, which is strongly supported by this *Action Plan*.

The breadth of the 2010 goal for preventing heart disease and stroke calls attention to the wide range of opportunities for intervention—both to prevent CVD through primary and secondary prevention and to promote CVH. This goal also underscores the increased role for public health agencies, including CDC. As population-wide approaches become more common, the skills and resources of public health agencies at all levels of government will be increasingly called upon.

In recent years, it has also been realized that effective, concerted action requires partnerships with familiar organizations and agencies, as well as with nontraditional partners with distinct perspectives and contributions. As a result, new alliances are being formed, and new ideas, expertise, and resources are being shared. The Healthy People 2010 Heart and Stroke Partnership is a good example of this type of partnership, which can potentially include partners within and beyond the health sector. Already, channels of communication have been opened that will help identify common areas of interest and opportunities for synergy among these national organizations and agencies. Additional agreements between federal agencies and other organizations further illustrate the development of key partnerships in CVH.

Recent advances in knowledge heighten confidence that public health intervention can improve on our CVD forecast for the next two decades. For example, researchers demonstrated that high blood pressure can be prevented with dietary interventions.³⁵ We now know that diabetes can be prevented or delayed with dietary and physical activity interventions.³⁶ And recent findings strongly suggest that by preventing CVD risk factors from emerging in adolescence and early adulthood, we can expect to prevent atherosclerosis later in life.²⁰ Evidence that blood cholesterol and blood pressure levels are improving in the population reinforce the belief that positive changes are occurring and can be accelerated, even while adverse changes (e.g., the obesity and diabetes epidemics) call for more innovative approaches to reverse these alarming trends.^{37,38}

The health of this nation is the central focus of the *Action Plan*, but not to the exclusion of concern for the global dimensions of the burden of heart disease and stroke and recognition of the potential value of international collaboration in their prevention. The Global Burden of Disease Study, cited earlier, stated that heart disease and stroke were the foremost causes of death throughout the world in 1990 and projected that they will remain so in 2020.⁵ In its 1999 report, *Impending Global Pandemic of Cardiovascular Diseases*, the World Heart Federation provides extensive documentation of this epidemic, as well as resources and strategies by which to address it.³⁹

In the same year, the Director-General of the World Health Organization presented a report titled, *Global Strategy for the Prevention and Control of Noncommunicable Diseases*, which noted that, “Four of the most prominent noncommunicable diseases—cardiovascular disease, cancer, chronic obstructive pulmonary diseases and diabetes—are linked by common preventable risk factors related to lifestyle. These factors are tobacco use, unhealthy diet and physical inactivity . . . Intervention at the level of the family and community is essential for prevention because the causal risk factors are deeply entrenched in the social and cultural framework of the society. Addressing the major risk factors should be given the highest priority in the global strategy for the prevention and control of noncommunicable diseases.”⁴⁰

A major contribution toward this end is *The World Health Report 2002: Reducing Risks, Promoting Healthy Life*.⁶ This report presents an extensive analysis of the major risk factors and the potential impact of their prevention and control on the burden of cardiovascular and other chronic diseases throughout the world. The report notes, “In order to protect people—and help them protect themselves—governments need to be able to assess risks and choose the most cost-effective and affordable interventions to prevent risks from occurring.”⁶ Significant advances in approaches and methods for such an assessment are offered by that report.

Does this nation have a role in the global arena of heart disease and stroke prevention? Addressing this question, the Institute of Medicine’s 1997 report, *America’s Vital Interest in Global Health*, concluded that “. . . the United States should build on its strengths and seize the

unprecedented opportunities to work with its international partners to improve health worldwide.”⁴¹ Proposed action areas included biomedical research and development, education and training in the health sciences, and effective international cooperation. An underlying premise of the report was that “global health problems affect all peoples in all countries and transcend national boundaries, levels of development, and political systems.”⁴¹ A sequel to this report, *Control of Cardiovascular Diseases in Developing Countries: Research, Development, and Institutional Strengthening*, appeared in 1998 and recommended specific steps to be taken to assess the burden, develop intervention plans, and take effective action country by country.⁴² At the same time, it was noted that, “Many organizations and programs are engaged in activities relevant to CVD prevention and control. The impact of their work can be enhanced, and duplication avoided, by effective exchange of information on CVD activities.”⁴²

These recent reports, which have documented the global problem of CVD and the growing recognition of its worldwide importance, strongly suggest that this nation does have a role in the global arena of heart disease and stroke prevention. This role includes providing information from our own experiences to support the work of others and gaining from their growing knowledge and experience in return. Another basis for this view stems from the position of HHS, which is conducting and supporting programs to advance global health issues, including policy development, public health infrastructure strengthening, scientific research and research training, and tobacco control (see www.hhs.gov/news/press/2002pres/global.html). The recommendations of this *Action Plan* for engaging in regional and global partnerships for heart disease and stroke prevention are in full accord with this view.

The challenging circumstances we face today, in combination with significant advances in research, provide strong justification for developing a public health action plan to prevent heart disease and stroke. In response, this *Action Plan* has been developed. If effectively implemented, this plan can arrest or reverse the epidemic of heart disease and stroke in the United States and contribute substantially to preventing these conditions throughout the world.

References

1. American Heart Association. *2003 Heart and Stroke Statistics—2003 Update*. Dallas, TX: American Heart Association; 2003.
2. US Department of Health and Human Services. *Healthy People 2010: Understanding and Improving Health and Objectives for Improving Health*. 2nd ed. Vol 1. Washington, DC: US Government Printing Office; November 2000.
3. Labarthe DR. *Epidemiology and Prevention of Cardiovascular Diseases: A Global Challenge*. Gaithersburg, MD: Aspen Publishers; 1998.
4. Cooper R, Cutler J, Desvigne-Nickens P, et al. 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. *Circulation* 2000;102:3137–47.

5. Murray CJL, Lopez A. Alternative Projections of Mortality and Disability by Cause 1990–2020: Global Burden of Disease Study. *Lancet* 1997;349: 1498–1504.
6. World Health Organization. *The World Health Report 2002: Reducing Risks, Promoting Healthy Life*. Geneva: World Health Organization; 2002.
7. Gorelick PB. Prevention. In: Erkinjuntti T, Gauthier S, editors. *Vascular Cognitive Impairment*. London: Martin Dunitz LTD; 2002:571–86.
8. The Associated Press. Playing Through the Pain. *Atlanta Journal Constitution* 2002 June 24;Sect. D:1.
9. Office of Management and Budget. *Standards for the Classification of Federal Data on Race and Ethnicity*. Washington, DC: Executive Office of the President, Office of Management and Budget; 1994. Available at www.whitehouse.gov/omb/fedreg/notice_15.html.
10. Casper ML, Barnett E, Halverson JA, et al. *Women and Heart Disease: An Atlas of Racial and Ethnic Disparities in Mortality*. Second Edition. Morgantown, WV: Office for Social Environment and Health Research; 2000.
11. Barnett E, Casper ML, Halverson JA, et al. *Men and Heart Disease: An Atlas of Racial and Ethnic Disparities in Mortality*. First Edition. Morgantown, WV: Office for Social Environment and Health Research; 2001.
12. Casper ML, Barnett E, Williams GI Jr, et al. *Atlas of Stroke Mortality: Racial, Ethnic, and Geographic Disparities in the United States*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention; January 2003.
13. Centers for Disease Control and Prevention. *Health, United States, 2002. With Chartbook on Trends in the Health of Americans*. Hyattsville, MD: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2002. DHHS publication no. 1232.
14. Asian & Pacific Islander American Health Forum. *A Public Health Action Plan. Eliminating Racial and Ethnic Disparities in Cardiovascular Health: Improving the Cardiovascular Health of Asian American and Pacific Islander Populations in the United States*. San Francisco, CA: Asian & Pacific Islander American Health Forum; 1999.
15. Foot DK, Lewis RP, Pearson TA, Beller GA. Demographics and Cardiology, 1950–2050. *Journal of the American College of Cardiology* 2000;35:(No. 5 Suppl B):66B–80B.
16. Howard G, Howard VJ. Stroke Incidence, Mortality, and Prevalence. In: Gorelick PB, Alter M, editors. *The Prevention of Stroke*. New York, NY: The Parthenon Publishing Group; 2002:1–10.
17. Minino AM, Arias E, Kochanek KD, Murphy SL, Smith BL. Deaths: Final Data for 2000. Hyattsville, MD: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2002. (*National Vital Statistics Reports*, vol 50, no. 15).
18. Enos WF, Holmes RH, Beyer J. Coronary Disease Among United States Soldiers Killed in Action in Korea. *JAMA* 1953;152:1090–3.
19. McNamara JJ, Molot MA, Stremple JF, Cutting RT. Coronary Artery Disease in Combat Casualties in Vietnam. *JAMA* 1971;216:1185–7.
20. Berenson GS, Wattigney WA, Tracy RE, et al. Atherosclerosis of the Aorta and Coronary Arteries and Cardiovascular Risk Factors in Persons Ages 6 to 30 Years and Studied at Necropsy (the Bogalusa Heart Study). *American Journal of Cardiology* 1992;70:851–8.
21. Pathobiological Determinants of Atherosclerosis in Youth (PDAY) Research Group. Relationship of Atherosclerosis in Young Men to Serum Lipoprotein Cholesterol Concentrations and Smoking. *JAMA* 1990;264:3018–24.
22. Kottke TE, Puska P, Salonen JT, Tuomilehto J, Nissinen A. Projected Effects of High-Risk Versus Population-Based Prevention Strategies in Coronary Heart Disease. *American Journal of Epidemiology* 1984;121:697–704.
23. Magnus P, Beaglehole R. The Real Contribution of the Major Risk Factors to the Coronary Epidemics: Time to End the “Only 50%” Myth. *Archives of Internal Medicine* 2001;161:2657–60.

24. Puska P, Tuomilehto J, Nissinen A, Vartiainen E, editors. *The North Karelia Project: 20 Year Results and Experiences*. Finland: National Public Health Institute (KTL); 1995.
25. O'Connor B, Cameron R, Farquharson J, et al. Marketing the Heart Health Vision: Delivering the "Preventive Dose." Ottawa, Canada: WHO Collaborating Centre for Policy Development in the Prevention of Noncommunicable Disease; 2000.
26. White PD, Wright IS, Sprague HB, et al. *A Statement on Arteriosclerosis: Main Cause of "Heart Attacks" and "Strokes."* New York, NY: National Health Education Committee, Inc.; 1959.
27. Atherosclerosis Study Group (Stamler J, chair), Epidemiology Study Group (Lilienfeld A, chair). Primary Prevention of the Atherosclerotic Diseases. In: Wright IS, Frederickson DT. *Cardiovascular Diseases. Guidelines for Prevention and Care*. Reports of the Inter-Society Commission for Heart Disease Resources. New York, NY: Inter-Society Commission for Heart Disease Resources; 1972:44.
28. Wilson E, Farquhar JW, O'Connor B, Harriman ME, McLean D, Pearson TA. *International Action On Cardiovascular Disease: A Platform For Success* (in press).
29. CVD Plan Steering Committee. *Preventing Death and Disability from Cardiovascular Diseases: A State-Based Plan for Action*. Washington, DC: Association of State and Territorial Health Officers; 1994.
30. Rose G. Strategy of Prevention: Lessons from Cardiovascular Disease. *BMJ* 1981;282:1847–51.
31. Strasser T. Reflections on Cardiovascular Diseases. *Interdisciplinary Science Reviews* 1978;3:225–30.
32. Barker DSP, editor. Fetal and Infant Origins of Adult Disease. London: *British Medical Journal*; 1992.
33. Pearson TA, McBride PE, Miller NH, Smith SC Jr. Task Force 8: Organization of Preventive Cardiology Service. *Journal of the American College of Cardiology* 1996;27:1039–47.
34. US Department of Health and Human Services. *Healthy People 2000 Final Review*. Washington, DC: US Department of Health and Human Services; 2001. DHHS publication no. 01-0256.
35. Sacks FM, Svetkey LP, Vollmer WM, et al. Effects on Blood Pressure of Reduced Dietary Sodium and the Dietary Approaches to Stop Hypertension (DASH) Diet. DASH-Sodium Collaborative Research Group. *New England Journal of Medicine* 2001;344:3–10.
36. Knowler WC, Barrett-Connor E, Fowler SE, et al and the Diabetes Prevention Program Research Group. Reduction in the Incidence of Type 2 Diabetes with Lifestyle Intervention or Metformin. *New England Journal of Medicine* 2002;346:393–403.
37. Goff DC Jr, Howard G, Russell GB, Labarthe DR. Birth Cohort Evidence of Primary Prevention of High Blood Pressure in the United States, 1887–1994. *Annals of Epidemiology* 2000;11:271–9.
38. Goff DC Jr, Labarthe DR, Howard G and Russell GB. Primary prevention of high blood cholesterol concentrations in the United States. *Archives of Internal Medicine* 2002;162:913–9.
39. Chockalingam A, Balaguer-Vintró I, editors. *Impending Global Pandemic of Cardiovascular Diseases*. Barcelona: Prous Science; 1999.
40. Brundtland GH. *Global Strategy for the Prevention and Control of Noncommunicable Diseases*. Geneva: World Health Organization; 1999:1.
41. Institute of Medicine. *America's Vital Interest in Global Health*. Washington, DC: National Academy Press; 1997:44, 46.
42. Institute of Medicine. *Control of Cardiovascular Diseases in Developing Countries: Research, Development, and Institutional Strengthening*. Washington, DC: National Academy Press; 1998:60.