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Defining and Setting National Goals for Cardiovascular Health Promotion and Disease Reduction The American Heart Association's Strategic Impact Goal Through 2020 and Beyond

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Abstract—This document details the procedures and recommendations of the Goals and Metrics Committee of the Strategic Planning Task Force of the American Heart Association, which developed the 2020 Impact Goals for the organization. The committee was charged with defining a new concept, *cardiovascular health*, and determining the metrics needed to monitor it over time. Ideal cardiovascular health, a concept well supported in the literature, is defined by the presence of both ideal health behaviors (nonsmoking, body mass index <25 kg/m², physical activity at goal levels, and pursuit of a diet consistent with current guideline recommendations) and ideal health factors (untreated total cholesterol <200 mg/dL, untreated blood pressure <120/<80 mm Hg, and fasting blood glucose <100 mg/dL). Appropriate levels for children are also provided. With the use of levels that span the entire range of the same metrics, cardiovascular health status for the whole population is defined as poor, intermediate, or ideal. These metrics will be monitored to determine the changing prevalence of cardiovascular health status and define achievement of the Impact Goal. In addition, the committee recommends goals for further reductions in cardiovascular disease and stroke mortality. Thus, the committee recommends the following Impact Goals: “By 2020, to improve the cardiovascular health of all Americans by 20% while reducing deaths from cardiovascular diseases and stroke by 20%.” These goals will require new strategic directions for the American Heart Association in its research, clinical, public health, and advocacy programs for cardiovascular health promotion and disease prevention in the next decade and beyond. (*Circulation*. 2010;121:586-613.)

Key Words: AHA Special Reports ■ obesity ■ quality of life ■ epidemiology ■ risk factors ■ quality of care

When introducing broad new concepts and objectives that will drive the agenda for the American Heart Association (AHA) for the next decade, it is necessary to provide a detailed accounting of the processes that resulted in the consensus recommendations of the Goals and Metrics Committee of the Strategic Planning Task Force of the AHA.

*The findings and conclusions in this report are those of the authors and do not necessarily reflect the official position of the Centers for Disease Control and Prevention. The American Heart Association makes every effort to avoid any actual or potential conflicts of interest that may arise as a result of an outside relationship or a personal, professional, or business interest of a member of the writing panel. Specifically, all members of the writing group are required to complete and submit a Disclosure Questionnaire showing all such relationships that might be perceived as real or potential conflicts of interest.

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This committee, which was composed of members of the Statistics Committee, the Strategic Planning Task Force, and other ad hoc members, was formed in February 2008 and met regularly through June 2009. Its recommendations were formally approved by the AHA National Board of Directors in February 2009. The final recommendation of the committee, as approved by the Board of Directors, was that the AHA 2020 Impact Goals should be as follows:

“By 2020, to improve the cardiovascular health of all Americans by 20% while reducing deaths from cardiovascular diseases and stroke by 20%.”

Although important refinements in monitoring and improving rates of cardiovascular diseases (CVDs) and stroke were also to be considered and are reviewed here, the major challenge confronted by the committee was to address cardiovascular health as an Impact Goal: How to define it and how to measure it. This document details the commission, underlying rationale, processes, and recommendations of the committee, which outline bold new strategic directions for the AHA in cardiovascular health promotion and disease prevention for the next decade and beyond.

Public Health Burden of CVD and Stroke

Despite 4 decades of declines in age-standardized CVD and stroke death rates, the numbers of heart disease, stroke, and related vascular deaths continue to make these by far the leading causes of morbidity and mortality in the United States.^{1,2} The burden of CVD and stroke in terms of life-years lost, diminished quality of life, and direct and indirect medical costs also remains enormous.² Downward shifts in population levels of cholesterol, blood pressure, and smoking account for nearly half (after adjustment for the impact of increasing prevalence of obesity and diabetes) of the decline in coronary heart disease (CHD) deaths that would have been expected in 2000 on the basis of rates in 1980; wider use of effective treatments among persons with existing CVD accounts for an equal share in this decline. Offsetting trends in prevalence of obesity and diabetes, as well as growth in the older population at highest risk for CVDs, have contributed to the persistent national CVD and stroke burden.³ Very recent data also suggest a slowing of reductions in coronary death rates⁴ and growing numbers of hospitalizations for acute and chronic manifestations of CVD, such as heart failure and atrial fibrillation.^{1,2} It has also become clear that many CVDs with ultimate outcomes in adulthood actually have their origins during childhood. Unfortunately, there are disturbing trends of increasing obesity, increasing severe obesity, and increasing prevalence of hypertension and type 2 diabetes mellitus in the pediatric population.² These trends will very likely result in future increases in the burden of CVD and stroke among adults, including a trend for events to occur at younger ages.

As the leading voluntary health organization in the field of heart diseases and stroke, the AHA has taken a major leadership role in promoting the implementation of interventions that have contributed to the improvements in CVD and stroke morbidity and mortality rates seen to date. The AHA policies and programs designed to achieve the AHA 2010

Impact Goal appear to have contributed substantially to improvements in morbidity and mortality, as reviewed below.

However, it appears clear that the AHA and the nation must add a substantial new effort in the coming decade, building on the gains to date, if we are to arrest or reverse a rising tide of CVD events due to aging of the population and ongoing adverse levels of unhealthy behaviors (dietary imbalance, physical inactivity, smoking) and unhealthy risk factors (adverse blood lipids, high blood pressure, diabetes, obesity). To design and implement this next phase of CVD and stroke prevention, the AHA has decided not only to continue efforts at reducing CVD but also to adopt a major new focus: To improve cardiovascular health in the population as a whole. This fundamental expansion of prevention efforts will require an array of new tools and competencies for implementing public health policy and population- and community-level interventions to complement the traditional, predominantly medically oriented interventions that the AHA has promoted successfully in the past. To understand the new role being charted for the AHA, a review of past and current AHA efforts is warranted, because they laid the foundation for the new 2020 Impact Goals.

Development of the AHA 2010 Impact Goal

Process

The AHA 2010 Impact Goal was developed by a task force appointed by the Board of Directors in 1999. The task force began with a process to rank order risk factors, risk behaviors, and disease states in the order that they should be addressed to have a significant effect on CVD and stroke. Approximately 170 scientists were selected from the various executive committees of scientific councils within the AHA and were surveyed for their responses. The rank-ordering results showed CHD and stroke in the positions of highest importance. Risk factors followed in order of importance, with smoking, high blood pressure, high cholesterol, and physical inactivity deemed the most important, in that order. Obesity and diabetes were later added to the list as major risk factor metrics; nutrition ultimately was not included because of challenges present at that time for measurement of population nutritional habits in the United States.

Groups of scientists within the 2010 Task Force were assigned to each of the priority disease states and risk factors to estimate potential reductions for each by 2010. The group referenced trends for the previous decades and projected forward to 2010, considering various scenarios for treatment and control of risk factors and implementation of acute and chronic therapies. One portion of this group recommended that the 2010 Impact Goal aim for 30% relative reductions in CHD and stroke mortality, as well as in the prevalence of each of the risk factors. Another portion of this group recommended 20% reductions be targeted. Consensus was reached around a compromise goal of 25% reductions as the target for the 2010 Impact Goal.

Product

The final version of the goal approved in February 2004 by the AHA Board of Directors was, “By 2010, to reduce coronary

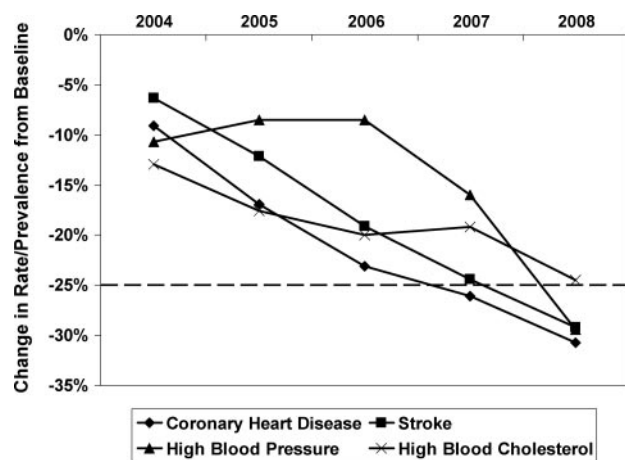


Figure 1. Trajectory of mortality rates from CHD and stroke, rate of uncontrolled high blood pressure, and prevalence of high blood cholesterol from 2004 to 2008.

heart disease, stroke, and risk by 25%,” with the following indicators:

- Reduce death rate due to CHD and stroke by 25%;
- Reduce prevalence of smoking, high blood cholesterol, uncontrolled high blood pressure, and physical inactivity by 25%; and
- Eliminate the growth of obesity and diabetes (0% increase).

Levels of mortality rates and risk factor prevalences in 1999 were used as the baseline. The goal also aligned well with the objective and goals of the US Healthy People 2010 focus area 12 on heart disease and stroke, although indicators and target goals were not identical.

From 2000 on, AHA staff and volunteers worked from this Impact Goal to develop multiple supporting goals in the areas of prevention, treatment, acute care, and resources. At the time, the 2010 Impact Goal and its supporting strategic programs represented a bold step for a voluntary health organization in the arena of national and public health policy focused on treatment and acute care. The concept of quantifying the impact on death rates and risk factors was a critical step in the evolution of the AHA’s prevention strategies. The 2010 goal focused the AHA’s agenda, efforts, and resources on a national scale and in a concerted way that had not been present previously.

Progress

Despite the ambitious nature of the 2010 Impact Goal, the targets for most components of the first 3 indicators were achieved well in advance of 2010 (Figure 1). The goals for indicators of smoking, physical inactivity, obesity, and diabetes have proven to be more difficult to achieve and will represent major challenges to the even more ambitious 2020 Impact Goal. The achievement of lower mortality goals was accomplished in part as the result of the work of practitioners and scientists engaged in the medical prevention and treatment of acute and chronic atherosclerotic CVD by accelerating existing trends toward lower heart disease and stroke death rates. Similarly, public health and policy measures instituted before the development of the 2010 goals had

emphasized the importance of elimination of smoking, the importance of physical activity, and the control of risk factors for CHD and stroke such as high blood pressure and dyslipidemia. The work of the AHA also contributed to these declines through the development of guidelines and their implementation in the “Get With the Guidelines” programs and numerous other initiatives.

Monitoring of the 2010 Impact Goal revealed by 2008 a 30.7% reduction in the death rate due to CHD, a 29.2% reduction in the death rate due to stroke (data from the National Vital Statistics Sample), a 29.4% reduction in uncontrolled high blood pressure (data from the National Health and Nutrition Examination Survey [NHANES] 2005–2006), a 24.5% reduction in prevalence of high cholesterol (NHANES 2005–2006), and a 15.8% reduction in prevalence of smoking (data from the National Health Interview Survey 2006) compared with baseline levels (<http://www.cdc.gov/nchs/deaths.htm>, <http://www.cdc.gov/nchs/nhanes.htm>, <http://www.cdc.gov/nchs/nhis.htm>, and the AHA Heart Disease and Stroke Statistics—2009 Update²). There was only limited impact on other risk factors, including increases in prevalence of obesity and diabetes, and a small 2.5% reduction in those not engaged in moderate or vigorous physical activity (National Health Interview Survey 2006).

Proposal for 2020

The strategic approach and progress toward the 2010 Impact Goal pointed to innovations that are required to define and implement new strategies for improving cardiovascular health and preventing disease events and deaths. Accordingly, in June 2007, the AHA Board of Directors commissioned a Strategic Planning Task Force of the AHA to oversee drafting and implementation of the 2020 Impact Goal, with a directive to incorporate the novel aim of improving the cardiovascular health of all Americans while reducing death due to CVD and stroke.

In addition to refining the longstanding focus on reducing the burden of CHD and stroke mortality, the charge for the Goals and Metrics Committee suggested that the design of the new metric for cardiovascular health would require that attention be paid to a number of critical issues. Success in this task would enable the AHA to undertake a new and more proactive organizational mission, not only continuing the tremendous success in improved treatment but also addressing the need for a new and expanded emphasis on prevention, control of risk, improving quality of life, and promoting health rather than solely treating disease. It was acknowledged that at that time, no comprehensive metric for cardiovascular health existed, and the committee was charged with developing such a metric.

In addition, it was recommended that the committee broaden its scope to encompass all of CVD and stroke mortality, not just CHD and stroke, in support of existing and future programs and initiatives of the AHA in all areas of CVD. This is important because it recognizes areas such as congenital heart disease, which is the leading cause of mortality of any congenital defect and is an area in which progress is being made in prevention and treatment. As with the 2010 goal, an implicit aspect of the 2020 Impact Goal is

the ability to measure the current status and progress of each component with nationally representative samples. Thus, although further focus on reducing the incidence of nonfatal CVD events was also suggested, it was acknowledged that this would entail establishing means for national surveillance of nonfatal events. Other areas for consideration were to include quality of life, quality of care, and health disparities, although each of these areas also presents significant challenges with regard to measurement over time in nationally representative samples. With this charge, the committee began its work to develop recommendations to complete the following draft 2020 Impact Goals statement: **“By 2020, to improve the cardiovascular health of all Americans by ___% while reducing deaths from cardiovascular diseases and stroke by ___%.”**

Defining and Measuring Cardiovascular Health

Concepts of Prevention

In considering the concept of cardiovascular health, the committee took into account 3 key concepts in health promotion and disease prevention: (1) The power of primordial prevention; (2) the evidence that CVD and risk factors for it often develop early in life; and (3) the appropriate balance between population-level approaches for health promotion and disease prevention and individualized high-risk approaches. These concepts informed the definition of cardiovascular health, as well as the metrics that would be needed to monitor it and the strategies that would be needed to improve it across the lifespan.

Primordial Prevention

Most clinicians are familiar with the concepts of secondary and primary prevention. In secondary prevention, efforts are aimed at preventing the recurrence of clinical events in patients who have manifest clinical disease. For example, therapeutic lifestyle change and aspirin and statin medications are used to prevent recurrent myocardial infarction (MI) in patients who have already experienced an MI. In primary prevention, efforts focus on preventing the first occurrence of a clinical event among individuals who are at risk. Examples are the use of blood pressure-lowering medications and dietary intervention in patients with hypertension to prevent the first occurrence of stroke. As such, primary prevention efforts are aimed at individuals who already have adverse levels of known risk factors. However, as reviewed below, once adverse levels of risk factors are present, even in young adulthood and middle age, substantial elevations in long-term and lifetime risks for CVD and stroke are largely unavoidable. Furthermore, whereas clinical guidelines impose thresholds on risk factor levels to guide decision making, the association of risk factor levels with CVD risk is continuous and graded across all levels. Therefore, it is of paramount importance to focus on prevention at all levels of risk. Risk factors may result in the development of subclinical atherosclerosis and other myocardial and vascular changes over the course of years to decades. In turn, subclinical CVD typically precedes the occurrence of clinical events by years to decades. Thus, it makes sense that

avoidance of adverse levels of risk factors in the first place may be the most effective means for avoiding clinical events during the remaining lifespan.

This is the meaning of *primordial prevention*, a concept introduced by Strasser in 1978.⁵ On a population-wide basis, primordial prevention was conceived as a strategy to prevent whole societies from experiencing epidemics of the risk factors. The corresponding strategy at the individual level is to prevent the development of risk factors in the first place. Although this terminology may be unfamiliar to some, the strategy of promoting healthy behaviors for this purpose is well recognized and common to many guidelines and recommendations in CVD prevention, especially those that focus on childhood and adolescence.⁶ Thus, primordial prevention has relevance and urgency in the high-income nations of today, given the substantial burden of obesity and the adverse health behaviors and environment that often begin in childhood and are present in most high-income nations, especially the United States. Primordial prevention was also a guiding feature of the Healthy People 2010 goals for heart disease and stroke prevention, which include prevention of risk factors.⁷ The concept of primordial prevention therefore formed a cornerstone for the committee's deliberations in defining ideal cardiovascular health.

High-Risk and Population-Wide Approaches to Prevention

Rose^{8,9} articulated the important complementary relation between interventions that focus on individuals at highest risk (the high-risk strategy) and those that address the risk distribution in the entire population (the population-wide strategy). Primary prevention requires a focus on individuals known to be at risk for disease. Hence, screenings for elevated cholesterol or blood pressure in at-risk groups are key facets of CVD prevention guidelines, even in children and adolescents.⁶ By identifying and treating those at the highest risk for events because of markedly elevated risk factor levels, a number of clinical events may be avoided. Indeed, a large proportion of the reductions in CHD mortality experienced in the United States and other high-income nations since the 1960s has been ascribed to the development and institution of efficacious primary and secondary prevention interventions in people at elevated risk³; however, individuals with markedly elevated levels of risk factors are relatively uncommon in the population.^{2,10} It is widely recognized that the majority of CVD and stroke events occur in individuals with average or only mildly adverse levels of risk factors, simply because this is where the majority of the population lies.^{9,10} Therefore, for effective disease prevention, population-level strategies are essential to shift the entire distribution of risk. As explained by Rose, health thus becomes an issue for populations and not just for individuals, and health promotion and disease prevention strategies must embrace both high-risk and population strategies. Of the 2, however, greater power resides with the population strategy when risk is widely diffused throughout the whole population, as is the case for CVD.⁹

For example, Stamler¹¹ has demonstrated that modest and achievable reductions in salt intake in populations can likely

result in dramatic reductions in stroke. National data from the Centers for Disease Control and Prevention (CDC) show that 69.2% of the adult population belongs to a specific group that should aim to consume no more than 1500 mg of sodium per day.^{10a} Because approximately 80% of dietary salt is consumed from processed foods,¹² lower salt intake would likely be achieved most effectively through food policy decisions and negotiation with the food industry rather than efforts focused on individuals. The concomitant lowering of blood pressure levels would reduce the prevalence of individuals with hypertension, the highest-risk group. However, even greater absolute reductions in stroke would come through the modest lowering of blood pressure among the far larger proportion of the population with blood pressure near or slightly above the mean.^{9–11}

A number of recent examples of successful population-level prevention strategies are available. Some include policy changes that have population-wide impact. In the city of Helena, Mont, a smoke-free ordinance was implemented on June 5, 2002. The ordinance was subsequently repealed by a ballot initiative and therefore was only in effect for 6 months. However, during those 6 months in 2002, hospital admissions for acute MI were less than half what they had been during the same 6 months in 2001, and this reversed a trend of increasing admissions over the preceding years. In 2003, with no smoke-free ordinance, admissions rebounded to higher levels. No such pattern was observed in areas immediately surrounding Helena, where the ordinance did not apply.¹³ Similar results, with rapid and substantial reductions in hospitalizations for acute coronary events after the institution of smoking bans, have been demonstrated in diverse locales, including Pueblo, Colo,¹⁴ Italy,¹⁵ Scotland,¹⁶ and others.^{17,18}

Another striking example of population-level prevention strategies having a rapid effect on population risk occurred in the island nation of Mauritius in the late 1980s. At the time, the population of Mauritius had among the highest rates of CHD mortality of any low-income nation,¹⁹ and in 1987, it had a mean total cholesterol level of 5.8 mmol/L (225 mg/dL). The government then instituted a number of population-level interventions focused on CHD and its risk factors. One intervention included changing the composition of imported oils used for cooking from predominantly palm oil, which is very high in saturated fat, to almost exclusively soybean oil, which includes predominantly polyunsaturated fats. By 1992, the mean serum total cholesterol concentration had fallen to 4.7 mmol/L (182 mg/dL), and the prevalence of hypercholesterolemia (defined as cholesterol ≥ 6.5 mmol/L [250 mg/dL]) had decreased from 24.5% to 5.6% in men and from 22.0% to 4.5% in women.^{20,21} The North Karelia Project in Finland is perhaps the best example of a large, comprehensive, community-based population strategy that was associated with double the reduction in CHD mortality rates from 1974 to 1979 compared with the remainder of Finland.²²

In most high-income nations, there has been a marked reduction in CHD mortality rates over the past 4 decades. Using data from a number of different populations, Capewell and colleagues^{23–29} have attempted to explain the reasons for these declines. For example, in the United States, there were 341 745 fewer CHD deaths in 2000 than would have been

expected if CHD death rates from 1980 had still applied to the larger 2000 US population. Ford et al³ examined multiple possible factors that may have explained the lower death rates, including both population shifts in risk factor levels due to changes in behavioral, lifestyle, and environmental factors and more widespread use of evidence-based therapies for acute and chronic CHD, use of revascularization procedures, and use of medications for primary and secondary prevention. Favorable population shifts in risk factor levels explained 61% of the reduction (including 12% from lower smoking prevalence, 20% from lower systolic blood pressure, 24% from lower total cholesterol levels, and 5% from improvements in rates of physical inactivity), but these were offset by a 17% increase in CHD death rates due to an increasing prevalence of obesity and diabetes. They estimated that 47% of the reduction in expected CHD deaths was due to the use of medical treatments. Thus, medical treatments and population shifts in risk factors each appeared to account for about 45% of the reduction in expected CHD mortality (the remaining 10% could not be explained by the model).³ In many other countries, population shifts in risk factor levels (not due to medications) have explained up to two thirds to three fourths of the dramatic reductions in CHD mortality rates,^{25–27,29,30} which indicates the importance of population strategies to reduce risk factor levels and focus on primordial prevention for cardiovascular health promotion. These examples also show that population-level prevention strategies go beyond just the health-care system to the public health arena, which has important implications for the AHA's implementation strategies.

Definitions of Cardiovascular Health

A General Approach

The concept of cardiovascular health reframes important questions regarding how best to approach CVDs, which have long been the focus of the AHA. As stated above, the AHA Impact Goal for 2010 focused primarily on reducing CHD and stroke death rates and the prevalence of risk factors. The implicit assumption was that this would improve health. However, it is increasingly evident that health is a broader, more positive construct than just the absence of clinically evident disease. In the process of defining cardiovascular health, therefore, the committee sought to satisfy a number of criteria, which are listed in Table 1.

One early point of discussion was whether the definition of cardiovascular health differed substantially from that of general health. Although there appears to be substantial overlap between the components of cardiovascular health and general health, the committee acknowledges that there are other components to general health related to physical, mental, and social functioning, among other things, that have not been addressed here. Future efforts should include consideration of these important aspects of health and their impact on cardiovascular health and disease as the science evolves. However, substantial data support the promotion of cardiovascular health as defined herein to improve general healthy longevity through prevention of numerous other chronic diseases and conditions, including cancer, diabetes, renal disease, and blindness.

Table 1. Criteria Used in Defining Ideal Cardiovascular Health

The definition of ideal cardiovascular health should:

- Encompass more than the absence of CVD;
- Be based on data that suggest excellent prognosis with regard to CVD-free survival, longevity, healthy longevity, and quality of life;
- Have face validity (ie, there would be consensus that the components of the definition each represent important facets of achieving and maintaining cardiovascular health);
- Be consistent with current clinical practice and public health guidelines;
- Be simple and accessible to practitioners to provide guidance in promoting cardiovascular health in their patients;
- Be simple and accessible to individuals to provide nonmedical guidance regarding lifestyle components of cardiovascular health;
- Contain actionable items on which individuals, practitioners, and policy makers could focus to improve cardiovascular health;
- Allow for *all* subsets of the population to make progress toward achieving or maintaining cardiovascular health; and
- Be readily measured with existing and future data from nationally representative samples, to allow for current assessment and monitoring of changes over time.

To define cardiovascular health, the committee adopted positive language to identify the construct as far as possible. In so doing, the committee defined health factors for cardiovascular health rather than risk factors for CVD. Similarly, the committee defined health behaviors that promote cardiovascular health rather than risk behaviors that increase the likelihood of developing CVD and stroke or predisposing conditions such as hypertension, dyslipidemia, and diabetes.

Ideal Cardiovascular Health

To meet the criteria outlined in Table 1, the committee initially defined a construct of *ideal cardiovascular health*, which is defined as (1) the simultaneous presence of 4 favorable health behaviors (abstinence from smoking within the last year, ideal body mass index [BMI], physical activity at goal, and consumption of a dietary pattern that promotes cardiovascular health); (2) the simultaneous presence of 4 favorable health factors (abstinence from smoking within the last year, untreated total cholesterol <200 mg/dL, untreated blood pressure <120/<80 mm Hg, and absence of diabetes mellitus); and (3) the absence of clinical CVD (including CHD, stroke, heart failure, etc). Given the importance of abstinence from smoking and smoking cessation to health promotion, smoking appears in both lists of health factors and health behaviors. Hence, the committee defined a total of 7 health behaviors and health factors critical to the definition of ideal cardiovascular health and to satisfy all of the criteria enumerated above. These health behaviors and health factors are summarized and described in detail in Table 2. The health-promoting benefits of each of the component metrics of health behaviors and health factors singly have been well established; however, to meet the complete definition of ideal cardiovascular health, an individual would need to meet the ideal levels of all 7 components.

Abundant evidence supports the ideal cardiovascular health construct with respect to longevity, disease-free survival, quality of life, and healthcare costs. We illustrate this

Table 2. Definition of Ideal Cardiovascular Health

Goal/Metric	Ideal Cardiovascular Health Definition
Current smoking	
Adults >20 y of age	Never or quit >12 mo ago
Children 12–19 y of age	Never tried; never smoked whole cigarette
Body mass index	
Adults >20 y of age	<25 kg/m ²
Children 2–19 y of age	<85th Percentile
Physical activity	
Adults >20 y of age	≥150 min/wk moderate intensity or ≥75 min/wk vigorous intensity or combination
Children 12–19 y of age	≥60 min of moderate- or vigorous-intensity activity every day
Healthy diet score*	
Adults >20 y of age	4–5 Components*
Children 5–19 y of age	4–5 Components*
Total cholesterol	
Adults >20 y of age	<200 mg/dL†
Children 6–19 y of age	<170 mg/dL†
Blood pressure	
Adults >20 y of age	<120/<80 mm Hg†
Children 8–19 y of age	<90th Percentile†
Fasting plasma glucose	
Adults >20 y of age	<100 mg/dL†
Children 12–19 y of age	<100 mg/dL†

*The committee selected 5 aspects of diet to define a healthy dietary score. The score is not intended to be comprehensive. Rather, it is a practical approach that provides individuals with a set of potential concrete actions. A comprehensive rationale is set forth in the text of this document, and a comprehensive set of nutrition recommendations is provided in the 2006 Nutrition Guidelines.^{12,54,55}

†Untreated values.

evidence below in relation to both health behaviors and health factors.

Evidence for Health Behaviors

Health behaviors have significant and substantial associations with greater longevity and CVD-free survival. Among 84 129 middle-aged US nurses, Stampfer et al³¹ defined 5 healthy lifestyle factors, including being a nonsmoker, having a BMI <25 kg/m², participating in 30 minutes or more of moderate to vigorous physical activity daily (on average), drinking greater than or equal to one-half glass of wine (or its equivalent) daily, and having a healthy diet, defined as being in the top 40% of a dietary score that emphasized a low glycemic load, high cereal fiber, high folate, high marine omega-3 fatty acid, a high polyunsaturated to saturated fat ratio, and low trans fat content. After 14 years of follow-up, women with 3, 4, or all 5 health behaviors, respectively, had 57%, 66%, and 83% lower risks for incident CHD.³¹ Similar outcomes were observed in a study of 24 444 postmenopausal Swedish women, with a 92% lower risk for MI among those with an optimal diet and lifestyle pattern.³²

The relationships of health behaviors to CHD risk are similarly robust among men. Among 42 847 US male health professionals 40 to 75 years of age at baseline, health behaviors were assessed (defined as in the study of US women above) and incidence of CHD events was ascertained prospectively over 16 years of follow-up.³³ After adjustment, men having 1, 2, 3, 4, or all 5 health behaviors had 54%, 63%, 71%, 78%, and 87% lower risks for CHD, respectively, than men who had no healthy behaviors. Thus, having even 1 health behavior was associated with substantially lower risk, and a strong dose-response relationship was present for each additional health behavior. Notably, the strong protective associations of health behaviors with CHD risk were very similar whether or not the men were receiving drug treatment for hypertension or high cholesterol, which indicates that drug treatments for these conditions do not alter the importance of lifestyle.³³

Health behaviors are also strongly associated with the risk for total and ischemic stroke. In separate prospective cohort studies involving 71 243 US women and 43 685 US men followed up for as long as 20 years, health behaviors were assessed prospectively with similar definitions as above.³⁴ Similar graded relationships were observed, with progressively and substantially lower risks for both total stroke and ischemic stroke with greater numbers of health behaviors in both men and women.

These associations also extend to risk for new-onset diabetes, which is of particular relevance given that both diabetes and adiposity are increasing dramatically in the United States and most other nations around the world. In a cohort of 84 941 middle-aged US female nurses followed up for 16 years, each of the 5 health behaviors was also independently associated with lower risk for incident diabetes. In combination, women having just the 3 health behaviors of a healthy diet, physical activity, and healthy BMI had an 88% lower risk for diabetes. The addition of nonsmoking and moderate alcohol use improved this relationship only slightly, to a 91% lower risk of incident diabetes, which suggests that just a moderately healthy diet, physical activity, and weight control alone might prevent most new cases of diabetes. Findings were identical in the subset of women who might be genetically predisposed to diabetes.³⁵

Benefits of healthy cardiovascular behaviors appear to extend even to older individuals. Among 4883 older US men and women (mean age 73 years at baseline), lifestyle behaviors were assessed and incidence of diabetes was prospectively ascertained during 10 years of follow-up.³⁶ Health behaviors were defined by leisure-time physical activity and walking above the median for this group; a healthy diet, characterized by being in the top 40% of a dietary score defined by higher consumption of fiber and polyunsaturated fat and lower consumption of trans fat and higher-glycemic-index foods; never smoking (or former smoking ≥ 20 years ago or < 5 pack-years); alcohol use, which was predominantly light or moderate; BMI < 25 kg/m²; and waist circumference < 88 cm in women or < 92 cm in men. After adjustment, each lifestyle factor was independently associated with incident diabetes, with 35% lower risks for each single additional health behavior. Participants whose physical

activity and dietary habits alone were in the healthy group had 46% lower risk of diabetes; participants whose physical activity, dietary, and smoking habits were in the healthy group had 58% lower risk of diabetes; and participants whose physical activity, dietary, smoking, and alcohol habits were in the healthy group had 82% lower risk of diabetes. When absence of adiposity (defined by either BMI or waist-circumference criteria) was added to the other 4 healthy lifestyle behaviors, incidence of diabetes was 89% lower.

Similarly, among 2339 individuals 70 to 90 years of age in 11 European countries, 10-year survival was approximately 75% for those with 4 healthy behaviors compared with $< 50\%$ for those with 0 or 1 healthy behaviors. In that study,³⁷ healthy behaviors were defined by absence of smoking, moderate or greater daily physical activity, any alcohol intake, and a Mediterranean diet pattern, including a high monounsaturated to saturated fat ratio; a high intake of legumes, nuts, seeds, grains, fruits, vegetables, potatoes, and fish; and a low intake of meat and dairy products.

Favorable health behaviors in middle age are also associated with substantially less disability at older ages. Vita et al³⁸ studied the associations between health behaviors (measured at a mean age of 43 years) and cumulative disability present at later ages (66 to 74 years) among a group of 1741 university alumni followed up longitudinally from 1962 to 1994. They assigned points for amount of cigarettes smoked per day, BMI strata, and minutes of vigorous exercise per week and defined 3 strata of health behaviors in middle age. Disability was measured with a validated cumulative disability index. Compared with those with favorable health behaviors in middle age, individuals with the least favorable patterns of health behaviors had double the cumulative disability at older ages (disability index 1.02 versus 0.49, $P < 0.001$). Similar patterns of results were observed among men and women, those who survived to the end of the study, and those who died before age 75 years. Disability was also significantly lower during both the previous year and the previous 2 years of observation at older ages for those who had favorable health behaviors in middle age. Indeed, the onset of disability was postponed by more than 5 years in individuals with favorable health behaviors compared with the least favorable group. Even among decedents, the disability index for the group with favorable health behaviors in middle age was half that for the high-risk subjects in the previous 1 or 2 years of observation.³⁸

Evidence for Health Factors

Numerous studies support the prognostic importance of the cardiovascular health factor construct adopted by the committee. Stamler et al³⁹ examined groups of young adult and middle-aged men, as well as middle-aged women, from the Chicago Heart Association Detection Project in Industry cohort and the Multiple Risk Factor Intervention Trial screening cohort. In this study, healthy factors were defined as serum total cholesterol < 200 mg/dL, blood pressure $\leq 120/ \leq 80$ mm Hg, no diabetes, and no current smoking (as well as absence of major electrocardiographic findings that suggest prevalent cardiac disease). Over 16 to 22 years of follow-up, they observed 70% to 85% lower cardiovascular mortality,

40% to 60% lower total mortality, and 6 to 9 years' greater life expectancy among individuals having each of these healthy factors than among those who had 1 or more adverse health factors.³⁹ These results subsequently were found to extend to younger women (<40 years of age) from the Chicago cohorts and in longer-term follow-up.⁴⁰

The aggregate of cardiovascular health factors has been linked not just to lower cardiovascular mortality rates but to lower all-cause mortality as well. Middle-aged adults with ideal cardiovascular health factor status (by use of similar definitions) also have substantially lower rates of noncardiovascular death, which indicates the importance of these health factors for avoidance or postponement of death due to both cardiovascular and noncardiovascular causes, including cancers, diabetes, and chronic lung and kidney diseases. Indeed, the risk for noncardiovascular mortality is greater than for cardiovascular mortality among those with any burden of CVD risk factors.⁴¹ Thus, ideal levels of cardiovascular health factors clearly promote overall longevity.

In the Atherosclerosis Risk In Communities (ARIC) Study,⁴² the combination of untreated total cholesterol <200 mg/dL, blood pressure <120/<80 mm Hg, the absence of diabetes, and being a never-smoker were defined as all optimal cardiovascular health factors. As in prior studies, this pattern of health factors was associated with marked reductions in risk for death due to all causes (hazard ratios 0.00 to 0.37) and death due to CVD (hazard ratios 0.00 to 0.20), as well as risk for fatal and nonfatal CVD events (hazard ratios 0.00 to 0.19), in both black and white men and women.

Data from the Framingham Heart Study further demonstrate the association of ideal cardiovascular health factors with overall survival and morbidity-free survival to older ages. Terry et al⁴³ examined overall survival to age 85 years and survival free of significant morbidity (MI, hospitalized unstable angina, heart failure, stroke, cancer, or dementia) among Framingham participants who were examined at least twice between the ages of 40 and 50 years. Factors measured in middle age that were associated with survival to age 85 years included female sex, lower systolic blood pressure and total cholesterol, absence of glucose intolerance, no current smoking, and greater education. The factors associated with morbidity-free survival to age 85 years were essentially identical. Only approximately 3% of men and 15% of women with 4 or more unfavorable health factors survived to age 85 years, whereas more than 35% of men and 65% of women with all ideal health factors survived to 85 years of age.⁴³

Further supporting data for the concept of ideal cardiovascular health factors come from analyses that examined the lifetime risk for development of CVD. The concept of lifetime risk considers the absolute risk for development of disease (ie, CVD) before dying of something else. As such, it considers the risk for nonfatal or fatal CVD events in the context of remaining lifespan and competing causes of mortality. Remaining lifetime risks for atherosclerotic CVD were examined among Framingham participants based on the aggregate burden of health factors present at age 50 years.⁴⁴ Men and women at age 50 years with all optimal levels of 4 health factors, including untreated total cholesterol <180

mg/dL, untreated blood pressure <120/<80 mm Hg, non-smoking, and absence of diabetes, had remaining lifetime risks for atherosclerotic CVD of approximately 5%, whereas those with 2 or more major risk factors had remaining lifetime risks of 50% for women and 69% for men. Furthermore, those with optimal health factors at age 50 years had a median survival of more than 40 years compared with 28 to 31 years among those with 2 or more major risk factors.⁴⁴

The presence of ideal cardiovascular health factors in middle age is also associated with better quality of life at older ages. For example, Daviglius et al⁴⁵ measured quality of life in men and women at a mean age of 73 years, approximately 25 years after a baseline examination during which cardiovascular health factors were measured. At older ages, several measures of quality of life, including self-reported social functioning, mental health, walking ability, and health perception, were each significantly higher among those who had all optimal cardiovascular health factors 25 years earlier than among those who did not.

Ideal cardiovascular health also has important implications for burdens of healthcare delivery and resource utilization. The presence of ideal cardiovascular health in middle age is associated with substantially lower annual healthcare costs later in life (ie, once Medicare eligibility is reached). Both men and women with optimal health factors in middle age required significantly and substantially lower Medicare costs later in life with regard to total and CVD-related costs. In men, there were even lower cancer-related Medicare costs later in life for those with optimal health factors than for those with 3 or more adverse factors.⁴⁶ In the current climate of increasing concern regarding healthcare expenditures, such data highlight the tremendous potential and importance of primordial prevention as a population and public policy strategy.

Thus, there are numerous and substantial implications of having an ideal cardiovascular health factor profile in middle age. Individuals who achieve or maintain all ideal cardiovascular health factors into middle age have greater longevity, longer morbidity-free survival, compression of morbidity to the end of the lifespan, greater health-related quality of life (HRQOL) in older age, and substantially lower healthcare costs later in life.

Notably, data from the above-mentioned and current studies indicate that the prevalence of ideal cardiovascular health in United States populations is currently extremely low, at approximately 5%.^{39,44,45,47} This highlights the tremendous gap but also the tremendous potential for focusing on new individual- and population-based efforts to increase the prevalence of ideal cardiovascular health in the United States. The correlations between healthy behaviors and ideal health factors suggest strongly that these individuals may achieve and maintain ideal cardiovascular health through healthy behaviors and lifestyles rather than through genetic predisposition alone with no influence of environment and lifestyle. For this reason, as well as others enumerated below, healthy cardiovascular behaviors must play an equal role in defining ideal cardiovascular health.

Ideal Cardiovascular Health Pattern: Combined Health Behaviors and Health Factors

The simultaneous combination of many ideal health factors and healthy behaviors is also associated with longevity and particularly with healthy aging without disability. Willcox et al⁴⁸ described outcomes for 5820 Japanese American men in the Honolulu Heart Program who were followed up from 1965 to 2005. Health behaviors and health factors were measured at a mean age of 54 ± 5 years, and overall survival and disease-free survival (exceptional survival) were observed to ages >85 years. In middle age, avoidance of overweight (BMI ≥ 25 kg/m²), hyperglycemia, hypertension, ever smoking, and heavy alcohol use, among other factors, were each associated with both overall survival to older age and exceptional survival free of CHD, stroke, cancer, chronic obstructive pulmonary disease, Parkinson disease, and treated diabetes. Exceptional survival beyond age 85 years occurred in 55% of men with all ideal health factors and health behaviors in middle age but in only 9% of those with 6 or more unfavorable factors and behaviors.⁴⁸

Likewise, among 1200 Finnish men 48 ± 4 years of age in 1974, Strandberg et al⁴⁹ defined a healthy profile that included lower BMI; minimal or no smoking; lower blood pressure, total cholesterol, and triglycerides; and low 1-hour glucose after an oral glucose challenge. Men with all healthy factors and behaviors in middle age were at significantly lower risk for self-reported diabetes, congestive heart failure, and hospitalization within the previous 5 years when surveyed at a mean age of 74 years. Of note, men with the more ideal cardiovascular health profile also had significantly better quality-of-life scores at older ages with regard to physical functioning, role physical, bodily pain, general health, social functioning, and physical component summary scores on the 36-Item Short Form Health Survey.⁴⁹

Taken together, the data reviewed above provide consistent and compelling evidence supporting the concept of monitoring health behaviors and health factors to reflect ideal cardiovascular health. Of greatest importance are the consistent associations observed with regard to CVD-free survival, overall longevity, healthy longevity, compression of morbidity, maintenance of quality of life, and reduction in healthcare costs.

Metrics for Cardiovascular Health

The 7 metrics (Table 2) proposed to define and monitor the prevalence of ideal cardiovascular health in the US population each meet the other criteria outlined in Table 1. As defined, the metrics for ideal cardiovascular health would apply only to those free of CVD and stroke who also meet the definition for all 7 criteria, thus ensuring that ideal cardiovascular health represents more than the absence of CVD. Indeed, the positive attributes of the cardiovascular health behaviors and health factors outlined above go far beyond the mere absence of CVD. They also provide goals and targets to be recommended by clinicians and achieved by patients largely through healthy lifestyles.

Health Behaviors

The extensive body of observational literature reviewed above, together with numerous randomized controlled trials

of intermediate phenotypes and risk factors, strongly supports the importance of health behaviors for achieving and maintaining ideal cardiovascular health. Thus, in selecting the thresholds for defining ideal cardiovascular health behaviors, the committee relied on the data available from current national guidelines and literature reviews with regard to ideal weight, levels of physical activity, and dietary habits.

Smoking

The health consequences of smoking and the data to support abstinence from or cessation of cigarette smoking as the ideal health state are overwhelming and have been reviewed extensively elsewhere.⁵⁰

Weight

The National Heart, Lung, and Blood Institute has defined normal body weight as a BMI of 18.5 to 24.9 kg/m².⁵¹ The committee discussed the importance of defining the ideal weight metric as a BMI <25 kg/m² versus a BMI of 18.5 to 24.9 kg/m² for adults. It was thought that a major issue confronting cardiovascular health at present and for the foreseeable future is the high and increasing prevalence of overweight and obesity. Although the health risks of being underweight (BMI <18.5 kg/m²) are acknowledged, this is a relatively rare condition in high-income nations with high CVD burden, has relatively few implications for overall cardiovascular health, and should be addressed on an individualized basis. The committee also recognized that a gradient of health and disease events also exists within the BMI range of 18.5 to 24.9 kg/m², with individuals having lower values within this range (eg, BMI <22 kg/m²) generally having the most favorable outcomes. The committee chose to retain the higher cut point of 24.9 kg/m² to define cardiovascular health rather than a lower cutpoint to be consistent with national guidelines and with the relatively moderate definitions of other health behaviors, such as diet and physical activity.

The committee deliberated over a metric for weight that would allow for direct measurement of improvements in weight over time, but there are no nationally representative longitudinal data that monitor weight (as well as caloric intake and expenditure) in the same individuals. It is thus currently impossible to track weight changes directly in the US population other than by observing population means and tracking the prevalences of normal weight, overweight, and obesity. The committee also recognized that a decrease in the prevalence of obesity could be due to individuals in the population losing weight and becoming less overweight or obese (a desirable outcome) or to individuals with adiposity dying at greater rates than leaner individuals (an undesirable outcome). Therefore, simple tracking of obesity prevalence is inadequate without the context of the prevalence of overweight and normal weight as well. The most desirable outcome is a decrease in the prevalence of obesity with a concomitant increase in the prevalence of normal weight and a stable or decreased prevalence of overweight. (These issues apply to other health behaviors and factors as well but are particularly troublesome for weight, given the current obesity epidemic.)

Physical activity

In 2008, the US Department of Health and Human Services released its first-ever “Physical Activity Guidelines for Americans”⁵² to complement the “Dietary Guidelines for Americans.”⁵³ The physical activity guidelines review in extensive detail the major research findings on the health benefits, including cardiovascular health benefits, of physical activity. Regular physical activity reduces the risk of many adverse health outcomes. In brief, it has become clear that any physical activity is better than none and that additional benefits occur as the amount of physical activity increases through higher intensity, greater frequency, and/or longer duration, especially with regard to cardiovascular health. It appears that for adults, most health benefits occur with at least 150 minutes a week of at least moderate-intensity physical activity, such as brisk walking. Additional benefits occur with more physical activity, but the marginal benefit is less than that observed with increases in physical activity at lower levels (eg, changing from nothing to walking 10 minutes per day of walking). The guideline therefore recommends that for substantial health benefits, adults should pursue at least 150 minutes per week of moderate-intensity physical activity, or 75 minutes per week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activities. Health benefits of physical activity occur across the age spectrum, in both sexes, and in every studied racial and ethnic group.⁵² The recommendations for physical activity among children (at least 60 minutes per day, every day) are even higher. Physical activity data in national data sets may need to be reconsidered on the basis of availability of future data. For example, NHANES data on physical activity will be evolving over the next few years, so comparability of estimates over time will need to be assessed.

Diet

The issue of defining optimal diet metrics for monitoring cardiovascular health required extensive review of the literature, consultation with nutrition experts, and discussion with the Nutrition Committee of the AHA. Characterization of dietary metrics required this extra scrutiny because of several factors unique to our understanding of the relationship between diet and cardiovascular health. First, measurement of diet is complex and evolving. Specific challenges include the accuracy and precision of measurements and the representativeness of population estimates. Fortunately, measurement and analytical techniques are improving, but such developments hinder the assessment of changes in dietary intake over time. Second, diet is not actually 1 factor but a complex constellation of multiple factors, including numerous individual foods and nutrients, each of which has varying strength and quality of evidence with regard to promotion of cardiovascular health. Third, although explicit, objective, and measurable national metrics for lipoprotein profiles, blood pressure, blood glucose, BMI, smoking, and physical activity currently exist, no such single biomarker or other objective metric exists for heart-healthy dietary habits. Thus, on the basis of these issues and the guiding principles for the definition of ideal cardiovascular health (Table 1), several

principles were formulated by the committee to guide the approach to identifying the dietary metric. The committee believed strongly that the dietary metrics for defining and monitoring ideal cardiovascular health should be based as much as possible on the following:

- Dietary habits that have the strongest evidence base for likely causal effects on cardiovascular events (ie, not just risk factors), diabetes, and/or obesity;
- An overall recommended dietary pattern based on foods rather than nutrients, both due to the challenges of measuring nutrients in large populations and, more importantly, for better communication, translation, and action by practitioners, individuals, and policy makers;
- Elements consistent with existing national⁵³ and AHA^{12,54,55} dietary guidelines; and
- Parsimony, with the inclusion of as few as possible elements that should therefore have minimal overlap with each other while at the same time having some overlap with other relevant dietary guidelines that are not included.

Early and consistently throughout the deliberations, the committee recognized that energy balance—caloric intake appropriate for weight control or maintenance—is a critical aspect of a healthy cardiovascular diet, particularly in the setting of the present obesity pandemic. However, assessment of calories consumed cannot be used to ascertain energy balance, because the appropriate goal for total calories consumed varies widely among individuals because of tremendous differences in basal metabolic rate, body size, lean body mass, and physical activity. The optimal metric for assessment of energy balance is weight change (gain, loss, or stability), which on a population level is assessed as having more people with appropriate BMI and fewer people who are overweight or obese. Thus, the committee recognized that energy balance, a critical aspect of a cardiovascular-healthy diet, is best expressed in the 2020 Impact Goal by the BMI goal/metric.

Nonetheless, the committee also concluded that energy balance can be affected by dietary quality, that is, the types of foods or overall dietary pattern consumed. Thus, in characterizing the dietary metrics for defining and monitoring ideal cardiovascular health, it was considered essential to include foods and dietary patterns with a strong evidence base for causal relationships to energy balance. For example, although the AHA recently published a statement on dietary sugar intake and cardiovascular health, the focus in the recommended metrics is on sugar-sweetened beverages given their demonstrated association with obesity and the difficulty of creating a relevant definition for other forms of sweets that would be consistent over time.

The final decision regarding recommendations for the definition of the dietary goals and metric for cardiovascular health represented a consensus and compromise among members of this committee and members of the AHA Nutrition Committee. This definition is also consistent with the current Dietary Guidelines for Americans⁵³ and AHA recommendations^{12,54,55} regarding appropriate diet; recognition of long-standing evidence reporting adverse dietary factors (eg,

caloric intake and saturated fat content); recognition that 69.2% of US adults fall into the groups (ie, all persons with hypertension, all middle-aged and older adults, and all blacks) that should consume no more than 1500 mg/day and the rest of US adults should consume no more than 2300 mg/day of sodium^{10a}; the need to recommend a dietary pattern that will assist in curbing the epidemic of overweight and obesity, while also promoting other aspects of cardiovascular health factors and health behaviors defined above; the desire to focus more on whole foods and dietary patterns rather than specific nutrients; and the quality and availability of the data that are currently available in NHANES that will likely be available in the future. The committee recognized that more elements could have been included, but they rated the principle of parsimony as essential for simplifying communication, measurement, and translation.

The recommendation for the definition of the dietary goals and metric, therefore, is as follows: "In the context of a diet that is appropriate in energy balance, pursuing an overall dietary pattern that is consistent with a DASH [Dietary Approaches to Stop Hypertension]-type eating plan, including but not limited to:

- Fruits and vegetables: ≥ 4.5 cups per day
- Fish: \geq two 3.5-oz servings per week (preferably oily fish)
- Fiber-rich whole grains (≥ 1.1 g of fiber per 10 g of carbohydrate): \geq three 1-oz-equivalent servings per day
- Sodium: < 1500 mg per day*
- Sugar-sweetened beverages: ≤ 450 kcal (36 oz) per week."

Intake goals are expressed for a 2000-kcal diet and should be scaled accordingly for other levels of caloric intake. For example, ≤ 450 calories per week represents only up to one quarter of discretionary calories (as recommended⁵⁴) coming from any types of sugar intake for a 2000-kcal diet.

The committee recognized that several other factors are important for the definition of an overall healthy dietary pattern, including avoidance of trans fat (partially hydrogenated fat) and saturated fat; avoidance of processed meats or other highly processed foods; displacement of the foregoing with unsalted nuts, seeds, legumes, and vegetable sources of protein and unsaturated fats; and meeting nutrient needs, especially known shortfall nutrients such as calcium, potassium, magnesium, and dietary fiber, through increased intake of nonfat dairy and other food sources of the electrolytes and through increased intakes of fruits, vegetables, and whole grains (for fiber). The committee further acknowledged

emerging evidence supporting potential benefits of other dietary habits, such as coffee intake and nonfat dairy intake to reduce risk of metabolic syndrome and diabetes but believed that further investigation was needed before such evidence could be considered convincingly causal.

Secondary dietary metrics will also be used for further monitoring of dietary patterns that are consistent with a DASH-like eating plan and support cardiovascular health. Among these secondary dietary metrics are the following:

- Nuts, legumes, and seeds: ≥ 4 servings per week
- Processed meats: none or ≤ 2 servings per week
- Saturated fat: $< 7\%$ of total energy intake

Low trans fat intake was considered highly desirable as a dietary metric but could not be included presently because of the lack of a means for monitoring consumption in nationally representative samples. Two other points regarding the dietary goals metric must be emphasized. First, as described previously, the recommended dietary metrics do not necessarily represent the only components of an optimal diet with regard to consistency with a DASH-like eating plan or ideal cardiovascular health. However, the committee desired to focus largely on whole foods, and monitoring requires the availability of appropriate data in the NHANES data sets. Therefore, the dietary metrics represent the best available means for monitoring the achievement of healthy dietary goals in the population with data that are currently available and should be available through 2020. Second, because there are no data from nationally representative samples that allow adequate quantification of caloric expenditure, it was deemed impossible at present to make a recommendation on a metric regarding appropriate caloric intake at the population level. However, the committee included several elements in the metric that are likely to affect energy balance favorably, including higher consumption of fiber-rich fruits, vegetables, and whole grains, which can contribute to satiety, and lower consumption of sweets and sugar-sweetened beverages. In addition, the committee believed that with simultaneous monitoring of the goals/metrics for BMI, physical activity, and diet, the AHA would be able to assess population trends in energy balance. This issue should be a matter for future discussion about incorporation into national surveys if appropriate methodology becomes available.

Health Factors

Although the achievement of ideal levels of a cardiovascular health factor through medication use is important and lowers risk for many people with adverse levels, the committee recognized that this is not equivalent (in terms of favorable outcome or risk for events) to having maintained or achieved ideal levels of cardiovascular health factors from childhood to young adulthood to middle age without medications. Risk reduction for the primary prevention of CVD events has been demonstrated for lipid-lowering medications^{56–59} and antihypertensive medications,^{60–63} but the risk reduction achieved by medications does not appear to restore risk to the levels of those who never had adverse levels of the risk factor. Thus, the definition of ideal cardiovascular health does not include those who achieve ideal levels of cardiovascular health factors through

*In 2004, the Institute of Medicine (IOM) set the adequate intake (AI) for sodium at 1500 mg per day and the tolerable upper intake level (UL) at 2300 mg per day for adults.^{55a} The IOM definition for the AI suggests that an individual should aim for this intake, especially if there is also an UL.^{55a} The IOM definition for UL indicates that it is intended to be used as a guide to limit intake,^{55a} thus the UL of 2300 mg per day was not recommended as an intake to aim for. Rather, both AHA and the US Dietary Guidelines took into account the high sodium levels in the available food supply and the current high levels of sodium consumption, felt that a reduction in sodium intake to 1500 mg/d (65 mmol/d) was not easily achievable and thus made an interim recommendation of 2300 mg per day for the general population and less than 1500 for individuals with hypertension, African-Americans, and middle- and older-aged Americans.^{53,55} In 2009, the CDC released data that the 1500 mg/day sodium recommendation applies to 69.2% of US adults (ie, all persons with hypertension, all middle-aged and older adults, and all blacks).^{10a} In light of the CDC data and keeping within the definition of ideal cardiovascular health, the committee has chosen to use the IOM AI for sodium of 1500 mg/d for defining ideal cardiovascular health. The recommendation for 1500 mg/d does not apply to individuals who lose large volumes of sodium in sweat, such as competitive athletes and workers exposed to extreme heat stress (eg, foundry workers and fire fighters), or to those directed otherwise by their healthcare provider.

medication use (ie, lipid-lowering, antihypertensive, or hypoglycemic agents). Conversely, as discussed below, medication treatment can certainly reduce risk and can allow movement of the population and individuals from poor cardiovascular health to intermediate cardiovascular health.

Cholesterol, Blood Pressure, and Blood Glucose

With regard to the individual health factors, each suggested threshold for the definition of ideal levels is in agreement with current clinical practice guidelines. For example, selection of total cholesterol <200 mg/dL as the level to define ideal cholesterol concentration is also consistent with the definition of desirable cholesterol levels used by the Third Adult Treatment Panel of the National Cholesterol Education Program.⁶⁴ Likewise, the definitions of blood pressure <120/<80 mm Hg and fasting blood glucose <100 mg/dL are consistent with the levels defined as optimal by the Seventh Joint National Committee of the National High Blood Pressure Education Program⁶⁵ and the American Diabetes Association,⁶⁶ respectively. Data supporting these levels as thresholds for the definition of ideal levels of health factors have been reviewed in detail by each of these bodies.

Issues Related to Cardiovascular Health in Children and Adolescents

Although few data exist linking specific levels of risk factors in childhood with CVD outcomes in adults, increasing evidence shows that atherosclerosis has its origins in childhood, is associated with early risk factor levels, and is progressive.^{67–70} In addition, it is clear that behavior related to health or risk of CVD frequently begins in childhood or adolescence. For example, the initiation of smoking is often during adolescence.⁵⁰ It has also been demonstrated that dietary patterns and levels of physical activity are established during childhood and may worsen during adolescence.

These issues should not be viewed as purely theoretical. Changes in lifestyle over the past 30 years have resulted in an increase in the levels of obesity and severe obesity, the emergence of type 2 diabetes mellitus in adolescents, and an increase in the average level of blood pressure and the prevalence of hypertension among children and adolescents.² There has also been a cessation of the trend to lower total and low-density lipoprotein cholesterol in the pediatric population. These observations have led to speculation that the current generations may have a shorter expected lifespan than their parents or grandparents.⁷¹

One concern is the question of how to characterize and measure cardiovascular health and risk factor status in children and adolescents. Children are growing and developing over time, and this presents some challenges. First, risk factor levels have been shown to track over time.⁷² This means that a child or adolescent who has elevation of a CVD risk factor relative to his or her peers is likely to still have elevated levels compared with peers across subsequent age ranges. Second, pathology studies have demonstrated that the risk factors known to be important for adults are also the important factors for increased risk in children.⁷³ Third, CVD risk factors can be measured in children and adolescents, and clinical care guidelines have been developed by the National

Heart, Lung, and Blood Institute to identify and treat higher-risk children and adolescents.^{74,75} The treatment approaches emphasize that many of these abnormalities may occur as a result of lifestyle issues. Therefore, modification of diet and physical activity are first-line interventions. However, the guidelines also recognize that genetic influences may be present and recommend appropriate pharmacological intervention when lifestyle change is not successful.

In children, health factors such as lipid levels, BMI, and blood pressure normally change with age, growth, and development. This means that a single threshold to identify elevated risk across all of childhood is not appropriate. This has led to population-based definitions of risk factor status and the use of percentiles that are often based on age and sex from a standardized population to define higher-risk levels. The use of these percentiles is appropriate for population monitoring and is important to account for the impact of appropriate growth and development.

It is also clear that cardiovascular health behaviors are as important for children and adolescents as for adults. In fact, they are perhaps even more important for children and adolescents, because it is the establishment of those behaviors in childhood that translates into maintenance of ideal cardiovascular health status into young adulthood and ultimately middle age. Thus, the US guidelines for diet⁵³ and physical activity⁵² for Americans have emphasized the inclusion of children and adolescents in their recommendations. There are challenges in the measurement and follow-up of CVD risk factors and cardiovascular health behaviors in children and adolescents that result from how data in nationally representative studies are collected and reported. This has sometimes led to limitations in how the metrics for cardiovascular health can be constructed, with somewhat different age groups being available or appropriate for inclusion in the cardiovascular health metrics shown in Table 2. Nonetheless, the monitoring of available data in children will be critical to increase the prevalence of ideal cardiovascular health and maintain ideal cardiovascular health to middle and older ages in the long term.

Improving the Cardiovascular Health of the Entire Population

Achieving ideal cardiovascular health in large proportions of the population is the ultimate goal, and increases in the prevalence of the ideal cardiovascular health phenotype over the coming decades would likely result in dramatic improvements in healthy longevity and reductions in healthcare costs, as discussed previously. However, the current prevalence of ideal cardiovascular health in the US population is very low,⁴⁷ because it includes only those without manifest CVD who are not undergoing treatment for cardiovascular risk factors and who have ideal levels of all 7 cardiovascular health factors and health behaviors. Therefore, a focus solely on ideal cardiovascular health as a preventive strategy would have little impact over the next decade, before 2020.

To achieve improvements in cardiovascular health across the entire population, the committee recommended the use of the same 7 metrics as the primary means for monitoring

Table 3. Definitions of Poor, Intermediate, and Ideal Cardiovascular Health for Each Metric, Along With NHANES 2005–2006 Unadjusted Prevalence Estimates for AHA 2020 Goals

Goal/Metric	Poor Health		Intermediate Health		Ideal Health	
	Definition	Prevalence, %	Definition	Prevalence, %	Definition	Prevalence, %
Current smoking						
Adults >20 y of age	Yes	24	Former ≤12 mo	3	Never or quit >12 mo	73 (51 never; 22 former >12 mo)
Children 12–19 y of age	Tried prior 30 days	17			Never tried; never smoked whole cigarette	83
Body mass index						
Adults >20 y of age	≥30 kg/m ²	34	25–29.9 kg/m ²	33	<25 kg/m ²	33
Children 2–19 y of age	>95th Percentile	17	85th–95th Percentile	15	<85th Percentile	69
Physical activity						
Adults >20 y of age	None	32	1–149 min/wk moderate intensity or 1–74 min/wk vigorous intensity or 1–149 min/wk moderate+vigorous	24	≥150 min/wk moderate intensity or ≥75 min/wk vigorous intensity or ≥150 min/wk moderate+vigorous	45
Children 12–19 y of age	None	10	>0 and <60 min of moderate or vigorous activity every day	46	≥60 min of moderate or vigorous activity every day	44
Healthy diet score						
Adults >20 y of age	0–1 Components	76	2–3 Components	24	4–5 Components	<0.5
Children 5–19 y of age	0–1 Components	91	2–3 Components	9	4–5 Components	<0.5
Total cholesterol						
Adults >20 y of age	≥240 mg/dL	16	200–239 mg/dL or treated to goal	38 (27; 12 treated to goal)	<200 mg/dL	45
Children 6–19 y of age	≥200 mg/dL	9	170–199 mg/dL	25	<170 mg/dL	67
Blood pressure						
Adults >20 y of age	SBP ≥140 or DBP ≥90 mm Hg	17	SBP 120–139 or DBP 80–89 mm Hg or treated to goal	41 (28; 13 treated to goal)	<120/<80 mm Hg	42
Children 8–19 y of age	>95th Percentile	5	90th–95th Percentile or SBP ≥120 or DBP ≥80 mm Hg	13	<90th Percentile	82
Fasting plasma glucose						
Adults >20 y of age	≥126 mg/dL	8	100–125 mg/dL or treated to goal	34 (32; 3 treated to goal)	<100 mg/dL	58
Children 12–19 y of age	≥126 mg/dL	0.5*	100–125 mg/dL	18	<100 mg/dL	81

Some percentages do not appear to add up because of rounding.

SBP indicates systolic blood pressure; DBP, diastolic blood pressure.

*Estimate not reliable.

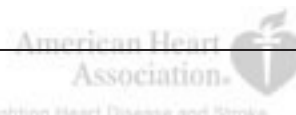
overall cardiovascular health in the US population from 2010 to 2020. For this purpose, definitions of the 7 metrics were expanded to encompass the entire spectrum of cardiovascular health, from ideal to intermediate to poor. As shown in Table 3, the spectrum of levels for each metric is represented within each of the 3 cardiovascular health categories, and it is shown for children as well as adults. For example, for smoking, ideal health is defined as not currently smoking (never smoking or having quit >12 months ago), whereas

intermediate health is defined as having quit within 12 months, and poor health is defined by current active smoking. For the BMI metric, intermediate and poor health are defined by the presence of overweight or obesity, respectively. In the case of physical activity, any level greater than 0 is believed to be better than none (as discussed previously), thus defining the intermediate and poor health groups. Finally, poor health on the dietary metric was defined arbitrarily as meeting 0 or only 1 criterion, whereas intermediate health was defined as

Table 4. Spreadsheet Used to Estimate Potential Improvement in Overall Cardiovascular Health Metric

Metric	Poor Health		Intermediate Health, Prevalence, %	Ideal Health	
	Prevalence, %	Delta, %		Prevalence, %	Delta, %
Current smoking					
Adults	24	20	3	73 (51+22)	20
Children 12–19 y of age	17	20	...	83	20
Body mass index					
Adults	34	20	33	33	20
Children 2–19 y of age	17	20	15	69	20
Physical activity					
Adults	32	20	24	45	20
Children 12–19 y of age	10	20	46	44	20
Healthy diet score					
Adults	76	20	24	<0.5	20
Children 5–19 y of age	91	20	9	<0.5	20
Total cholesterol					
Adults	16	20	38 (27+12)	45	20
Children 6–19 y of age	9	20	25	67	20
Blood pressure					
Adults	17	20	41 (28+13)	42	20
Children 8–19 y of age	5	20	13	82	20
Fasting plasma glucose					
Adults	8	20	34 (32+3)	58	20
Children 12–19 y of age	0.5	20	18	81	20
Enter different deltas into the delta cells above and see the effect on the overall average change below					
Average improvement in overall cardiovascular health	20.00	%			

Data from NHANES 2005–2006.



meeting 2 or 3 criteria and ideal health as meeting 4 or 5 criteria.

In this algorithm, individuals with a history of clinical CVD and stroke would never be considered to have ideal cardiovascular health; however, with control of all of their health behaviors and health factors, they could be considered to have intermediate cardiovascular health. Similarly, individuals without clinical CVD but with adverse levels of health behaviors or health factors (poor cardiovascular health) could achieve intermediate health status through control of these metrics to goal levels with lifestyle and medication, or ideal health status if they can achieve control of all metrics through lifestyle alone.

Thus, Table 3 displays the primary means for monitoring the achievement of the AHA 2020 Impact Goal with regard to cardiovascular health. Because the desire is to improve the cardiovascular health of all Americans, this will require reductions in the prevalence of poor cardiovascular health while simultaneously increasing the prevalence of ideal cardiovascular health levels. The current prevalence of poor, intermediate, and ideal health for each of the 7 metrics is also displayed in Table 3. For example, for blood pressure, the current prevalence of poor cardiovascular health is 17%, which indicates that 17% of adults have systolic blood pressure ≥ 140 mm Hg or diastolic blood pressure ≥ 90 mm Hg. Forty-one percent of adults have intermediate

cardiovascular health with respect to blood pressure: 28% have untreated systolic pressure of 120 to 139 mm Hg or diastolic pressure of 80 to 89 mm Hg, and an additional 13% have hypertension treated to recommended goal levels. Finally, 42% of adults have ideal cardiovascular health levels of blood pressure at $<120/<80$ mm Hg (untreated). Similar approaches using thresholds based on clinical practice guidelines are used for total cholesterol and fasting plasma glucose. In addition, definitions for ideal, intermediate, and poor cardiovascular health in children are provided on the basis of availability of data from NHANES and are consistent with current guidelines.

Quantifying Improvements in Overall Cardiovascular Health

To quantify the recommendation for the AHA 2020 Impact Goal for improving cardiovascular health, the committee created a spreadsheet modeled on Table 3. As shown in Table 4, the national prevalence of each level of cardiovascular health was first determined from NHANES 2005–2006 data and provided on the spreadsheet (<http://www.cdc.gov/nchs/nhanes.htm> and the AHA Heart Disease and Stroke Statistics—2009 Update²). Committee members were then asked to determine ranges for proportional improvements for each health behavior and health factor that they thought could be achieved by 2020 with regard to relative reductions in the

prevalence of poor health levels and increases in the prevalence of ideal health levels. Relative rather than absolute changes, with current prevalence as the baseline value, were considered for consistency across all metrics. The potential proportional changes in each health behavior or health factor were then averaged to derive 1 overall goal. For example, on the basis of recent national trends, most committee members expected smaller relative reductions in the prevalence of obesity (poor health) but believed that there could be somewhat larger relative improvements made with regard to metrics such as diet, smoking, and physical activity. However, even small changes in trends, such as a leveling of obesity prevalence (ie, 0% change), could be considered a significant achievement.

The committee elected not to weight the importance of improvements in metrics differently. Although the committee acknowledged that reductions in smoking prevalence would have a greater impact in improving cardiovascular health in the short term (before 2020) than would reductions in the prevalence of obesity, fully quantitative analyses of the effects on cardiovascular health were deemed to be beyond the capabilities of the committee at present, particularly given the fact that this definition of cardiovascular health is newly created. In the future, as the metrics are refined and quantitative methods improve, differential weighting of metrics would be desirable given their likely differential effects on the cardiovascular health of the population.

Committee members proposed a range of improvements in overall cardiovascular health that generally fell between 15% and 25%. The consensus of the committee was that some of the metrics might be readily improved with appropriate policy, practitioner, and public health focus, but others might be very difficult to improve substantially by 2020. Thus, an overall improvement of 25% by 2020 was deemed unrealistic by many members. Likewise, overall improvements of only 15% were thought to be insufficient to merit a firm commitment by the AHA to change the cardiovascular health of all Americans. Therefore, the consensus of the committee was to recommend that the AHA strive to achieve a 20% overall improvement in the cardiovascular health of all Americans by 2020.

Of note, the committee placed special emphasis on the words “all Americans” in the Impact Goal statement to highlight the fact that the AHA should focus attention on underserved minority populations in order to achieve the 2020 Impact Goal in these groups as well. Indeed, a particular effort in these groups, who generally have the lowest prevalence of ideal health behaviors and factors and a higher prevalence of poor health levels, would assist the AHA in achieving the overall Impact Goal.

Secondary Metrics for Monitoring Cardiovascular Health, Including HRQOL

The committee recommended that a number of secondary metrics also be included to monitor the cardiovascular health of the population from 2010 to 2020, to measure progress toward the 2020 Impact Goal, and to identify opportunities for the AHA to develop programs and interventions that might have a large impact on improving overall cardiovas-

cular health and achieving the Impact Goal. These are presented in Table 5. Each of the 7 metrics used to define ideal cardiovascular health and overall cardiovascular health will be monitored individually. This will allow for tracking of the major cardiovascular health (and risk) factors in the population and will identify needs at the primordial, primary, and secondary prevention levels. In addition, as shown in Table 5, the health behavior and health factor indices will be monitored separately and for children as well as adults. Further metrics of health promotion and risk reduction will track prevalence (for all metrics) and awareness, treatment, and control (as appropriate) of various health and risk factors, including tobacco exposure, hypertension, hypercholesterolemia, overweight and obesity, diabetes, physical activity, family history, metabolic syndrome, numbers of major risk factors, and population levels of Framingham risk score over time. Health disparities will be monitored by assessing sex/race-specific prevalences and awareness/treatment/control of the primary and secondary cardiovascular health metrics. Finally, quality of care and outcomes with regard to cardiovascular health will be assessed by use of awareness/treatment/control metrics of cardiovascular health.

HRQOL in the absence of CVD will also be monitored for the first time by the AHA as a measure of cardiovascular health. The committee and the AHA recognized the importance of improving HRQOL (not merely reducing disease) as an important component of cardiovascular health in its 2020 Impact Goal. The concept of HRQOL generally goes beyond traditional measures of mortality and morbidity and may include physical, mental, and social functioning, as well as overall well-being.⁷⁶

HRQOL measures include generic scales that measure HRQOL in the general population and across conditions, as well as disease-specific scales that examine the impact of conditions on particular domains of life such as cognitive status and functional status. Generic HRQOL scales are generally brief, can be used to make comparisons across groups with differing conditions, and provide an overall picture of perceived HRQOL in a population.

Cardiovascular conditions have major effects on the functional status and on the well-being and public health of the community. Studies using various measures of HRQOL have shown expected decrements associated with cardiovascular conditions including MI/CHD,^{77–82} stroke,^{78,83,84} heart failure,⁸⁰ and hypertension,^{78,80,85–87} as well as with risk factors.^{45,78,81,88–103} Differences in HRQOL are also an important dimension of health disparities.^{104–109} Interventions and treatments have been associated with improvements in HRQOL.^{110,111} Analyses that use statistical modeling suggest improvements in HRQOL with increased use of proven interventions.¹¹²

The committee recommended that HRQOL be monitored as a secondary rather than a primary measure for the AHA’s 2020 Impact Goal for several reasons. A number of generic and disease-specific HRQOL measures are available in the literature; however, use of these scales is limited in ongoing national databases. Additionally, although there are national HRQOL data to set a baseline, there are few studies as to what constitutes a meaningful change in order to recommend

Table 5. Secondary Metrics for Monitoring Cardiovascular Health

	Specific Metrics	Definition	Source of Definition	Age-Specific, Age-Adjusted, or Both	Data Sources
Ideal cardiovascular health status	Prevalence	All 7 components			
Ideal health factors index	Prevalence	All 4 components	Various	Both	NHANES
Components (must have all 4)					
Total cholesterol	Prevalence	<200 mg/dL (untreated)	ATP-III	Both	NHANES
Blood pressure	Prevalence	SBP <120 and DBP <80 mm Hg (untreated)	JNC 7	Both	NHANES
Not current smoker	Prevalence	Never or quit \geq 12 mo	Various	Both	NHANES
No DM	Prevalence	No history of DM, untreated and FBG <126 mg/dL	ADA	Both	NHANES
Ideal health behaviors index	Prevalence	All 4 components	Various	Both	NHANES
Components (must meet all 4)					
Physical activity at goal	Prevalence	\geq 150 min/wk moderate or \geq 75 min/wk vigorous or combination	DHHS	Both	NHANES
Not current smoker	Prevalence	Never or quit \geq 12 mo	Various	Both	NHANES
BMI <25 kg/m ²	Prevalence	BMI <25 kg/m ²	Obesity guidelines, WHO	Both	NHANES
4–5 Diet goals met*	Prevalence	4–5 Diet goals met	USDA, DHHS, † AHA	Both	NHANES
Fruits and vegetables	Prevalence	\geq 4.5 cups/d	USDA, DHHS, AHA	Both	NHANES
Fish 3.5-oz servings (preferably oily fish)	Prevalence	\geq 2 servings/wk	USDA, DHHS, AHA	Both	NHANES
Sodium	Prevalence	<1500 mg/d†	USDA, DHHS, AHA	Both	NHANES
Sweets/sugar-sweetened beverages	Prevalence	\leq 450 kcal (36 oz)/wk	Based on 1/4 of discretionary calories for average sedentary individual	Both	NHANES
Whole grains (1.1 g of fiber in 10 g of carbohydrates), 1-oz-equivalent servings	Prevalence	\geq 3 servings/d	Based on definition of whole grains, and USDA, DHHS, AHA	Both	NHANES
Other dietary measures					
Nuts, legumes, seeds	Prevalence	\geq 4 servings/wk	USDA	Both	NHANES
Processed meats	Prevalence	\leq 2 servings/wk	Various	Both	NHANES
Saturated fat	Prevalence	<7% of total energy intake (kcal)	AHA	Both	NHANES
Health promotion/risk reduction					
Tobacco exposure	Prevalence	Current cigarette smoking	Consensus	Both	NHANES
High blood pressure	Prevalence, awareness/treatment/control	SBP \geq 140 or DBP \geq 90 mm Hg or treated	JNC 7	Both	NHANES
Hypercholesterolemia	Prevalence, awareness/treatment/control	TC \geq 240 mg/dL or treated	ATP-III	Both	NHANES
Overweight/obesity	Prevalence	BMI 25–29.9 kg/m ² ; BMI \geq 30 kg/m ²	Obesity guideline	Both	NHANES
DM	Prevalence, awareness/treatment/control	History of DM, FBG \geq 126 mg/dL or treated	ADA	Both	NHANES
Physical activity	Prevalence	\geq 150 min/wk moderate or \geq 75 min/wk vigorous	DHHS	Both	NHANES
Positive family history	Prevalence	CVD in first-degree relative age <55 y (M) <65 y (W)	ATP-III	Both	NHANES
FRS over time	Prevalence	Estimated ATP-III 10-year risk	ATP-III	Age-specific	NHANES

(Continued)

Table 5. Continued

	Specific Metrics	Definition	Source of Definition	Age-Specific, Age-Adjusted, or Both	Data Sources
Numbers of major risk factors	Prevalence	Defined as DM, current smoking, TC \geq 240 mg/dL, hypertension	ATP-III, JNC 7	Both	NHANES
Metabolic syndrome	Prevalence	ATP-III modified definition	ATP-III	Both	NHANES
Waist circumference	Prevalence	>100 cm (M)/>88 cm (W)	ATP-III	Both	NHANES
Triglycerides	Prevalence	>150 mg/dL	ATP-III	Both	NHANES
HDL cholesterol	Prevalence	<40 mg/dL (M)/<50 mg/dL (W)	ATP-III	Both	NHANES
Blood pressure	Prevalence	SBP >130 or DBP >85 mm Hg or treated	ATP-III	Both	NHANES
FBG	Prevalence	>100 mg/dL	ATP-III	Both	NHANES
Quality of life in the absence of CVD					
Obesity	Levels in obese, overweight	Healthy days	Various	Both	NHANES
Hypertension	Levels in hypertension	Healthy days	Various	Both	NHANES
Dyslipidemia	Levels in dyslipidemia	Healthy days	Various	Both	NHANES
Smoking	Levels in smokers	Healthy days	Various	Both	NHANES
DM	Levels in DM	Healthy days		Both	NHANES
Eliminating health disparities					
Risk reduction	Sex/race-specific prevalence of all measures			Both	NHANES
Quality of care/outcomes	Awareness/treatment/control measures above			Both	NHANES

ATP-III indicates Adult Treatment Panel III; SBP, systolic blood pressure; DBP, diastolic blood pressure; JNC 7, Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; DM, diabetes mellitus; FBG, fasting blood glucose; ADA, American Diabetes Association; DHHS, Department of Health and Human Services; WHO, World Health Organization; USDA, US Department of Agriculture; TC, total cholesterol; M, men; W, women; FRS, Framingham Risk Score; and HDL, high-density lipoprotein.

*Scaled for 2000 kcal/d and in the context of intake with appropriate energy balance and a DASH-like eating plan (details in text).

†The DHHS/USDA Dietary Guidelines for Americans are currently under revision.

‡The 1500 mg/d sodium recommendation applies to 69.2% of US adults (ie, all persons with hypertension, all middle-aged and older adults, and all blacks).^{10a} The remainder of the population should consume no more than 2300 mg/d of sodium.^{53,55}

an improvement or target for 2020. Likewise, among patients with various cardiovascular conditions, disease-specific scales are not available in national data sets to adequately assess HRQOL associated with particular cardiovascular conditions.

In national data sets, NHANES currently includes 4 questions that have been used to measure HRQOL. These measures, developed by the CDC, have been used in the Behavioral Risk Factor Surveillance System by state health departments since 1993.⁷⁶ These “Healthy Days” measures are a generic instrument to assess the burden of impaired HRQOL in different population and disease groups. Four main questions target overall perceived health status and the number of physically unhealthy days, mentally unhealthy days, and days when poor physical or mental health kept one from doing his or her usual activities during the prior 30 days.

The Healthy Days measures are reliable and valid for population health surveillance.^{113–115} The measures predict morbidity, healthcare use, and mortality and are associated with chronic diseases, disability, risky health behaviors, and sociodemo-

graphic factors.^{78,116,117} They have been used to assess population group differences and have shown expected differences among persons with and without cardiovascular risk factors^{88,89,92,93,102} and conditions.^{77–79,85} Studies have assessed how the Healthy Days measures compare to other HRQOL measures and could be calibrated to other scales.^{118,119} The Healthy Days measures appear to be valid for adolescents, although further studies may be needed.¹²⁰ The Healthy Days measures have been recommended as surveillance measures for state chronic disease indicators.¹²¹ More recently, the Institute of Medicine proposed the Healthy Days measures in its “State of the USA Health Indicators” report.¹²²

The 4 general Healthy Days questions available through the NHANES and the Behavioral Risk Factor Surveillance System can be monitored to assess changes in perceived HRQOL among participants in the general population and among those with specific health/risk factors and cardiovascular conditions. Additional questions regarding physical, mental, and social functioning and disability are also currently available in these data sets and could be used to supplement analyses.

Reducing CVD and Stroke

Primary 2020 Impact Goal Metric

As discussed above, the AHA 2010 Impact Goal sought to reduce age-adjusted mortality rates due to CHD and stroke and risk by 25% by 2010, with 1999 mortality data as the baseline. In selecting the 2020 Impact Goal metrics, the committee considered a number of issues. First, there was consensus that a broader focus on all CVDs and stroke was needed, not just on CHD and stroke mortality. The AHA has numerous programs and activities that address the substantial morbidity and mortality resulting from all manifestations of CVD and stroke, including such areas as congenital CVD and venous thromboembolic disease. Thus, a limited focus on coronary and stroke mortality is no longer warranted. The new 2020 Impact Goal focused on CVD and stroke seeks to reduce age-adjusted death rates due to CVDs and stroke by 20%, with 2010 as the baseline year. This will reflect some changes from the AHA's previous goals with regard to mortality and will be more inclusive by including vascular diseases other than stroke, as well as congenital cardiovascular defects. International Classification of Diseases codes for CVD in the Impact Goals will thus include 390–459 and 745–747 (*International Classification of Diseases, 9th Revision*) or I00–I99 and Q22–Q28 (*International Classification of Diseases, 10th Revision*). We will be using the 2000 US standard population to calculate by the direct method the adjusted mortality rates, similar to the methods used to track the 2010 goal. It is, however, also important to monitor the absolute number of CVD and stroke deaths to understand the burden of the disease in the entire population or in a given state or locality.

The second major issue on which the committee formed a consensus was that despite the desirability of including nonfatal events in the primary 2020 Impact Goal metrics, there were insufficient data to do so. Goff et al¹²³ recently outlined the substantial limitations of surveillance of nonfatal CVD events in the United States and made recommendations for improving this gap in our knowledge.

Finally, the committee acknowledged the limitations of using death certificate data for assignment of cause of death. Previous studies have suggested overestimation of CHD as the underlying cause of death by death certificates, particularly among older individuals, compared with physician adjudication as the gold standard.¹²⁴ Nonetheless, there do not appear to be better methods available to serve as a referent for cause-specific mortality in 2010 for monitoring through 2020. Further attention at the national level to this deficiency in disease surveillance is clearly warranted.

Quantifying the 2020 Impact Goal for CVD and Stroke Mortality Reduction

The committee was mindful of the substantial reductions that have been achieved in CVD and stroke mortality over the past 40 years.^{1,2} However, there was some concern regarding the sustainability of these trends, particularly in light of recent data that suggest a flattening of or increases in CHD mortality among certain segments of the population (young men and women).⁴ The committee members therefore considered sev-

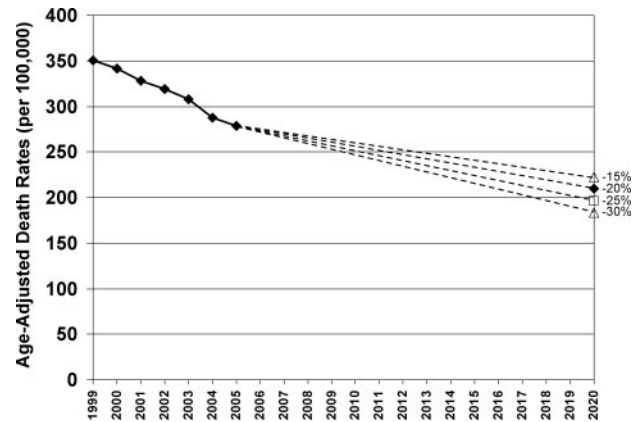


Figure 2. Age-adjusted death rates (per 100 000) due to all CVDs and stroke in the United States from 1999 to 2005 and potential further declines in CVD and stroke death rates from 2005 through 2020.

eral possible scenarios and provided their estimates for what would be achievable as further reductions in CVD and stroke mortality by 2020, using the available baseline mortality data in January 2010 as the referent. To assist with this process, a graph of recent trends in mortality was provided to committee members (Figure 2). Most members believed that further relative reductions of 25% would likely not be achievable by 2020 but that reductions of 20% were achievable with maximum effort from the AHA and its partners. Therefore, the consensus of the committee was to recommend an Impact Goal that aimed for a 20% reduction in CVD and stroke mortality. The committee acknowledges that the achievement of these ambitious goals by 2020 will likely require renewed efforts in existing programs targeting acute care processes and medical and procedural therapies, as well as efforts to advocate, promote, and implement population-level programs that will affect nonfatal and fatal CVD and stroke rates.

Secondary Metrics

Because of the limitations in surveillance of nonfatal CVD events, the committee recommended that these be monitored as secondary metrics. Therefore, in addition to the primary Impact Goal for mortality, the AHA will also monitor incidence, prevalence, disease severity, and 30-day case fatality, as well as quality of care and HRQOL measures, for those with CVD and stroke.

Incidence and Prevalence Burden of CVD Subtypes

Mortality alone does not capture the entire picture of the burden of a disease. Incidence and prevalence data are essential in our efforts to evaluate the effectiveness of primordial, primary, and secondary prevention. The current nationally representative prevalence data for CVD and stroke are self-reported data from the NHANES surveys (<http://www.cdc.gov/nchs/nhanes.htm>). The AHA will be able to monitor hypertension, CHD, heart failure, and angina prevalence separately from overall CVD prevalence in NHANES. The prevalence of peripheral arterial disease can also be estimated from the NHANES survey with ankle-brachial index data and self-report.

It is impossible to infer CVD incidence from NHANES and other sources. The available incidence data are generally

Table 6. Primary and Secondary Metrics for Monitoring CVD

	Specific Metrics	Data Sources	Definition	Source of Definition	Age-Specific, Age-Adjusted, or Both
Mortality					
Total CVD mortality	Annual incidence	Death certificate national mortality data	CVD as underlying cause (<i>ICD-10</i> codes I00–I99, Q20–Q28)	NCHS/CDC	Age-adjusted
Stroke mortality	Annual incidence	Death certificate national mortality data	Stroke as underlying cause (<i>ICD-10</i> codes I60–I69)	NCHS/CDC	Age-adjusted
CHD mortality	Annual incidence	Death certificate national mortality data	CHD as underlying cause (<i>ICD-10</i> codes I20–I25)	NCHS/CDC	Age-adjusted
Other CVD mortality	Annual incidence	Death certificate national mortality data	Cause-specific (<i>ICD-10</i> codes I00–I99, Q20–Q28, other than stroke and CHD)	NCHS/CDC	Age-adjusted
Prevalence					
CHD	Prevalence	ARIC surveillance, CHS, CARDIA, MESA, Jackson Heart Study, NHANES, REGARDS	Study-specific or <i>ICD-9</i> codes 410–414; self-report	Joint guidelines for definition of MI; study-specific	Both
Stroke	Prevalence	GCKNS, ARIC surveillance, REGARDS, NOMASS, NHANES	Study-specific or <i>ICD-9</i> codes 430–438; self-report	Study-specific	Both
CHF	Prevalence	ARIC surveillance, CHS, FHS, Olmsted, NHANES, REGARDS	<i>ICD-9</i> code 428; study-specific FHS criteria/CHS criteria/ARIC criteria/self-report	Study-specific	Both
AF	Prevalence	Observational studies, NHANES	Study-specific or <i>ICD-9</i> code 427.3	NHANES	Both
PVD	Prevalence	Observational studies, NHANES	Study-specific or ICD codes 441–443; ABI	NHANES	Both
EMS-treated cardiac arrest	Annual incidence	ROC, CARES	Experience cardiac arrest outside the hospital, are evaluated by organized EMS personnel, and (1) receive attempts at external defibrillation (by lay responders or emergency personnel), or receive chest compressions by organized EMS personnel or (2) are pulseless but do not receive attempts to defibrillate or CPR by EMS personnel	ROC	
Witnessed VF	Annual incidence	ROC, CARES	OHCA with initial rhythm VF, ventricular tachycardia, or shockable by automated external defibrillator	ROC	
In-hospital cardiac arrest					
		NRCPR	In-hospital cardiac arrest		
Incidence					
CHD	Annual incidence	ARIC surveillance and cohort, CHS, FHS, CARDIA, MESA, Jackson Heart Study, REGARDS	Study-specific or <i>ICD-9</i> codes 410–414	Joint guidelines for definition of MI; study-specific	Both
Stroke	Annual incidence	GCKNS, ARIC surveillance and cohort, CHS, FHS, CARDIA, MESA, NOMASS, REGARDS	Study-specific or <i>ICD-9</i> codes 430–438	Study-specific	Both
CHF	Annual incidence	ARIC surveillance, CHS, FHS, Olmsted, REGARDS	<i>ICD-9</i> code 428; study-specific FHS criteria/CHS criteria/ARIC criteria	Study-specific	Both
Case fatality					
CHD	Annual incidence	ARIC, Olmsted, Worcester, Minnesota, ACTION-GWTG, Kaiser, REGARDS	Death within 30 days of ACS/MI	Study-specific	Both
Stroke	Annual incidence	GWTG-Stroke, REGARDS	Death within 30 days of stroke	Study-specific	Both

(Continued)

Table 6. Continued

	Specific Metrics	Data Sources	Definition	Source of Definition	Age-Specific, Age-Adjusted, or Both
CHF	Annual incidence	ARIC, REGARDS	Death within 30 days of AHFS hospitalization	Study-specific	Both
EMS-treated cardiac arrest	Annual incidence	ROC, CARES, NEMSIS	Experience cardiac arrest outside the hospital, are evaluated by organized EMS personnel, and (1) receive attempts at external defibrillation (by lay responders or emergency personnel), or receive chest compressions by organized EMS personnel or (2) are pulseless but do not receive attempts to defibrillate or CPR by EMS personnel	ROC	
Witnessed VF	Annual incidence	ROC, CARES, NEMSIS	OHCA with initial rhythm VF, ventricular tachycardia, or shockable by automated external defibrillator	ROC	
In-hospital cardiac arrest Recurrence/rehospitalization	Annual incidence	NRCPR	In-hospital cardiac arrest		
CHD	Annual incidence	NHDS, NCDR, CMS, observational studies	ICD-9 codes 410–414	NCHS/CDC, CMS, study-specific	Both
Stroke	Annual incidence	NHDS, GWTG-Stroke, CMS, REGARDS	ICD-9 codes 430–438	NCHS/CDC, CMS, study-specific	Both
CHF	Annual incidence	NHDS, CMS	ICD-9 code 428	NCHS/CDC, CMS, study-specific	Both
Severity measures					
Rates of STEMI	Prevalence, annual incidence	ACTION-GWTG Registry, observational studies	ICD-9 codes 410.1–410.6, 410.8; joint guidelines for definition of MI; study-specific	Study-specific	Both
Rates of NSTEMI	Prevalence, annual incidence	ACTION-GWTG Registry, observational studies	ICD-9 code 410.7; joint guidelines for definition of MI; study-specific	Study-specific	Both
Post-MI EF	Prevalence	NCDR		Study-specific	Both
Ambulatory status after stroke	Prevalence	Coverdell, TJC, GWTG		Study-specific	Both
Chronic nursing care after stroke	Prevalence, annual incidence	Coverdell, TJC, GWTG		Study-specific	Both
Claudication	Prevalence, annual incidence	ARIC, CMS		Study-specific	Both
Amputation/critical limb ischemia	Prevalence, annual incidence	CMS, ARIC, GLEAS		Study-specific	Both
Quality of life in presence of CVD					
CHD (or heart disease)		BRFSS Healthy Days		CDC	Both
Stroke		BRFSS Healthy Days		CDC	Both
CHF		BRFSS Healthy Days		CDC	Both
Control of symptoms (angina/dyspnea/claudication)		GWTG–Outpatient		GWTG	Both
Risk factor control in presence of CVD					
Tobacco exposure	Prevalence	Current cigarette smoking	Consensus	Both	Both

(Continued)

Table 6. Continued

	Specific Metrics	Data Sources	Definition	Source of Definition	Age-Specific, Age-Adjusted, or Both
High blood pressure	Prevalence, awareness/treatment/control	SBP \geq 140 or DBP \geq 90 mm Hg or treated	JNC 7	Both	Both
Hypercholesterolemia	Prevalence, awareness/treatment/control	TC \geq 240 mg/dL or treated	ATP-III	Both	Both
Overweight/obesity	Prevalence	BMI 25–29.9 kg/m ² ; BMI \geq 30 kg/m ²	Obesity guideline	Both	Both
Diabetes	Prevalence, awareness/treatment/control	History of DM, FBG \geq 126 mg/dL or treated	ADA	Both	Both
Physical activity	Prevalence	\geq 150 min/wk moderate or \geq 75 min/wk vigorous		Both	Both
Health disparities					
Mortality/incidence	Sex/race/age-specific prevalences of all measures	NHDS, ARIC, MESA		NCHS/CDC, study-specific	Both
Risk reduction	Treatment/control measures above	NCQA, NHANES		NCHS/CDC, NCQA	Both
Quality of life	Sex/race/age-specific prevalences of all measures	BRFSS, NHANES		NCHS/CDC	Both
Quality of care					
	Composite performance measure index, risk-adjusted in-hospital mortality, 30-day mortality				
Post-MI discharge	Same as above	GWTG-ACTION; NCQA, TJC, REGARDS		Study-specific	Both
Poststroke discharge	Same as above	GWTG, NCQA, TJC, AVAIL, REGARDS		Study-specific	Both
Post-HF discharge	Same as above	GWTG, NCQA, TJC		Study-specific	Both
Treatment/control to secondary prevention goals		VA, CMS, Kaiser, NHANES		Study-specific	Both
Prehospital care of STEMI		Mission: Lifeline, NEMSIS			
Prehospital care of stroke		NEMSIS			
Prehospital care of OHCA		ROC, CARES, NEMSIS			
In-hospital care of those resuscitated from OHCA		ROC, CARES			
Care of in-hospital cardiac arrest		NRCPR			

ICD-10 indicates *International Classification of Diseases, 10th Revision*; NCHS, National Center for Health Statistics; CDC, Centers for Disease Control and Prevention; ARIC, Atherosclerosis Risk In Communities; CHS, Cardiovascular Health Study; CARDIA, Coronary Artery Risk Development In young Adults; MESA, Multi-Ethnic Study of Atherosclerosis; REGARDS, REasons for Geographical And Racial Differences in Stroke; ICD-9, *International Classification of Diseases, 9th Revision*; GCKNS, Greater Cincinnati/Northern Kentucky Stroke Study; NOMASS, Northern Manhattan Stroke Study; CHF, congestive heart failure; FHS, Framingham Heart Study; Olmsted, Olmsted County/Rochester Epidemiology Project; AF, atrial fibrillation; PVD, peripheral vascular disease; ABI, ankle-brachial index; EMS, emergency medical services; ROC, Resuscitation Outcomes Consortium; CARES, Cardiac Arrest Registry to Enhance Survival; CPR, cardiopulmonary resuscitation; VF, ventricular fibrillation; OHCA, out-of-hospital cardiac arrest; NRCPR, National Registry of Cardiopulmonary Resuscitation; Worcester, Worcester Heart Attack Study; Minnesota, Minnesota Heart Failure Consortium; ACTION-GWTG, Acute Coronary Treatment and Intervention Outcomes Network—Get With The Guidelines; Kaiser, Kaiser-Permanente; ACS, acute coronary syndrome; GWTG, Get With The Guidelines; AHFS, acute heart failure syndrome; NEMSIS, National Emergency Medical Services Information System; NHDS, National Hospital Discharge Survey; NCDR, National Cardiovascular Data Registry; CMS, Centers for Medicare and Medicaid Services; STEMI, ST-segment elevation myocardial infarction; NSTEMI, non-ST-segment elevation myocardial infarction; EF, ejection fraction; Coverdell, Paul Coverdell National Acute Stroke Registry; TJC, The Joint Commission; GLEAS, Global Lower Extremity Amputation Study; BRFSS, Behavioral Risk Factor Surveillance System; SBP, systolic blood pressure; DBP, diastolic blood pressure; JNC 7, Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; TC, total cholesterol; ATP-III, Adult Treatment Panel III; DM, diabetes mellitus; FBS, fasting blood sugar; ADA, American Diabetes Association; NCQA, National Committee for Quality Assurance; AVAIL, Adherence Evaluation After Ischemic Stroke Longitudinal Registry; HF, heart failure; and VA, Veterans Administration.

limited to acute coronary events, stroke, and heart failure. The best available sources, which typically provide physician-adjudicated event data, are from National Institutes of Health-funded observational cohort studies; however, in most cases, these studies may not be nationally representative. Data on hospital admission rates for some CVD subtypes can give an approximate estimate of the incidence, although these administrative data may be biased by coding issues related to billing. There are 3 major data sources for hospitalization data, which include the National Center for Health Statistics/CDC National Hospital Discharge Survey (<http://www.cdc.gov/nchs/nhds.htm>), the Agency for Healthcare Research and Quality's Nationwide Inpatient Sample survey (<http://www.hcup-us.ahrq.gov/nisoverview.jsp>), and the Centers for Medicare and Medicaid Services' Medicare coverage database (<http://www.cms.hhs.gov/mcd/overview.asp>). The latter database is limited largely to those 65 years of age and older. Table 6 indicates the primary and secondary metrics related to CVD incidence and prevalence that will be monitored by the AHA despite these limitations and the data sources from which they will be derived.

Case Fatality

Survival rate in the presence of disease is a statistic that can be used to evaluate the effectiveness of quality of care and access to care for those who have a specific disease. The current survival (eg, 30-day) data for acute coronary events and stroke are limited and are derived largely from population-based surveys with small sample sizes. Nationally representative survival data after first hospitalization for a CVD event are lacking. Centers for Medicare and Medicaid Services databases can provide statistics on 30-day survival rate for first hospitalization for acute MI and heart failure, which will be limited to those 65 years of age and older or with chronic disability.

Case Severity

Case severity for all manifestations of CVDs will be important to monitor, because improvements in case severity might well lead to improved quality of life and longevity. For example, the decline in CHD mortality over the past 4 decades could have been attributable to declining incidence, declining severity, or improvements in quality of care. Thus, the monitoring of CHD case severity could help explain why and how the decline of mortality happened and indicate what policies might be successful in the future. Several severity indicators have been proposed, which include the proportion of ST-segment elevation MIs among all MIs, the proportion with a new Q wave, the proportion with any major Q wave, the proportion with a new subsequent ST-segment elevation, the percent of incident MI cases with abnormal biomarkers, and the percent that meet criteria for definite MI.¹²⁵ In addition, a risk score for predicting risk of death in patients with coronary disease (PREDICT) using administrative data has been proposed by Jacobs et al.¹²⁶ The data sources for some of these severity measures could come from population-based cohort studies such as the ARIC (<http://www.csc.unc.edu/aric/links/>), Cardiovascular Health Study (CHS; <http://www.chs-nhlbi.org/>), Coronary Artery Risk Development in Young Adults (CARDIA; <http://www.cardia.dopm.uab.edu/>),

Multi-Ethnic Study of Atherosclerosis (MESA; <http://www.mesa-nhlbi.org/>), and Framingham Study cohorts (<http://www.framinghamheartstudy.org/>). However, more nationally representative data sources from a better CVD surveillance system are urgently needed, not just for CHD but for out-of-hospital sudden cardiac arrest, heart failure, stroke, and other manifestations of CVD. In the case of stroke, the REasons for Geographical And Racial Differences in Stroke (REGARDS) Study (<http://www.regardsstudy.org/index.htm>), Coverdell registry (http://www.cdc.gov/DHDS/stroke_registry.htm), and other sources may provide opportunities for better surveillance in the near future.

Health-Related Quality of Life

As discussed previously, the Healthy Days measures were selected by the committee for the assessment of quality of life in NHANES and Behavioral Risk Factor Surveillance System samples to monitor HRQOL in the population as a whole, as well as in subgroups with CVD and specific CVD subtypes. Identification of representative patient populations with particular conditions and in which HRQOL information is collected in the future may provide additional information to monitor disease-specific HRQOL issues.

Quality-of-Care Measures

Improvements in quality of care for individuals with manifest clinical CVD have contributed significantly to the marked decline in CHD mortality.³ Performance measures for coronary artery disease/CHD, heart failure, and stroke have been adopted by The Joint Commission, the Centers for Medicare and Medicaid Services, the National Committee for Quality Assurance, the Agency for Healthcare Research and Quality, the AHA and American College of Cardiology, the American Stroke Association, and others. These performance measures include composite scores for each of these disease domains. The details for these measures and the current level of these measures may be found in the AHA Heart Disease and Stroke Statistics—2009 Update.² These will serve as important tools for monitoring quality of care in the United States from 2010 to 2020. The continuation of the AHA Get With the Guidelines—Coronary Artery Disease, Stroke, and Heart Failure modules that were launched in 2001, 2004, and 2005 and other quality-improvement initiatives, including new outpatient programs and Centers for Medicare and Medicaid Services physician quality reporting, will further enhance the monitoring of quality of care for those with CVD and stroke in the future.

Out-of-Hospital Sudden Cardiac Arrest

The monitoring of rates of out-of-hospital sudden cardiac arrest is of particular interest because of its impact on society and the fact that it frequently represents the initial manifestation of cardiac disease. Some but not many communities are able to treat it effectively. The number of out-of-hospital cardiac arrests in the United States is estimated to be around 295 000 annually, and the survival rate remains extremely low, with substantial regional variations.^{2,127} The AHA has called for out-of-hospital cardiac arrest to be a reportable disease,¹²⁸ which will be an important step to better understand the burden of out-of-hospital cardiac arrests and may help improve outcomes for those who experience them. Improved policies and programs to address out-of-hospital

cardiac arrests, such as regional systems of care, could have a major impact on achieving the primary Impact Goal metric for CVD and stroke mortality, while also improving numerous secondary metrics related to CVD.^{129,130}

Other Issues in Defining the AHA 2020 Impact Goals

Numerous other metrics pertaining to cardiovascular health and disease were considered for inclusion but were rejected for various reasons. For example, the consensus of the committee was that alcohol intake should not be included as a metric of cardiovascular health or disease. Moderate alcohol consumption has been associated in observational studies with lower CVD incidence and has been included as a component in some studies of ideal cardiovascular health. However, the committee believed that the risks of alcohol abuse were significant and prevalent enough that the AHA should not recommend universal alcohol use as a means to achieve cardiovascular health. Psychosocial stress was also considered, but limitations of data collection in nationally representative samples led to its exclusion. Other examples of metrics that were considered but not recommended as surveillance metrics were measures of subclinical atherosclerosis, because these are not recommended for universal screening and are not routinely obtained in national samples, and metrics related to the built environment, because these are not currently well measured. The committee also acknowledges the importance of monitoring adherence to therapy and controlling symptoms (eg, angina, dyspnea, and claudication) among individuals with CVD but believes that current national data are inadequate for monitoring trends in symptom control. Likewise, there are numerous environmental exposures that appear to have a significant impact on CVD health and on CVD and stroke risk, such as air quality and particulate matter, and the committee endorsed increased efforts in the collection of individual-level exposure in nationally representative data sets. Each of the above represents an important gap in our ability to assess the status of and monitor trends in cardiovascular health and disease in the population. These gaps should be addressed with new policies and data sources at the national level. Numerous other metrics were considered for inclusion but were deemed to be of lower priority or were difficult to measure in national data.

Available Data Sources and Their Limitations

Tables 5 and 6 demonstrate the suggested data sources for each of the recommended primary and secondary metrics for the 2020 Impact Goals. Throughout the document, we have identified limitations of these data sources, particularly with regard to national representativeness, reliance on death certificate data, and lack of surveillance for nonfatal CVD and stroke events. Some of these issues have been addressed in detail by the AHA recently,^{123,128} and the committee recommends strongly that improving surveillance should remain a major area of advocacy and education for the AHA.

Importance of Health and Healthcare Disparities

As discussed above, the significant issues of health and healthcare disparities will be addressed for now through the

monitoring of sex/race-specific trends in the primary and secondary Impact Goal metrics, with the goal of ensuring that the benefits of achieving these goals are attained by all groups. The committee strongly recommended that the AHA expand its focus on underserved populations to improve the cardiovascular health of all Americans substantially and to reduce the burden of CVD and stroke in the population substantially and rapidly.

Issues Regarding Goals and Metrics

During the deliberations of the committee, a recurring tension was evident between defining the goals and outcomes of improved cardiovascular health and disease by 2020 and the practical metrics by which progress toward these goals would be measured and monitored. To a certain extent, the 2 competing imperatives represent the same process, but with important differences. In large part, tension arose when the measures available from nationally representative samples did not directly measure or capture the spirit of the goal that they might address. For example, in defining the dietary metric for ideal and overall cardiovascular health, there was difficulty in matching the goal statement to a metric that could be used to monitor it. Thus, a hybrid statement became necessary that outlined the overall goal (having more Americans eating a diet that is appropriate for achieving energy balance, that is low in saturated fat and cholesterol, and that conforms to a DASH-type eating plan) but also provided specific guidance both to consumers as to how to accomplish this (eg, eating more fruits and vegetables, fish, whole grains, nuts, legumes, and seeds and consuming less sodium, sweets, sugar-sweetened beverages, and processed meats) and to the AHA as to how to monitor this goal. Thus, the AHA should not limit its scope to the specific metrics in designing programs to achieve the overall goal, but it can monitor its progress toward improving cardiovascular health by understanding the changes in these metrics over time. Other examples have been highlighted throughout this document.

Conclusions

The foregoing document represents the work of numerous individuals, including AHA volunteers and staff and liaisons from government agencies including the National Heart, Lung, and Blood Institute and the CDC. The committee acknowledges that this is merely a step in an ongoing process. In the case of cardiovascular health, this document represents a first step in defining and setting goals for cardiovascular health, as well as monitoring cardiovascular health over time in the US population. With regard to reducing the burden of cardiovascular morbidity and mortality, this approach represents a significant step forward over previous efforts and identifies significant further gaps that need to be addressed. The committee looks forward to future work to refine these definitions and metrics. As a result of the process described herein, for the next decade, the AHA has committed itself to achieving the following Impact Goal:

“By 2020, to improve the cardiovascular health of all Americans by 20% while reducing deaths from cardiovascular diseases and stroke by 20%.”

Disclosures

Writing Group Disclosures

Writing Group Member	Employment	Research Grant	Other Research Support	Speakers' Bureau/Honoraria	Expert Witness	Ownership Interest	Consultant/Advisory Board	Other
Donald Lloyd-Jones	Northwestern University	None	None	None	None	None	None	None
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Yuling Hong	CDC	None	None	None	None	None	None	None
Darwin Labarthe	CDC	None	None	None	None	None	None	None
Michael S. Lauer	NHLBI	None	None	None	None	None	None	None
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Dariush Mozaffarian	Harvard School of Public Health	Investigator-initiated research grant† from Sigma Tau, Pronova, and GlaxoSmithKline	None	Honoraria for speaking at scientific conferences and providing reviews on topics related to diet and cardiovascular disease, including from the US Food and Drug Administration, United Nations, World Health Organization, UpToDate, International Life Sciences Institute, Aramark, and several universities and scientific organizations	None	None	None	None
Graham Nichol	University of Washington-Harborview Medical Center Professor of Medicine & Medic One Foundation Chair in Prehospital Emergency Care	Resuscitation Outcomes Consortium† (NIH U01 HL077863-05) 2004–2009, co-PI; Randomized Trial of CPR Training Aid (Asmund S. Laerdal Foundation for Acute Medicine) PI*; Randomized Trial of Hemofiltration After Resuscitation from Cardiac Arrest (NHLBI R21 HL093641-01A1) 2009–2011, PI†; Randomized Field Trial of Cold Saline IV After Resuscitation from Cardiac Arrest (NHLBI R01 HL089554-03) 2007–2012, Co-Investigator†	None	INNERcool Inc*; Radiant Inc*	None	None	None	Past Chair, AHA Basic Life Support Subcommittee*; Member, AHA Advanced Cardiac Life Support Subcommittee; Member, AHA Executive Database Steering Committee; Member, AHA Epidemiology and Statistics Committee; Chair, AHA Resuscitation Science Symposium Planning Committee; Received travel reimbursement, AHA; Collaborator, Resynchronization in Advanced Failure (RAFT) Trial [CHR, Medtronic Inc]*; Laerdal Inc,* Physio-Control Inc,* Channing Bete Inc*

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Linda Van Horn	Northwestern University	None	None	None	None	None	None	None
Clyde W. Yancy	Baylor University Medical Center	Terminated in 2007: NitroMed*; Scios, Inc*; DSMBS: Mayo Clinic*; Texas Medical Center*; Thoratec, Inc*	None	None	None	None	None	Associate Editor for <i>American Journal of Cardiology</i> ; on Editorial Board for <i>American Heart Journal</i> , <i>Cardiology Quarterly</i> ; <i>Circulation</i> ; <i>Circulation: Heart Failure</i> ; <i>Circulation: Cardiovascular Quality and Outcomes</i> ; <i>Congestive Heart Failure</i> ; government appointments: Food and Drug Administration, Chair of circulatory devices panel; NHLBI, member of study section Clinical and Integrative Cardiovascular Science

This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (1) the person receives \$10 000 or more during any 12-month period or 5% or more of the person's gross income; or (2) the person owns 5% or more of the voting stock or share of the entity or owns \$10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

†Significant.

References

1. *Morbidity & Mortality: 2007 Chart Book on Cardiovascular, Lung, and Blood Diseases*. Bethesda, Md: National Heart, Lung, and Blood Institute; 2007.
2. Lloyd-Jones D, Adams R, Carnethon M, De Simone G, Ferguson TB, Flegal K, Ford E, Furie K, Go A, Greenlund K, Haase N, Hailpern S, Ho M, Howard V, Kissela B, Kittner S, Lackland D, Lisabeth L, Marelli A, McDermott M, Meigs J, Mozaffarian D, Nichol G, O'Donnell C, Roger V, Rosamond W, Sacco R, Sorlie P, Stafford R, Steinberger J, Thom T, Wasserthiel-Smolter S, Wong N, Wylie-Rosett J, Hong Y. Heart disease and stroke statistics—2009 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation*. 2009;119:e21–e181.
3. Ford ES, Ajani UA, Croft JB, Critchley JA, Labarthe DR, Kottke TE, Giles WH, Capewell S. Explaining the decrease in U.S. deaths from coronary disease, 1980–2000. *N Engl J Med*. 2007;356:2388–2398.
4. Ford ES, Capewell S. Coronary heart disease mortality among young adults in the U.S. from 1980 through 2002: concealed leveling of mortality rates. *J Am Coll Cardiol*. 2007;50:2128–2132.
5. Strasser T. Reflections on cardiovascular diseases. *Interdiscip Sci Rev*. 1978;3:225–230.
6. Kavey RE, Daniels SR, Lauer RM, Atkins DL, Hayman LL, Taubert K. American Heart Association guidelines for primary prevention of atherosclerotic cardiovascular disease beginning in childhood. *Circulation*. 2003;107:1562–1566.
7. *Healthy People 2010*. 2nd ed. Washington, DC: US Dept of Health and Human Services; 2000.
8. Rose G. Strategy of prevention: lessons from cardiovascular disease. *Br Med J (Clin Res Ed)*. 1981;282:1847–1851.
9. Rose G. *The Strategy of Preventive Medicine*. Oxford, United Kingdom: Oxford University Press; 1992.
10. Stamler J, Stamler R, Neaton JD. Blood pressure, systolic and diastolic, and cardiovascular risks: US population data. *Arch Intern Med*. 1993; 153:598–615.
- 10a. Centers for Disease Control and Prevention (CDC). Application of lower sodium intake recommendations to adults—United States, 1999–2006. *MMWR Morb Mortal Wkly Rep*. 2009;58:281–283.
11. Stamler R. Implications of the INTERSALT study. *Hypertension*. 1991; 17(suppl):116–120.
12. Appel LJ, Brands MW, Daniels SR, Karanja N, Elmer PJ, Sacks FM. Dietary approaches to prevent and treat hypertension: a scientific

- statement from the American Heart Association. *Hypertension*. 2006;47:296–308.
13. Sargent RP, Shepard RM, Glantz SA. Reduced incidence of admissions for myocardial infarction associated with public smoking ban: before and after study. *BMJ*. 2004;328:977–980.
 14. Bartecchi C, Alsever RN, Nevin-Woods C, Thomas WM, Estacio RO, Bartelson BB, Krantz MJ. Reduction in the incidence of acute myocardial infarction associated with a citywide smoking ordinance. *Circulation*. 2006;114:1490–1496.
 15. Cesaroni G, Forastiere F, Agabiti N, Valente P, Zuccaro P, Perucci CA. Effect of the Italian smoking ban on population rates of acute coronary events. *Circulation*. 2008;117:1183–1188.
 16. Pell JP, Haw S, Cobbe S, Newby DE, Pell AC, Fischbacher C, McConachie A, Pringle S, Murdoch D, Dunn F, Oldroyd K, MacIntyre P, O'Rourke B, Borland W. Smoke-free legislation and hospitalizations for acute coronary syndrome. *N Engl J Med*. 2008;359:482–491.
 17. Glantz SA. Meta-analysis of the effects of smokefree laws on acute myocardial infarction: an update. *Prev Med*. 2008;47:452–453.
 18. Dinno A, Glantz S. Clean indoor air laws immediately reduce heart attacks. *Prev Med*. 2007;45:9–11.
 19. Khaw KT. Epidemiology of coronary heart disease in women. *Heart*. 2006;92(suppl III):iii2–iii4.
 20. Dowse GK, Gareebo H, Alberti KG, Zimmet P, Tuomilehto J, Purran A, Fareed D, Chitson P, Collins VR. Changes in population cholesterol concentrations and other cardiovascular risk factor levels after five years of the Non-communicable Disease Intervention Programme in Mauritius. *BMJ*. 1995;311:1255–1259.
 21. Uusitalo U, Feskens EJ, Tuomilehto J, Dowse GK, Haw U, Fareed D, Hemraj F, Gareebo H, Alberti KG, Zimmet P. Fall in total cholesterol concentration over five years in association with changes in fatty acid composition of cooking oil in Mauritius: cross sectional survey. *BMJ*. 1996;313:1044–1046.
 22. Puska P, Nissinen A, Tuomilehto JT, Koskela K, McAlister A, Kotke TE, Maccoby N, Farquhar JW. The community-based strategy to prevent coronary heart disease: conclusions from the ten years of the North Karelia Project. *Annu Rev Public Health*. 1985;6:147–193.
 23. Capewell S, Hayes DK, Ford ES, Critchley JA, Croft JB, Greenlund KJ, Labarthe DR. Life-years gained among US adults from modern treatments and changes in the prevalence of 6 coronary heart disease risk factors between 1980 and 2000. *Am J Epidemiol*. 2009;170:229–236.
 24. Cheng J, Zhao D, Zeng Z, Critchley JA, Liu J, Wang W, Sun J, Capewell S. The impact of demographic and risk factor changes on coronary heart disease deaths in Beijing, 1999–2010. *BMC Public Health*. 2009;9:30.
 25. Björck L, Rosengren A, Bennett K, Lappas G, Capewell S. Modelling the decreasing coronary heart disease mortality in Sweden between 1986 and 2002. *Eur Heart J*. 2009;30:1046–1056.
 26. Bennett K, Kabir Z, Unal B, Shelley E, Critchley J, Perry I, Feely J, Capewell S. Explaining the recent decrease in coronary heart disease mortality rates in Ireland, 1985–2000. *J Epidemiol Community Health*. 2006;60:322–327.
 27. Laatikainen T, Critchley J, Vartiainen E, Salomaa V, Ketonen M, Capewell S. Explaining the decline in coronary heart disease mortality in Finland between 1982 and 1997. *Am J Epidemiol*. 2005;162:764–773.
 28. Critchley J, Liu J, Zhao D, Wei W, Capewell S. Explaining the increase in coronary heart disease mortality in Beijing between 1984 and 1999. *Circulation*. 2004;110:1236–1244.
 29. Unal B, Critchley JA, Capewell S. Explaining the decline in coronary heart disease mortality in England and Wales between 1981 and 2000. *Circulation*. 2004;109:1101–1107.
 30. Unal B, Critchley JA, Fidan D, Capewell S. Life-years gained from modern cardiologic treatments and population risk factor changes in England and Wales, 1981–2000. *Am J Public Health*. 2005;95:103–108.
 31. Stampfer MJ, Hu FB, Manson JE, Rimm EB, Willett WC. Primary prevention of coronary heart disease in women through diet and lifestyle. *N Engl J Med*. 2000;343:16–22.
 32. Akesson A, Weismayer C, Newby PK, Wolk A. Combined effect of low-risk dietary and lifestyle behaviors in primary prevention of myocardial infarction in women. *Arch Intern Med*. 2007;167:2122–2127.
 33. Chiuve SE, McCullough ML, Sacks FM, Rimm EB. Healthy lifestyle factors in the primary prevention of coronary heart disease among men: benefits among users and nonusers of lipid-lowering and antihypertensive medications. *Circulation*. 2006;114:160–167.
 34. Chiuve SE, Rexrode KM, Spiegelman D, Logroscino G, Manson JE, Rimm EB. Primary prevention of stroke by healthy lifestyle. *Circulation*. 2008;118:947–954.
 35. Hu FB, Manson JE, Stampfer MJ, Colditz G, Liu S, Solomon CG, Willett WC. Diet, lifestyle, and the risk of type 2 diabetes mellitus in women. *N Engl J Med*. 2001;345:790–797.
 36. Mozaffarian D, Kamineni A, Carnethon M, Djoussé L, Mukamal KJ, Siscovick D. Lifestyle risk factors and new-onset diabetes mellitus in older adults: the Cardiovascular Health Study. *Arch Intern Med*. 2009;169:798–807.
 37. Knoops KT, de Groot LC, Kromhout D, Perrin AE, Moreiras-Varela O, Menotti A, van Staveren WA. Mediterranean diet, lifestyle factors, and 10-year mortality in elderly European men and women: the HALE project. *JAMA*. 2004;292:1433–1439.
 38. Vita AJ, Terry RB, Hubert HB, Fries JF. Aging, health risks, and cumulative disability. *N Engl J Med*. 1998;338:1035–1041.
 39. Stamler J, Stamler R, Neaton JD, Wentworth D, Daviglius ML, Garside D, Dyer AR, Liu K, Greenland P. Low risk-factor profile and long-term cardiovascular and noncardiovascular mortality and life expectancy: findings for 5 large cohorts of young adult and middle-aged men and women. *JAMA*. 1999;282:2012–2018.
 40. Daviglius ML, Stamler J, Pirzada A, Yan LL, Garside DB, Liu K, Wang R, Dyer AR, Lloyd-Jones DM, Greenland P. Favorable cardiovascular risk profile in young women and long-term risk of cardiovascular and all-cause mortality. *JAMA*. 2004;292:1588–1592.
 41. Lloyd-Jones DM, Dyer AR, Wang R, Daviglius ML, Greenland P. Risk factor burden in middle age and lifetime risks for cardiovascular and non-cardiovascular death (Chicago Heart Association Detection Project in Industry). *Am J Cardiol*. 2007;99:535–540.
 42. Hozawa A, Folsom AR, Sharrett AR, Chambless LE. Absolute and attributable risks of cardiovascular disease incidence in relation to optimal and borderline risk factors: comparison of African American with white subjects: Atherosclerosis Risk in Communities Study. *Arch Intern Med*. 2007;167:573–579.
 43. Terry DF, Pencina MJ, Vasan RS, Murabito JM, Wolf PA, Hayes MK, Levy D, D'Agostino RB, Benjamin EJ. Cardiovascular risk factors predictive for survival and morbidity-free survival in the oldest-old Framingham Heart Study participants. *J Am Geriatr Soc*. 2005;53:1944–1950.
 44. Lloyd-Jones DM, Leip EP, Larson MG, D'Agostino RB, Beiser A, Wilson PW, Wolf PA, Levy D. Prediction of lifetime risk for cardiovascular disease by risk factor burden at 50 years of age. *Circulation*. 2006;113:791–798.
 45. Daviglius ML, Liu K, Pirzada A, Yan LL, Garside DB, Feinglass J, Guralnik JM, Greenland P, Stamler J. Favorable cardiovascular risk profile in middle age and health-related quality of life in older age. *Arch Intern Med*. 2003;163:2460–2468.
 46. Daviglius ML, Liu K, Greenland P, Dyer AR, Garside DB, Manheim L, Lowe LP, Rodin M, Lubitz J, Stamler J. Benefit of a favorable cardiovascular risk-factor profile in middle age with respect to Medicare costs. *N Engl J Med*. 1998;339:1122–1129.
 47. Ford ES, Li C, Zhao G, Pearson WS, Capewell S. Trends in the prevalence of low risk factor burden for cardiovascular disease among United States adults. *Circulation*. 2009;120:1181–1188.
 48. Willcox BJ, He Q, Chen R, Yano K, Masaki KH, Grove JS, Donlon TA, Willcox DC, Curb JD. Midlife risk factors and healthy survival in men. *JAMA*. 2006;296:2343–2350.
 49. Strandberg A, Strandberg TE, Salomaa VV, Pitkälä K, Häppölä O, Miettinen TA. A follow-up study found that cardiovascular risk in middle age predicted mortality and quality of life in old age. *J Clin Epidemiol*. 2004;57:415–421.
 50. *The Health Consequences of Smoking: A Report of the Surgeon General*. Atlanta, Ga: US Dept of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2004.
 51. *Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults*. Bethesda, Md: National Heart, Lung, and Blood Institute; 1998.
 52. *2008 Physical Activity Guidelines for Americans*. Washington, DC: US Dept of Health and Human Services; 2008.
 53. US Department of Health and Human Services and US Department of Agriculture. *Dietary Guidelines for Americans, 2005*. 6th ed. Washington, DC: US Government Printing Office; 2005.
 54. Johnson RK, Appel LJ, Brands M, Howard BV, Lefevre M, Lustig RH, Sacks F, Steffen LM, Wylie-Rosett J; on behalf of the American Heart Association Nutrition Committee of the Council on Nutrition, Physical Activity, and Metabolism and the Council on Epidemiology and Prevention. Dietary sugars intake and cardiovascular health: a scientific

- statement from the American Heart Association. *Circulation*. 2009;120:1011–1020.
55. Lichtenstein AH, Appel LJ, Brands M, Carnethon M, Daniels S, Franch HA, Franklin B, Kris-Etherton P, Harris WS, Howard B, Karanja N, Lefevre M, Rudel L, Sacks F, Van Horn L, Winston M, Wylie-Rosett J. Diet and lifestyle recommendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee [published corrections appear in *Circulation*. 2006;114:e629 and 2006;114:e27]. *Circulation*. 2006;114:82–96.
 - 55a. Institute of Medicine. *Dietary Reference Intakes: Water, Potassium, Sodium, Chloride, and Sulfate*. Washington, DC: National Academies Press; 2004.
 56. Delahoy PJ, Magliano DJ, Webb K, Grobler M, Liew D. The relationship between reduction in low-density lipoprotein cholesterol by statins and reduction in risk of cardiovascular outcomes: an updated meta-analysis. *Clin Ther*. 2009;31:236–244.
 57. Kearney PM, Blackwell L, Collins R, Keech A, Simes J, Peto R, Armitage J, Baigent C; Cholesterol Treatment Trialists' (CTT) Collaborators. Efficacy of cholesterol-lowering therapy in 18,686 people with diabetes in 14 randomised trials of statins: a meta-analysis. *Lancet*. 2008;371:117–125.
 58. Cheng AY, Leiter LA. Implications of recent clinical trials for the National Cholesterol Education Program Adult Treatment Panel III guidelines. *Curr Opin Cardiol*. 2006;21:400–404.
 59. Baigent C, Keech A, Kearney PM, Blackwell L, Buck G, Pollicino C, Kirby A, Soufajina T, Peto R, Collins R, Simes R; Cholesterol Treatment Trialists' (CTT) Collaborators. Efficacy and safety of cholesterol-lowering treatment: prospective meta-analysis of data from 90,056 participants in 14 randomised trials of statins. *Lancet*. 2005;366:1267–1278.
 60. Gueyffier F, Boutitie F, Boissel JP, Pocock S, Coope J, Cutler J, Ekblom T, Fagard R, Friedman L, Perry M, Prineas R, Schron E. Effect of antihypertensive drug treatment on cardiovascular outcomes in women and men: a meta-analysis of individual patient data from randomized, controlled trials: the INDANA Investigators. *Ann Intern Med*. 1997;126:761–767.
 61. Psaty BM, Lumley T, Furberg CD, Schellenbaum G, Pahor M, Alderman MH, Weiss NS. Health outcomes associated with various antihypertensive therapies used as first-line agents: a network meta-analysis. *JAMA*. 2003;289:2534–2544.
 62. Psaty BM, Smith NL, Siscovick DS, Koepsell TD, Weiss NS, Heckbert SR, Lemaitre RN, Wagner EH, Furberg CD. Health outcomes associated with antihypertensive therapies used as first-line agents: a systematic review and meta-analysis. *JAMA*. 1997;277:739–745.
 63. Staessen JA, Gasowski J, Wang JG, Thijs L, Den Hond E, Boissel JP, Coope J, Ekblom T, Gueyffier F, Liu L, Kerlikowske K, Pocock S, Fagard RH. Risks of untreated and treated isolated systolic hypertension in the elderly: meta-analysis of outcome trials [published correction appears in *Lancet*. 2001;357:724]. *Lancet*. 2000;355:865–872.
 64. National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. *Circulation*. 2002;106:3143–3421.
 65. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, Jones DW, Materson BJ, Oparil S, Wright JT Jr, Roccella EJ; National Heart, Lung, and Blood Institute Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; National High Blood Pressure Education Program Coordinating Committee. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report [published correction appears in *JAMA*. 2003;290:197]. *JAMA*. 2003;289:2560–2572.
 66. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care*. 2007;30(suppl 1):S42–S47.
 67. Li S, Chen W, Srinivasan SR, Bond MG, Tang R, Urbina EM, Berenson GS. Childhood cardiovascular risk factors and carotid vascular changes in adulthood: the Bogalusa Heart Study [published correction appears in *JAMA*. 2003;290:2943]. *JAMA*. 2003;290:2271–2276.
 68. Loria CM, Liu K, Lewis CE, Hulley SB, Sidney S, Schreiner PJ, Williams OD, Bild DE, Detrano R. Early adult risk factor levels and subsequent coronary artery calcification: the CARDIA Study. *J Am Coll Cardiol*. 2007;49:2013–2020.
 69. Urbina EM, Srinivasan SR, Tang R, Bond MG, Kieltyka L, Berenson GS; Bogalusa Heart Study. Impact of multiple coronary risk factors on the intima-media thickness of different segments of carotid artery in healthy young adults (the Bogalusa Heart Study). *Am J Cardiol*. 2002;90:953–958.
 70. Raitakari OT, Juonala M, Kähönen M, Taittonen L, Laitinen T, Mäki-Torkko N, Järvisalo MJ, Uusitalo U, Jökinen E, Rönkä M, Akerblom HK, Viikari JS. Cardiovascular risk factors in childhood and carotid artery intima-media thickness in adulthood: the Cardiovascular Risk in Young Finns Study. *JAMA*. 2003;290:2277–2283.
 71. Olshansky SJ, Passaro DJ, Hershow RC, Layden J, Carnes BA, Brody J, Hayflick L, Butler RN, Allison DB, Ludwig DS. A potential decline in life expectancy in the United States in the 21st century. *N Engl J Med*. 2005;352:1138–1145.
 72. Freedman DS, Shear CL, Srinivasan SR, Webb LS, Berenson GS. Tracking of serum lipids and lipoproteins in children over an 8-year period: the Bogalusa Heart Study. *Prev Med*. 1985;14:203–216.
 73. Berenson GS, Srinivasan SR, Bao W, Newman WP III, Tracy RE, Wattigney WA. Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults: the Bogalusa Heart Study. *N Engl J Med*. 1998;338:1650–1656.
 74. American Academy of Pediatrics. National Cholesterol Education Program: report of the Expert Panel on Blood Cholesterol Levels in Children and Adolescents. *Pediatrics*. 1992;89:525–584.
 75. National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Pediatrics*. 2004;114(suppl):555–576.
 76. Centers for Disease Control and Prevention. Health-related quality of life: methods and measures: measuring healthy days. Available at: <http://www.cdc.gov/hrqol>. Accessed May 28, 2009.
 77. Ford ES, Mokdad AH, Li C, McGuire LC, Strine TW, Okoro CA, Brown DW, Zack MM. Gender differences in coronary heart disease and health-related quality of life: findings from 10 States from the 2004 Behavioral Risk Factor Surveillance System. *J Womens Health (Larchmt)*. 2008;17:757–768.
 78. Zahran HS, Kobayashi R, Moriarty DG, Zack MM, Holt J, Donehoo R; Centers for Disease Control and Prevention (CDC). Health-related quality of life surveillance: United States, 1993–2002. *MMWR Surveill Summ*. 2005;54:1–35.
 79. Strine TW, Greenlund KJ, Brown DW, Mokdad A, Balluz L. Characteristics of people aged 45 years or older with heart disease by frequent mental distress status, 2001. *Prev Med*. 2004;39:191–196.
 80. Alonso J, Ferrer M, Gandek B, Ware JE, Aaronson NK, Mosconi P, Rasmussen NK, Bullinger M, Fukuhara S, Kaasa S, Lepplè A; IQOLA Project Group. Health-related quality of life associated with chronic conditions in eight countries: results from the International Quality of Life Assessment (IQOLA) Project. *Qual Life Res*. 2004;13:283–298.
 81. Oldridge NB, Stump TE, Nothwehr FK, Clark DO. Prevalence and outcomes of comorbid metabolic and cardiovascular conditions in middle- and older-age adults. *J Clin Epidemiol*. 2001;54:928–934.
 82. Alonso J, Permyer-Miralda G, Cascan P, Brotons C, Prieto L, Soler-Soler J. Measuring functional status of chronic coronary patients: reliability, validity and responsiveness to clinical change of the reduced version of the Duke Activity Status Index (DASI). *Eur Heart J*. 1997;18:414–419.
 83. Almborg AH, Berg S. Quality of life among Swedish patients after stroke: psychometric evaluation of SF-36. *J Rehabil Med*. 2009;41:48–53.
 84. Patrick DL, Kinne S, Engelberg RA, Pearlman RA. Functional status and perceived quality of life in adults with and without chronic conditions. *J Clin Epidemiol*. 2000;53:779–785.
 85. Hayes DK, Denny CH, Keenan NL, Croft JB, Greenlund KJ. Health-related quality of life and hypertension status, awareness, treatment, and control: National Health and Nutrition Examination Survey, 2001–2004. *J Hypertens*. 2008;26:641–647.
 86. Cook EL, Harman JS. A comparison of health-related quality of life for individuals with mental health disorders and common chronic medical conditions. *Public Health Rep*. 2008;123:45–51.
 87. Brown DW, Brown DR, Heath GW, Moriarty DG, Balluz L, Giles WH. Relationships between engaging in recommended levels of physical activity and health-related quality of life among hypertensive adults. *J Phys Act Health*. 2006;3:137–147.
 88. Li C, Ford ES, Mokdad AH, Balluz L, Brown DW, Giles WH. Clustering of cardiovascular disease risk factors and health-related quality of life among US adults. *Value Health*. 2008;11:689–699.
 89. Ford ES, Li C. Metabolic syndrome and health-related quality of life among U.S. adults. *Ann Epidemiol*. 2008;18:165–171.

90. Sach TH, Barton GR, Doherty M, Muir KR, Jenkinson C, Avery AJ. The relationship between body mass index and health-related quality of life: comparing the EQ-5D, EuroQol VAS and SF-6D. *Int J Obes (Lond)*. 2007;31:189–196.
91. Bize R, Johnson JA, Plotnikoff RC. Physical activity level and health-related quality of life in the general adult population: a systematic review. *Prev Med*. 2007;45:401–415.
92. Li C, Ford ES, Mokdad A, Jiles R, Giles WH. Clustering of multiple healthy lifestyle habits and health-related quality of life among U.S. adults with diabetes. *Diabetes Care*. 2007;30:1770–1776.
93. Zahran HS, Zack MM, Vernon-Smile ME, Hertz MF. Health-related quality of life and behaviors risky to health among adults aged 18–24 years in secondary or higher education: United States, 2003–2005. *J Adolesc Health*. 2007;41:389–397.
94. Bish CL, Michels Blanck H, Maynard LM, Serdula MK, Thompson NJ, Kettel Khan L. Health-related quality of life and weight loss among overweight and obese U.S. adults, 2001 to 2002. *Obesity (Silver Spring)*. 2006;14:2042–2053.
95. Mody RR, Smith MJ. Smoking status and health-related quality of life: findings from the 2001 Behavioral Risk Factor Surveillance System data. *Am J Health Promot*. 2006;20:251–258.
96. Strine TW, Okoro CA, Chapman DP, Balluz LS, Ford ES, Ajani UA, Mokdad AH. Health-related quality of life and health risk behaviors among smokers. *Am J Prev Med*. 2005;28:182–187.
97. Brown DW, Brown DR, Heath GW, Balluz L, Giles WH, Ford ES, Mokdad AH. Associations between physical activity dose and health-related quality of life. *Med Sci Sports Exerc*. 2004;36:890–896.
98. Brown DW, Balluz LS, Giles WH, Beckles GL, Moriarty DG, Ford ES, Mokdad AH. Diabetes mellitus and health-related quality of life among older adults: findings from the Behavioral Risk Factor Surveillance System (BRFSS). *Diabetes Res Clin Pract*. 2004;65:105–115.
99. Daviglus ML, Liu K, Yan LL, Pirezada A, Garside DB, Schiffer L, Dyer AR, Greenland P, Stamler J. Body mass index in middle age and health-related quality of life in older age: the Chicago Heart Association Detection Project in Industry Study. *Arch Intern Med*. 2003;163:2448–2455.
100. Hassan MK, Joshi AV, Madhavan SS, Amonkar MM. Obesity and health-related quality of life: a cross-sectional analysis of the US population. *Int J Obes Relat Metab Disord*. 2003;27:1227–1232.
101. Heo M, Allison DB, Faith MS, Zhu SK, Fontaine KR. Obesity and quality of life: mediating effects of pain and comorbidities. *Obes Res*. 2003;11:209–216.
102. Brown DW, Balluz LS, Heath GW, Moriarty DH, Ford ES, Giles WH, Mokdad AH. Associations between recommended levels of physical activity and health-related quality of life: findings from the 2001 Behavioral Risk Factor Surveillance System (BRFSS) survey. *Prev Med*. 2003;37:520–528.
103. Katz DA, McHorney CA, Atkinson RL. Impact of obesity on health-related quality of life in patients with chronic illness. *J Gen Intern Med*. 2000;15:789–796.
104. Xie J, Wu EQ, Zheng ZJ, Sullivan PW, Zhan L, Labarthe DR. Patient-reported health status in coronary heart disease in the United States: age, sex, racial, and ethnic differences. *Circulation*. 2008;118:491–497.
105. Skarupski KA, Mendes de Leon CF, Bienias JL, Scherr PA, Zack MM, Moriarty DG, Evans DA. Black-white differences in health-related quality of life among older adults. *Qual Life Res*. 2007;16:287–296.
106. Goins RT, John R, Hennessy CH, Denny CH, Buchwald D. Determinants of health-related quality of life among older American Indians and Alaska Natives. *J Appl Gerontol*. 2006;25(suppl):73S–88S.
107. Mensah GA, Mokdad AH, Ford ES, Greenlund KJ, Croft JB. State of disparities in cardiovascular health in the United States. *Circulation*. 2005;111:1233–1241.
108. Liao Y, McGee DL, Cao G, Cooper RS. Black-white differences in disability and morbidity in the last years of life. *Am J Epidemiol*. 1999;149:1097–1103.
109. Liao Y, McGee DL, Kaufman JS, Cao G, Cooper RS. Socioeconomic status and morbidity in the last years of life. *Am J Public Health*. 1999;89:569–572.
110. Roux L, Pratt M, Tengs TO, Yore MM, Yanagawa TL, Van Den Bos J, Rutt C, Brownson RC, Powell KE, Heath G, Kohl HW III, Teutsch S, Cawley J, Lee IM, West L, Buchner DM. Cost effectiveness of community-based physical activity interventions. *Am J Prev Med*. 2008;35:578–588.
111. Berra K. The effect of lifestyle interventions on quality of life and patient satisfaction with health and health care. *J Cardiovasc Nurs*. 2003;18:319–325.
112. Kahn R, Robertson RM, Smith R, Eddy D. The impact of prevention on reducing the burden of cardiovascular disease. *Circulation*. 2008;118:576–585.
113. Jia H, Muennig P, Lubetkin EI, Gold MR. Predicting geographical variations in behavioral risk factors: an analysis of physical and mental healthy days. *J Epidemiol Community Health*. 2004;58:150–155.
114. Andresen EM, Catlin K, Wyrwich KW, Jackson-Thompson J. Retest reliability of surveillance questions on health related quality of life. *J Epidemiol Community Health*. 2003;57:339–343.
115. Dominick KL, Ahern FM, Gold CH, Heller DA. Relationship of health-related quality of life to health care utilization and mortality among older adults. *Aging Clin Exp Res*. 2002;14:499–508.
116. Dominick KL, Ahern FM, Gold CH, Heller DA. Health-related quality of life among older adults with activity-limiting health conditions. *J Ment Health Aging*. 2003;9:43–53.
117. Campbell VA, Crews JE, Moriarty DG, Zack MM, Blackman DK. Surveillance for sensory impairment, activity limitation, and health-related quality of life among older adults: United States, 1993–1997. *MMWR CDC Surveill Summ*. 1999;48:131–156.
118. Jia H, Lubetkin EI. Estimating EuroQol EQ-5D scores from Population Healthy Days data. *Med Decis Making*. 2008;28:491–499.
119. Jia H, Lubetkin EI, Moriarty DG, Zack MM. A comparison of Healthy Days and EuroQol EQ-5D measures in two US adult samples. *Appl Res Qual Life*. 2007;2:209–221.
120. Zullig KJ, Valois RF, Huebner ES, Drane JW. Evaluating the performance of the Centers for Disease Control and Prevention core Health-Related Quality of Life scale with adolescents. *Public Health Rep*. 2004;119:577–584.
121. CDC; Council of State; Association of State and Territorial Chronic Disease Program Directors. Indicators for chronic disease surveillance. *MMWR Recomm Rep*. 2004;53(RR-11):1–6.
122. Committee on the State of the USA Health Indicators, Institute of Medicine. *State of the USA Health Indicators: Letter Report*. Washington, DC: Institute of Medicine; 2009.
123. Goff DC Jr, Brass L, Braun LT, Croft JB, Flesch JD, Fowkes FG, Hong Y, Howard V, Huston S, Jencks SF, Luepker R, Manolio T, O'Donnell C, Robertson RM, Rosamond W, Rumsfeld J, Sidney S, Zheng ZJ. Essential features of a surveillance system to support the prevention and management of heart disease and stroke: a scientific statement from the American Heart Association Councils on Epidemiology and Prevention, Stroke, and Cardiovascular Nursing and the Interdisciplinary Working Groups on Quality of Care and Outcomes Research and Atherosclerotic Peripheral Vascular Disease. *Circulation*. 2007;115:127–155.
124. Lloyd-Jones DM, Martin DO, Larson MG, Levy D. Accuracy of death certificates for coding coronary heart disease as the cause of death. *Ann Intern Med*. 1998;129:1020–1026.
125. Myerson M, Coady S, Taylor H, Rosamond WD, Goff DC Jr; ARIC Investigators. Declining severity of myocardial infarction from 1987 to 2002: the Atherosclerosis Risk in Communities (ARIC) Study. *Circulation*. 2009;119:503–514.
126. Jacobs DR Jr, Kroenke C, Crow R, Deshpande M, Gu DF, Gatewood L, Blackburn H. PREDICT: a simple risk score for clinical severity and long-term prognosis after hospitalization for acute myocardial infarction or unstable angina: the Minnesota Heart Survey. *Circulation*. 1999;100:599–607.
127. Nichol G, Thomas E, Callaway CW, Hedges J, Powell JL, Aufderheide TP, Rea T, Lowe R, Brown T, Dreyer J, Davis D, Idris A, Stiell I; Resuscitation Outcomes Consortium Investigators. Regional variation in out-of-hospital cardiac arrest incidence and outcome. *JAMA*. 2008;300:1423–1431.
128. Nichol G, Rumsfeld J, Eigel B, Abella BS, Labarthe D, Hong Y, O'Connor RE, Mosesso VN, Berg RA, Leeper BB, Weisfeldt ML. Essential features of designating out-of-hospital cardiac arrest as a reportable event: a scientific statement from the American Heart Association Emergency Cardiovascular Care Committee; Council on Cardiopulmonary, Perioperative, and Critical Care; Council on Cardiovascular Nursing; Council on Clinical Cardiology; and Quality of Care and Outcomes Research Interdisciplinary Working Group. *Circulation*. 2008;117:2299–2308.
129. Hunt EA, Mancini ME, Smyth M, Truitt TL; NRCPR Investigators. Using the American Heart Association's National Registry of Cardiopulmonary Resuscitation for performance improvement. *Jt Comm J Qual Patient Saf*. 2009;35:13–20.
130. Nichol G, Stiell IG, Hebert P, Wells GA, Vandemheen K, Laupacis A. What is the quality of life for survivors of cardiac arrest? A prospective study. *Acad Emerg Med*. 1999;6:95–102.