

30,000 Fewer Heart Attacks and Strokes in North Carolina: A Challenge to Prioritize Prevention

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Heart disease and stroke are leading causes of death in North Carolina and are also important contributors to poor health and excess health care expenditures. The risk factors for heart disease, stroke, and other forms of cardiovascular disease are well known, and include smoking, high blood pressure, elevated serum cholesterol levels, diabetes mellitus, and obesity. These risk factors persist as a result of sub-optimal assessment, treatment, and control; adverse trends in health behaviors; and environmental and societal conditions negatively affecting the pursuit of optimal cardiovascular health. If North Carolina is to do its share in making it possible for the national Million Hearts initiative to meet its goals, then 30,000 heart attacks and strokes need to be prevented in the state over the next 5 years. Both the Million Hearts initiative and North Carolina's Justus-Warren Heart Disease and Stroke Prevention Task Force Plan include specific recommendations aimed at the primary and secondary prevention of heart disease and stroke. Million Hearts focuses on the ABCS: aspirin use when appropriate, blood pressure control, cholesterol control, and smoking cessation or abstinence. The task force plan also addresses physical inactivity, poor nutrition, and the control of obesity and diabetes. The commentaries published in this issue of the NCMJ address the challenge of cardiovascular disease prevention among children and adults across the state and highlight efforts to enhance prevention via public policies and legislation, community coalitions, and quality improvement in the clinical arena.

This issue of the NCMJ highlights heart disease and stroke and challenges us to improve the prevention of these disorders in North Carolina. In 2011, a coalition of federal, state, and local government agencies launched a national campaign to prevent 1 million heart attacks and strokes over the next 5 years, which would represent a 10% reduction each year from the 2 million cases per year now occurring in the United States [1]. If North Carolina is to do its fair share in accomplishing the goal of the Million Hearts initiative, there will have to be 30,000 fewer heart attacks and strokes among the state's residents over the next 5 years. Census figures for 2010 show that nearly 3.1%

of the US population lives in North Carolina [2]; thus the state must prevent approximately 6,000 of the 200,000 heart attacks and strokes that must be prevented annually in order for the nation to meet the ambitious Million Hearts goal. Because the state has a population of approximately 10 million, 30,000 may not seem like a very large number of heart attacks and strokes to prevent. However, this is 1 fewer persons among every 333 residents having a heart attack or stroke. North Carolina's role in the Million Hearts initiative is discussed in this issue by Simpson and Massing [3].

If successful, the Million Hearts initiative will also likely reduce the incidence of other forms of heart disease including heart failure and peripheral vascular disease, as well as the number of persons requiring vascular interventions. This is, in part, because survivors of acute coronary heart disease and stroke events are at increased risk for other forms of cardiovascular disease (CVD). Finally, Million Hearts may have a substantial impact on the economic cost of CVD; the direct medical cost of CVD nationally in 2010 was estimated to be \$270 billion [4]. Reducing heart attacks and strokes is likely to have a positive impact on health costs in North Carolina, as well.

Million Hearts will likely reduce CVD deaths. In North Carolina, heart disease and stroke are the second and fourth leading causes of death, respectively, and all CVD is a major cause of premature death and years of potential life lost [5]. North Carolina is an average state with regard to heart disease mortality. For 2007-2009, the state death rate from heart disease was 184.8 per 100,000 population, and the national rate was 185.2 per 100,000 population [6]. However, North Carolina is part of the stroke belt, a large area of the country with excess stroke. The state death rate from stroke for 2007-2009 was 49.1/100,000, which substantially exceeded the national rate of 40.5/100,000 during that time period [7]. There are striking racial/ethnic

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and geographic differences in the burden of CVD in North Carolina. In general, African Americans have a higher burden of both heart disease and stroke than do whites. This contributes to some of the differences observed geographically across the state (Figure 1).

For all cardiovascular diseases (including stroke) and stroke specifically, hospitalizations and mortality are greater in Eastern North Carolina than in the rest of the state and are greater in rural counties than in the more populous and urban counties including Mecklenburg, Wake, Guilford, and Forsyth. Some of the counties with higher mortality rates—particularly in the eastern part of the state—have a higher proportion of the population that is nonwhite. However, the excess CVD death rates seen are not simply attributable to higher CVD rates among minorities. Whites residing in Eastern North Carolina have a greater burden of CVD than do whites in the central part of the state, and there is also a higher burden of CVD in the western mountain counties. Finally, there are striking differences in death rates by county: They range from 277.3 per 100,000 in the county with the lowest heart disease mortality rate (Forsyth) to 712.6 per 100,000 in the county with the highest mortality rate (Washington) [8].

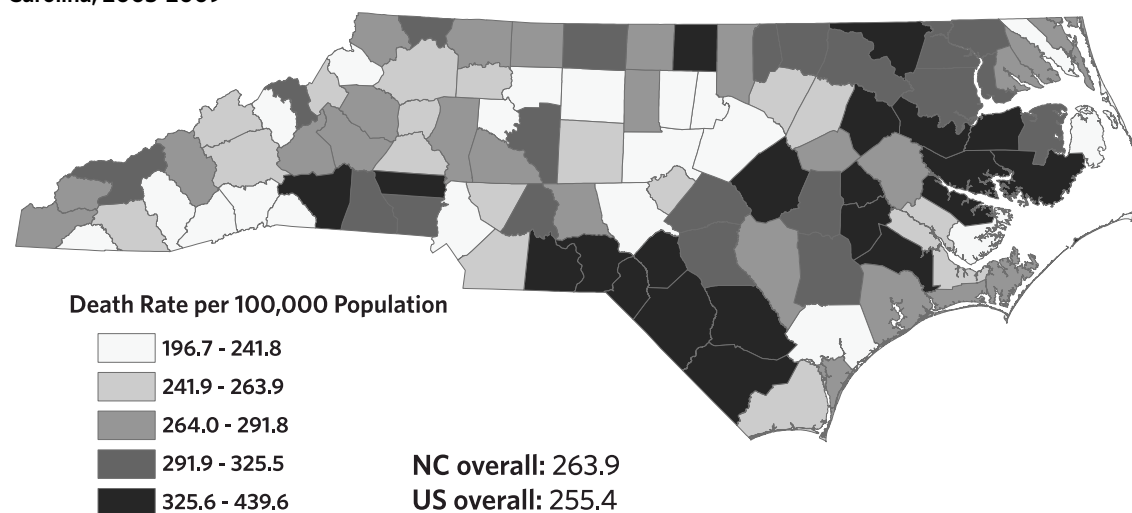
Sharp increases in heart attack and stroke rates in the mid-20th century led to research that contributed to an understanding of the underlying risk factors for heart disease. By the mid-1960s, it was established that elevated blood pressure and cholesterol levels were important contributors, along with older age [9]. Additional major risk factors include tobacco smoking, family history of CVD, and diabetes [10]. These factors contribute to the development

of atherosclerosis, the underlying biological substrate for most heart disease [11]. These conditions are largely the same factors predisposing towards cerebrovascular disease. An important additional risk factor for stroke is atrial fibrillation [12]. Obesity, physical inactivity, and poor dietary patterns are also associated with risk of heart disease and stroke. The extent to which lifestyle factors and obesity contribute independently to CVD risk is subject to ongoing debate, because these factors also influence blood pressure, diabetes, and dyslipidemia. Disability also greatly affects risk for CVD and CVD risk factors as Herrick and Luken discuss in their commentary. In fact, the prevalence of CVD among adults with disabilities is 3 times that of non-disabled adults, and disabled adults are twice as likely to have 3 or more CVD risk factors [13].

There have been major advances in the treatment of heart disease and stroke, and in the ability to control the underlying risk factors. It is very likely that advances in treatment and prevention led to the significant reduction in heart disease mortality seen since the 1960s [14]. Indeed, it has been estimated that roughly half of the recent reduction may be attributed to changes in risk factors (eg, reductions in tobacco use, reductions in cholesterol consumption, and increases in physical activity levels) and half to evidence-based medical therapies for events (eg, coronary care units, revascularization) and for management of risk factors (eg, effective drugs for controlling blood pressure and cholesterol levels) [15].

It is sobering, however, that despite progress, there remain many adults (and an increasing number of children) with inadequate control of risk factors. For example, recent

FIGURE 1.
Age-Adjusted Cardiovascular Disease Death Rates per 100,000 Population by County of Residence in North Carolina, 2005-2009



Note. Death rates are age-adjusted to the US standard population in 2000. Cardiovascular disease deaths are those attributed to ICD-10 codes 100-199, Q20-Q28.

Data source. Centers for Disease Control and Prevention, National Center for Health Statistics. Compressed Mortality File, 1999-2009. CDC WONDER online database. <http://wonder.cdc.gov/mortSQL.html>. Accessed October 26, 2012.

national statistics (2009-2010) showed that the prevalence of hypertension was 30.5% among men and 28.5% among women [16]. A 2012 study of US adults using 1999-2010 data found that awareness of one's own hypertension overall was 74.0%, and 71.6% of people with hypertension were being treated. Among those being treated, blood pressures were controlled ($< 140/90$ mm Hg) in 64.4% [16]. However, when those who were untreated or were unaware that they had hypertension were included, blood pressures were controlled in only 46.5% [16]. State-specific estimates are more difficult to ascertain. However, evidence of suboptimal control of blood pressure was found in patients seen between June 1, 2001 and May 31, 2003 at a sample of 60 primary care practices in North Carolina [17]. Similar patterns of inadequate awareness, treatment, and control are seen for hypercholesterolemia [18, 19].

In 2008, using data from NHANES from 1998-2004 and mathematical modeling using the results from clinical trial-supported interventions, Kahn and colleagues [20] estimated that 78% of adults aged 20-80 years in the United States were candidates for at least 1 prevention activity. If everyone received the activities for which they are eligible, heart attacks and strokes would be reduced by 63% and 31%, respectively [20]. When diet, physical activity, and excess weight are included in addition to the traditional risk factors, only 2% of adults in the United States display all of the following characteristics of optimal cardiovascular health: They do not smoke, are physically active, have normal blood pressure, have normal levels of blood glucose and total cholesterol, are of normal weight, and eat a healthy diet [21].

With respect to how best to prevent CVD in North Carolina, in 2005 the Justus-Warren Heart Disease and Stroke Prevention Task Force published a plan for 2005-2010 with a broad array of goals and recommendations to address CVD prevention in the state [22]. Additional information regarding the task force is available in the article by Holmes and Puckett [23], and an updated task force plan is in press. Importantly, the plan notes that a lot of CVD (as well as non-CVD) morbidity and mortality can be prevented by addressing 3 problematic health behaviors—physical inactivity, poor nutrition, and tobacco use. These behaviors contribute directly to several risk factors for heart disease and stroke. Improvements in the management of high blood pressure and elevated serum cholesterol levels will likely prevent CVD, while managing overweight or obesity will help to control blood pressure and lipid levels and to prevent diabetes. As will be discussed further below, there is uncertainty as to how best to manage glucose levels in order to maximally prevent CVD among those with diabetes; however, blood pressure and lipid control are beneficial.

Finally, the 2005-2010 task force plan and the update highlight the need to improve awareness of the symptoms of heart attack and stroke, the need for immediate treatment of heart attack and stroke, and the improvement of secondary prevention efforts by promoting high-quality care that

is consistent with established guidelines for acute coronary and cerebrovascular disease. Articles in this issue highlight quality improvement and access to care initiatives in regard to stroke and heart attack. Rosamund and colleagues discuss the North Carolina Stroke Care Collaborative, and its successes and challenges in improving quality of care for stroke in the state [24]. In their commentary, Cykert and colleagues discuss how the North Carolina Division of Public Health and the Area Health Education Centers Program are assisting practices to improve clinical preventive strategies such as these to reduce the burden of heart attack and stroke in North Carolina [25]. Halladay and Hinderliter discuss another quality improvement initiative—a course to train clinical office staff on how to accurately measure blood pressure [26].

Many of the factors cited in the task force plan are consistent with the more recent Million Hearts initiative, which is based on the premise that enhanced CVD prevention needs to be undertaken both in the clinical and community settings. Emphasis is placed on appropriate aspirin use, blood pressure control, cholesterol management, and smoking cessation as targets for enhanced clinical prevention. In addition to clinical strategies, the plan and the initiative call for complementary community-based prevention efforts focused on reducing smoking rates and exposure to second-hand smoke, and improving nutrition (reducing the intake of salt and trans fats). Excess dietary sodium contributes substantially to hypertension, and trans fats contribute to hyperlipidemia [27, 28].

A major difference between the Million Hearts initiative and the task force plan is the task force's inclusion of diabetes, which in 2009 affected approximately 9.5% of adults in North Carolina [29]. The close relationship between diabetes (especially type 2) and CVD has long been recognized [30]. The biochemical hallmarks of diabetes (hyperglycemia, increased levels of free fatty acids, and insulin resistance) contribute to the formation of atherosclerosis [31]. CVD complications may be reduced or delayed by intensive management of glycated hemoglobin A1c levels, blood pressure, and lipid levels [30]. Unfortunately, risk factor control among all US adults with diabetes is suboptimal [33, 34]. In the Action to Control Cardiovascular Risk in Diabetes (ACCORD) trial, the glycemic control portion of the study was halted after 3.5 years of follow-up, because the intensive-therapy group—which had achieved a stable median HbA1c level of 6.4% after 1 year, versus 7.5% for the standard-therapy group—had a higher rate of death from any cause than did the standard-therapy group (5.0% vs. 4.0%, hazard ratio 1.22; 95% CI, 1.01-1.46; $P = 0.04$) [35]. Intensive therapy was not associated with a decreased risk of the primary outcome, which was a combination of nonfatal myocardial infarction, nonfatal stroke, or death from cardiovascular causes (hazard ratio 0.90; 95% CI, 0.78-1.04; $P = 0.16$). Taken together, the results of the ACCORD trial, the Veterans Affairs Diabetes Trial, and the Action in Diabetes

and Vascular Disease—Preterax and Diamicron Modified Release Controlled Evaluation (ADVANCE) trial do not provide strong support for normalization of HbA1c levels by means of currently available pharmacologic therapies [36].

Perhaps the best way to prevent CVD among persons with diabetes is to prevent diabetes. In the Diabetes Prevention Program, in adults at high risk for diabetes, lifestyle modifications (losing at least 7% of body weight and engaging in physical activity for at least 150 minutes per week) were shown to reduce the incidence of diabetes by 58% compared with placebo, and metformin use was associated with a 31% reduction in the incidence of diabetes compared with placebo [37]. Recent research has demonstrated that approaches that translate the Diabetes Prevention Program intervention into community-based programs are effective and can be delivered at lower cost [38].

The article by O'Connell and Vetter in this issue discussing the role of nutrition, exercise, and tobacco cessation in prevention [39] leaves little doubt that behaviors that influence risk factors and heart disease and stroke incidence can be changed. There is strong evidence from randomized trials that interventions with 1 or more of the following components reduce blood pressure levels: reduction of dietary sodium, potassium supplementation, weight loss, moderation of alcohol consumption, participation in regular physical activity, and adoption of the Dietary Approaches to Stop Hypertension (DASH) and similar dietary patterns [27, 40]. Briefly, DASH entails increased consumption of fruits and vegetables (4-5 servings of each per day), low-fat dairy products, legumes, and other lean sources of protein, along with a reduction in consumption of saturated fats and of sweetened foods and beverages [41].

Cigarette smoking has long been recognized as a risk factor for cardiovascular diseases including heart disease and stroke, and smoking cessation leads to rapid reductions in risk. The excess risk of a heart attack goes down by about 50% in former smokers within a year of cessation; however, residual risk persists for many years [42]. Approximately 22% of all adults in North Carolina still smoke tobacco [43]. Increases in tobacco excise taxes have been particularly effective in reducing initiation of smoking among minors and in promoting cessation among all smokers [44]. Further increases in the tobacco excise tax in North Carolina would likely lead to substantial reductions in CVD.

In recent years, the benefits of eliminating exposure to secondhand smoke have been assessed [45]. A meta-analysis supports the conclusion that heart attack rates in the community may decrease by 17% within a year of implementing a work site smoking ban [46], resulting in tremendous public health benefits and health care cost savings. This evidence supported the implementation of a partial ban in North Carolina in 2010, affecting all restaurants and bars. A report to the state health director in late 2011 confirmed that the population of North Carolina experienced a benefit at least as great as that predicted by the meta-analysis [47].

Extending this benefit to all workers in all work sites in North Carolina may lead to further reductions in heart attack rates.

Resources available in communities have also been shown to affect CVD risk factors. Geographic areas with a relative paucity of stores with healthier foods for purchase have been labeled *food deserts* [48]. It has been shown nationally, and in at least 1 community in North Carolina, that minority residents are more likely to live in food deserts [48, 49]. A study that included residents of Forsyth County demonstrated that residence in neighborhoods with fewer resources for physical activity and fewer stores with healthy foods was associated with a greater incidence of diabetes [50]. A recent study confirmed that residents of areas with a shortage of primary care health professionals had a higher prevalence of CVD risk factors [51], although the analyses did not suggest that control of CVD risk factors was better among participants who lived in areas without a shortage of primary care providers; the greater prevalence of risk factors appeared to be attributable to the demographic and socioeconomic characteristics of the residents.

Combating heart disease and stroke in North Carolina has been viewed as a public health and medical challenge for the past century. In order to realize enhanced prevention of CVD, there is still a role to be played by improvements in the quality of medical care delivered in the hospital setting following acute events. Piper and Malfitano review the journey of Onslow Memorial Hospital, a rural hospital in Southeastern North Carolina, from its decision to focus on improving stroke care in 2006 to its certification by the Joint Commission as an Advanced Primary Stroke Center in 2012 [52]. And Tegeler describes the use of enhanced communication technologies to increase access to acute stroke services through the telestroke initiative, which is playing an important role in reducing the burden of cerebrovascular disease throughout North Carolina [53].

However, a model based on the efficacy of strategies for prevention and treatment as well as the prevalence of risk factors and disease among US adults found that ideal primary prevention (prevention before any event has taken place) would prevent or postpone 33% of all CVD deaths; secondary prevention (prevention between acute events) would prevent or postpone 22% of all such deaths; and ideal care during an acute event would prevent or postpone 8% of all such deaths [54]. This suggests that improvement of prevention in the ambulatory medical setting should be strongly emphasized. The American College of Cardiology Foundation and the American Heart Association (AHA) have collaborated to promulgate recommendations and performance metrics to be applied to enhance primary [55] and secondary prevention [56].

Recently, the American Heart Association has collaborated with the American Cancer Society and the American Diabetes Association to implement the Guideline Advantage program, which focuses on clinical prevention of heart disease, cancer, stroke, and diabetes in outpatient primary care

settings [54]. The program uses data collected through electronic health records or other platforms to support the use of evidence-based guidelines for prevention and disease management. In her sidebar, Schwartz discusses how early quality-improvement efforts, coupled with electronic medical record use, have helped Roanoke Chowan Community Health Center deliver high-quality care that also meets Meaningful Use standards [58].

Increasingly, it is recognized at the national and state levels that any successful public health intervention must involve individuals taking a more active role in managing their own health and in taking responsibility for promoting healthier communities and neighborhoods. This approach is made possible when community leaders, policymakers, businesses, work sites, and community groups including faith-based, fraternal, and social organizations, take a more active role in promoting health at the individual and community levels. Several community-based approaches are discussed in this issue, including the West and colleagues article on the Cabarrus Health Alliance's faith-based Healthy Lives, Healthy Futures program, which trains volunteers to lead exercise classes at their respective churches [59], and the article by Ransdell and colleagues discussing the Eastern North Carolina Stroke Network, which has 400 members in 30 North Carolina counties collaborating to promote the implementation of stroke best practices in the eastern part of the state [60]. Page et al discuss Project DIRECT Legacy for Men—Hyde County, which addresses hypertension and diabetes among African American men in that county [61].

Specific evidence-based strategies applicable to the entire community are reviewed in the Guide to Community Preventive Services [62]. The guide includes recommendations to increase community physical activity opportunities, enhance community tobacco control, and support tobacco cessation (Table 1). The guide provides less evidence regarding approaches for improving diet at the community level; however, a recent American Heart Association Scientific Statement [63] reinforces the recommendations found in the guide and provides several promising approaches for improving diet (Table 1).

A reemerging approach in health promotion programs and health care delivery is the utilization of community health workers and other health care extenders. Utilization of these individuals, who are grounded in the community, expands health care resources and better assures that programs and services are tailored to the individuals and communities they serve. One program in North Carolina that demonstrates such an approach, the Healthy Living Partnerships to Prevent Diabetes project, uses community health workers and group-based instruction to promote weight loss and to decrease glucose levels among adults at risk for type 2 diabetes [64].

The Justus-Warren Heart Disease and Stroke Prevention Task Force's update of its comprehensive plan gives increased attention to the roles of individuals, families, and

TABLE 1.
Strategies to Increase Physical Activity, Improve Nutrition, and Control and Reduce Tobacco Use

Community-level strategies to increase physical activity^a

- Community-wide informational campaigns
- Community-scale urban design and land-use policies
- Creation of enhanced access to places for physical activity combined with informational outreach activities
- Street-scale urban design and land-use policies
- Point-of-decision prompts to encourage use of stairs

Community-level strategies for improving nutrition^b

- Sustained, focused media and educational campaigns, using multiple modes, for increasing consumption of specific healthful foods or reducing consumption of specific less healthful foods or beverages, either alone or as part of multicomponent strategies;
- On-site supermarket and grocery store educational programs that support the purchase of healthful foods
- Mandated nutrition-facts panels or front-of-pack labels/icons as a means of influencing industry behavior and product formulations
- Agricultural subsidy strategies that lower prices of more healthful foods and beverages
- Tax strategies that increase prices of less healthful foods and beverages
- Changes in agricultural subsidies and other related policies in order to create an infrastructure that facilitates production, transportation, and marketing of healthful foods
- Regulatory policies aimed at reducing the presence of in food of nutrients such as salt, trans fats, and certain other fats
 - Point-of-decision prompts to encourage use of stairs

Community-level strategies for tobacco control and tobacco cessation^a

- Increasing the unit price for tobacco products (via taxes or user fees)
- Smoking bans and restrictions at work sites
- Community mobilization combined with additional interventions (such as stronger local laws directed at retailers, active enforcement of retailer sales laws, and retailer education with reinforcement to reduce minors' access to tobacco)
- Cessation interventions
 - o Telephone support
 - o Reductions in out-of-pocket costs for evidence-based tobacco-cessation treatments.
 - o Mass media campaigns can be effective when combined with other interventions, but are less effective as stand-alone efforts

^aStrategies excerpted from The Guide to Community Preventive Services [57]

^bStrategies excerpted from Mozaffarian D, Afshin A, Benowitz NL, et al [58].

communities in the prevention and management of risk factors for heart disease and stroke. These stakeholders can play a vital role in addressing social, behavioral, policy, and environmental changes that will improve population health. Families and communities are likely to be particularly influential in promoting prevention among North Carolina's youth. It is quite evident that cardiovascular health begins in childhood [4]. The recent national trend of an increasing proportion of children being obese [65] is alarming; obesity is associated with other CVD risk factors in children, just as it is in adults. Armstrong's paper in this issue on heart dis-

ease in childhood discusses the significance of the increasing prevalence of these risk factors in children [66].

In addressing the burden of heart disease and stroke in the state, the Justus-Warren Heart Disease and Stroke Prevention Task Force develops formal and informal relationships with different sectors of the community. This is an important strategy that has been successful and should be adopted at the regional and local levels. The Eastern North Carolina Stroke Network is a partnership of representatives from the state's Division of Public Health, local health departments, faith-based organizations, the American Heart Association and the American Stroke Association, community health centers, and other community groups, who have assembled to address stroke care and related risk factors. The results have enabled the residents of the eastern region of the state to actively participate in improving and coordinating the delivery of health services there.

In North Carolina, policymakers and other stakeholders and others have received a return on their investment: The state has experienced significant reductions in the mortality rates for heart disease and stroke. In this issue, Murry and colleagues note that legislators have an "opportunity to accelerate the adoption of Million Hearts objectives," and they suggest that "doing so will impact population health and perhaps generate cost-savings in the care of North Carolina's Medicaid population" [67]. It is imperative that the state avail itself of all its resources in addressing the challenges of heart disease, stroke, and other chronic diseases. The results will yield a better and more productive quality of life for all residents. NCMJ

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