Journal of Cardiovascular Nursing
Vol. 26, No. 4S, pp S1–S2 | Copyright © 2011 Wolters Kluwer Health | Lippincott Williams & Wilkins

Introduction

Global Cardiovascular Disease Prevention: A Call to Action for Nursing

The Global Burden of Cardiovascular Disease

Kathy Berra, MSN, RN, ANP, FAHA, FPCNA, FAAN; Barbara J. Fletcher, MSN, RN, FAHA, FPCNA, FAAN; Laura L. Hayman, PhD, RN, FAHA, FPCNA, FAAN; Nancy Houston Miller, BSN, RN, FAHA, FPCNA

Progress, from the Latin *progressus*, means "moving forward" or "advancing." Yet progress can be a paradoxical concept, and, as has frequently been observed, we often seem to be taking 2 steps backward even as we slowly inch forward. As our world grows richer, some populations become poorer, and many become sicker. As we live longer, too often we become less healthy. And, although we live in a period of increasing economic development and urbanization, as our lives become "better," cardiovascular disease (CVD), the principal cause of death throughout the world, imposes an ever-increasing burden of morbidity and mortality in both high- and low-income countries. In the first of the articles in this supplement, "The Global Burden of Cardiovascular Disease," Deaton and colleagues explain why CVD is, increasingly, a global issue; why it attacks both high and low socioeconomic groups; why, given that it results from the cumulative effects of a finite number of modifiable risk factors, it is nevertheless so difficult to eradicate; why different risk factors are endemic in different societies; and which interventional strategies may have the greatest impact in various locations and cultures.

Although risk for CVD increases with increasing age, the disease process begins very early in life. Because the risk factors that lead to CVD events are influenced over decades by both behavior and environment, intervention at any point to modify or reverse deleterious patterns is likely to be beneficial. In "A Life Course Approach to Cardiovascular Disease Prevention," Hayman et al describe effective interventions and present global risk assessment tools to help determine which populations need to be targeted.

These interventions can best be delivered by professionals who possess the wide range of skills required to change behaviors. In the third article in this supplement, Berra et al discuss "Nurse-Based Models for Cardiovascular Disease Prevention" and provide examples of nurse-led programs that have been successful in modifying multiple risk factors in both primary and secondary prevention populations. These models have the flexibility to be implemented successfully in a variety of settings and the proven potential to reverse unhealthy practices, such as poor diet, sedentary lifestyle, and smoking, and replace them with healthy ones, such as regular exercise and good nutrition. Nurse case managers also have the skills to mobilize family members to motivate and support positive behaviors, including diet, exercise, and adherence to medication regimens. New technologies provide additional opportunities for nurses to extend their reach in working to reduce cardiovascular risk factors in individuals and populations.

Effective strategies to tackle global problems often begin in communities. In the fourth article in this series, Fletcher and colleagues

Kathy Berra, MSN, RN, ANP, FAHA, FPCNA, FAAN
Clinical Director, Stanford Heart Network, Stanford Prevention Research Center, Stanford University School of Medicine, Palo Alto, California.

Barbara J. Fletcher, MSN, RN, FAHA, FPCNA, FAAN
Clinical Associate Professor, School of Nursing, University of North Florida, Jacksonville, Florida.

Laura L. Hayman, PhD, RN, FAHA, FPCNA, FAAN
Associate Dean for Research and Professor of Nursing, College of Nursing and Health Sciences, University of Massachusetts, Boston; Director of Research, GoKids Boston, Massachusetts.

Nancy Houston Miller, BSN, RN, FAHA, FPCNA
Associate Director, Stanford Cardiac Rehabilitation Program Stanford University School of Medicine, Palo Alto, California.

The authors have no conflicts of interest to report.

Correspondence
Barbara J. Fletcher, MSN, RN, FAHA, FPCNA, FAAN, School of Nursing, University of North Florida, 4567 St Johns Bluff Rd S, Jacksonville, FL 32224-2673 (bjflet@att.net).

DOI: 10.1097/JCN.0b013e31821485da

present "Community-Based and Public Health Prevention Initiatives" and explain why they are necessary, and why, with support from policy makers, such initiatives can be highly successful in encouraging and enabling behavior change for groups of people. The authors provide examples of communities that have been mobilized to adopt heart-healthy behaviors and whose environments have been modified so as to make those behaviors possible, for example, safe and attractive locations to walk and exercise. Community-Based Participatory Research is highlighted and illustrates how to involve communities in research efforts. Community participation in genetic research is increasing and is enabling improved understanding of how genes interact with lifestyles to enhance CVD risk. The authors describe the rewards and challenges of such participatory research, including ethical issues that remain to be resolved.

In the fifth article in the supplement, Burke and colleagues discuss ways in which health policy operates at municipal and local as well as national levels. Effective change requires an in-depth understanding of these multilevel policies and how they operate, particularly in poor and developing countries. Health care systems differ throughout the world and can have a significant impact on patient adherence to therapeutic lifestyle change, but so can a number of other factors delineated by the authors, including available therapies and the resources, skills, and beliefs of target populations. The authors present ways of overcoming obstacles to adherence and creating incentives for healthy behaviors.

In the final article in this supplement, the authors argue that, although nurses are the highly trained foot soldiers in the battle against CVD, many also have the potential to be generals—visionary leaders who can innovate, motivate, and inspire. In this article, the authors describe the kinds of programs, including mentorship programs that have been most successful in identifying and training these new leaders.

A sense of urgency permeates this supplement. Just as poverty engenders poor health, poor health also contributes to poverty and to loss of productivity worldwide. The challenge of CVD is enormous and unrelenting, but it is not insurmountable. The risk factors are known, and the skills to modify them are available. Cardiovascular nurses are deeply committed and determined to make authentic progress, to move forward steadily and without losing ground, so as to enable vulnerable populations and individuals throughout the world to avoid initial or recurrent CVD and to have a longer, healthier, and more productive future.

On behalf of the Preventive Cardiovascular Nurses Association (PCNA) International Committee:

Kathy Berra, MSN, RN, ANP, FAHA, FPCNA, FAAN

Barbara J. Fletcher, MSN, RN, FAHA, FPCNA, FAAN

Laura L. Hayman, PhD, RN, FAHA, FPCNA, FAAN

Nancy Houston Miller, BSN, RN, FAHA, FPCNA

Coeditors

The coeditors want to express their gratitude to Dr Ruth Sussman for her invaluable editorial assistance.

Journal of Cardiovascular Nursing
Vol. 26, No. 4S, p S3 | Copyright © 2011 Wolters Kluwer Health | Lippincott Williams & Wilkins

Statements From Participating Organizations

A goal of the Council on Cardiovascular Nursing and Allied Professions is to improve implementation of the guidelines of the European Society of Cardiology in clinical practice. One of the cornerstones of our strategy is to engage nurses more actively in implementing guidelines for patient care. The European Guidelines on Cardiovascular Disease Prevention provides an excellent opportunity to do so. Ensuring that patients receive evidence-based therapies, education, and support to modify behaviors to reduce risk is the responsibility of us all. We welcome this international white paper as a global call to action for nurses.

Kaat Siebens, PhD, RN, FESC
Chair
Council on Cardiovascular Nursing and Allied Professions

The American Heart Association Council on Cardiovascular Nursing has an international nursing focus with a strong emphasis on prevention of cardiovascular disease. Because we are a global nursing community, this "state-of-the-art international paper" offers a platform upon which we can build a strategic plan for global prevention of cardiovascular disease. The Council on Cardiovascular Nursing applauds this "Call to Action for Nurses" and reaches out to all nurses worldwide to make a difference in cardiovascular disease prevention.

Sandra B. Dunbar, DSN, RN, FAHA, FAAN
Chair
Council on Cardiovascular Nursing
American Heart Association

The World Heart Federation strongly emphasizes the importance of collaborative activities between governments, professional societies, foundations, and health care providers directed toward the prevention of cardiovascular disease. In this setting, the role of nursing is critical to the development of a successful team and to the achievement of optimal patient outcomes. This statement provides an important foundation for the development of international programs that can truly benefit activities focused on the prevention of cardiovascular events.

Sidney C. Smith Jr, MD, FACC, FAHA, FESC
President
World Heart Federation

The authors have no conflicts of interest to report.

DOI: 10.1097/JCN.0b013e31821485f4

Journal of Cardiovascular Nursing
Vol. 26, No. 4S, p S4 | Copyright © 2011 Wolters Kluwer Health | Lippincott Williams & Wilkins

Foreword

Global Cardiovascular Disease Prevention

A Call to Action for Nursing

Martha N. Hill, PhD, RN, FAAN; George A. Mensah, MD, FACP, FACC

The global epidemic of cardiovascular disease (CVD) and other chronic diseases calls for multidisciplinary and multiprofessional approaches with strategic emphasis on prevention, treatment, and control. In addition, there is increasing recognition that effective management of these chronic diseases requires greater patient, family, and community involvement, as well as a skilled and diverse workforce that pays attention to the social, environmental, and policy determinants of health. Nowhere are these approaches and strategies brought together, and more closely aligned, than in the field of preventive cardiovascular nursing.

The Preventive Cardiovascular Nurses Association and the editors and authors are to be commended for conceiving, writing, and publishing this timely supplement. The contents reflect the major shifts in recognition of the need to address chronic diseases as well as infectious diseases and the critical need for team-based approaches. Its publication, following on the heels of the Institute of Medicine (IOM) report,[1] *Promoting Cardiovascular Health in the Developing World: A Critical Challenge to Achieve Global Health*, is not only fortuitous but also timely! This IOM report recognizes the complex, interwoven determinants that call for a multilevel, comprehensive integrated approach across the life span and embedded in public health principles. It emphasizes the integration of a chronic disease model for the prevention and control of CVD rather than the traditional acute-care episodic model.

Much like the IOM report, this supplement highlights the growing burden of CVD. It stresses the need for a diverse, multidisciplinary, multiprofessional skilled workforce with attention to interventions for lifestyle and behavior change across the life span; and effective interventions well integrated into existing maternal, child health, and communicable disease prevention priorities within health system strengthening, rather than as a parallel and separate endeavor. "Global Cardiovascular Disease Prevention: A Call to Action for Nursing" is also a practical guide that addresses an important gap in the planning, provision, and evaluation of cardiovascular care and chronic illness. It provides practical examples of successful nurse-led models in the primary and secondary prevention of CVD. By focusing comprehensively on the role of nursing, it broadens the approach and potential effectiveness in the delivery of CVD prevention and control as well as nursing leadership and innovation in efforts to stem this global epidemic.

From a policy perspective, it is also fortuitous that this call to action for nurses comes in the same year as the United Nations General Assembly Special Session on Noncommunicable Diseases.[2] The multiple levels at which policy and environmental changes impact cardiovascular health and chronic illness and the crucial role of advocacy at the community, national, and regional levels are well addressed in this supplement. There could be no better time than now to rally a truly multidisciplinary array of professionals to stem the tide of the rising burden CVD and other chronic diseases worldwide.

We highly recommend this supplement to all professionals interested in cardiovascular health and believe it should be required reading for all nurses with a passion for global CVD prevention.

Martha N. Hill, PhD, RN, FAAN
Dean, Professor of Nursing, Medicine and Public Health, The Johns Hopkins University School of Nursing, Baltimore, Maryland.

George A. Mensah, MD, FACP, FACC
Director, Heart Health & Global Health Policy; Vice President, Global Nutrition, Global Research & Development, PepsiCo, Inc, Purchase, New York.

Dr Hill has no conflict of interest to report.

Dr Mensah is a salaried employee of PepsiCo Inc, and participates in the company's executive compensation plan.

Correspondence
Martha N. Hill, PhD, RN, FAAN, The Johns Hopkins University School of Nursing, 525 N Wolfe St, Suite 501, Baltimore, MD 21205-2110 (mnhill@son.jhmi.edu).

DOI: 10.1097/JCN.0b013e318213efe4

REFERENCES

1. Institute of Medicine. *Promoting Cardiovascular Health in the Developing World: A Critical Challenge to Achieve Global Health*. Washington, DC: National Academies Press; 2010.
2. The NCD Alliance. NCD Alliance Plan for the United Nations Summit on Noncommunicable Diseases. *NCD Alliance*. 2010. http://www.idf.org/webdata/NCD-Alliance%20Plan.pdf. Accessed November 6, 2010.

Journal of Cardiovascular Nursing
Vol. 26, No. 4S, pp S5–S14 | Copyright © 2011 Wolters Kluwer Health | Lippincott Williams & Wilkins

The Global Burden of Cardiovascular Disease

Christi Deaton, PhD, RN; Erika Sivarajan Froelicher, PhD, RN; Lai Har Wu, PhD, RN; Camille Ho, MS, RN; Kawkab Shishani, PhD, RN; Tiny Jaarsma, PhD, RN

Cardiovascular disease (CVD) today is responsible for approximately one-third of deaths worldwide, and that figure will surely increase in both developing and developed countries as risk factors for the disease—primarily dyslipidemia, hypertension, obesity, diabetes, physical inactivity, poor diet, and smoking—continue to increase. Although these risk factors are modifiable, to date there is a relative paucity of measures to prevent or control them, particularly in developing countries. A population strategy combined with a high-risk strategy for CVD prevention could greatly reduce the burden of disease in the coming decades. Many initiatives are working, but many more are needed. This chapter provides background on the global burden of CVD and provides the context for the subsequent chapters addressing nurses' roles in reversing the bleak predictions for the ravages of CVD if risk factors are left unchecked in the coming decades.

KEY WORDS: cardiovascular disease, developing countries, prevention

The Need for Global Cardiovascular Disease Prevention

Cardiovascular disease (CVD) is a major health problem across the world, accounting for 30% of all deaths (Figure).[1,2] Of the 58 million deaths from all causes worldwide in 2005, an estimated 17.5 million were due to CVD, 3 times more deaths than are caused by infectious diseases including HIV/AIDS, tuberculosis, and malaria combined.[2,3] It is estimated that noncommunicable conditions will account for more than three-fourths of all deaths in 2030, and deaths from CVD will rise to 23.4 million, an approximately 37% increase from 2004 rates. Furthermore, the leading causes of death in the world in 2030 are predicted to be ischemic heart disease (IHD) and cerebrovascular disease (stroke), both components of CVD.[2]

The World Health Organization (WHO) noted that CVD has no geographic, socioeconomic, or sex boundaries. It is estimated that, far from being confined to the most developed countries, CVD is the leading cause of death in developing countries as well. Low- and middle-income countries contribute to about 80% of CVD deaths.[3] Stroke deaths in low- and middle-income countries were 5 times more likely than in high-income countries.[4] In developed countries, lower socioeconomic groups have a higher prevalence of risk factors, higher incidence of disease, and higher mortality. As the CVD epidemic matures in developing countries, the greater disease burden will shift to lower socioeconomic groups.[3] Among women across the world, heart disease is the also the most common cause of death.[5] Tables 1 and 2 provide the prevalence of IHD across the world.[6]

Thus, CVD is a global health problem that demands a global approach to prevention. Its impact is greatest in developing countries because of scarcity of both financial resources and professionals with expertise in prevention and management of CVD. A global action for prevention needs to take into consideration stages of development in countries and regions—the epidemiologic transition—to be most effective.

Epidemiologic Transition

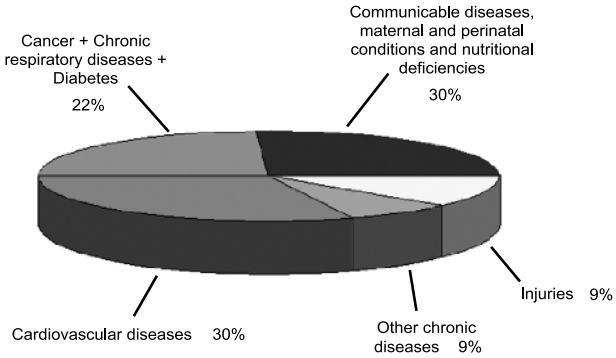
Epidemiologic transition refers to the shift that occurs in developing countries as mortality rates from infectious diseases and nutritional deficiencies decrease and mortality from noncommunicable diseases

Christi Deaton, PhD, RN
Professor of Nursing, School of Nursing, Midwifery and Social Work, University of Manchester and Central Manchester Foundation Trust; Manchester Academic Health Sciences Centre, Manchester, United Kingdom.
Erika Sivarajan Froelicher, PhD, RN
Professor, School of Nursing and Epidemiology and Biostatistics, School of Medicine, University of California, San Francisco.
Lai Har Wu, PhD, RN
Assistant Professor, The Hong Kong Polytechnic University, Hong Kong.
Camille Ho, MS, RN
Heart Program Manager, Hong Kong Adventist Hospital, Hong Kong.
Kawkab Shishani, PhD, RN
Assistant Professor, College of Nursing, Washington State University, Spokane.
Tiny Jaarsma, PhD, RN
Professor, Department of Social and Welfare Studies, Linköpings University, Norrköping, Sweden.

The authors have no conflicts of interest to report.

Correspondence
Christi Deaton, PhD, RN, University of Manchester, Jean McFarlane Bldg, Oxford Rd, Manchester, UK M20 3RA (mcdeaton@manchester.ac.uk).

DOI: 10.1097/JCN.0b013e318213efcf



Source: WHO. Cardiovascular diseases.[3] Available at: http://www.who.int/cardiovascular_diseases/en/index.html

FIGURE. *Causes of death globally. Source: WHO. Cardiovascular diseases. http://www.who.int/cardiovascular_diseases/en/index.html.*

increases. This shift or transition in disease and mortality rates reflects economic development, urbanization, industrialization, and changes in social organization within countries and regions with increased exposure to risk factors driven by changes in diet, physical activity, and environment.[2,7,8] The overall epidemiologic transition has been triggered by the "globalization" of dietary habits, characterized by increased consumption of fats and sugars,[9] and urbanization.[9–12] Statistical projections suggest that by 2025, 43.5% of the population in the developing world will be living in urban centers, compared with 21.9% in 1994.[13] For example, in India, the proportion of the population living in urban centers in 1981 was 23.3%, and this will increase to 42.8% in 2021.[14]

Yusuf et al[15] describe 5 stages of epidemiologic transition. Much of sub-Saharan Africa and rural regions of India and South America are in the first stage, in which circulatory diseases are primarily due to rheumatic heart disease and nutritional cardiomyopathies. Stage 2 sees an increase in hypertensive heart disease and hemorrhagic stroke (eg, China), and stage 3 is characterized by early onset of atherosclerotic CVD, obesity, and diabetes (urban India, former socialist economies, aboriginal communities), added to the continuing burden of infectious diseases. Developed countries are in stage 4, where noncommunicable diseases occur primarily at older ages. Stage 5 is a regressive stage caused by social upheaval or war, with resurgence in infectious diseases, and high mortality from both CVD and non-CVD causes.[15] The high burden of CVD in developing countries is due to not only to the high levels of risk factors, but also to the relatively early age at onset among largely young and middle-aged populations.[15] In the seminal INTERHEART Study, the average age of patients with acute myocardial infarction (AMI) in South Asians was 52 years, as compared with 60 to 65 years in European and North American cohorts.[8]

Risk Factor Prevalence and Burden in Developed and Developing Countries

Cardiovascular disease is usually associated with 1 or more characteristics, known as risk factors that describe "any attribute, characteristic or exposure of

TABLE 1 Deaths From Ischemic Heart Diseases: Males: 1999–2006 (Per 100 000 Inhabitants)

		1999	2000	2001	2002	2003	2004	2005	2006
1	Australia	158.6	148.0	145.0	142.0	148.0	140.4	139.9	139.6
2	Brazil	52.9	53.6	53.9	54.0	53.6	54.3	54.4	54.5
3	Canada	156.3	153.2	152.4	151.8	153.2	151.0	150.9	150.8
4	Chile	59.7	58.8	58.5	58.8	58.8	58.9	58.9	58.9
5	China								
6	Czechoslovakia	251.0	240.7	236.3	229.7	240.7	214.1	210.2	206.1
7	Demark	195.3	179.7	182.4	187.5	179.7	191.4	193.3	194.6
8	France	87.7	88.6	86.5	84.8	88.6	82.1	81.4	80.8
9	Germany	205.2	196.6	193.7	192.0	196.6	181.6	179.6	177.6
10	India								
11	Italy	143.0	137.3	138.2	142.2	137.3	143.1	144.0	144.3
12	Japan	64.3	61.6	62.5	63.6	61.6	63.2	63.1	63.0
13	Jordan								
14	Mexico	50.4	49.6	50.7	50.8	49.6	51.1	51.1	51.2
15	New Zealand	193.4	172.6	168.9	166.0	172.6	159.6	158.0	156.7
16	Pakistan								
17	Russia	393.5	420.1	435.3	462.4	420.1	490.2	499.5	507.2
18	Saudi Arabia								
19	Sweden	266.7	249.8	244.0	242.1	249.8	232.7	230.2	227.6
20	Switzerland	155.3	151.6	143.2	138.7	151.6	127.3	124.7	122.3
21	UAE								
22	UK	247.4	232.8	230.7	223.0	232.8	201.0	197.1	192.8
23	US	200.6	188.8	186.5	184.3	188.8	179.8	178.7	177.7

Source: *World Health Databook 2007/2008.*[6]

TABLE 2 Deaths From Ischemic Heart Diseases: Females: 1999–2006 (Per 100 000 Inhabitants)

		1999	2000	2001	2002	2003	2004	2005	2006
1	Australia	133.6	129.9	126.3	124.9	129.9	123.3	122.9	122.7
2	Brazil	37.6	37.9	38.0	38.0	37.9	38.1	38.2	38.2
3	Canada	123.4	122.7	121.9	121.4	122.7	121.0	120.9	120.8
4	Chile	46.4	42.2	43.0	43.4	42.2	43.9	44.0	44.0
5	China								
6	Czechoslovakia	226.6	215.2	213.6	212.0	215.2	198.5	195.1	191.3
7	Denmark	177.3	161.8	163.6	165.8	161.8	169.8	171.2	172.4
8	France	66.7	66.0	66.0	63.7	66.0	63.6	63.2	63.2
9	Germany	221.0	211.1	207.0	207.2	211.1	188.2	185.1	181.4
10	India								
11	Italy	121.0	117.8	117.2	122.2	117.8	123.2	124.2	124.5
12	Japan	53.7	50.4	50.5	50.3	50.4	49.6	49.5	49.3
13	Jordan								
14	Mexico	40.3	39.7	39.9	40.0	39.7	39.9	40.0	40.0
15	New Zealand	150.0	137.7	136.6	135.7	137.7	132.7	132.0	131.4
16	Pakistan								
17	Russia	374.7	382.7	386.7	406.4	382.7	423.5	429.2	434.2
18	Saudi Arabia								
19	Sweden	212.1	204.5	204.4	201.7	204.5	190.4	187.3	184.1
20	Switzerland	149.5	145.6	138.7	137.2	145.6	121.7	118.9	115.9
21	UAE								
22	UK	179.5	183.5	180.2	174.9	183.5	155.1	151.5	148.0
23	US	188.2	177.6	176.1	174.9	177.6	172.0	171.4	170.8

Source: *World Health Databook 2007/2008*.[6]

an individual that increases the likelihood of developing a disease or injury."[16] In general, risk factors for CVD include demographic characteristics, family history of CVD, cigarette smoking, physical inactivity, abnormal serum lipids and lipoproteins, body weight (obesity), hypertension, and diabetes mellitus.[17] Newly emerging CVD risk factors, such as low birth weight, folate deficiency, and infections, are also more frequent among the poorest segments of the population in low- and middle-income countries.[2]

Knowledge of risk factors that lead to the development of CVD has been derived mainly from developed countries, beginning with epidemiologic studies such as Framingham. These results have generally proven to be consistent throughout the world. INTERHEART was a case-control study of 27 098 participants in 52 countries in which 9 modifiable risk factors were found to account for 90% of AMI in men and women across all ages and major ethnic groups.[8] These risk factors were abnormal lipids, hypertension, smoking, diabetes, abdominal obesity, physical inactivity, unhealthy diet, no alcohol consumption, and psychosocial stress. In addition, in developed and developing countries, low income and poor education have been consistently associated with increased CVD mortality and higher rates of CVD risk factors such as smoking, obesity, and hypertension.[18] The INTERHEART study also found that poor education was associated with increased risk for AMI, largely through its association with modifiable risk factors, especially in those countries designated as high income.[19]

Although CVD is the leading cause of death for women as well as men, women are generally a decade older than men when CVD develops; in the INTERHEART study, two-thirds of women with AMI were 60 years or older, compared with 40% of men.[20] In that analysis, 80% of the earlier age at onset of the first AMI in men was due to a higher distribution of significant risk factors in men at younger ages.[20] Thus, the finding of an increase in the proportion of women smokers younger than 50 years in Europe from 1995 to 1996, to 2006 to 2007, as well as increases in obesity and diabetes for both sexes, is ominous.[21] Because risk from smoking is multiplicative when it occurs in the presence of other risk factors, this becomes even more worrisome. In other parts of the world, such as the Middle East, rates of obesity and hypertension are much higher in women than in men, although smoking rates remain lower.[22]

Although the same risk factors are important throughout the world, their specific prevalence varies. For example, the prevalence of hypertension in developing countries has been estimated to be between 1% and 30%, varying largely between continents.[23] Developing countries have the largest proportion of smokers in the world, and rates of smoking in these countries are on the rise (Table 3).[6] In contrast, the rates of smoking in developed countries have been declining dramatically.[24] The decline can be attributed to aggressive public antismoking policies: for example, increasing the cost of cigarettes through taxation, laws restricting smoking in public places, and laws that restrict advertising and sale of cigarettes to minors.

TABLE 3 Smoking Prevalence in Population 15 Years or Older for 1999–2006 (% of Population Aged ≥15 y)

		1999	2000	2001	2002	2003	2004	2005	2006
1	Australia	22.8	22.5	21.8	21.9	21.1	21.3	20.8	20.7
2	Brazil	33.5	33.3	33.5	33.2	33.1	32.9	32.9	32.8
3	Canada	23.8	20.9	21.3	20.8	20.5	20.5	20.8	20.1
4	Chile	26.1	26.6	26.3	26.8	26.4	25.9	25.5	25.1
5	China	37.0	36.7	36.3	36.0	35.5	35.0	34.3	33.7
6	Czechoslovakia	23.5	29.1	23.3	24.1	22.6	22.1	22.0	22.1
7	Denmark	31.0	30.5	29.5	28.0	30.4	30.2	30.1	29.9
8	Egypt	36.6	37.0	37.2	37.2	37.6	37.7	37.9	38.1
9	France	26.6	27.0	25.8	25.4	25.7	25.4	25.5	25.4
10	Germany	23.5	34.5	32.4	34.6	34.8	32.5	21.7	21.4
11	India	36.0	36.2	36.1	37.2	37.3	38.0	37.9	38.3
12	Italy	24.7	24.4	24.1	23.5	22.4	22.6	22.0	22.5
13	Japan	34.3	34.3	33.6	33.4	33.0	32.7	32.8	32.3
14	Jordan	30.3	30.5	30.8	31.4	31.9	32.4	32.4	32.8
15	Mexico	28.6	29.1	29.5	29.7	30.0	30.2	31.1	31.6
16	New Zealand	25.0	26.0	25.0	23.9	23.7	22.9	22.8	22.4
17	Pakistan	24.8	25.0	25.7	26.2	27.0	27.6	27.9	28.0
18	Russia	42.5	42.2	41.7	41.5	41.2	41.5	41.9	41.7
19	Saudi Arabia	25.7	27.3	27.3	27.7	28.0	28.4	29.0	28.9
20	Sweden	19.3	18.9	18.9	17.8	18.4	18.0	17.8	17.2
21	Switzerland	30.8	30.5	30.2	29.0	29.8	29.6	29.5	29.3
22	UAE	26.0	25.7	25.9	25.1	25.4	25.6	25.8	26.1
23	UK	27.0	27.0	27.0	26.6	25.4	24.8	25.3	24.8
24	US	19.9	19.1	19.0	18.6	18.1	17.7	17.5	17.2

Source: *World Health Databook 2007/2008*.[6]

In addition to cigarette smoking, a form of smoking that is a popular and common social practice in many regions in the world is the waterpipe (also known as argeela, arghileh, nargile, narghile, nargileh, hubbly-bubbly, shisha, sheesha, goza). This social activity usually involves 2 or more people who may share in the smoking of the same waterpipe.[25] Although there is a common misconception that smoking waterpipe is not as harmful as smoking cigarettes, in fact, 1 episode of smoking waterpipe produces as much tar as smoking 20 cigarettes. One study established that waterpipe smoke contains an abundance of chemicals known to be risk factors for cancer and CVD; for example, the ratio of carbon monoxide to nicotine was 50:1, as compared with 16:1 for cigarettes.[26] An analysis of studies done in Arab countries reveals that waterpipe smoking is highly prevalent,[27,28] ranging from 31% to 57% of people, and that more women than men smoke a waterpipe.[29]

The proportion of people who are physically inactive is on the rise in many regions of the world. According to the INTERHEART study, the least active regions were in the Middle East, Africa, and China.[8] A change in diet toward highly refined foods, meats, and dairy products with high levels of saturated fat, coupled with a sharp decrease in energy expenditure, has been occurring globally since the mid–20th century.[30] This has led to the widespread increase in obesity (Table 4).[6] In affluent societies, excess weight is more common among disadvantaged groups, but the inverse occurs in low income countries.[30] Obesity in children is also rising, with serious consequences for incidence of diabetes and CVD. An increased risk of IHD in adulthood is associated with higher body mass index in childhood and adolescence.[31,32]

Although high intakes of fat, salt, and refined sugar have not typically been a concern for developing countries, recent shifts to unhealthy fast-food trends in eating practices globally have resulted from socioeconomic changes that make these problems increasingly relevant for countries in transition.[23,33,34] In fact, in China, changing to a "Western diet" was linked to the dramatic increase in the IHD mortality rate.[35]

The trend in developed countries has been for mortality from IHD to decline in the last several decades. Between 1960 and 1990, CVD mortality declined by 34% to 50% in Australia, Canada, France, Japan, and the United States.[36–39] Mortality rates from IHD in the United Kingdom have declined steadily since their peak levels in the early 1970s.[40] Previous studies in the United Kingdom and United States suggested that modest changes in major population risk factors (notably smoking, lipid levels, and hypertension) have had the greatest effect in decreasing IHD mortality, but increases in obesity, diabetes, and sedentary lifestyles threaten to undermine these

TABLE 4 Obese Population (Body Mass Index ≥30 kg/m²) 1999–2006 (% of Population Aged ≥15 y)

		1999	2000	2001	2002	2003	2004	2005	2006
1	Australia	21.7	22.5	22.5	23.0	23.9	24.1	24.7	25.2
2	Brazil	11.0	11.1	11.2	11.3	11.4	11.5	11.5	11.6
3	Canada	13.7	13.8	13.9	14.0	14.3	14.5	14.5	14.6
4	Chile	17.8	18.1	18.4	18.9	19.1	19.5	20.1	20.7
5	China	4.0	4.1	4.2	4.3	4.4	4.5	4.7	4.8
6	Czechoslovakia	14.2	14.4	14.6	14.8	15.0	15.2	15.4	15.6
7	Demark	9.4	9.5	10.6	12.0	12.4	13.0	13.7	14.0
8	Egypt	5.6	5.6	5.7	5.7	5.8	5.9	5.9	5.9
9	France	8.6	9.0	9.3	9.4	9.4	9.5	9.6	9.8
10	Germany	11.5	11.9	12.2	12.6	12.9	13.3	13.6	13.9
11	India	5.2	5.3	5.4	5.3	5.4	5.4	5.4	5.5
12	Italy	8.8	8.6	8.5	8.5	9.0	9.3	9.4	9.7
13	Japan	2.9	2.9	3.2	3.6	3.2	3.3	3.4	3.5
14	Jordan	14.4	14.6	14.6	14.7	14.7	14.7	14.6	14.6
15	Mexico	23.8	24.2	24.5	25.0	25.2	25.5	25.7	26.0
16	New Zealand	18.5	19.9	20.2	20.7	20.9	21.0	21.4	21.8
17	Pakistan	5.6	5.7	5.8	5.7	5.8	5.8	5.8	5.8
18	Russia	18.2	18.0	18.0	17.5	17.5	17.5	17.3	17.4
19	Saudi Arabia	26.4	26.7	27.0	27.4	27.7	28.0	27.9	28.1
20	Sweden	8.1	9.2	9.2	10.2	9.7	9.8	10.1	10.3
21	Switzerland	7.2	7.5	7.6	7.7	8.1	8.3	8.5	8.6
22	UAE	26.4	26.7	26.7	26.8	26.8	26.8	27.0	27.1
23	UK	20.0	21.0	22.0	22.0	23.0	23.0	23.2	23.4
24	US	29.7	30.5	30.6	30.6	31.3	32.3	33.7	34.3

Source: *World Health Databook 2007/2008.*[6]

trends.[40–44] A similar trend toward lower mortality from cerebrovascular disease in both men and women has been found in developed countries such as the United Kingdom, Sweden, Switzerland, Germany, New Zealand, and Australia and in some developing countries (except Russia).

Although we have fewer epidemiologic data from developing countries, the following sections provide some insight into the rise in risk factors due to the epidemiologic transition in specific countries and regions.

India, China, and Japan

In India, it is estimated that hypertension is directly responsible for 57% of all stroke deaths and 24% of all heart disease deaths.[14] Although there is a low prevalence of multiple CVD risk factors, such as smoking and dyslipidemias, in urban Asian Indian adolescents, rapid escalation of these risk factors occurs by ages 30 to 39 years.[45]

Cardiovascular disease deaths are expected to increase by 77% by 2020 in China and by 106% in other Asian countries, compared with 15% for economically developed countries.[14] People living in the northern and northwestern areas of China consume significantly more sodium than do people from the south.[46] The prevalence of hypertension, elevated mean serum cholesterol, and high body mass index was greater in the north than in the south and in urban compared with rural areas.[13] Incidences of overweight and obesity nationwide in China have increased by nearly 39% and 82%, respectively, in the past 10 years.[46]

In Japan, hypertension is the most important CVD risk factor. Although traditional diets are low in saturated fat, increasing adoption of Western lifestyles has led to rises in diabetes, obesity, and hypercholesterolemia. Smoking rates among men remain high despite some decline.[13]

Sub-Saharan Africa

In sub-Saharan Africa, hypertension remains the most threatening risk factor, with national prevalence ranging between 15% and 30% in adults.[47] Rates of smoking among African men are also high, but the prevalence of most other conventional risk factors is low compared with other regions.[13] The per capita burden of CVD in sub-Saharan Africa increased between 1990 and 2000,[48] and deaths due to CVD are projected to more than double in sub-Saharan Africa between 1990 and 2020.[49]

South and Central America

Guyana has the highest CVD mortality rate in South America, followed by Suriname, Brazil, and Paraguay.[50] The aging population of Brazil is expected to significantly increase the burden of CVD in the coming decades.[51] About 2 million cases of severe CVD were reported in 2004 in Brazil; this accounts for 5.2% of the population older than 35 years.[28] Cardiovascular

disease mortality rates vary widely across South and Central America, with some of the highest rates found in Caribbean countries such as Grenada and Dominican Republic.[50]

Implications for Population-Based/Public Health and Individual/High-Risk Approaches to Cardiovascular Disease Prevention

Given that much of the CVD burden worldwide is avoidable, efforts to decrease modifiable risk factors are urgently needed. According to the WHO,[2] the key modifiable lifestyle or behavioral risk factors for CVD worldwide are smoking, physical activity, and dietary intake. In fact, a systematic review of the causes of CVD mortality demonstrated that 4 factors improved prognosis, of which 3 were associated with lifestyle: smoking cessation, increased physical activity, and dietary changes.[52] Unfortunately, in developing countries, there is a relative lack of prevention and control measures to decrease exposure to these risk factors.[39]

Two approaches to CVD prevention are a population strategy and an individual/high-risk strategy. The population strategy of preventive health care was proposed by Rose[53] in 1992 as a radical strategy to identify and if possible remedy the underlying cause of major health problems. Rose[53] argued that people with particular health problems (eg, elevated blood pressure) represent one extreme of the continuous distribution of the factor overall in the population. Shifts in the population distribution reduce the number of persons at risk; even small shifts decrease the number of persons in the most vulnerable tail of the distribution. Furthermore, because most adverse health events will occur in those with only moderate risk, simply because they comprise the largest group, so shifting the distribution to lower risk will have a huge impact.[53] Thus, effective prevention requires changes that involve the population as a whole. The population strategy aims to reduce the burden of disease in the whole community while conferring small benefits on each individual.[13]

For Rose,[53] a population strategy was based on sociological, moral, and medical grounds: (1) society is an entity with its own collective characteristics that affect health; (2) people with health problems are not independent of the rest of society and are its collective responsibility; and (3) the underlying causes of poor health are known, and this implies a duty to use that knowledge. Treating only cases and high-risk individuals was seen as a superficial and symptomatic approach.[53]

The reasons for declines in CVD mortality in developed countries have been evaluated in the WHO Monitoring Trends and Determinants in Cardiovascular Disease Project[54] and in other analyses. Contributions to decreased CVD mortality rates occurring in most of the 21 participating countries were greater because of declining event rates (and the factors driving event rates).[54] Similarly, mortality models in England and Wales showed that more than half of the decline (58%) in CVD mortality between 1981 and 2000 was attributable to reductions in population risk factors (primarily smoking, cholesterol, and blood pressure), and 42% was due to medical and surgical treatments.[41] Changes in risk factors explained almost all the decline in CVD mortality in the 1970s in Finland and 53% of the decline between 1982 and 1997.[55] National smoking bans in the early years of the 21st century have led to reductions in acute coronary events.[56]

A population approach to the primary prevention of obesity throughout the world is thought to be more likely to be beneficial. Tackling obesity requires an understanding of the complex societal factors that contribute to it: access to nutritional food supplies, built environments that promote healthier options, and living/working conditions that produce more equal material and psychosocial resources between and within social groups.[30,57] The European Commission has been increasingly focusing on its public health activities, with the aim of increasing cooperation and a more strategic approach to health issues in the European Union. One initiative, modeled on the French campaign EPODE, is to recruit town mayors and citizens to encourage healthy eating among young people.[58,59]

Criticism of the population approach centers on the lack of consistent success in these interventions. Despite the success of programs such as the North Karelia Project in eastern Finland, and the Stanford 5-Cities Heart Disease Prevention Program, other community-based interventions have not shown a strong effect on risk factors and CVD mortality.[60] A recent Cochrane Collaboration systematic review on multiple-risk–factor interventions for primary prevention of CVD found no significant pooled effect on mortality and modest changes in risk factors.[60] Population strategies need to recognize the multiple factors that impact population health and bring CVD prevention to the highest policy level.

In contrast, individual/high-risk strategies are dependent on identifying persons who are apparently well but at high multifactorial risk of developing CVD, as well as those with established CVD, to modify and/or manage risk factors and decrease the likelihood of disease development, progression, and events. The multivariable approach to predicting CVD risk in individuals is essential; consensus reached in the 1990s advocated an assessment of multiple factors to determine absolute risk of CVD.[61,62] Those who favor

Clinical Pearls

- The top 2 leading causes of death in the world in 2030 are predicted to be ischemic heart disease and cerebrovascular disease (stroke).
- Increasing CVD mortality in developing countries reflects economic development, urbanization, industrialization, and changes in social organization with increased exposure to risk factors driven by changes in diet, physical activity, and environment.
- Developing countries have higher rates of smoking than developed countries and are seeing rises in sedentary lifestyles, obesity, and hypertension while often lacking prevention and control measures to decrease these risk factors.
- Population and individual approaches are necessary for decreasing the global burden of CVD, and lessons learned about prevention of CVD from developed countries could prove beneficial in halting the rapid increase in lifestyle-related risk in developing countries.
- Concerted global action is needed and requires effective intercountry, interregional, and global networks and partnerships.
- Governments and ministries of health must be committed to capacity building of a cadre of personnel qualified in the education, counselling, and behavioral interventions for health promotion and risk factor reduction.

this approach note that clinicians' ability to assess total baseline risk has greatly improved with risk algorithms incorporating multiple risk factors. As absolute risk differs among populations, so risk prediction systems derived from one population may not be as accurate for individuals from another population. In Europe, the SCORE risk charts are available for high- and low- risk countries, and the HEARTSCORE project offers assistance to countries in recalibrating risk models and charts using current national data.[61] Women are less frequently assessed for risk; therefore, the American Heart Association and the European Society of Cardiology emphasize risk estimation of women with particular attention to smoking, obesity, and use of oral contraceptives.[63,64]

Thresholds for intervention are lower than in the 1990s. Asymptomatic individuals with multiple risk factors resulting in a 10-year risk of 5% or greater for developing a fatal CVD event, or markedly raised levels of a single risk factor, are considered high risk. Individuals at high risk might be in need of medication or individual lifestyle changes, such as diet interventions and/or changing activity levels. Although individuals who are at high risk for CVD can benefit from lifestyle changes that lower blood pressure, cholesterol, and bodyweight, specific interventions aimed at this group of patients are not widely tested, and long-term hard end points are mostly not evaluated.[65] Multifactorial lifestyle interventions are increasingly recognized as important, and individuals at high risk for CVD can make positive changes in biological and lifestyle risk factors for diabetes and CVD. Only limited research is available on the effect of multifactorial intervention on the prevention of CVD.[66,67] It is often challenging to motivate patients to change their lifestyle or to take medication if they do not directly perceive themselves to be at risk of CVD and its possible consequences, or if they feel that the burden of treatment outweighs the possible advantages.[68]

In truth, both population and individual approaches are necessary for decreasing the global burden of CVD. We cannot afford to ignore the societal factors that promote the development of unhealthy behaviors and risk factors for CVD; neither can we turn away from individuals who are at high risk. The European Heart Health Charter was developed by the European Society of Cardiology and the European Heart Network, with the support of the European Commission and WHO Regional Office for Europe, and emphasizes the importance of both population and individual strategies for reducing CVD in Europe. The charter calls on the countries and organizations that are its signatories to promote and support measures for CVD prevention, giving priority to lifestyle interventions.[69]

The WHO motto "think globally and act locally" can serve the international community well. The WHO proposes developing effective intercountry, interregional, and global networks and partnerships for concerted global action.[2] Lessons learned about prevention of CVD from developed countries could prove beneficial in halting the rapid increase in lifestyle-related risk in developing countries.[63,70–72] The Catalonia Declaration (1995)[70] and The Victoria Declaration (1992)[71] promoted the establishment of networks with experts from developed countries to share scientific knowledge and expertise for comprehensive health policies and efficient and cost-effective public health services. The Catalonia and Victoria Declarations also emphasized women's influential role as change agents toward CVD risk factor reduction. Specific interventions that target awareness and long-term motivation need to be developed and tested. Research supports the role of nurses in providing safe and effective primary and secondary prevention, although greater collaboration, innovation, and support for CVD risk reduction are urgently needed.[73] Subsequent sections of this article review the evidence and address the important role of nurses in prevention.

Summary

Cardiovascular disease has no geographic, socioeconomic, or sex boundaries and is the leading cause of

death in developing as well as developed countries. Risk factors that lead to the development of CVD are consistent throughout the world, and many are increasing in prevalence as developing countries transition to more urban, industrialized environments. Population and individual approaches are necessary for decreasing the global burden of CVD: societal factors cannot be ignored as they promote the development of unhealthy behaviors and risk factors for CVD; neither can we turn away from individuals who are at high risk. Cardiovascular disease is a global health problem that demands a global approach to prevention. Governments and Ministries of Health must make the necessary commitment to the education and training of nurses and physicians and capacity building for personnel qualified to support health promotion and risk reduction.

REFERENCES

1. Gaziano TA. Economic burden and the cost-effectiveness of treatment of cardiovascular disease in Africa. *Heart*. 2008;94(2):140–144.
2. World Health Organization, 2009. Cardiovascular Diseases. http://www.who.int/mediacentre/factsheets/fs317/en/index.html; http://www.who.int/cardiovascular_diseases/priorities/en/index.html. Accessed June 17, 2010.
3. World Health Organization, 2005. Preventing chronic diseases: a vital investment. http://www.who.int/chp/chronic_disease_report/contents/en/index.html. Accessed June 17, 2010.
4. Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJ. Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. *Lancet*. 2006;367(9524):1747–1757.
5. World Health Organization. *Women and Health: Today's Evidence, Tomorrow's Agenda*. Geneva, Switzerland: WHO Press; 2009. All rights reserved. Publications of the World Health Organization.
6. *World Health Databook 2007/2008*. London: Euromonitor International. London, UK: Euromonitor International Ltd; 2008.
7. Omran A. The epidemiologic transition: a theory of the epidemiology of population change. *Milbank Q*. 2005;83(4):731–757. Reprinted from *Milbank Mem Fund Q*. 1971;49(4):509–538.
8. Yusuf S, Hawken S, Ounpuu S, et al; INTERHEART Study Investigators. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet*. 2004;364(9438):937–952.
9. Drewnowski A, Popkin B. The nutrition transition: new trends in the global diet. *Nutr Rev*. 1997;55(2):31–43.
10. Alwan AA. Cardiovascular diseases in the eastern Mediterranean region. *World Health Stat Q*. 1993;46(2):97–100.
11. Muna WF. Cardiovascular disorders in Africa. *World Health Stat Q*. 1993;46(2):125–133.
12. Reddy KS. Cardiovascular diseases in India. *World Health Stat Q*. 1993;46(2):101–107.
13. Yusuf S, Reddy S, Ounpuu S, Anand S. Global burden of cardiovascular diseases part II: variations in cardiovascular disease by specific ethnic groups and geographic regions and prevention strategies. *Circulation*. 2001;104(23):2855–2864.
14. Gupta R. Trends in hypertension epidemiology in India. *J Hum Hypertens*. 2004;18(2):73–78.
15. Yusuf S, Reddy S, Ounpuu S, Anand S. Global burden of cardiovascular diseases part I: general considerations, the epidemiologic transition, risk factors and impact of urbanization. *Circulation*. 2001;104(22):2746–2752.
16. World Health Organization. Health Topics: Risk Factors. 2010. http://www.who.int/topics/risk_factors/en/. Accessed June 17, 2010.
17. Kramer KM, Newton KM, Sivarajan Froelicher ES. Cardiovascular risk factors. In: Woods SL, Sivarajan Froelicher ES, Adams Motzer Underhill S, Bridges EJ, eds. *Cardiac Nursing*. 6th ed. Philadelphia, PA: Lippincott, Williams & Wilkins; 2008:753–782.
18. Mackay J, Mensah GA. *The Atlas of Heart Disease and Stroke*. Geneva, Switzerland: World Health Organization; 2004.
19. Rosengren A, Subramanian SV, Islam S, et al; for the INTERHEART Investigators. Education and risk for acute myocardial infarction in 52 high, middle and low-income countries: INTERHEART case-control study. *Heart*. 2009;95(24):2014–2022.
20. Anand SS, Islam S Rosengren A, Franzosi MG, Steyn K, Yusufali AH, et al; on behalf of the INTERHEART Investigators. Risk factors for myocardial infarction in women and men: insights from the INTERHEART study. *Eur Heart J*. 2008;29(7):932–940.
21. Kotseva K, Wood D, DeBacker G, DeBacquer D, Pyorala K, Keil U, for the EUROASPIRE Study Group. Cardiovascular prevention guidelines in daily practice: a comparison of EUROASPIRE I, II, and III surveys in eight European countries. *Lancet*. 2009;373(9667):929–940.
22. Motlagh B, O'Donnell M, Yusuf S. Prevalence of cardiovascular risk factors in the Middle East: a systematic review. *Eur J Cardiovasc Prev Rehabil*. 2009;16(3):268–280.
23. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. *Lancet*. 2005;365(9455):217–223.
24. Gajalakshmi CK, Jha P, Ranson K, Nguyen S. Global patterns of smoking and smoking-attributable mortality. In: Jha P, Chaloupka F, eds. *Tobacco Control in Developing Countries*. OUP for World Bank and World Health Organization. http://www1.worldbank.org/tobacco/tcdc/009TO040.pdf. Accessed June 17, 2010.
25. World Health Organization. Water pipe tobacco smoking: health effects, research needs and recommended actions by regulations. The WHO Study Group on Tobacco Product Regulation. 2005. http://www.who.int/tobacco/global_interaction/tobreg/waterpipe/en/index.html.
26. Shihadeh A, Saleh R. Polycyclic aromatic hydrocarbons, carbon monoxide, "tar," and nicotine in the mainstream smoke aerosol of the narghile water pipe. *Food Chem Toxicol*. 2005;43(5):655–661.
27. Maziak W. Patterns of waterpipe use and dependence: implications for intervention development. *Pharmacol Biochem Behav*. 2005;80(1):173–179.
28. Maziak W. Prevalence and characteristics of narghile smoking among university students in Syria. *Int J Tuberc Lung Dis*. 2004;8(7):882–889.
29. Maziak W, Ward K, Soweid A, Eissenberg T. Tobacco smoking using a waterpipe: a re-emerging strain in a global epidemic. *Tob Control*. 2004;13(4):327–333.
30. Friel S, Chopra M, Satcher D. Unequal weight: equity oriented policy responses to the global obesity epidemic. *BMJ*. 2007;335:1241–1243.
31. Baker JL, Olsen LW, Sorenson TIA. Childhood body-mass index and the risk of coronary heart disease in adulthood. *N Engl J Med*. 2007;357:2329–2337.

32. Bibbens-Domingo K, Coxson P, Pletcher MJ, Lightwood J, Goldman L. Adolescent overweight and future adult coronary heart disease. *N Engl J Med*. 2007;357:2371–2379.
33. Popkin BM. The nutrition transition in low-income countries: an emerging crisis. *Nutr Rev*. 1994;52(9):285–298.
34. World Health Organization. *Preparation and Use of Food-Based Dietary Guidelines. WHO Technical Report, Series 880. Report of a Joint FAO/WHO Consultation*. Geneva, Switzerland: World Health Organization; 1996.
35. Critchley J, Liu J, Zhao D, Wei W, Capewel S. Explaining the increase in coronary heart disease mortality in Beijing between 1984–1999. *Circulation*. 2004;110(10): 1236–1244.
36. Reddy KS, Yusuf S. Emerging epidemic of cardiovascular disease in developing countries. *Circulation*. 1998;97(6): 596–601.
37. Rosamond WD, Chambless LE, Folsom AR, et al. Trends in the incidence of myocardial infarction and in mortality due to coronary heart disease, 1987 to 1994. *N Engl J Med*. 1998;339(13):861–867.
38. Sytkowski PA, D'Agostino RB, Belanger AK, Kannel WB. Secular trends in long-term sustained hypertension, long-term treatment, and cardiovascular mortality. The Framingham Heart Study 1950 to 1990. *Circulation*. 1996;93(4):697–703.
39. Okrainec K, Benerjee D, Eisenberg M. Coronary artery disease in the developing world. *Am Heart J*. 2004;148(1):7–15.
40. Clarke R, Emberson J, Fletcher A, Breeze E, Marmot M, Shipley MJ. Life expectancy in relation to cardiovascular risk factors: 38 year follow-up of 19,000 men in the Whitehall study. *BMJ*. 2009;339:b3513.
41. Unal B, Critchley JA, Fidan D, Capewell S. Life-years gained from modern cardiological treatments and population risk factor changes in England and Wales, 1981–2000. *Am J Public Health*. 2005;95(1):103–108.
42. O'Flaherty M, Ford E, Allender S, Scarborough P, Capewell S. Coronary heart disease trends in England and Wales from 1984 to 2004; concealed leveling of mortality rates among young adults. *Heart*. 2007;94(2):178–181.
43. Capewell S, Morrison CE, McMurray JJ. Contribution of modern cardiovascular treatment and risk factor changes to the decline in coronary heart disease mortality in Scotland between 1975 and 1994. *Heart*. 1999;81(4):380–386.
44. 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(22):2128–2132.
45. Gupta R, Misra A, Vikram NK, et al. Younger age of escalation of cardiovascular risk factors in Asian Indian subjects. *BMC Cardiovasc Disord*. 2009;9:28.
46. Liu Z. Dietary sodium and the incidence of hypertension in the Chinese population: a review of nationwide surveys. *Am J Hypertens*. 2009;22(9):929–933.
47. Kadiri S. Tackling cardiovascular disease in Africa. *BMJ*. 2005;331(7519):711–712.
48. Lopez AD, Mathers CD. Measuring the global burden of disease and epidemiological transitions: 2002–2030. *Ann Trop Med Parasitol*. 2006;100(5–6):481–499.
49. Murray CJ, Lopez AD. *The Global Burden of Disease: A Comprehensive Assessment of Mortality and Disability From Diseases, Injuries and Risk Factors in 1990 and Projected to 2020*. Cambridge, MA: Harvard; 1996.
50. World Health Organisation Global Infobase International Comparisons. https://apps.who.int/infobase/Comparisons.aspx. Accessed January 5, 2011.
51. Azambuja MI, Foppa M, Maranhao MF, Achutti AC. Economic burden of severe cardiovascular diseases in Brazil: an estimate based on secondary data. *Arq Bras Cardiol*. 2008;91(3):148–155.
52. Iestra J, Kromhout D, van der Schouw Y, Grobbee D, Boshuizen H, van Staveren W. Effect size estimates of lifestyle and dietary changes on all-cause mortality in coronary artery disease patients: a systematic review. *Circulation*. 2005;112(6):924–934.
53. Rose G. *The Strategy of Preventive Medicine*. Oxford: Oxford Medical Publications; 1994.
54. Tunstall-Pedow H, Kuulasmaa K, Mahonen M, Tolonen H, Ruokokoski E, Amouyel P; for the WHO MONICA (Monitoring Trends and Determinants in Cardiovascular Disease) project. Contribution of trends in survival and coronary-event rates to changes in coronary heart disease mortality: 10-year results from 37 WHO MONICA project populations. Monitoring trends and determinants in cardiovascular disease. *Lancet*. 1999;353(9164):1547–1557.
55. Laatikainen T, Critchley J, Vartianinen 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(8):764–773.
56. European Society of Cardiology 2008. General Press Release: heart attack rates fall following smoking bans. http://www.escardio.org/about/press/press-releases/pr-08/pages/heart-attack-rates-fall.aspx. Accessed June 17, 2010.
57. Lawlor DA, Chaturvedi N. Treatment and prevention of obesity—are there critical periods for intervention? *In J Epidemiol*. 2006;35(1):3–9.
58. Watson R. Steps to a leaner Europe. *Br Med J*. 2007; 335(7632):1238.
59. Westley H. Thin living. *Br Med J*. 2007;335(7632):1236–1237.
60. Ebrahim S, Beswick A, Burke M, Davey Smith G. Multiple risk factor interventions for primary prevention of coronary heart disease. *Cochrane Database Syst Rev*. 2006;4: CD001561.
61. Pyorala K. Cardiovascular risk prediction systems have to be adapted and updated to current national conditions. *Eur J Cardiovasc Prev Rehabil*. 2006;113(5):674–675.
62. Wood DA, Kotseva K. Should cardiovascular disease prevention be undertaken by doctors or policymakers and politicians? *Dialogues Cardiovasc Med*. 2009;14(2):83–98.
63. Graham I, Atar D, Borch-Johnsen K, et al. Fourth Joint Task Force of the European Society of Cardiology and other societies on cardiovascular disease prevention in clinical practice. European guidelines on cardiovascular disease prevention in clinical practice: executive summary. *Eur J Cardiovasc Prev Rehabil*. 2007;14(suppl 2):E1–E40.
64. Mosca L, Banka CL, Benjamin EJ, et al. American Heart Association, American Academy of Family Physicians, American College of Obstetricians and Gynecologists, American College of Cardiology Foundation, Society of Thoracic Surgeons, American Medical Women's Association, Centers for Disease Control and Prevention, Office of Research on Women's Health, Association of Black Cardiologists, American College of Physicians, World Heart Federation, National Heart, Lung, and Blood Institute, American College of Nurse Practitioners. Evidence-based guidelines for cardiovascular disease prevention in women: 2007 update. *Circulation*. 2007;115(11):1481–1501.
65. Fagard RH. Prescription and results of physical activity. *J Cardiovasc Pharmacol*. 1995;25(suppl 1):S20–S27.
66. Goldstein MG, Whitlock EP, DePue J. Planning Committee of the Addressing Multiple Behavioral Risk Factors in Primary Care Project. Multiple behavioral risk factor interventions in primary care. Summary of research evidence. *Am J Prev Med*. 2004;27(2 suppl):61–79.
67. Holme I, Haaheinm LL, Tonstad S, Hjermann I. Effect of dietary and antismoking advice on the incidence of myocardial infarction: a 16-year follow-up of the Oslo

Diet and Antismoking Study after its close. *Nutr Metab Cardiovasc Dis*. 2006;16(5):330–388.
68. Berra K, Houston Miller N, Fair JM. Cardiovascular disease prevention and disease management: a critical role for nursing. *J Cardiopulm Rehab*. 2006;26(4):197–206.
69. Kamensky G, Murin J. Should cardiovascular disease prevention be undertaken by national cardiac societies? *Dialogues Cardiovasc Med*. 2009;14(2):1–6, 111.
70. The Catalonia Declaration investing in heart health. Declaration of the Advisory Board of the Second International Heart Health Conference; June 1, 1995; Barcelona, Catalonia, Spain. http://www.med.mun.ca/chhdbc/pdf/catalona.pdf. Accessed June 17, 2010.
71. The Victoria Declaration on heart health. Declaration of the Advisory Board of the International Heart Health Conference; May 28, 1992; Victoria, Canada. http://www.internationalhearthealth.org/Publications/victory_eng_1992.pdf. Accessed June 17, 2010.
72. New Zealand Guidelines Group (NZGG). Cardiac rehabilitation. 2002. http://www.nzgg.org.nz/guidelines/0001/cardiac_rehabilitation.pdf. Accessed June 17, 2010.
73. Pearson T, Blair S, Daniels S, et al. AHA Guidelines for Primary Prevention of Cardiovascular Disease and Stroke: 2002 update: census panel guide to comprehensive risk reduction for adult patient with coronary or other atherosclerotic vascular diseases. *Circulation*. 2002;106(3):388–391. http://www.circ.ahajournals.org/cgi/content/full/106/3/388. Accessed June 17, 2010.

Journal of Cardiovascular Nursing
Vol. 26, No. 4S, pp S15–S21 | Copyright © 2011 Wolters Kluwer Health | Lippincott Williams & Wilkins

Global Cardiovascular Disease Prevention: A Call to Action for Nursing

Multilevel Policies

Lora E. Burke, PhD, MPH, FAHA, FAAN; David R. Thompson, PhD, MBA, MA, BSc, RN, FESC, FRCN, FAAN; Sabine Roos, RN; Annemieke van Rijssen, RN, MANP; H. C. L. (Lenneke) Verdouw, MANP; Eva Troe, RN, MANP

This section, multilevel policies, reviews the impact that has been and can be made by health policy changes at multiple levels, strategies and resources for increasing adherence to population prevention recommendations, and how changes at the microlevel and macrolevel of the environment can provide opportunities and rewards for healthy behaviors and disincentives for unhealthy behaviors. Policies that support primary prevention of cardiovascular disease require the participation of numerous stakeholders at multiple levels, such as governmental and regulatory agencies. Such policy changes support a healthy lifestyle, as in designated smoke-free areas; laws that mandate that food purveyors reduce sodium and fat content or, eliminate *trans*-fats; and availability of safe parks and bike and walking trails; and also provide a supportive environment that in turn reinforces adherence to primary prevention. Health-related policies have a major impact at the societal level in both developed and developing countries; thus, it is important to understand the role that policy plays in promoting a healthier lifestyle and the prevention of cardiovascular disease. This section discusses how health policies can impact primary prevention and adherence to healthful recommendations, with examples focused on physical activity and diet.

KEY WORDS: multilevel policies, policy change, prevention

Impact of Multilevel Health Policy Change

Globalization has resulted in the transnationalization of production and finance, which has fostered interdependent geopolitical and economic relations.[1] As economic changes impact social conditions (inequities, social status) and affect health outcomes, health policy has to be seen not only in a global context but also as operating at national and municipal/local levels. Globalization also has consequences for health systems, in that the market-oriented initiatives of developed countries, such as the World Trade Organization and General Agreement on Trade in Services, can displace the promotion of social welfare and equity.[2] Therefore, the need for creative thinking and action by governments and stakeholders is evident at multiple levels and needs to embrace the dimensions of a diverse set of stakeholders at each level, taking account of, and influencing, environmental, regulatory, and institutional policies.

At the community level, for example, partnership models that include government agencies, nongovernmental organizations, professional bodies, communities, and the private sector are necessary. Such models require networks, alliances, and coalitions, including philanthropic and public-private partnerships, and the cross-fertilization of ideas to raise awareness and to develop, implement, and share an agreed-upon set of "best practices," taking into account resources such as infrastructure support, including research capacity. Policy development at the global level usually involves larger networks.

Lora E. Burke, PhD, MPH, FAHA, FAAN
Professor of Nursing and Epidemiology, Clinical and Translational Science Institute, University of Pittsburgh, Pennsylvania.
David R. Thompson, PhD, MBA, MA, BSc, RN, FESC, FRCN, FAAN
Professor of Nursing, Cardiovascular Research Centre, Australian Catholic University, Melbourne, Australia.
Sabine Roos, RN
Registered Nurse, Department of Internal and Vascular Medicine, Rijnstate Hospital, the Netherlands.
Annemieke van Rijssen, RN, MANP
Nurse Practitioner, Vasculair Medicine Clinic, Diakonessenhuis Utrecht and Zeist, the Netherlands.
H. C. L. (Lenneke) Verdouw, MANP
Nurse Practitioner, Groene Hart Ziekenhuis, Gouda, the Netherlands.
Eva Troe, RN, MANP
Nurse Practitioner, Multidisciplinaire Vasculair geneeskundige Poli, the Netherlands.
L.E.B. and D.R.T. are cochairs; S.R., A.R., and E.T. are contributors.
The authors have no conflicts of interest to report.
Correspondence
Lora E. Burke, PhD, MPH, FAHA, FAAN, Clinical and Translational Science Institute, University of Pittsburgh, 3500 Victoria St, PA 15261 (lbu100@pitt.edu).
DOI: 10.1097/JCN.0b013e318213efb3

At the global level, there is a need for a formal coalition, including, for example, the World Bank, International Monetary Fund, and finance ministries, most likely coordinated by the World Health Organization (WHO), to define a global agenda related to diet and physical activity. This might be done by linking the agenda to, and learning from, existing initiatives, such as the WHO policy on tobacco control and the Countrywide Integrated Noncommunicable Diseases Intervention program[3] or the Wellness in the Workplace Initiative of the World Economic Forum and the WHO.[3] The coalition will also need to build appropriate systems and infrastructures. A population strategy tackling the major social, economic, and cultural determinants of cardiovascular disease (CVD) at a societal level is paramount[4] and involves educating the public about good cardiovascular health, changing public policy to create heart-healthy environments, and persuading industries to reduce the manufacture/sale of unhealthy products.

We must take account of the needs of developing countries, which are particularly vulnerable to the negative health effects of economic globalization. Poor health contributes to poverty at the individual and societal levels through reduced productivity, particularly for lower-income countries. It may be possible to improve health equity by harnessing the growing capacity of these countries for health innovation through networks.[5]

At any level, social rather than purely technical solutions are probably required, working with key players to develop an interactive model of what works best, drawing on systems theory. There is a need for coordinated multilevel interventions (programs and policies) and multisector partnerships that are culturally relevant and context-specific. Approaches should consider safety, accessibility, availability, affordability, and sustainability and should emphasize the return on investment through enhanced productivity and health and economic gains. The impact of this health policy change needs to be determined at interpersonal, organizational, and community levels by a well-developed public health surveillance system.[6] Finally, the consequences of inaction should be stressed.

Lifestyle habits such as poor diet and physical inactivity are major factors in the cost of health care as well as morbidity and mortality. Indeed, the leading causes of death are related to lifestyle.[7] Policies initiated at the societal level can impact these lifestyle habits, for example, restriction on added sugar and sodium to the diet and easy access to venues that facilitate physical activity, which in turn improve health behaviors and quality of life. Improved health and quality of life, reduced health care costs, and reduced morbidity and mortality are the goals of prevention and thus should drive the health-related policies at the societal level. The cornerstone of prevention is a healthy lifestyle, which can be impacted by well-thought-out policies.

Multilevel Adherence

Traditionally, the multiple levels of adherence are considered as 3 major components and include the patient, the provider, and the health delivery system.[8] However, the multiple determinants of adherence can vary by the level of prevention. In the context of primordial and primary prevention, it may be the individual and personal-related factors, for example, social and economic factors such as affordability or access to healthy foods and nearness to safe sites for exercising. The provider and health delivery system may have nonexistent or minor roles.

The framework that seems to best fit the societal level approach to prevention is the social-ecological model (also see section II), a conceptual framework that can be used to examine the multiple effects and interrelatedness of social elements in an environment.[9] The social-ecological model posits that individuals' behaviors are influenced by their surroundings—physical, social, and cultural environments.[10] This suggests that the greatest impact of a policy is made when it optimizes the environments where people spend their time, that is, homes, workplaces, schools, and the greater community. This approach makes healthier behaviors the norm and healthier choices and places individual behavior in the context of multiple-level influences. It creates a supportive community and facilitates adherence to lifestyle recommendations.

Although a healthy lifestyle is the centerpiece of CVD prevention, adherence to prevention guidelines is also one of the most challenging tasks facing the population today. In the United States, less than 50% of the population achieves the recommended level of physical activity. On a more global basis, it is estimated that physical inactivity causes 1.9 million deaths per year.[11] A universal recommendation is for increased consumption of fruits and vegetables; however, this goal is far from being realized in industrialized nations such as the United States.[12] Among those with existing chronic disorders, only 11% of individuals with diabetes are reported to follow the dietary recommendations for saturated fat.[13] The global epidemic of overweight and obesity presents an added burden of increased CVD risk. Thus, these facts suggest that adherence to prevention strategies is seriously deficient and that strategies are needed at the societal level if we are to be successful in preventing CVD.

Despite the numerous studies focused on adherence and the voluminous body of literature on the topic, adherence has not improved much over recent decades. Many interventions are available; however, many are intense and not practicable for delivery in a clinical

setting,[14] and moreover, most interventions at the individual level cannot be sustained after contact is discontinued. Often the focus is on the patient, which can be helpful but is not sufficient to make a major impact in a multidimensional problem. Multicomponent and multilevel strategies are more likely to have a positive effect on adherence.[15] An extensive review of evidence-based strategies to promote a healthy diet and physical activity was published in 2010.[15] This article also emphasized that policies are needed to ensure an environment that will support preventive interventions, interventions that can be delivered in numerous settings and over sustained periods.

Multilevel Risk Factor–Specific Strategies and Resources for Increasing Adherence

The prevention model that is cited most often as a multilevel approach to risk reduction and to behavior change at the societal level is the tobacco control program implemented in several countries.[16] If a similar program could be implemented in terms of diet-related issues, for example, sweetened beverages, calorie-dense foods, and large portion sizes, it might be possible to reduce the obesity and type 2 diabetes epidemics. Attempts are being made to work with the food industry to modify food products, and initiatives are under way to restrict the availability of sweetened beverages in school settings; legislation at the local level is requiring restaurants to label menu items with the nutrient content.[17] New York City was the first city to introduce menu labeling and the restriction of *trans*-fat in foods. These programs are in their early stages, and so far, the results have been mixed. Other organizations, such as the Centers for Disease Control and Prevention and the American Heart Association, are addressing the content of salt in foods as a means to reduce the incidence of hypertension and the associated sequelae.

Similar to the eating-related behaviors that are being reinforced by the changing environment, the reduction in physical activity in many countries is related to a migration to an urban or suburban setting that often does not provide opportunities for physical activity.[18–21] It is extremely challenging to engage in behavior changes recommended by a provider (eg, reduce weight or become physically active) in an obesogenic environment that does not support healthful behaviors. To address this problem, some communities are reengineering the city to foster physical activity, for example, building parks and adding sidewalks. These initiatives are providing an environment that will support behavior change at both the societal and individual levels. Other problems that are being addressed include limited access to healthy foods and lack of safe physical areas for walking in impoverished areas; cities are negotiating with grocers to locate grocery stores in these urban areas and also to improve sidewalks and lighting.

Providing Incentives for Healthy Behaviors

Rewarding innovative approaches that lead to health gains and penalizing those who continue with practices that impede progress have been advocated.[22] Rewards and incentives can increase participation and successful outcome rates and help employees who are having difficulty deciding to make healthy choices.[23] An important point to bear in mind is that the costs of most unhealthy activities have an impact in the future, whereas the benefits of change occur in the present.[23] Targeted schemes of incentives include central government support via matching grants to commissioners who fund health promotion or disease prevention programs, matching grants to employers, direct payments to individuals engaged in health promotion or disease prevention, and taxes on unhealthy behaviors.[24]

The use of financial incentives by public agencies and private employers to encourage healthy behaviors has increased significantly. Some evidence suggests that financial incentives, even relatively small ones, can have a positive influence on health-related behaviors such as low-cholesterol diets and enhanced physical activity, but the effects may diminish over time.[25] Also, most of the evidence for using financial incentives to encourage exercise and weight control was carried out in work settings and is therefore more relevant for private-sector employers. Few studies conducted in the public sector have included long-term follow-up and have compared "positive" and "negative" incentives.[25]

It seems sensible that any system of incentives or rewards should take account of consumer characteristics such as health literacy, income, and self-efficacy, while recognizing that rewards might not necessarily be purely financial. Psychological and social strategies, such as receiving positive feedback to boost morale, instill confidence, increase satisfaction, and enhance self-esteem, may also be effective. Many community-based programs include reinforcement for progress, such as programs that set goals for weight loss or distance walked.

Social support has been associated with a reduced risk of CVD.[26] Available data clearly indicate that social relationships have potential for health-promoting and health-damaging effects in older adults and that there are biologically plausible pathways for these effects. Such evidence suggests that aspects of the social environment could play an important role in health promotion efforts for older adults, although careful consideration of both potentially positive as well as negative social influences is needed.[27]

Pay-for-performance programs instituted by health plans or by provider organizations in cooperation with

health plans seem to produce improvement in selected quality measures, but the contribution of financial incentives to this improvement is unclear.[28] Also, initial improvements in performance relative to quality measures may not necessarily reflect actual improvements in quality.[28] Nevertheless, initiatives such as incentive-based online physical activity interventions result in smaller increases in health care costs for participants compared with those for nonparticipants.[29] Consideration needs to be given to incentive strategies, types and amounts of rewards, and ethical and regulatory considerations. For example, holding employees accountable for their health behaviors, particularly through the use of penalties, may be perceived as violating individual liberties and discriminating against the unhealthy, and therefore ethical guidelines are necessary.[30]

Modifying Microenvironments to Increase Physical Activity

Urbanization has resulted in several environmental factors that may discourage participation in physical activity; these include population overcrowding, increased poverty, increased levels of crime, high density of traffic, low air quality, and absence of parks, sidewalks, and sports or recreational facilities.[31] After adjusting for environmental factors, educational attainment is inversely directly associated with leisure-time physical activity.[32]

Many developed countries have initiated physical activity interventions at the national, state, and community levels. Countries that rapidly transitioned from an agricultural-based society to one that is highly mechanized are faced with the challenge of promoting healthy levels of physical activity and preventing the development of conditions associated with a sedentary lifestyle.[33] However, often these countries do not have the resources to provide an environment that facilitates regular exercise. Societal efforts are needed to increase physical activity levels.[34] One approach could include offering individuals exercise prescriptions or creating a walking or jogging track in local municipal parks.[35] Whereas adults may respond to these types of interventions and feedback mechanism, children require different approaches. Providing playground markings or play equipment is not likely to increase activity levels during preschool recess; however, supervision that includes interaction with children and more structured physical activity seems to be needed.[36]

Commitment from powerful individuals in government is crucial, as it may drive the inclusion of physical activity promotion on the political agenda, particularly if the commitment is officially announced to the public. A network of relevant stakeholders (eg, ministries, private sector organizations, sports associations, schools, employers, parents, local community groups) is necessary for implementing physical activity interventions in specified settings (eg, school, community, workplace) and to disseminate intervention messages through relevant media (eg, television, radio, newspaper). Such networking and building of partnerships require shared values, mutual respect, and skillful articulation of arguments among stakeholders.[33]

National policies on physical activity should comprise multiple strategies that target supporting the individual and creating a supportive environment. A combination of different actions and programs is likely to be needed in different settings. The impact of physical activity interventions in developing countries needs to be better developed and examined through a systematic process and impact/outcome evaluation. To date, evaluation has been limited in developing countries.

Changes in the Food Supply and Population-Based Nutrition Education

Changes in diets and lifestyles that have occurred with industrialization, urbanization, economic development, and market globalization have accelerated in the past decade. These changes are having a significant impact on the health and nutritional status of populations, particularly in developing countries and in countries in transition. The pandemic of obesity and subsequent development of diabetes are of increasing concern; for example, in 2006, 1.6 billion people were overweight, and 400 million people were obese.

Several factors are contributing to the increasing prevalence of obesity, including the increased consumption of food through larger portion sizes, increased caloric density, and increased consumption of sweetened beverages.[37] The structure of the diet has changed with a higher consumption of fat, sugars, and saturated fat and a reduced intake of complex carbohydrates, fiber, fruits, and vegetables. In the past 15 years, there has been an increase of 250 kcal per capita per day. Similarly, in the past 3 decades, the per capita fat intake per day has increased by 14 g in Eastern Europe and 31 g in the European community. In 2 of the most affluent regions (North America and Europe), the intake of saturated fat is at or greater than 10% of total energy intake. In other regions, the intake of saturated fat is lower, ranging from 5% to 8 %. Only in recent years has fish consumption increased to the recommended twice a week, and this is in only a few countries.[38]

Recommendations have been made to improve dietary habits and nutrition at the population level.[39,40] The Mediterranean dietary pattern has been shown to improve CVD risk factors.[41] As nutritional habits are influenced by several factors, nutritional education needs to start early and target the family.[42,43] Each country needs to select the optimal mix of actions according to

Clinical Pearls

- Health policies need to be developed and coordinated at multiple levels, for example, local and national government and nongovernment organizations, through global agencies such as the WHO and the Centers for Disease Control and Prevention.
- Adherence to primary prevention consists of following the population-based guidelines provided by major government and nongovernment agencies as well as what is recommended by a health care provider. The social-ecological model provides a framework that examines the multiple effects and interrelatedness of social elements in an environment.
- Cardiovascular risk factors can be addressed at multiple levels, for example, the macroenvironmental and microenvironmental factors related to eating and physical activity. The focus needs to be on creating an environment in which healthy lifestyle habits are the norm, which represents a major shift from the obesogenic environment of today. Prevention-oriented services delivered at multiple levels, prevention clinic, work site, home, and community are critical to improving individual and population lifestyle habits.
- There is a critical need for research on the translation of interventions that target improved adherence, which can be delivered in more community-oriented settings and require less intensity.

their populace, use of food products, and capability of the country and its laws and realities.[38] The government can take a strong steering role in developing strategies and interventions for promoting a healthy diet, restricting the marketing of unhealthy foods, and promoting effective food labeling.[38] Population subgroups need extra attention: children during the fast-growth periods of infancy and adolescence[44] and families with a low income.[38] Health care professionals also need to be better educated about nutrition and how to counsel patients about lifestyle changes. This has implications for the curriculum of schools educating health professionals.

Economic Incentives for Organizations, Businesses, and Individuals

Macroenvironmental factors include not only air and water pollution, sanitation, nutrition, physical activity, and hygiene, but also the built environment and level of urbanization and land-use patterns. Thus, urban planning and design and building features in the home, school, and workplace can impact accessibility to recreational activity facilities, which, in turn, impacts the physical activity of the citizens and, consequently, lifestyle patterns and risk factors such as weight gain.[21] Political or legislative action may be required to modify recreational facilities and reduce population density and improve air quality. Legislation may be required to improve access to healthy foods and accurate labeling and to increase the numbers of foods with reduced salt, sugar, and saturated fats.[45] Lobbying and working in partnership with the tobacco and food industry may be useful but are likely to be more effective if accompanied by incentives for organizations, businesses, or individuals. At the organizational level, this may mean providing resources or expert consultation to monitor health improvement. At the individual level, this may mean exploiting opportunities for structural change, such as ensuring that schoolchildren can conveniently access vendors who sell fruits and vegetables. In essence, these measures are about giving stakeholders something they want to obtain buy-in. When salutary change is sought and achieved at community and national levels, we will begin to see improvements in disease prevention and public health.

Summary and Conclusions

The focus of this section has been on the development of health-related policies that support the primary prevention of CVD. Creating an environment that is supportive of healthful lifestyle habits promotes adherence to population-based health recommendations, such as those outlined in Healthy People 2010[46] and the WHO goals.[47] Increasingly more organizations are publishing health-oriented goals, for example, the American Heart Association.[48] As noted previously, the social-ecological model focuses on the greater environment such as the diet and physical activity programs discussed in this section, for example, reducing sodium from the food supply.[49] This approach can have a major impact on a large segment of the population. Moreover, it can lead to significant improvements in the population's cardiovascular health.

Although significant changes are occurring as a result of major initiatives to improve health at the societal level, a great deal remains to be done at multiple levels, which will only reinforce the sustainability of healthy lifestyle habits. At the level of health care delivery, reimbursement policies that support individual interventions to improve lifestyle will provide assistance to those who need more than what is provided in the community. At the community level, numerous stakeholders, from industry to health care professionals to citizens/patients, need to work together to promote legislative initiatives that will correct the obesogenic environment of today and modify it so that the default is healthy habits. An example of where more work needs to be done is the overwhelming amount of diet-related information that is presented to the public as well as the overwhelming array of food products that hype their healthful nutrients. Legislative initiatives

could be undertaken to provide more helpful information that could guide the consumer in food choices, as well as initiatives to limit the use of certain food components.[15] Similarly, initiatives need to be undertaken to improve the environment of communities and the workplace.

REFERENCES

1. MacLean SJ, MacLean DR. (Transnational) affairs of the heart: political economy and the globalization of cardiovascular disease. *Global Health Gov.* 2008;2(2):1–19.
2. Woodward D, Drager N, Beaglehole R, Lipson D. Globalisation and health: a framework for analysis and action. *Bull World Health Organ.* 2001;79(9):875–881.
3. Leurent HRK, Voûte J, Yach D. Wellness in the workplace: a multi-stakeholder health-promoting initiative of the World Economic Forum. *Am J Health Promot.* 2008;22(6):379–380.
4. Wood DA, Kotseva K. Should cardiovascular disease prevention be undertaken by doctors or policymakers and politicians? *Dialogues Cardiovasc Med.* 2009;14(2):83–98.
5. Morel CM, Acharya T, Broun D, et al. Health innovation networks to help developing countries address neglected diseases. *Science.* 2005;309(573):401–404.
6. Goff DC Jr, Brass L, Braun LT, et al. 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(1):127–155.
7. Mokdad AH, Ford ES, Bowman BA, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *JAMA.* 2001;289(1):76–79.
8. Miller NH, Hill M, Kottke T, Ockene IS. The multilevel compliance challenge: recommendations for a call to action. A statement for healthcare professionals. *Circulation.* 1997; 95(4):1085–1090.
9. Gregson J. System, environmental, and policy changes: using the social-ecological model as a framework for evaluating nutrition education and social marketing programs with low-income audiences. *J Nutr Educ.* 2001;33(1):4–15.
10. Oetzel JG, Ting-Toomey S, Rinderle S. Conflict communication in contexts: a social ecological perspective. In: Oetzel JG, Ting-Toomey S, eds. *The SAGE Handbook of Conflict Communication.* Thousand Oaks, CA: Sage; 2006.
11. Lloyd-Jones DM, Leip EP, Larson MG, et al. Prediction of lifetime risk for cardiovascular disease by risk factor burden at 50 years of age. *Circulation.* 2006;113(6):791–798.
12. Centers for Disease Control and Prevention. Prevalence of fruit and vegetable consumption and physical activity by race/ethnicity—United States 2005. *MMWR.* 2007;56(13): 301–304.
13. Eilat-Adar S, Xu J, Zephier E, O'Leary V, Howard BV, Resnick HE. Adherence to dietary recommendations for saturated fat, fiber, and sodium is low in American Indians and other US adults with diabetes. *J Nutr.* 2008;138(9):1699–1704.
14. World Health Organization. *Adherence to Long-Term Therapies: Evidence for Action.* Geneva, Switzerland: World Health Organization; 2003.
15. Artinian NT, Fletcher GF, Mozaffarian D, et al; on behalf of the American Heart Association Prevention Committee of the Council on Cardiovascular N. Interventions to Promote Physical Activity and Dietary Lifestyle Changes for Cardiovascular Risk Factor Reduction in Adults. A scientific statement from the American Heart Association. *Circulation.* 2010;122:406–441.
16. Leischow SJ. Setting the national tobacco control agenda. *JAMA.* 2009;301(10):1058–1060.
17. Ludwig DS, Brownell KD. Public health action amid scientific uncertainty: the case of restaurant calorie labeling regulations. *JAMA.* 2009;302(4):434–435.
18. Lopez R. Urban sprawl and risk for being overweight or obese. *Am J Public Health.* 2004;94(9):1574–1579.
19. Joshu CE, Boehmer TK, Brownson RC, Ewing R. Personal, neighbourhood and urban factors associated with obesity in the United States. *J Epidemiol Community Health.* 2008; 62(3):202–208.
20. Ewing R, Brownson RC, Berrigan D. Relationship between urban sprawl and weight of United States youth. *Am J Prev Med.* 2006;31(6):464–474.
21. Booth KM, Pinkston MM, Poston WSC. Obesity and the built environment. *J Am Diet Assoc.* 2005;105(5 suppl 1):S110–S117.
22. Quam L, Smith R, Yach D. Rise to the global challenge of the chronic disease epidemic. *Lancet.* 2006;368(9543):1221–1223.
23. CDC's LEAN Works! A Workplace Obesity Prevention Program. Determine Incentives and Rewards. http://www.cdc.gov/leanworks/promote/incentives.html. Accessed July 23, 2010.
24. Health England. Incentives for Prevention in Health England Report No. 3. 2009. http://www.healthengland.org/publications/HealthEnglandReportNo3.pdf. Accessed August 1, 2010.
25. Sutherland K, Christianson JB, Leatherman S. Impact of targeted financial incentives on personal health behaviour. A review of the literature. *Med Care Res Rev.* 2008;65(6):36S–78S.
26. Fischer Aggarwal BA, Liao M, Mosca L. Physical activity as a potential mechanism through which social support may reduce cardiovascular disease risk. *J Cardiovasc Nurs.* 2008; 23(2):90–96.
27. Seeman TE. Health promoting effects of friends and family on health outcomes in older adults. *Am J Health Promot.* 2000;14(6):362–370.
28. Christianson JB, Leatherman S, Sutherland K. Lessons from evaluations of purchaser pay-for-performance programs. A review of the evidence. *Med Care Res Rev.* 2008;65(6):5S–35S.
29. Lu C, Schultz AB, Sill S, Petersen R, Young JM, Edington D. Effects of an incentive-based online physical activity intervention on health care costs. *J Occup Environ Med.* 2008; 50(11):1209–1215.
30. Pearson SD, Lieber SR. Financial penalties for the unhealthy? Ethical guidelines for holding employees responsible for their health. *Health Aff.* 2009;28(3):845–852.
31. World Health Organization. A guide for population-based approaches to increasing levels of physical activity. 2007. http://www.who.int/dietphysicalactivity/physical-activity-promotion-2007.pdf. Accessed August 1, 2010.
32. Cirera L, Tormo MJ, Chirlaque MD, Navarro C. Cardiovascular risk factors and educational attainment in Southern Spain: a study of a random sample of 3091 adults. *Eur J Epidemiol.* 1998;14(8):755–763.
33. Shapo L, Pomerleau J, McKee M. Physical inactivity in a country in transition: a population-based survey in Tirana City, Albania. *Scand J Public Health.* 2004;32(1):60–67.
34. Trojani M, Palmieri L, Vanuzzo D, et al. C. Gruppo di Ricerca dell'Osservatorio Epidemiologico [Occupational and leisure time physical activity: trend in the Italian population]. *G Ital Cardiol.* 2006;7(7):487–497.
35. Smetanova BS, Lukl E, Slachta J, Stejskal RP. Steps to health. *Prakt Lekar.* 2006;86(8):443–445.
36. Cardon G, Labarque V, Smits D, Bourdeaudhuij ID. Promoting physical activity at the pre-school playground: the effects of providing markings and play equipment. *Prev Med.* 2009;48(4):335–340.

37. American Heart Association Nutrition Committee, Lichtenstein A, Appel L, Brands M, et al. Diet and lifestyle recommendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee. *Circulation*. 2006;114(1):82–96.
38. Gidding SS, Lichtenstein AH, Faith MS, et al. Implementing American Heart Association Pediatric and Adult Nutrition Guidelines: a scientific statement from the American Heart Association Nutrition Committee of the Council on Nutrition, Physical Activity and Metabolism, Council on Cardiovascular Disease in the Young, Council on Arteriosclerosis, Thrombosis and Vascular Biology, Council on Cardiovascular Nursing, Council on Epidemiology and Prevention, and Council for High Blood Pressure Research. *Circulation*. 2009;119(8):1161–1175.
39. Corbalan MD, Morales EM, Canteras M, Espallardo A, Hernandez T, Garaulet M. Effectiveness of cognitive-behavioral therapy based on the Mediterranean diet for the treatment of obesity. *Nutrition*. 2009;25(7–8):861–869.
40. Ranetbauer M, Hackl JM. Nutritional habits in 15-year-old students. *J Ernahrungsmedizin*. 2007;9(4):14–19.
41. Siero FW, Broer J, Bemelmans WJ, Meyboom-de Jong BM. Impact of group nutrition education and surplus value of Prochaska-based stage-matched information on health-related cognitions and on Mediterranean nutrition behavior. *Health Educ Res*. 2000;15(5):635–647.
42. Exl-Preysch B-M, Muhlemann P, Stauble-Tercier N, Gex C, Ryser H. Preventive nutrition for children. [Nutrition education for children and young people]. *Schweiz Zeitschrift Ganzheitsmedizin*. 2002;14(3):150–157.
43. World Health Organization, The European tobacco control report 2007. http://www.euro.who.int/__data/assets/pdf_file/0005/68117/E89842.pdf. Accessed August 1, 2010.
44. van Berkel TF, Boersma H, Roos-Hesselink JW, Erdman RA, Simoons ML. Impact of smoking cessation and smoking interventions in patients with coronary heart disease. *Eur Heart J*. 1999;20(24):1773–1782.
45. World Health Organization. *www.who.gov.* Accessed May 30, 2005.
46. Lloyd-Jones DM, Hong Y, Labarthe D, et al; on behalf of the American Heart Association Strategic Planning Task Force and Statistics Committee. Defining and setting national goals for cardiovascular health promotion and disease reduction: the American Heart Association's Strategic Impact Goal Through 2020 and Beyond. *Circulation*. 2010;121(4):586–613.
47. Dall TM, Fulgoni VL 3rd, Zhang Y, Reimers KJ, Packard PT, Astwood JD. Potential health benefits and medical cost savings from calorie, sodium, and saturated fat reductions in the American diet. *Am J Health Promot*. 2009;23(6):412–422.
48. Stokols D. Translating social ecological theory into guidelines for community health promotion. *Am J Health Promot*. 1996;10:282–298.
49. Stokols D, Grzywacz JG, McMahan S, Phillips K. Increasing the health promotive capacity of human environments. *Am J Health Promot*. 2003;18:4–13.

Journal of Cardiovascular Nursing
Vol. 26, No. 4S, pp S22–S34 | Copyright © 2011 Wolters Kluwer Health | Lippincott Williams & Wilkins

A Life Course Approach to Cardiovascular Disease Prevention

Laura L. Hayman, PhD, RN, FAAN, FAHA, FPCNA; Liz Helden, MEd, BSN, RN; Deborah A. Chyun, PhD, RN, FAAN, FAHA; Lynne T. Braun, PhD, CNP, FAAN, FAHA, FPCNA

During the past 2 decades, life-course social-ecological frameworks have emerged across health, developmental, social, behavioral, and public health disciplines as useful models for explaining how health trajectories develop over an individual's lifetime and how this knowledge can guide and inform new approaches to clinical and public health practice, multilevel policies, and research. Viewed from this perspective, and with emphasis on global cardiovascular health promotion and prevention of cardiovascular disease (CVD), this article summarizes evidence on the early origins and progression of CVD processes across the life course of individuals and diverse populations. Current evidence-based guidelines for CVD prevention are summarized, and recommendations for future research are suggested.

KEY WORDS: CVD, life course, prevention

Cardiovascular Disease Processes and Prevention in Early Life

Considerable evidence has accumulated over the past 5 decades indicating that atherosclerotic and hypertensive processes begin early in life and are influenced over time by the interaction of potentially modifiable behaviors and environmental exposures. Important to note, however, is that multidecade, population-based longitudinal data linking absolute levels of risk factors in childhood to incident cardiovascular disease (CVD) in adult life are not existent. Similarly, no randomized clinical trial data exist indicating that reduction of risk factors in childhood prevents cardiovascular events in adult life. The collective evidence, however, reviewed briefly in this article, supports a life course social-ecological approach to CVD prevention[1,2] and has prompted and informed the development of guidelines focused on prevention and management of risk factors for CVD in children and adolescents.[3–5]

Laura L. Hayman, PhD, RN, FAAN, FAHA, FPCNA
Associate Dean for Research and Professor of Nursing, College of Nursing and Health Sciences, University of Massachusetts, Boston; Director of Research, GoKids Boston, Massachusetts.
Liz Helden, MEd, BSN, RN
Nurse Codirector, Pediatric Lipid Clinic, Hamilton Health Sciences, McMaster Children's Hospital, Ontario, Canada.
Deborah A. Chyun, PhD, RN, FAAN, FAHA
Associate Professor and Director, Florence S. Downs PhD Program in Nursing Research, New York University College of Nursing.
Lynne T. Braun, PhD, CNP, FAAN, FAHA, FPCNA
Nurse Practitioner, Rush Heart and Vascular Institute, Professor, Rush University College of Nursing, Chicago, Illinois.

The authors have no conflicts of interest to report.

Correspondence
Laura L. Hayman, PhD, RN, FAAN, FAHA, FPCNA, College of Nursing and Health Sciences, University of Massachusetts Boston, 100 Morrissey Blvd, Boston, MA 02125-3393 (laura.hayman@umb.edu).

DOI: 10.1097/JCN.0b013e318213ef7f

Evidence from Pathology, Autopsy, and Noninvasive In Vivo Studies

The Bogalusa Heart Study,[6] a long-term epidemiologic study of cardiovascular risk factors, included cross-sectional and longitudinal surveys of healthy, community-dwelling children (n = 3500; 65% white; 35% black) and a pathology/autopsy component designed to examine the associations of established risk factors for CVD measured prior to accidental death and the extent of postmortem aortic and coronary artery atherosclerosis. Autopsy data from 93 individuals (35% black; 31% female) who were 15 to 28 years of age at time of death indicated that the extent of fatty streaks and fibrous plaques in the aorta and coronary arteries increased with age and was stronger in the coronary arteries ($r = 0.60$; $P < .001$) than in the aorta ($r = 0.23$; $P = .03$). As a group, body mass index (BMI), systolic blood pressure (SBP), diastolic blood pressure, and serum concentrations of total cholesterol (TC), triglycerides (TGs), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C) were strongly associated with the extent of lesions in the aorta and coronary arteries (canonical correlation, $r = 0.70$; $P < .001$). Of note, cigarette smoking increased the percentage of intimal surface involved with fibrous plaques in the aorta (1.22% in smokers vs 0.12% in nonsmokers, $P = .02$). Important and oft-cited results

from this Bogalusa pathology study, subjects with multiple risk factor clustering had more extensive atherosclerosis; the extent of fatty streak lesions in the coronary arteries was 8.5 times as great in persons with 3 or 4 risk factors compared with those with none (P = .03), and the extent of fibrous-plaque lesions in the coronary arteries was 12 times as great (P = .006).

These findings concur with those observed in the multicenter Pathobiological Determinants of Atherosclerosis in Youth (PDAY) study of 1443 persons (25% female, 53% black) 15 to 34 years of age who died of noncardiovascular causes and were autopsied within 48 hours after death in forensic laboratories. Specifically, in this PDAY analysis, atherosclerosis of the aorta and right coronary arteries was quantitated as the extent of intimal surface involved with both fatty streaks and raised lesions and analyzed postmortem serum for lipoprotein cholesterol (very-low-density lipoprotein cholesterol, LDL-C, HDL-C) and thiocyanate (indicator of smoking) were included and viewed as risk factors for CVD. Similar to Bogalusa results, atherosclerosis increased with age in all arterial segments of all sex and race groups. Although some sex and race differences in fatty streaks and raised lesions were observed, 3 potentially modifiable risk factors measured (very-low-density lipoprotein cholesterol + LDL-C, smoking) adversely affected atherosclerotic processes to the same extent in black and white males and females. Combined with the pathology results from Bogalusa,[6] PDAY findings[7,8] added to the developing database regarding the associations of established risk factors for CVD and atherosclerotic processes in childhood and young adulthood, provided support for primary prevention beginning early in life, and prompted the need for additional research.

More recently, noninvasive imaging has been used to examine the association of potentially modifiable risk factors for CVD with vascular structure and function in childhood and adolescence and atherosclerosis in young adult life (Table 1). Data from the Muscatine Study, a longitudinal study of CVD risk factors in children and youth, demonstrated positive associations between carotid intima-media thickness (CIMT) measured in adults 33 to 42 years of age and levels of serum TC and BMI measured in childhood.[9] In the Bogalusa Heart Study, similar results were observed: childhood LDL-C and BMI predicted increased CIMT in adulthood.[10] Results from the Young Finns Study, a population-based prospective cohort study of young adults 24 to 39 years of age, reaffirm the link between risk factors present in adolescence and preclinical atherosclerosis in adulthood.[11] The potentially modifiable risk factors and behaviors that predicted preclinical atherosclerosis included LDL-C, BMI, cigarette smoking, and SBP. More recently, in a cross-sectional comparative study of lean and obese children and children and youth with type 2 diabetes mellitus (T2DM), Urbina and colleagues[12] showed that adolescents and young adults with T2DM have significantly greater CIMT than lean controls for all carotid artery segments examined. Of note, obese and T2DM children and youth had stiffer carotid arteries with higher Young elastic modulus and β stiffness index than their lean counterparts. Collective results indicated that youth with T2DM demonstrate significant abnormalities in carotid function and structure. In obese youth, changes were observed before progression to overt T2DM. Importantly, given the global increase in obesity and T2DM in children and youth, the presence of either of these conditions contributed independently to adverse changes in carotid structure and function.[12]

Evidence From Epidemiologic Studies

Evidence from epidemiologic studies conducted in the United States and globally indicates that risk factors and adverse health behaviors associated with CVD in adulthood, such as cigarette smoking, dyslipidemias (high levels of LDL-C and low levels of HDL-C), high blood pressure, physical inactivity, obesity, and diabetes, have their origins in childhood and adolescence. Population- based studies including those conducted in Muscatine,[13] Bogalusa,[14] Europe (European Youth Heart),[15] Finland (Young Finns),[16] and Canada[17,18] describe the distribution and determinants of CVD risk factors in their countries' youth (Table 2). Tracking of risk factors, maintenance of percentile rank over time, from childhood to young adulthood has been documented in males and females from diverse racial/ethnic groups and is particularly evident in the upper and lower extremes of the distribution.[13,14,16] Tracking is relevant to primary prevention because of the potential for identifying children at risk for CVD early in life. Intraindividual clustering of risk factors (obesity, elevated blood pressure, dyslipidemia) and adverse health behaviors has also been observed in children and adolescents in studies conducted in the United States and globally.[19–24]

Obesity, a recognized major risk factor for CVD, has increased in prevalence in children and adolescents in the United States and globally throughout the past 3 decades (Table 2). Although precise global estimates of the prevalence of childhood obesity are difficult to ascertain because of the use of nonrepresentative samples in many countries and between country differences in measurement of obesity, an international study (Health Behaviour in School-aged Children Study), conducted in collaboration with the World Health Organization, provides relevant global data.[19] This 2001–2002 cross-sectional survey of 137 593 children and adolescents (10–16 years of age) from 34 countries, primarily European, documented the highest prevalence

TABLE 1 Noninvasive Imaging Studies: Cardiovascular Disease (CVD) Risk Factors and Vascular Structure and Function in Childhood, Adolescence, and Young Adulthood

Study	Purpose	Method and Sample	Results	Conclusions
Davis et al[9] (2001)	Examine the association of CVD risk factors measured in childhood, young, and middle adulthood and load from childhood to adulthood and CIMT in young and middle adulthood	Carotid ultrasound studies were performed in n = 346 men and n = 379 women aged 33–42 y who were representative of a cohort followed since childhood (8–18 y of age at baseline) as part of Muscatine study	The significant current/adulthood predictors of CIMT were age and LDL-C in both males and females and DBP in females. TC was a significant childhood predictor in both males and females; BMI was also significant in females. For males, in risk factor load model, LDL-C, HDL-C, and DBP were predictive of CIMT; in females, LDL-C, BMI, and triglycerides were predictive.	In this primarily white population, higher CIMT in young and middle-aged adults was associated with childhood and current CVD risk factors as well as risk factor load.
Li et al[10] (2003)	Examine the association of CIMT in young adults and traditional CVD risk factors measured since childhood	This cohort study of n = 486 adults aged 25–37 y (71% white; 39% men) was conducted in a semirural biracial community in Bogalusa, Louisiana. Participants had ≥3 measurements of traditional risk factors since childhood.	Significant predictors for being in top vs lower 3 quartiles of CIMT in young adults were childhood measures of LDL-C, BMI, and adulthood measures of LDL-C, HDL-C, and SBP. An increasing trend in CIMT across quartiles of childhood measures of LDL-C was observed with a mean value of 0.761 mm (95% CI, 0.743–0.780 mm) for those at top quartile vs 0.724 mm (95% CI, 0.715–0.734 mm) for those in lower 3 quartiles ($P < .001$).	Potentially modifiable childhood measures of LDL-C and BMI predict CIMT in black and white male and female young adults.
Raitakari et al[11] (2003)	Examine the relationship between CVD risk factors in childhood and adolescence and CIMT as marker of clinical atherosclerosis measured in adulthood	Population-based prospective cohort study conducted at 5 centers in Finland and included n = 2229 white adults 24–39 y old who were examined during childhood and adolescence and then 21 y later	In multivariable models adjusted for age and sex, CIMT in adulthood was associated with childhood LDL-C levels ($P = .001$), SBP ($P < .001$), BMI ($P = .007$), and smoking ($P = .02$) and with adult SBP ($P < .001$), BMI ($P < .001$), and smoking ($P = .004$). Number of CVD risk factors measured in 12- to 18-y-olds (LDL-C, SBP, BMI, and cigarette smoking) was directly related to CIMT in young adults (at ages 33–39 y) and remained significant ($P < .001$) after adjustment for adult measures.	In this Young Finns study, risk factor profiles assessed in adolescence predict adult CIMT independently of adult risk factor levels suggesting that exposure to CVD risk factors early in life may induce adverse changes in arteries that contribute to development of atherosclerosis.
Urbina et al[12] (2009)	Examine and compare CIMT and carotid stiffness in youth who are lean, obese, and those with T2DM	Cross-sectional, comparative study of n = 446 youth (10–24 y of age; 65% nonwhite; 39% male)	Adolescents and young adults with T2DM had significantly greater CIMT than lean controls for all carotid artery segments. Obese and T2DM participants had stiffer carotid arteries with higher Young elastic modulus and β stiffness index than lean counterparts.	Adolescents and young adults with obesity and/or T2DM are at risk for adverse changes in carotid function and structure. Although additional research is warranted, these results suggest the need for prevention of obesity and T2DM early in life.

Abbreviations: BMI, body mass index; CIMT, carotid intima-media thickness; DBP, diastolic blood pressure; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; MI, myocardial infarction; SBP, systolic blood pressure; T2DM, type 2 diabetes mellitus; TC, total cholesterol.

TABLE 2 Epidemiologic Studies of Cardiovascular Risk Factors and Cardiovascular Disease (CVD) Related Health Behaviors in Children and Adolescents

Study	Purpose	Method	Results	Conclusions
Lauer and Clarke[13] (1990)	Examine the validity and utility of cholesterol screening tests for school-aged children in relation to prediction of adult hypercholesterolemia	Six biennial cross-sectional surveys were conducted with n = 2367 children (51% female), 8–18 y of age at baseline) and followed to 20–30 y of age	For children with TC levels >75% tile on 2 occasions, 75% females and 56% males would not qualify for intervention as adults by the NCEP criteria (TC ≥200 mg/dL). For children with TC >90th percentile: 57% females and 30% males would not qualify as adults	In this white population of children from Muscatine, Iowa, childhood results suggest that screening for TC without measuring LDL-C in childhood may fail to identify those at risk and falsely label those not at risk.
Webber et al[14] (1991)	Assess tracking of serum lipids and lipoproteins over 12-y period from childhood to adulthood	Community-based population study including n = 1586 children (55% female; 36% black) examined at baseline in 1973–1974 and in 1984–1986	Approximately 50% of children with TC or LDL-C levels >75th percentile at baseline remained elevated 12 y later. Tracking, as measured by correlation coefficients and persistence at extreme quartiles, was evident for all lipids and lipoproteins. The best predictor of follow-up lipid or lipoprotein level was baseline level, and the next best predictor was increase in weight as defined by weight/height^3, an index of obesity.	In this biracial community-based sample, childhood levels of serum lipids and lipoproteins are predictive of young adult levels. Lipids and lipoproteins track from childhood into young adulthood, suggesting the utility of baseline measures early in life and emphasis on development of healthy lifestyle behaviors early in life.
Riddoch et al[15] (2005)	Ultimate goal: establish nature, strength, and interactions between personal, environmental, and lifestyle influences on CVD risk factors in children and youth.	Cross-sectional survey of n = 4169 children (9–15 y of age) from 4 countries: Denmark, Estonia, Norway, Portugal. Protocol includes physiological, behavioral-lifestyle, personal, (biological and psychological), and environmental measures.	Results demonstrated the feasibility of field-based assessment, reliability and validity of measures/methods, and acceptability of the survey protocol.	Multilevel influences on CVD risk factors in children can be measured with advanced technology and quality control.
Porkka et al[16] (1994)	Analyze tracking and predictiveness of serum lipoprotein measurements in Finnish youth	Main cross-sectional study conducted in 1980 with follow-up studies in 1983, 1986, 1989, 1992. Sample consisted of n = 3596 children 3–18 y of age at baseline. Follow-ups were conducted 4 times over a 12-y period. Cohort for analysis: n = 883 (47% male)	Approximately 50% of subjects initially in extreme quintiles of TC, LDL-C, and HDL-C were in same quintiles after 12 y. Multiple regression results: childhood serum lipid levels are the most important predictor of adult lipid levels.	In this study of young Finns, serum lipids and lipoproteins track from childhood and adolescence to adulthood and suggest that screening in childhood—particularly in children with family history of premature CHD may assist in identifying children at risk early in life
Lee et al[17] (2009)	Examine temporal trends (1994–2005) in risk factors for CVD and impact of socioeconomic status (SES) on risk factors	Data from the National Population Health (NPH) Survey and Canadian Community Health Survey (CCHS) used to examine trends in CVD, hypertension, T2DM and, obesity (BMI) (1994–2005), adjusted for age and sex. Data were stratified by category of income adequacy, BMI and region of residence. Sample included individuals ≥12 y of age who participated in NPH in 1994 (n = 17 626); 1996 (n = 73 402) and CCHS: 2001 (n = 131 535); 2003 (n = 135 573); and 2005 (n = 132 947).	CVD increased by 19% for men and 2% for women (1994–2005); CVD increased significantly in lowest-income category (27%), in lower middle category (37%), and upper middle category (12%). In highest-income group, CVD increased by 6%. Diabetes increased in all but highest-income group (56% in lowest-income group). Hypertension and BMI increased in all groups; lowest (85% and 20%, respectively).	Trends over time (1994–2005) in CVD and risk factors indicate increasing prevalence particularly in lower SES groups and point to the need for population-based prevention and targeted efforts to reduce disparities in CVD and its major risk factors.

(continued)

TABLE 2 Epidemiologic Studies of Cardiovascular Risk Factors and Cardiovascular Disease (CVD) Related Health Behaviors in Children and Adolescents, continued

Study	Purpose	Method	Results	Conclusions
Janssen et al[19] (2005)	Present and compare international estimates of prevalence of overweight and obesity in school-aged children and youth from 34 countries and examine relationship of diet and physical activity to weight status	Data consisted of a cross-sectional survey: (n = 137 593, 10–16 y of age; 47% female). Prevalence of overweight and obesity: based on self-reported height and weight and international child body mass index standards. Dietary intake was measured with food frequency questionnaires; physical activity and sedentary behaviors were measured by self-report.	Two countries with highest prevalence of overweight and obese children were Malta (25.4% and 7.9%) and US (25.1% and (6.8%), respectively. Within most countries, physical activity levels were lower, and TV viewing times were higher in overweight compared with normal-weight children. Overweight status was not associated with intake of fruits, vegetables, or soft drinks or computer time.	Increasing physical activity and decreasing TV viewing (sedentary behaviors) should be focal points of strategies for preventing and managing overweight and obesity in children and youth. Results viewed in context of limitations of self-reported weight status and health behaviors.

Abbreviations: BMI, body mass index; CHD, coronary heart disease; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; MI, myocardial infarction; T2DM, type 2 diabetes mellitus; TC, total cholesterol.

of overweight and obesity in Malta (25.4% and 7.9%, respectively) and the United States (25.1% and 6.8%, respectively). The 2 countries with the lowest prevalence were Lithuania (5.1% and 0.4%, respectively) and Latvia (5.9% and 0.5%, respectively). Overweight and obesity rates were higher in countries in North America, Great Britain, and southwestern Europe. Of note, reported levels of physical activity were lower and television viewing higher in countries with the highest prevalence of overweight and obesity.[19] Results from clinical and epidemiologic studies indicate that overweight and obese children and adolescents are at greater risk for early-onset comorbidities including insulin resistance,[20] type 2 diabetes,[21] dyslipidemia,[22] and hypertension,[23] all of which contribute to and accelerate risk for CVD in adulthood.[24]

As a result of these clinical and epidemiologic studies and the known obesity-CVD associations, a number of countries have established guidelines for the prevention and management of obesity in children and adolescents.[25,26]

Emerging Evidence: Research in Progress

Morrison and colleagues[27] recently initiated the prospective longitudinal Canadian Family Atherosclerosis Monitoring In earLY life (FAMILY) study, which is designed to follow a cohort of 850 children and their families (mother, father, eldest sibling). The purpose of this study was to examine the fetal/maternal and early childhood family-based determinants for the development of obesity and CVD risk factors (dysglycemia, dyslipidemia, and hypertension) in the progression of atherosclerosis in childhood.[27] Other counties have also initiated prospective cohort studies to examine the distribution and determinants of risk factors for CVD in childhood.[28,29] These data are necessary to guide and inform country-specific CVD prevention practices and policies for children and adolescents.

Prevention of CVD in Early Life: Current Guidelines

As noted above and based on available evidence, a series of guidelines for cardiovascular health promotion and risk reduction in childhood and adolescence has been issued by the American Heart Association (AHA) and US and Canadian child health agencies and pediatric expert panels.[3–5,25,26] Coordinated by the National Heart, Lung, and Blood Institute, National Institutes of Health, integrated guidelines for assessing and managing risk factors and health behaviors in children and youth have been developed and will be available in 2011.[30] In addition, initiatives are currently in progress in several countries that are designed to result in guidelines for cardiovascular health promotion/risk

reduction beginning early in life and extending across the life course. Major emphasis in current guidelines for cardiovascular health promotion and risk reduction in children and youth is focused on development and maintenance of healthy lifestyle behaviors and therapeutic behavioral-lifestyle change (TLC), respectively.[3–5,25,26,30] Smoke-free lifestyles and environments, 60 minutes of moderate-to-vigorous-physical activity per day, less than 2 hours per day of leisure-time sedentary activity, and a heart-healthy pattern of dietary intake are recommended in the majority of guidelines for children 2 years or older.[3–5,25,26,30] The AHA's most recent dietary recommendations for all children and youth (≥2 years of age) emphasize balancing caloric intake with physical activity to maintain normal growth and developmental processes while minimizing the development of CVD risk factors, particularly dyslipidemia, elevated blood pressure and glucose levels, and excessive body weight.[5] Recommendations for essential and discretionary calories based on age, sex, and activity level as well as specific guidelines for daily intakes of macronutrients and micronutrients are suggested with emphasis on establishing and maintaining a healthful overall dietary pattern. The AHA recommends patterns of dietary intake that include a variety of fruits and vegetables, whole grains, low-fat and nonfat dairy products, legumes, fish (preferably oily fish high in omega-3 fatty acids), poultry, and lean meat.[5] For all children 2 years or older, moderate fat intake (25%–35% of daily energy intake), with primary sources of added fats from vegetable oils (soybean, canola, corn, olive, sunflower, and safflower), is recommended. Limiting saturated fat intake to less than 7%, *trans*-fat to less than 1% of daily energy intake, and cholesterol to less than 300 mg/d is also recommended along with minimizing intake of foods and beverages with added sugars and processed foods with added salt.

Whereas an extensive discussion of TLC recommendations for children with specific CVD risk factors is beyond the scope of this article, an adequate trial of TLC (normally 3 months) with emphasis on normalization of body weight is recommended in most guidelines for initial management of risk factors including dyslipidemias and elevated blood pressure in children and youth.[3–5,25,26,30] Many factors are recommended for consideration before progressing beyond TLC to pharmacotherapy or other treatment modalities, including family history of CVD, the child's age and maturational level, total risk profile, response to TLC, and patient and family preferences and resources.[3–5,25,26,30] Important from a social-ecological perspective is that recent guidelines also consider such contexts as the child's family, school, and community environments, which influence health behaviors and lifestyles central to cardiovascular health.[30] The AHA and American Academy of Pediatrics guidelines, for example, encourage parent and family involvement in the development and implementation of strategies for health behavior change including patterns of dietary intake and physical activity, parent and consumer advocacy for healthy school environments with emphasis on healthy foods served in all venues, and advocacy for multilevel policies that affect access to and availability of healthy foods and outlets and built environments conducive to physically active and smoke-free lifestyles.[3–5]

Cardiovascular Disease Processes and Prevention in Midlife

Viewed from a life course perspective, CVD prevention in midlife, similar to childhood and adolescence, places emphasis on healthy lifestyle behaviors and the contexts and social influences that affect these behaviors.[1,2,31–33] The Framingham Heart Study (FHS) documented the associations of age, sex, hypertension, hyperlipidemia, and diabetes with absolute risk for developing coronary heart disease (CHD).[32] In most industrialized nations, CVD increases with age; however, in developing countries, the age at onset is much younger. Although CVD is the No. 1 cause of mortality in the United States, age-specific data in 2000 showed that malignancy surpassed heart disease as the leading cause of death from ages 35 to 74 years. In this age group, heart disease has declined by 26% since 1980, although it is now the major cause of death after age 75 years.[31] In industrialized nations, clinical and community-based initiatives that have focused on promotion of heart-healthy diets, smoking cessation, smoke-free environments, and physically active lifestyles, together with drug treatment for hypertension and hypercholesterolemia, and percutaneous and surgical interventions when needed, have combined to reduce overall deaths from CVD and to shift CVD as a cause of death from middle to old age. This is not the case in the developing world. In the Russian Federation, CVD mortality is 5 times the US rate for working-age people, 30 to 59 years.[33] In India, the prevalence of CHD has risen 4-fold over the last 40 years, and now CVD is the leading cause of death, responsible for 29% of all deaths in 2005. In the age group of 35 to 64 years, deaths due to CVD resulted in 9.2 million "potentially productive" years of lost life in 2000, almost 6-fold more than in the United States.[34]

The AHA estimates that approximately 44% of the decline in the CHD death rate between 1980 and 2000 was attributable to changes in risk factors, particularly lower TC (24%), lower SBP (20%), lower smoking prevalence (12%), and increased physical activity (5%).[35] In addition, clinical outcome trials conducted in the United States, Europe, and Asia have shown

significant reductions in CHD events, strokes, and CVD mortality when major risk factors including blood pressure and cholesterol are lowered with behavioral interventions (TLC) and pharmacotherapy.[36–38] The benefits of maintaining optimal cardiovascular risk profiles in midlife are detailed in the next section of this article.

Cardiovascular Disease Prevention in Older Adults

Although there is wide geographic variability, currently, 10% of the world's population is 60 years or older. This is expected to increase to 22% by 2050, ranging from 10% of the population in Africa to 35% in Europe. Asia will see its elderly population almost doubled.[39–41] In addition, the percentage of the population 80 years or older is expected to increase rapidly. In 2005, this segment accounted for 1% of the population, whereas by 2050 it is expected to reach more than 4%; in Europe, those 80 years or older will comprise 10% of the population, and in North America, 8%.[40,41] Global population trends reveal several important factors in relation to CVD in older adults. The transformation from levels of high mortality and high fertility to one of low mortality and low fertility, known as the "demographic transition," is responsible for rapid and accelerating population growth, along with slowing of that growth and for population aging.[42] Nearly all the population growth is occurring in less developed countries,[39] and life expectancy varies widely by region. In more developed countries, life expectancy averages 76 years, compared with only 49 years in Africa. Currently, infants born around the world can expect to live an average of 65 years, which represents an increase of 9 years since the late 1960s. Asia has experienced the largest increase in life expectancy, from 54 years to 67 years.[39] Although different areas of the world are at difference stages of the demographic transition, with less developed countries having significantly younger populations than more developed countries, these countries will eventually experience a similar increase in their older adult population relative to their younger population. This shift presents important challenges to governments and policy makers, as well as to health care providers, as it is changing the old-age dependency ratio; that is, there will be fewer workers to support the growing number of older adults, and with a decrease in fertility, there will be fewer children to care for aging parents.[43] The burden of CVD in older adults over the next 50 years will be greatest in the Asian-Pacific region.[44–46] Finally, these trends have important implications given the prevalence of CVD in women, particularly in older women. Currently, women comprise about half the world's population. By the end of the next quarter century, women will account for more than half (54%) of people 60 years or older, and 63% of very old people (aged ≥80 years).[39]

As noted above, the prevalence of risk factors for CVD increases with increasing age in both men and women. The metabolic syndrome, which includes elevated blood pressure, TGs, and blood glucose, low HDL-C, and central obesity, predicts CVD morbidity and mortality as well as the development of T2DM, rises sharply with increasing age, and is present in almost 44% of the population aged 60 to 69 years.[47] These same risk factors are important, not only for their contribution to chronic disease, but also for their impact on disability in the elderly. Therefore, efforts to reduce modifiable health risks may postpone the onset of initial disability as well as decrease lifetime disability.[48] This is important, as persons 65 years or older account for the largest percentage of the disability in the United States, and this percentage will increase as the older population increases.[49] Maintaining functional independence is an important goal of health care for older persons, yet at least 10% of nondisabled, community-living older adults develop dependence in 1 or more activities of daily living each year.[49] The onset of dependence frequently heralds a downward spiral, with increasing frailty, greater use of formal and informal home care services, and frequent hospitalization and nursing home placement, all of which translate into higher health care costs.[49]

A prevalent chronic condition that poses challenges for maintaining functional independence in older adults, T2DM has been associated with a 2- to 4-fold higher risk of CVD as well as increased risk of mortality by up to 3-fold.[35] A recent report from FHS designed to examine change in all-cause, CVD, and non-CVD mortality rates among FHS participants in 2 time periods (1950–1975 and 1976–2001) reaffirms the T2DM-mortality associations.[50] Specifically, although a decline in all-cause and CVD mortality rates was observed among both men and women with and without diabetes, both men and women remained at higher risk of all-cause and CVD mortality than those without diabetes. Among women, the hazard ratios (HRs) for all-cause mortality in the later (1976–2001) versus the earlier (1950–1975) time period were 0.59 (95% confidence interval [CI], 0.50–0.70; $P < .0001$) for those without diabetes and 0.48 (95% CI, 0.32–0.71; $P = .002$) for those with diabetes. Similar results were observed in men. In the earlier time period, comparing participants with diabetes to those without diabetes, the HRs for CVD mortality were 5.08 ($P < .001$) for women and 2.95 ($P < .001$) for men; in the later time period, the HRs for CVD mortality were 3.49 ($P < .0001$) for women and 2.35 ($P < .0001$) for men.

Important to note is that FHS participants are primarily white; thus, observed mortality trend data may not be generalizable to men and women from other

racial/ethnic groups. Despite this limitation, data from clinical and epidemiologic studies underscore the adverse cardiovascular consequences of T2DM and support the need for prevention of this chronic condition beginning early in the life course and reduction and control of other established risk factors for CVD in individuals with T2DM.[35,36]

Results from population-based and clinical studies support the importance of risk reduction in older adults with and without CVD. The Scandinavian Simvastatin Survival Study (4S), conducted in patients with known CHD demonstrated that reduction in TC, LDL-C, and TGs, along with increases in HDL-C, was just as pronounced in patients 65 years or older as in younger patients and that patients on simvastatin had significantly lower rates for total mortality, coronary mortality, and the need for revascularization.[51] Furthermore, the reductions in major coronary events, CHD mortality, nonfatal myocardial infarction (MI), all-cause mortality, and the need for revascularization in patients 65 years or older were as great or greater than in younger subjects, with an overall relative risk reduction (RRR) in major coronary events of 32% in persons 65 years or older and 31% in persons younger than 65 years. This resulted in an absolute risk reduction in mortality that was twice as great in older patients (44 per 1000; 95% CI, 30–58 per 1000) compared with individuals younger than 65 years (32 per 1000; 95% CI, 24–40 per 1000).[51] These results are consistent with other lipid-lowering trials.[52–54] In addition, in the Diabetes Prevention Program, a greater reduction in development of diabetes was demonstrated in older subjects as compared with their younger counterparts.[55]

The INTERHEART study demonstrated that 9 modifiable risk factors—smoking, low fruit and vegetable consumption, lack of exercise, alcohol consumption, high apolipoprotein B–apolipoprotein A_1 ratio, self-reported hypertension and diabetes, abdominal obesity, and psychosocial factors—were consistently and strongly associated with MI across the globe and across different subgroups—geographic regions and ethnic groups, young and older adults, men and women, and different socioeconomic strata.[56] Daily consumption of fruits or vegetables, moderate or strenuous physical exercise, and consumption of alcohol 3 or more times per week were associated with a lower risk of MI.[56] As all MIs were included as cases, and controls were matched to within 5 years of cases, adults older than 60 years accounted for more than 25% of the subjects, with the highest end of the interquartile range varying from 59 (Middle East) to 72 years (western Europe). Thus, INTERHEART has provided important information not only on the global contribution of these risk factors, but also on their importance in older adults.[56]

Overall, the population attributable risk (PAR) for all 9 risk factors was 90.4% (99% CI, 88.1%–92.4%), meaning that 90.4% of all MIs could be accounted for by these factors. Conversely, 90.4% of MIs could be eliminated if these 9 factors were eliminated. Although, at 93.8% (99% CI, 90.9%–95.8%), the PAR was significantly greater ($P < .0001$) in younger individuals (≤55 years in men and ≤65 years in women), the PAR was still high in older individuals at 87.9% (99% CI, 84.1%–90.9%). Although the strength of the risk factors, as assessed by odds ratios (ORs), was lower for smoking, hypertension, diabetes, abdominal obesity, psychosocial factors, and high apolipoprotein B–apolipoprotein A_1 ratio, and less protective for fruit and vegetable consumption in older versus young individuals, alcohol consumption and exercise were more protective in older adults, although the difference was not significant. Lipid levels (OR, 2.50; 99% CI, 2.05–3.05), smoking (OR, 2.44; 99% CI, 2.10–2.84), and psychosocial factors (OR, 2.43; 99% CI, 1.86–3.18) were the factors most strongly associated with MI. Importantly, given the global epidemic of type 2 diabetes, the risk of MI associated with diabetes was greater in women at both younger (OR, 3.53; 99% CI, 2.49–5.01) and older ages (2.59; 99% CI, 1.78–3.78) than in younger (OR, 2.66; 99% CI, 2.04–3.46) and older men (OR, 1.93; 99% CI, 1.58–2.37). Similar to these observations of Western populations, in the Asia-Pacific Cohort Studies Collaboration, the risk of stroke and CHD jointly increased according to levels of SBP and serum cholesterol.[57]

Thus, the strength of these associations and the high PAR challenges the assumption that established CVD risk factors are not as informative in predicting risk or targeting interventions in older adults. The debate remains, however, as to the predictive validity of traditional risk factors in older adults, as most risk equations were developed in populations younger than 75 years of age (Table 3). In adults 85 years or older, available data suggest that major, classic risk factors may not be as useful in predicting CVD mortality as in younger male and female counterparts.[58] Nevertheless, despite the ongoing controversy about the predictive ability of classic CVD risk factors in older adults and the fact that few studies have included adults 75 years or older, the data regarding efficacy of treatment and prevention of adverse cardiac events in older adults in Western countries are overwhelmingly positive. Smoking cessation, hypertension and lipid management, and obesity, psychosocial, and physical activity interventions have all shown that these interventions reduced risk to a level comparable to younger adults.[59–61] Given that older adults are at higher risk for CVD than are younger individuals, this translates into significant reductions on a population level. Despite this evidence, however, primary and secondary prevention in the elderly is frequently compounded by age bias, the belief that older individuals should not be treated aggressively.

TABLE 3 Examples of Currently Available Cardiovascular Disease (CVD) Risk Assessment/Prediction Tools[64,a]

Name	Description/Comments
Framingham[32] (1998)	End point: all CHD; includes CHD death, MI unstable angina, and angina pectoris
ATP-III Risk Estimator (Framingham)[65,66]	End point: hard CHD; includes CHD, death, and nonfatal MI
ETHRISK[67]	Framingham Risk Score recalibrated to estimate 10-y risk for CHD and CVD in 7 British black and minority ethnic groups; 3778 men and 3544 women, aged 35–54 y
Framingham[68] global CVD, 2008	End point: global CVD; includes CVD death, all CHD, stroke, heart failure, and claudication
PROCAM[69]	End point: hard CHD; includes CHD death and nonfatal MI; http://www.assmann-stiftung.de/en/procam/procam-risk-scores/
QRISK[70]	End point: CVD; includes CHD, stroke, and transient ischemic attack
Reynolds risk score (women)[71]	End point: global CVD; includes CVD death, MI, stroke, revascularization; http://www.reynoldsriskscore.org/
Reynolds risk score (men)[72]	End point: global CVD; includes CVD death, MI, stroke, revascularization
New Zealand cardiovascular risk assessment and management chart[73]	http://www.sld.cu/galerias/pdf/servicios/hta/ebm_cardio_new_zeland.pdf
Joint British Society[63]	http://www.patient.co.uk/doctor/How-to-use-the-Coronary-Risk-Prediction-Charts-for-Primary-Prevention.htm
SCORE[74]	End point: CVD death; includes CVD death only; does not include nonfatal events; multiple region-specific (northern European, southern European) and country-specific versions available

Abbreviations: CHD, coronary heart disease; MI, myocardial infarction.
[a]Adapted from Lloyd-Jones, *Circulation*. 2010;121:1769.[64]

Clearly, assessment of CVD risk and management of established and nontraditional risk factors for CVD in older adults in the United States and globally remains a fertile area for future research.

Global Risk Assessment

The AHA and the Joint British Societies recommend that all adults 40 years or older or those with 2 or more risk factors should have a global risk assessment performed.[62,63] Several CVD risk assessment and prediction tools being used with ethnically diverse populations are available in the literature and/or via the Internet; these tools generally depict an individual's short-term risk for developing a CVD event (Table 3).[32,63–74] These tools involve the assignment of a point value to selected risk factors and the calculation of a global risk score. For example, the Framingham Risk Score (FRS),[65] which estimates the 10-year absolute risk for developing CHD, is particularly useful in patients with multiple risk factors and a high risk for CHD in the next 10 years (≥20%). A clinical limitation of the FRS and other short-term risk estimates is the underestimation of risk in women and younger individuals, as age is the most heavily weighted risk factor. Individuals with low or intermediate 10-year risk for CHD may actually be at high risk in the long term, because any single risk factor can lead to cumulative atherosclerotic burden and adverse outcomes if left untreated for many years.[75] Therefore, the determination of lifetime risk is useful for assessing the cumulative risk of developing a disease during the remainder of an individual's life.[76]

Lloyd-Jones and colleagues[77] used FHS cohorts of patients to estimate lifetime risk for CVD and to examine overall survival with regard to established risk factors. Framingham Heart Study participants were free of CVD (MI, coronary insufficiency, angina, stroke, claudication) at 50 years of age and were followed up to 95 years of age. Participants included 3564 men and 4362 women who were followed up for a total of 111 777 person-years. During follow-up, 1757 participants had an incident CVD event, and 1641 died of something other than overt CVD. Men who were free of CVD at 50 years of age had a lifetime risk (to 95 years of age) for developing CVD of 51.7% (95% CI, 49.3%–54.2%).[77] Median overall survival for men was 30 years. Women who were free of CVD at 50 years of age had a lifetime risk (to 95 years of age) for developing CVD of 39.2% (95% CI, 37.0%–41.4%). Median overall survival for women was 36 years. The effect of individual risk factors, such as elevated blood pressure and TC, was associated with increased lifetime risk for CVD and with shorter median survival in both men and women. The presence of diabetes at age 50 years yielded the highest lifetime risk for CVD of any single risk factor—67.1% for men and 57.3% for women through 75 years of age. Smokers had CVD events much earlier than nonsmokers. Although lifetime risk for CVD was similar for smokers and nonsmokers, the risk of death from other smoking-related causes shortened the median survival of smokers by 5 years. Compared with participants who had 2 or more major risk factors at age 50 years, participants with optimal risk factor levels had much lower lifetime risks (5.2% vs 68.9% in men; 8.2% vs 50.2% in women) and

significantly longer median survival (>11 years in men, >8 years in women). In addition, when low HDL-C (<40 mg/dL in men, <50 mg/dL in women) and obesity (BMI ≥30 kg/m^2) were evaluated, lifetime risks for CVD were similar to those associated with major risk factors (elevated TC and blood pressure).

The results of this study fully support the observation that CVD is a major cause of mortality in the United States. For individuals free of CVD at age 50 years, more than half of men and almost 40% of women will develop CVD during their remaining life span.[77] Therefore, the presence of risk factors in a young or middle-aged individual will make a substantial contribution to the development of atherosclerosis if they are not modified early in the life course.

Important to emphasize is that CVD risk prediction (in the United States and globally) has been a focal point for substantial controversy and research. Historically, the assessment of risk has been a key component in efforts to define risk factors for CVD, to identify and assess potential targets for therapy, and to enhance the cost-effective implementation of therapies for both primary and secondary prevention.[64] Recent emphasis has been placed on the need for additional research to understand the clinical utility and impact of both short- and long-term risk estimation and corresponding strategies for provider-patient risk communication.[64] A cornerstone of CVD risk assessment and management, as CVD risk prediction models and prevention algorithms for risk communication, patient motivation, and clinical decision making are modified to reflect results of ongoing research, guidelines for primary and secondary prevention (discussed in the following section) will also be modified.

Primary and Secondary Prevention of Cardiovascular Disease: Overview of Recent Evidence-Based Guidelines

Based on available evidence, the AHA issued revised guidelines for primary prevention of CVD and stroke in 2002.[62] These guidelines present a comprehensive approach to the prevention of a first episode of CHD or stroke and focus in large part on the adoption of a healthy lifestyle, which is the cornerstone of primary prevention. Included in the guidelines are recommendations for the avoidance of tobacco, healthy dietary patterns, weight control, and regular exercise, as well as blood pressure and lipid targets, and aspirin therapy based on individual CVD risk status. The need for the management of diabetes and atrial fibrillation is also addressed. In 2006, the AHA and the American College of Cardiology published secondary prevention guidelines for patients with CHD and other atherosclerotic vascular disease.[78] These differ from the primary prevention guidelines by including recommendations for aggressive risk-reducing therapies that have been shown to improve survival and quality of life and to prevent recurrent events and the need for coronary interventions. The secondary prevention guidelines added the optional lower LDL-C target of less than 70 mg/dL for very high-risk CHD patients. Complete smoking cessation, good blood pressure control, regular physical activity, weight management, a heart-healthy diet, and diabetes management are recommended, in addition to antiplatelet agents, renin-angiotensin-aldosterone system–blocking agents, and β-blockers in most patients, unless otherwise contraindicated. Finally, the guidelines state that patients with CVD should have an annual influenza vaccination.[78]

Evidence-based prevention guidelines specific to women were updated in 2011 by the AHA.[79] These guidelines were prompted by the recognition of CVD as a major cause of mortality among women worldwide. They address the limitations of the Framingham global risk score in women and appreciate that the average lifetime CVD risk in women is very high. Recommendations are based on a risk stratification scheme that classifies women into high risk, at risk, or at optimal risk. These guidelines provide recommendations for both primary and secondary prevention, including both lifestyle and drug therapies. Daily administration of omega-3 fatty acids and screening for depression were added as considerations for women with CHD. In addition, potential risks and benefits of hormone replacement therapy, antioxidant vitamins, folic acid supplementation, and aspirin to prevent MI in women younger than 65 years of age were identified and discussed. As noted above, these guidelines for women are likely to be revised as additional evidence becomes available.

The Joint British Societies (British Cardiac Society, British Hypertension Society, Diabetes UK, HEART UK, Primary Care Cardiovascular Society, and The Stroke Association) have published integrated prevention guidelines for patients with established CVD, those with diabetes, and healthy individuals at high risk (≥20% over 10 years).[63] These guidelines are similar to the AHA/American College of Cardiology secondary prevention guidelines; however, they are written in more comprehensive, narrative form with substantiating evidence and also include audit standards for CVD prevention. They represent the combined work and agreement of many medical societies and organizations committed to the important goal of CVD prevention.

Summary

Global evidence indicates that CVD processes begin early in life and are influenced over the life course by both nonmodifiable and potentially modifiable behaviors, risk factors, and environmental exposures. Viewed from a life course social-ecological perspective,

Clinical Pearls

- Global evidence indicates that CVD processes begin early in life and are influenced over time by both nonmodifiable and potentially modifiable behaviors, risk factors, and environmental exposures.
- Viewed from a life course social-ecological perspective, efforts to promote cardiovascular health and reduce the risk and burden of CVD globally must extend beyond the level of the individual and include such contexts as the family, school, community, and broader societal influences.
- Extensive evidence has emerged over the past several decades that prompted the development of CVD prevention guidelines for children, adolescents, and adults.
- Ongoing research is focused on determining optimal individual and population-based approaches to CVD prevention on a global level.

efforts designed to promote cardiovascular health and reduce the risk and burden of CVD globally must attend to individual modifiable factors and those that extend beyond the level of the individual including such contexts as the family, school/community, and broader societal influences. Extensive evidence has emerged over the past several decades that prompted the development and dissemination of CVD prevention guidelines for children, adolescents, and adults. As new evidence becomes available, guidelines for CVD prevention will be revised. Ongoing research is focused on determining and developing optimal individual and population-based approaches to CVD prevention on a global level.

REFERENCES

1. Halfon N, Holstein M. Life course health development: an integrated framework for developing health, policy and research. *Milbank Q*. 2002;80(3):433–479.
2. Ben-Shlomo Y, Kuh D. A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. *Int J Epidemiol*. 2002;31(2):285–293.
3. 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(4):1562–1566.
4. Daniels SR, Greer FR; and the Committee on Nutrition. Lipid screening and cardiovascular health in childhood. *Pediatrics*. 2008;122(1):198–208.
5. Gidding SS, Lichtenstein AH, Faith MS, et al. Implementing American Heart Association pediatric and adult nutrition guidelines: a scientific statement from the American Heart Association Nutrition Committee of the Council on Nutrition, Physical Activity and Metabolism, Council on Cardiovascular Disease in the Young, Council on Arteriosclerosis, Thrombosis and Vascular Biology, Council on Cardiovascular Nursing, Council on Epidemiology and Prevention, and Council for High Blood Pressure Research. *Circulation*. 2009;119:1161–1175.
6. Berenson GS, Srinivasan SR, Bao W, et al. Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults: the Bogalusa Heart Study. *N Engl J Med*. 1998;338(23):1650–1656.
7. McGill HC Jr, McMahan CA, Malcom GT, Oalmann MC, Strong JP. Effects of serum lipoproteins and smoking on atherosclerosis in young men and women. The PDAY Research Group. Pathobiological Determinants of Atherosclerosis in Youth. *Arterioscler Thromb Vasc Biol*. 1995;15(9):512–1531.
8. McGill HC Jr, McMahan CA, Malcom GT, Oalmann MC, Strong JP; and the Pathobiological Determinants of Atherosclerosis in Youth (PDAY) Research Group. Relation of glycohemoglobin and adiposity to atherosclerosis in youth. *Arterioscler Thromb Vasc Biol*. 1995;15:431–440.
9. Davis PH, Dawson JD, Riley WA, Lauer RM. Carotid intimal-media thickness is related to cardiovascular risk factors measured from childhood through middle age: the Muscatine Study. *Circulation*. 2001;104:2815–2819.
10. Li S, Chen W, Srinivasan SR, et al. Childhood cardiovascular risk factors and carotid vascular changes in adulthood: the Bogalusa Heart Study. *JAMA*. 2003;290(17):2271–2276.
11. Raitakari OT, Juonala M, Kahonen M, et al. Cardiovascular risk factors in childhood and carotid intima-media thickness in adulthood: the Cardiovascular Risk in Young Finns Study. *JAMA*. 2003;290(17):2277–2283.
12. Urbina EM, Kimball TR, McCoy CE, Khoury PR, Daniels SR, Dolan LM. Youth with obesity and obesity-related type 2 diabetes mellitus demonstrate abnormalities in carotid structure and function. *Circulation*. 2009;119(22):2913–2919.
13. Lauer RM, Clarke WR. Use of cholesterol measurements in childhood for the prediction of adult hypercholesterolemia: the Muscatine Study. *JAMA*. 1990;264(23):3034–3038.
14. Webber LS, Srinivasan SR, Wattigney WA, Berenson GS. Tracking of serum lipids and lipoproteins from childhood to adulthood; the Bogalusa Heart Study. *Am J Epidemiol*. 1991;133(9):884–899.
15. Riddoch C, Edwards D, Page A, et al. The European Youth Heart Study. Cardiovascular disease risk factors in children: rationale, aims, design, and validation of methods. *J Phys Act Health*. 2005;2:115–129.
16. Porkka KV, Viikari JS, Taimela S, Dahl M, Akerblom HK. Tracking and predictiveness of serum lipid and lipoproteins measurements in childhood: a 12-year follow-up: the Cardiovascular Risk in Young Finns study. *Am J Epidemiol*. 1994;140(12):1096–1110.
17. Lee DS, Chiu M, Manuel DG, et al; Canadian Cardiovascular Outcomes Research Team. Trends in risk factors for cardiovascular disease in Canada: temporal, socio-demographic and geographic factors. *CMAJ*. 2009;181(3–4):E55–E66.
18. Paradis G, Lambert M, O'Loughlin J, et al. The Quebec Child and Adolescent Health and Social Survey: design and methods of a cardiovascular risk factor survey for youth. *Can J Cardiol*. 2003;19(5):523–531.
19. Janssen I, Katzmarzyk PT, Boyce WF, et al; Health Behavior in School-Aged Children Obesity Working Group. Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. The International Association for the Study of Obesity. *Obes Rev*. 2005;6(2):123–132.
20. Caprio S, Bronson M, Sherwin RS, Rife F, Tamborlane WV. Co-existence of severe insulin resistance and hyperinsulinaemia in pre-adolescent obese children. *Diabetologia*. 1996;39(12):1489–1497.
21. Fagot-Campagna A, Pettitt DJ, Engelgau MM, et al. Type 2 diabetes among North American children and adolescents:

an epidemiologic review and a public health perspective. *J Pediatr*. 2000;136(5):664–672.
22. Gidding SS. Dyslipidemia in the metabolic syndrome in children. *J Cardiometab Syndr*. 2006;1(4):282–285.
23. Hansen ML, Gunn PW, Kaelber DC. Underdiagnosis of hypertension in children and adolescents. *JAMA*. 2007;298(8):874–879.
24. Steinberger J, Daniels SR, Eckel R, et al. Progress and challenges in the metabolic syndrome in children and adolescents. *Circulation*. 2009:119(4);628–647.
25. Lau D, Douketis J, Morrison KM, Hramiak I, Sharma A, Ur E. Expert panel. 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children: summary report. *CMAJ*. 2007;176(suppl 8):S1–S13.
26. Barlow SE; for the Expert Committee. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent, overweight and obesity: summary report. *Pediatrics*. 2007;20(suppl 4):S164–S192.
27. Morrison KM, Atkinson SA, Yusuf S, et al; FAMILY Investigators. The Family Atherosclerosis Monitoring In earLY life (FAMILY) study: rationale, design, and baseline data of a study examining the early determinants of atherosclerosis. *Am Heart J*. 2009;158(4):533–539.
28. Olsen J, Melbye M, Olsen SF, et al. The Danish national birth cohort—its background, structure and aim. *Scand J Public Health*. 2001;29(4):300–307.
29. Reilly JJ, Armstrong J, Dorosty AR, et al. Early life risk factors for obesity in childhood: cohort study. *BMJ*. 2005;330(7504):1357–1364.
30. National Institutes of Health. National Heart, Lung, and Blood Institute. *NHLBI Pediatric Guidelines for Cardiovascular Health Promotion and Risk Reduction*. 2010. In press.
31. A Race Against Time. The Challenge of Cardiovascular Disease in Developing Economies. http://www.earth.columbia.edu/news/2004/images/raceagainsttime_FINAL_051104.pdf. Accessed June 18, 2010.
32. Wilson PW, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. *Circulation*. 1998;97(18):1837–1847.
33. Greenberg H, Raymond SU, Leeder SR. Cardiovascular disease and global health: threat and opportunity. *Health Affairs Web Exclusive*. 2005;W5-31-W5-41. http://content.healthaffairs.org.ezproxy.lib.umb.edu/cgi/reprint/hlthaff.w5.31v1. Accessed June 20, 2010.
34. Reddy KS. India wakes up to the threat of cardiovascular diseases. *J Am Coll Cardiol*. 2007;50(14):1370–1372.
35. American Heart Association. Heart disease and stroke statistics: 2009 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation*. 2009;119(3):e21–e181.
36. Grundy SM, Cleeman JI, Merz CNB, et al, for the Coordinating Committee of the National Cholesterol Education Program. Implications of recent clinical trials for the National Cholesterol Education Program Adult Treatment Panel III Guidelines. *Circulation*. 2004;110(2):227–239.
37. Nakamura H, Arakawa K, Itakura H, et al; for the MEGA Study Group. Primary prevention of cardiovascular disease with pravastatin in Japan (MEGA Study): a prospective randomized controlled trial. *Lancet*. 2006;368(9540):1155–1163.
38. Blood Pressure Lowering Treatment Trialists' Collaboration. Effects of ACE inhibitors, calcium antagonists, and other blood-pressure-lowering drugs: results of prospectively designed overviews of randomized trials. *Lancet*. 2000;356(9246):1955–1964.
39. United Nations. *World Population Prospects: The 2002 Revision (Medium Scenario)*. New York, NY: United Nations Publication; 2003.
40. United Nations. *World Population Prospects: The 2004 Revision*. United Nations Publication; 2005.
41. United Nations. *Population Challenges and Development Goals*. United Nations Publication; 2005. Sales No. E.05.XIII.8.
42. Department of Economic and Social Affairs. *UN Secretariat. The Diversity of Changing Population Age Structures in the World*. New York, NY: Department of Economic and Social Affairs Population Division; 2005.
43. Population Reference Bureau Staff. *Popul Bull*. 2004;59.
44. Asia Pacific Cohort Studies Collaboration. The impact of cardiovascular risk factors on the age-related excess of coronary heart disease. *Int J Epidemiol*. 2006;35(4):1025–1033.
45. Martiniuk AL, Lee CM, Lawes CM, et al; for the Asia-Pacific Cohort Studies Collaboration. Hypertension: its prevalence and population-attributable fraction for mortality from cardiovascular disease in the Asia-Pacific region. *J Hypertens*. 2007;25(1):73–79.
46. Sasayama S. Heart disease in Asia. *Circulation*. 2008;118:2669–2671.
47. Ford ES, Giles WH, Dietz WH. Prevalence of the metabolic syndrome among US adults: findings from the Third National Health and Nutrition Examination Survey. *JAMA*. 2002;287(3):356–359.
48. Vita AJ, Terry RB, Hubert HB, Fries JF. Aging, health risks, and cumulative disability. *N Engl J Med*. 1998;338(15):1035–1041.
49. Gill TM, Baker DI, Gottschalk M, Gahabuer EA, Charpentier PA, de Regt PT. A rehabilitation program for physically frail community-living older persons. *Arch Phys Med Rehabil*. 2003;84(3):394–404.
50. Preis SR, Hwang SJ, Coady S, et al. Trends in all-cause and cardiovascular disease mortality among women and men with and without diabetes mellitus in the Framingham Heart Study, 1950 to 2005. *Circulation*. 2009;119(13):1728–1735.
51. Miettinen TA, Pyorala K, Olsson AG, et al. Cholesterol lowering therapy in women and elderly patients with myocardial infarction or angina pectoris: findings from the 4S study. *Circulation*. 1997;96(12):4211–4218.
52. LaRosa JC, He J, Vupputuri S. Effects of statins on risk of coronary disease: a meta-analysis of randomized controlled trials. *JAMA*. 1999;282(24):2340–2346.
53. Lewis SJ, Moye LA, Sacks FM, et al. Effect of pravastatin on cardiovascular events in older patients with myocardial infarction and cholesterol levels in the average range: results of the Cholesterol and Recurrent Events Trial (CARE). *Ann Intern Med*. 1998;129(9):681–689.
54. LIPID Study Group. Prevention of cardiovascular events and death with pravastatin in patients with coronary heart disease and a broad range of initial cholesterol levels. *N Engl J Med*. 1998;339(19):1349–1357.
55. Diabetes Prevention Program Research Group. Reduction of the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med*. 2002;346(6):393–403.
56. Yusuf S, Hawken S, Ôunpuu S, et al; and the INTERHEART Study Investigators. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet*. 2004;364(9438):937–952.
57. Asia Pacific Cohort Studies Collaboration. Joint effects of systolic blood pressure and serum cholesterol on cardiovascular disease in the Asia Pacific region. *Circulation*. 2005;112(22):3384–3390.
58. de Ruijter W, Westendorp RG, Assendelft WJ, et al. Use of Framingham Risk Score and new biomarkers to predict

cardiovascular mortality in older people: population based observational cohort study. *BMJ*. 2008;337:a3083. doi:10.1136/bmj.a3083.
59. Williams MA, Fleg JL, Ades PA, et al. Secondary prevention of coronary heart disease in the elderly (with emphasis on patients ≥75 years of age). *Circulation*. 2002;105(14): 1735–1743.
60. Shepherd J, Blauw GJ, Murphy MB, et al. Pravastatin in Elderly Individuals at Risk of Vascular Disease (PROSPER): a randomised controlled trial. *Lancet*. 2002;360(9346): 1623–1630.
61. Beckett NS, Peters R, Fletcher AE, et al. Treatment of hypertension in patients 80 years of age or older. *N Engl J Med*. 2008;358(18):1887–1898.
62. Pearson TA, Blair SN, Daniels SR, et al. AHA guidelines for primary prevention of cardiovascular disease and stroke: 2002 update. Consensus panel guide to comprehensive risk reduction for adult patients without coronary or other atherosclerotic vascular diseases. *Circulation*. 2002;106(3):388–391.
63. British Cardiac Society, British Hypertension Society, Diabetes UK, HEART UK, Primary Care Cardiovascular Society, the Stroke Association. JBS 2: Joint British Societies' guidelines on prevention of cardiovascular disease in clinical practice. Heart. 2005;91(suppl V):v1–v52.
64. Lloyd-Jones DM. Cardiovascular risk prediction: basic concepts, current status and future directions. *Circulation*. 2010;121:1768–1777.
65. 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(25):3143–3421.
66. D'Agostino RB, Grundy SM, Sullivan LM, Wilson P; for the CHD Risk Prediction Group. Validation of the Framingham coronary heart disease prediction scores: results of a multiple ethnic groups investigation. *JAMA*. 2001;286:180–187.
67. Brindle P, May M, Gill P, et al. Primary prevention of cardiovascular disease: a Web-based risk score for seven British black and minority ethnic groups. *Heart*. 2006; 92(11):1595–1602.
68. D'Agostino RB, Vasan RS, Pencina MJ, et al. General cardiovascular risk profile for use in primary care. The Framingham Heart Study. *Circulation*. 2008;117(6):743–753.
69. Assmann G, Cullen P, Schulte H. Simple scoring scheme for calculating the risk of acute coronary events based on the 10-year follow up of the Prospective Cardiovascular Munster (PROCAM) study. *Circulation*. 2002;105:310–315.
70. Hippisley-Cox J, Coupland C, Vinogradova Y, Robson J, May M, Brindle P. Derivation and validation of QRISK a new cardiovascular risk score for the United Kingdom: prospective open cohort study. *BMJ*. 2007;335(7611):136.
71. Ridker PM, Buring JE, Rifai N, Cook NR. Development and validation of improved algorithms for the assessment of global cardiovascular risk in women: the Reynolds risk score. *JAMA*. 2007;297:611–619.
72. Ridker PM, Paynter NP, Rifai N, Gaziano JM, Cook NR. C-reactive protein and parental history improve global risk prediction: the Reynolds score for men. *Circulation*. 2008;118:2243–2251.
73. New Zealand Guidelines Group. *New Zealand Cardiovascular Guidelines Handbook: A Summary Resource for Primary Care Practitioners*. 2nd ed. Wellington, New Zealand: New Zealand Guidelines Group, 2009.
74. Conroy RM, Pyorala K, Fitzgerald AP, et al; SCORE Project Group. Estimation of ten year risk of fatal cardiovascular disease in Europe: the SCORE project. *Eur Heart J*. 2003; 24(11):987–1003.
75. Lloyd-Jones DM, Wilson PWF, Larson MG, et al. Framingham Risk Score and prediction of lifetime risk for coronary heart disease. Am J *Cardiol*. 2004;94(1):20–24.
76. Lloyd-Jones DM, Larson MG, Beiser A, Levy D. Lifetime risk of developing coronary heart disease. *Lancet*. 1999; 353(9147):89–92.
77. Lloyd-Jones DM, Leip EP, Larson MG, et al. Prediction of lifetime risk for cardiovascular disease by risk factor burden at 50 years of age. *Circulation*. 2006;113(6):791–798.
78. Smith SC, Allen J, Blair SN, et al. AHA/ACC guidelines for secondary prevention for patients with coronary and other atherosclerotic vascular disease: 2006 update. *Circulation*. 2006;113(19):2363–2372.
79. Mosca L, Benjamin E, Berra K, et al. Evidence-based guidelines for the prevention of cardiovascular disease in women 2011 update: a guideline from the American Heart Association. [published online ahead of print February 16, 2011] *Circulation*. 2011;123:1243–1262.

Journal of Cardiovascular Nursing
Vol. 26, No. 4S, pp S35–S45 | Copyright © 2011 Wolters Kluwer Health | Lippincott Williams & Wilkins

Global Cardiovascular Disease Prevention: A Call to Action for Nursing

Community-Based and Public Health Prevention Initiatives

Barbara J. Fletcher, MSN, RN, FAHA, FPCNA, FAAN; Cheryl Dennison Himmelfarb, PhD, RN; Maria Teresa Lira, RN, FPCNA; Janet C. Meininger, PhD, RN, FAAN; Sala Ray Pradhan, MSN, RN, ARNP-C; Joanna Sikkema, MSN, ANP-BC, FAHA, FPCNA

Policy changes are necessary to promote cardiovascular disease prevention. These will involve community-based and public health initiatives for primary and secondary prevention of cardiovascular disease. In this article, we discuss such interventions, community-based participatory research that has been conducted in this area, and implications for capacity building in genetics research. Finally, areas for future research in this area will be identified.

KEY WORDS: community-based participatory research, prevention

Policy Changes Needed to Promote Cardiovascular Disease Prevention at the Community Level

The goal of this article is to take a close look at community initiatives that reduce cardiovascular (CV) mortality, including the use of community-based participatory research (CBPR). Interplay exists between genetics and environmental factors in the development of CV disease (CVD). There is an opportunity to further our understanding of this interplay via CBPR as many socioeconomic and environmental factors can be directly linked to one's community.

Several highly respected organizations in health care such as the American Heart Association (AHA) and the International Heart Health Network have long realized the integral role of the community environment in implementing primordial (health promotion),[1] primary, and secondary prevention for CVD. Both organizations have published statements regarding initiatives for addressing CV health and thereby decreasing CV mortality globally.

The AHA guide for improving CV health at the community level provides a comprehensive approach to reducing the burden of CVD and promoting CV health through improving local policies and environments.[1] The emphasis focuses on improvements in facilities and resources in the places where people work and live in effort to achieve the following goals: cessation of tobacco use; avoidance of environmental tobacco smoke; reduction in dietary saturated fat, cholesterol, sodium, and calories; increased plant-based food intake; increased physical activity; and access to preventive health care services.[1]

The International Heart Health Network provides a policy framework for population approaches. It calls on governmental agencies, the private sector, voluntary health organizations, employers, and health care providers to "join forces in eliminating this modern epidemic by adopting new policies, making regulatory changes, and implementing health promotion and disease prevention programs directed at entire populations."[1]

The vast majority of CVD and stroke can be attributed to a few deleterious behaviors and lifestyles many times

Barbara J. Fletcher, MSN, RN, FAHA, FPCNA, FAAN
Clinical Associate Professor, School of Nursing, Brooks College of Health, University of North Florida, Jacksonville, Florida.
Cheryl Dennison Himmelfarb, PhD, RN
Associate Professor, The Johns Hopkins University School of Nursing, Baltimore, Maryland.
Maria Teresa Lira, RN, FPCNA
Nurse Researcher, Hospital FACh, Clinica Las Condes, Chile, Santiago.
Janet C. Meininger, PhD, RN, FAAN
Professor, Schools of Nursing and Public Health, University of Texas Health Science Center at Houston.
Sala Ray Pradhan, MSN, RN, ARNP-C
Nurse Practitioner, Mayo Clinic Jacksonville, Division of Cardiology, Jacksonville, Florida.
Joanna Sikkema, MSN, ANP-BC, FAHA, FPCNA
Faculty and Director of Acute Care Nurse Practitioner Program, University of Miami School of Nursing and Health Studies, Florida.

The authors have no conflicts of interest to report.

Correspondence
Barbara J. Fletcher, MSN, RN, FAHA, FPCNA, FAAN, School of Nursing, University of North Florida, 4567 St Johns Bluff Rd South, Jacksonville, FL 32224-2673 (bjflet@att.net).

DOI: 10.1097/JCN.0b013e318213ef97

encouraged or perpetrated by the communities in which people live. Modifying harmful behavior and encouraging a healthful lifestyle within the community have the potential to significantly alter global CV mortality. Given the current high prevalence of CVD risk factors and of CVD itself, a 3-pronged approach, including primordial,[1] primary, and secondary prevention, must be incorporated in community-based CVD prevention models (Figure). The Figure represents a 3-pronged approach for community-based CVD prevention. The model includes implementation of community programs and CBPR to target prevention at the primordial, primary, and secondary levels. Prevention is achieved through improved management of major CV risk factors.

Many community-based efforts suffer from inadequate resources to implement needed interventions. However, proper implementation of merely a single intervention can be beneficial and create an impact on CV health in a community. For example, a workplace-wellness study randomized subjects to either an active intervention versus usual care.[2] The active intervention implemented a multifaceted approach providing health education, nutritional counseling, smoking cessation counseling, physical activity promotion, and physician referral.[2] Significant benefits were demonstrated through quality-of-life scores and reduction in body fat, cholesterol, blood pressure, and total health risk, with a 48% reduction in medical claim costs.[2] With strong support and collaborative efforts from the community and policy makers, program planners can set priorities and implement and evaluate effective programs (Table 1). Table 1 provides examples of programs developed and implemented via collaborative efforts of policy makers and health care professionals. Another representation of successful policy-level intervention is the recent introduction of community-level policy regarding public and workplace smoking restrictions. These restrictions have resulted in a significant decrease in the rate of hospital admissions for acute myocardial infarction.[3]

Community-level research initiatives, CBPR, and roles for CBPR in CV genetic and environmental exploration are integral to reducing this modern-day epidemic of CVD in local populations and subsequently impact the larger global community.

Research Initiatives for Cardiovascular Disease Prevention at the Community-Based Levels

A research base exists providing evidence that community-level interventions can change community-wide behaviors.[1,4–8] For more than 3 decades, community prevention trials in the United States and abroad have supported the notion that behaviors can be changed through concerted efforts to organize communities, educate them through mass messaging and direct education, provide screenings for risk factors, and change environments through local programs and policies. Screening tools must be sensitive to specific populations. For example, one of the first CV risk prediction tools was the Framingham equation, which has provided a basis for the majority of risk stratification instruments developed worldwide; the equation is being modified in efforts to address the limitations of the original tool.[2–6] One such modification is currently being developed in Santiago, Chile. Here, the Framingham equation was modified based on numerical values that were derived via observational data from this country.

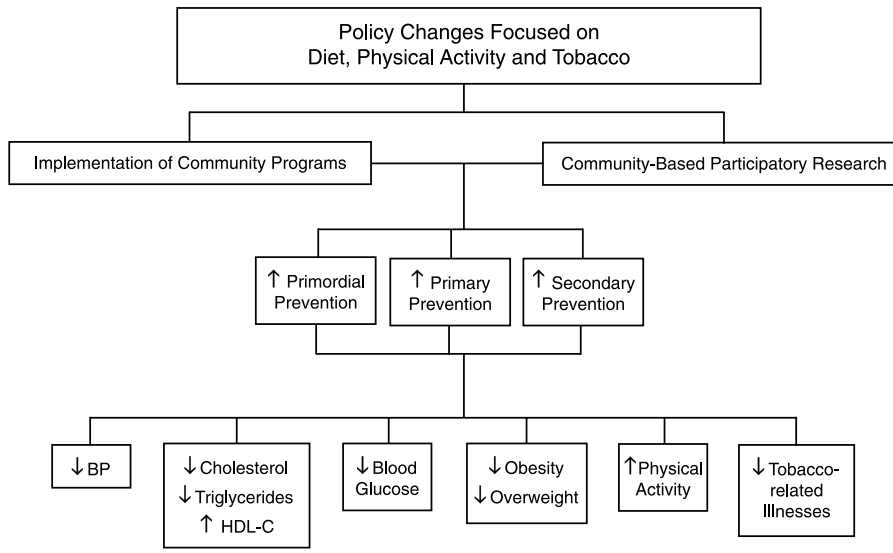


FIGURE. *Community-based cardiovascular disease (CVD) prevention. This figure represents a 3-pronged approach for community-based CVD prevention. The model includes implementation of community programs and community-based participatory research to target prevention at the primordial, primary, and secondary levels. Prevention is achieved through improved management of major CV risk factors.*

TABLE 1 Examples of Effective Community-Based Programs

- New York State Heart Healthy Program
  - Zero *trans*-fats in all New York City restaurants
  - Education to encourage drinking low-fat milk in New York worksites and faith communities
- Prohibiting smoking in restaurants and bars in most of US
- Rails to Trails Program in US
- Health Web as a School Teacher Tool in North East Florida
- Minnesota ''Vitality Project'' addressing diet, exercise, and living habits
- CDC's Health Communities Program
  - Targeting the Taqueria: Implementing Healthy Food Options at Mexican American Restaurants (Steps to a Healthy Salinas, California)
  - Evaluating Mobilization Strategies With Neighborhood and Faith Organizations to reduce Risk for Health Disparities (REACH): Kansas City, Missouri
  - A Community Response to the Food Environment (Pioneering Healthier Communities: West Michigan)
  - A Comprehensive Worksite Wellness Program in Austin, Texas: Partnership Between Steps to a Healthier Austin and Capital Metropolitan Transportation Authority
  - A Pebble in the Pond: The Ripple Effect of an Obesity Prevention Intervention Targeting the Child Care Environment (Steps to a Healthier Arizona) (*http://www.cdc.gov/healthycommunitiesprogram/evaluation-innovation/successarticles.htm*)

Additional research has identified schools, worksites, religious organizations, and health care facilities as sites to facilitate community-wide behavior change.[1] Community-based prevention initiatives include a range of risk-reducing, disease prevention strategies to support healthy behaviors and must be easily accessible within a neighborhood. Several large-scale community-based initiatives have proven to be successful and can serve as models for implementing targeted CVD risk reduction. Three successful programs are discussed here.

New York City Community-Based Prevention Model

For the past 6 years, the New York City Community-Based Prevention Model has implemented public policy and community-based preventive services that target tobacco use and healthy food availability in key impoverished neighborhoods of New York City (east and central Harlem, south Bronx, and north Brooklyn). These include providing a healthy food environment with fresh fruit and vegetables through vendors, food stands, and government-supported food stamps, health bucks (for the purchase of healthy foods), and farmers markets located in neighborhoods. This program also focuses on providing safe, structured fitness programs for children and adults and neighborhood-based medical providers and clinics.[9]

Centers for Disease Control and Prevention's Health Communities Program

The Centers for Disease Control and Prevention (CDC) have embarked on a very successful initiative, "CDC's Health Communities Program." This national program provides resources and funding for chronic disease prevention initiatives at the community level; these have led to a variety of successful local-level initiatives that have improved community CV health. A few examples are listed in Table 1. These large interdisciplinary programs have targeted the work and home environments of vulnerable populations, successfully supporting behavior change for chronic disease prevention.

Worksite risk reduction, faith-based risk reduction, and nurse-managed risk reduction programs are examples of common delivery modalities for providing CVD preventive tools. They have been documented to be quite successful.

Several studies reported the benefit of providing CVD risk reduction at worksite locations. The convenience of worksite location promotes employee participation, especially when incentives for reaching goals are provided. These may be in the form of monetary rewards, days off from work, or employer recognition.[10,11]

There is a strong evidence base supporting the partnership of faith-based organizations and community-based health promotion initiatives. These organizations have been engaged to provide both screening and health education in the areas of high blood pressure, diabetes, obesity, tobacco use, and cholesterol management. Faith-based organizations have been found to be especially effective in providing these services to uninsured and vulnerable populations. A review of the literature performed by DeHaven et al[12] found that, of 340 programs, the majority (43.4%) were "faith placed," developed by health professionals outside the congregation, versus 24.5% that were "faith based," developed by an internal health ministry. These programs reported significant improvement in overall health status, increased fruit and vegetable consumption, and decreases in weight and blood pressure. Evidence suggests that most of these programs were targeted to African Americans.[12–14]

The effectiveness of nurse-managed programs for CV risk reduction, including individual, group, and community interventions, has been well documented in the literature.[15–17] It was also reported that use of

nurses who are indigenous to the community and ethnically, linguistically, and experientially sensitive to community needs enhanced program effectiveness and outcomes.[18,19] Thus, providing community-based nurse-managed CVD risk reduction programming has been found to significantly impact the health of communities.

Vulnerable populations are at particularly high risk for CVD and must not be overlooked in the development of community-based educational tools, screening, and disease management. Traditionally, the most vulnerable populations have the highest incidence of CVD and the least access to risk reduction and disease prevention initiatives. These CV health disparities result from a complex interplay of factors, including ethnicity, socioeconomic status, access to health care, and sex and provider bias.[20–22] Disparities commonly manifest themselves as limited availability of easily accessible and affordable healthy foods, absence of safe exercise environments, and limited access to preventive health care. The opportunity to engage in risk-factor modification and healthy lifestyle changes is limited and therefore increases the CVD burden in these populations. Incorporating cultural, ethnic, and socioeconomic parameters into community-based programs promotes lifestyle change and improves the health status of the local and global population. One program addressing CV risk from a culturally and ethnically sensitive stance is the Well-integrated Screening and Evaluation for Women Across the Nation.

Well-integrated Screening and Evaluation for Women Across the Nation

The Well-integrated Screening and Evaluation for Women Across the Nation program had 10 unique community-based projects incorporating approximately 8164 women across the United States.[23] This program evolved from a CDC initiative for the early detection of cervical cancer and breast cancer (National Breast and Cervical Cancer Early Detection Program) and has expanded to include CVD screening and intervention. These projects developed culturally and regionally appropriate nutrition and physical activity interventions for a variety of racial and ethnic populations. They were funded and operated by a combination of government, state, and territorial health departments and tribal agencies. Program participants were screened for high blood pressure, high cholesterol, abnormal glucose, and obesity. Many were also screened for tobacco use, poor dietary habits, and sedentary lifestyle, in order to better provide unique, culturally relevant intervention strategies for the specific cohort. This large-scale study was designed to evaluate the effectiveness of "enhanced" risk reduction interventions, compared with "minimum" interventions or usual care. Minimum intervention was defined as baseline screening for CVD risk factors and minimal on-site counseling, education, and referral. Repeat screening was recommended at 6 and 12 months. Women enrolled in the "enhanced" intervention received all services of the minimum intervention plus specially designed community-based education tailored to the population, including racial, ethnic, and age considerations. These projects used a combination of developed resources that were adapted for the local environment. Examples include the following:

- New Leaf: A comprehensive risk reduction program designed for a Southern, multiethnic, low literacy population
- Vida Saludable, Corazon Contento: A Spanish-language adaptation of New Leaf used in North Carolina
- Traditions of the Heart: An adaptation of New Leaf used in Alaska, which was revised to include a 12-week, interactive group program incorporating Native Alaskan tradition
- Physician-Assisted Counseling and Evaluation: A program used in Connecticut to promote physical activity
- Active Living Every Day: A program used in South Dakota to promote physical activity
- ABCs for Good Health: Developed by the US Department of Agriculture and was coupled with the 10 000 Steps Program in Nebraska.

The results of this multicenter, multiethnic study showed that those who had obtained the enhanced interventions reported less fat in their diet and improvements in cholesterol panels, blood pressure profiles, and smoking cessation. The study reported that cultural adaptation involves much more than translation of documents and must include identifying barriers to change cultural norms. Some of these include such factors as social isolation, unsafe neighborhoods, and lack of access to healthful foods. The benefits of extending participation to family members and friends, using local community health workers who could encourage attendance, arranging transportation, providing child care, encouraging exercise in safe environments (eg, YMCA, local indoor swimming pools), and extending hours for participation were also reported.[23–25]

Community-Based Participatory Research

Community-based participatory research is neither a research design nor a method, but rather an orientation or an approach to conducting research in partnership with a community. It may be used in observational (nonexperimental) or experimental research and may incorporate quantitative and/or qualitative methods.[26] Community-based participatory research has been defined as a "systematic inquiry, with the participation of those affected by the issue being studied, for the purpose of education and taking action or effecting social change."[27]

Debate is present regarding terms that represent different ideological stances and historical traditions of various approaches to CBPR.[28] There are, however, certain core principles and values that have evolved over time and transcend these variations. These principles include working with existing communities; building on strengths and resources of the community; facilitating collaborative, equitable partnerships; promoting mutual learning and capacity building among partners; and considering health issues in an ecological context, with explicit recognition of the multiple determinants of health and disease. Competence is developed through an iterative, cyclical process designed to be sustainable and committed to continuing work over the long term, with dissemination of knowledge and findings to all partners.[29]

There is increasing recognition of the value of CBPR, particularly as an approach to addressing health disparities in areas of research that require behavioral and/or environmental changes to prevent or ameliorate a health problem. Sustained efforts using participatory approaches to address environmental issues have been published. Recently, investigators interested in the prevention and control of CVD have been challenged to move CBPR into the mainstream of preferred research approaches.[30]

Variations in Design and Examples of CBPR Focused on Prevention of Cardiovascular Disease

Examples of CBPR focused on primary or secondary prevention of CVD have been published. The studies included in this section are (1) research described by one of several terms that included the word "participatory"; (2) studies using 1 or more strategies that incorporated CBPR principles in the design, implementation, and/or dissemination of the research; (3) studies focused on some aspect of primary or secondary prevention of CVD; and (4) studies published in English. These examples do not necessarily represent the full spectrum of relevant research. Studies done in countries outside the United States and Canada may be underrepresented.

In Table 2, examples of CBPR strategies are presented by stage of the research process. Five studies provided examples of involvement of the community in planning and oversight.[31–35] Community involvement in assessment and/or building community capacity to engage in research was illustrated in 5 studies.[32,36–39] Community participation in the study implementation stage of research, including community members' involvement in the design and delivery of interventions in experimental studies, was evident in 4 studies.[31,35,40,41] Three studies provided examples of community members' involvement in analysis and/or interpretation and dissemination of data.[32,37,42] Several studies involved CBPR strategies in more than 1 stage of the research process; 2 additional reports described CBPR strategies in all stages.[43,44] There were more examples of community participation in earlier than in later stages of the research process. This is similar to the trend observed for the broad range of CBPR research,[45] not just those focused on CV health. Various research approaches were used including qualitative or descriptive approaches, ethnographic studies, observational studies based on survey data and other measurements, and experimental designs (Table 2). Some of the studies were classified as "methodological," because they focused on development of an intervention or measurement.

There are some barriers to dissemination of CBPR. Scientific rigor may be compromised in some instances in favor of approaches that are compatible with the community's values and norms. Because CBPR usually involves recursive processes, rather than a linear approach to research design and methods, it may be difficult to report CBPR using standard manuscript headings (background, methods, findings, discussion). Journal reviewers may not be familiar with the principles of CBPR, which complicates finding appropriate reviewers and publication outlets. Despite said barriers, CBPR demonstrates a promising research modality to use in focusing on the disparities existing among CVD prevention and how it relates to specific communities on both a local and global scale.

Building Community Capacity for Participation in Genetic Research in Cardiovascular Disease Prevention and Reducing the Potential for Harm/Exploitation

Cardiovascular disease arises from a complex web of causes that encompass genetic and environmental factors and their interactions. Although familial patterns are discernable, the mode of inheritance is complex, with many genetic factors involved. Each genetic factor may make a small contribution to risk of disease and operate in concert with combinations of other genetic factors and environmental risks, including lifestyle behaviors.[46,47] Understanding this complex web of causative factors is necessary to refine strategies for preventing or delaying the pathophysiologic processes that lead to clinically apparent CVD states.

Genetic studies of any of the complex diseases, including CVD, require large samples and access to diverse populations. Review of the literature on participation in genetic studies indicates that much of the research on building community capacity for participation and reducing the potential for exploitation and harm is not disease specific. Common themes that emerged included analysis of (1) building capacity

TABLE 2 Examples of Community-Based Participatory Research Studies for the Prevention of Cardiovascular Disease, by Stage of Research

Research Stage	Reference	Research Approach/and Location	CBPR Strategies
Planning and oversight	Pazoki et al[31] (2007)	• Experimental; Iran	• Set priorities for research in collaborative group sessions with community members, academic researchers, health care providers, and policy makers
	Boyer et al[32] (2005)	• Observational; southwest Alaska	• Interacted with community leaders to gain access to the community and its members; local research assistant engaged to translate and serve as liaison between community members and the research team; committed to protecting participants from discrimination and exploitation
	Mohatt et al[33] (2007)	• Observational; southwest Alaska	• Local tribal leaders nominated rural communities for participation and provided advice on recruitment of participants
	Levy et al[34] (2004)	• Observational; Chicago, Illinois	• Engaged community leaders and experts in writing grant proposal
	Kannan et al[35] (2008)	• Methodological; Detroit, Michigan	• Planning and oversight through a community-based steering committee
Assessment/and Building Community Capacity	Boyer et al[32] (2005)	• Observational; southwest Alaska	• Conducted workshops on genetics for health directors, tribal council members, and village representatives; extensive interaction with the community through presentations and bilingual, local, research coordinators
	Kalra et al[36] (2004)	• Qualitative; Asian Indian communities in Northern California	• Community-based groups assessed perceptions of risk for cardiovascular disease and identified components of a culturally relevant intervention
	Higgins et al[37] (2006)	• Qualitative; Pacific northern areas of United States and Canada	• Through focus groups and individual interviews, members explored social and economic contexts shaping heart health–related experiences
	Grigg-Saito et al[38] (2008)	• Qualitative; Cambodian immigrants in Massachusetts	• Obtained information through ''community conversations'' about knowledge, needs, attitudes, beliefs, strengths, and behaviors in relation to CVD, diabetes, and access to care; outreach strategies to increase community participation including door-to-door outreach to socially isolated residents; peer support groups; business, faith based, media, and provider outreach; special events. Educational workshops, learning tours, exercise groups to build skills and participation
	Ebbesen et al[39] (2004)	• Methodological; 4 provinces in Canada	• This is an example of community capacity building at the health systems level; capacity building efforts of the Canadian Heart Health Initiative are described, and critical issues in measurement of health promotion capacity are identified
Design and Delivery of Intervention; Study Implementation	Kannan et al[35] (2008)	• Methodological; Detroit, Michigan	• Community representatives designed and modified study materials to match regional and cultural food preferences; community members assessed readability of materials and enhanced usefulness of feedback to participants through visual cues and positive reinforcement
	Pazoki et al[31] (2007)	• Experimental; Iran	• Community advisory board tailored the study to the target community by providing input on readability and cultural appropriateness of intervention materials and length of the program
	Wilcox et al[40] (2007)	• Experimental; churches in South Carolina	• A delayed intervention for the comparison group was delivered so that an experimental approach would be acceptable to the church leaders; church members were trained to deliver the intervention through their existing church ministries; spiritual messages were integrated into all physical activity promotion messages
	Allen and Scott[41] (2003)	• Review article; various US locations	• Studies provide evidence of involvement of community health workers in primary and secondary prevention of coronary heart disease as members of multidisciplinary teams

TABLE 2 Examples of Community-Based Participatory Research Studies for the Prevention of Cardiovascular Disease, by Stage of Research, continued

Research Stage	Reference	Research Approach/and Location	CBPR Strategies
Data Analysis and Dissemination	Boyer et al[32] (2005)	• Observational; southwest Alaska	• Community members in 1 village explored data to set goals for health promotion based on the results
	Arthur et al[42] (2001)	• Qualitative; Ontario, Canada	• Participants reviewed results of data analysis to design a program that they thought would benefit other women living with heart disease
	Higgins et al[37] (2006)	• Qualitative; Pacific northern areas of United States and Canada	• Participants were involved in analysis and dissemination of data on factors and conditions that shape heart-related health behaviors from the perspective of low-income, single mothers
All Stages of the Research Process	Schulz et al[43] (2005)	• Observational; Detroit, Michigan	• The research team, which included representatives of health service organizations and community organizations along with academic researchers, collaborated on all aspects of the research process: planning, design, implementation, interpretation, and dissemination
	Chotibang et al[44] (2009)	• Qualitative; Chiang-Mai Thailand	• University-based researchers worked collaboratively with school personnel, parents, food vendors, and children to design, implement, and evaluate a program to promote healthy eating and physical activity among school-aged children

Abbreviations: CBPR, community-based participatory research; CVD, cardiovascular disease.

through community engagement and consultation, (2) ethical issues related to ongoing genetic studies as well as biobanking of specimens for future studies, and (3) sharing benefits of genetics research.

Building Capacity Through Community Engagement and Consultation

In building capacity for participation in genetics research, it is important to consider values, beliefs, literacy, experience, knowledge levels, and preferred learning styles of the population.[48] For instance, an article evaluates Hindu perspectives on genetic research in an Indian American community in Houston, Texas.[49,50] Another explores the opinions of African Americans regarding genetic testing. More negative views were elicited from African Americans when compared with white participants in a genetic epidemiology study of risk for colon cancer. After controlling for confounding factors, African Americans were more likely to believe that genetic research would result in higher insurance, reinforce racism, not benefit minorities, and that minorities are more likely to be used as "guinea pigs" in research.[49,50] To address these and other related concerns of discrimination and exploitation of minorities in genetic research, there is increasing momentum to develop models of community engagement to educate, build consensus, and empower individuals and communities in policy making for genetic research.[51]

Community engagement can range from investigator-controlled advisory panels, to more equitable partnerships between researchers and community leaders and members. The Marshfield Clinic Personalized Medicine Research Project in the United States (Wisconsin) engaged the community throughout the process for a population-based biobank, from the planning stages through to dissemination. Central to this community engagement was the formation of a community advisory group. This group, composed of 19 members residing in the target zip codes, was advisory to the researchers, with the agenda set by the principal investigator. They served as a sounding board to review alternative approaches in the community, recruitment strategies, issues of confidentiality, incentives for participation, and frequency of contact with participants.[52] In contrast, the Healthy Environments Partnership, which investigated the prevalence of biologic risk factors of CVD and social and physical environmental exposures as mediators of risk-factor inequalities, involved the community collaboratively in all stages of the research process.[43] It was affiliated with the Detroit Community Academic Urban Research Center, with participation of public health and academic institutions, as well as health services and community-based organizations.[53]

Ethical Issues Related to Genetic Studies and Biobanks

In the United States, biobanking of specimens is taking place to provide an infrastructure of data for ongoing and future studies.[54] Increases in genetic research since the completion of the human genome project and in biobanks for the collection and storage of human tissues and cells have brought ethical issues into focus.

Although informed consent has driven the efforts to protect the rights of humans involved in research, the establishment of biobanks has challenged traditional methods and norms for obtaining consent of participants. In some cases, participants are asked to give blanket consent for all future studies using their specimens. In other studies, samples are deidentified, and the study is declared exempt from the requirement for informed consent. The fact that it is impossible to deidentify genetic information is one of the critical ethical issues in the current debate on making genetic databases publicly available.[55,56] On the other hand, public availability of large genetic databases is considered essential for progress in genetic research and personalized medicine, including pharmacogenomics. The latter provides a basis for tailoring specific interventions and drugs to those individuals who have the genetic propensity to respond to them.[57] Tiered consent procedures are emerging, along with additional safeguards to protect privacy and to reduce the potential harm associated with breaches of privacy.[56] Opinions on these and other issues related to informed consent for biobanking were reported in recently published studies.[58,59]

In population-based research, it is important to involve community leaders, obtain their approval, and to then engage with the community as a whole before approaching potential participants in genetics research.[48,60] Although there is the potential for a population to benefit from participation in genetic research, there is also the potential for harm, exploitation, and stigmatization for populations that provide biological samples for genetic research. A recent legal settlement between a Native American tribe and a university in the United States illustrates this potential for harm.[61] Controversies arose surrounding the future uses of genetic samples beyond the research topics included in the informed consent process. Removing donors' identifying information from the samples did not eliminate the risks to the population. Thus, the ethical debates continue regarding risks and benefits of genetic research for populations, as well as the processes for obtaining informed consent for future uses of stored samples.

Sharing Benefits of Genetics Research

Genetics research is proliferating in both developed countries and developing countries with limited resources. Caution is necessary to ensure that populations from countries with limited resources are not exploited as participants in genetics research that will benefit only populations from developed countries.[62] Patenting of biological entities such as genes and single-nucleotide polymorphisms raises questions about whether participants or communities should share in profits for use of their biological materials in research and development.[48,63]

Community-Based Translational Research

The usual route for translational research is from the "bench" (basic research) to the "bedside" (clinical research) and back. Although this is an important route, the more challenging translation for population health is the route from the bench or the bedside to the community and back. With the bedside as the primary destination, attention is placed on disease states and their treatments. For translational research to have an impact on population health through prevention of disease and promotion of health, translation to the community is essential.[64]

Interventions to prevent disease are subjected to the same rigorous tests as clinical research in humans, the randomized controlled trial. However, when interventions are found to be efficacious under ideal circumstances, they are rarely tested further to demonstrate effectiveness under "real world" conditions or for feasibility of broad dissemination in the community. Furthermore, many interventions that have been efficacious in the short term are not sustainable over the long term. Much of the effort to prevent CVD and the corresponding research initiatives are focused on interventions to change behavior at the individual level. There is increasing recognition that the contexts in which health behaviors occur have a powerful influence on their likelihood of occurring. For example, consider the relationship between salt consumption and its link to elevated blood pressure. Individuals can be taught and even motivated to consume less salt, but how easy is it to enact that behavior in an environment of processed foods? Social-ecological models that incorporate multiple layers of influences on health behaviors are framing many community-based, translational research studies for the prevention of CVD.[65,66]

Genetic-Environmental Interactions and Implications for Population-Based Cardiovascular Disease Prevention

The clinical manifestations of CVD are end points of a complex set of processes that are affected by multiple factors and mechanisms. Coronary artery disease, as conceptualized by Lanktree and Hegele,[67] is the result of inflammation, coagulation, dyslipidemia, dysglycemia, hypertension, plaque growth, instability, and so on. Each of these processes may be fueled by a complex set of genes that may be responsive to environmental factors such as infection, stress, exercise, diet, smoking, and chemical exposures. A new era of CVD prevention will emerge with the increasing understanding of gene-gene and gene-environmental interactions.

Needed: Community-Based Research for Implementation of Cardiovascular Disease Prevention

Community-based participatory research is an approach to qualitatively and quantitatively evaluate local population patterns related to the environment they live in as well as how that environment persuades their lifestyle. This style of research can be applied to CVD prevention when considering how to effectively reach a local community. Several questions one might consider for guidance in reaching a specific community include (1) what tool to promote CV health and CVD prevention is best suited for this population considering socioeconomic status and culture? And (2) what is the biggest deterrent to promoting CVD prevention in this community? Ultimately, CBPR shows great promise as an up and coming valuable commodity to the prevention of CVD at the local and subsequently global level.

A unique opportunity exists to incorporate CBPR and community-based genetic research. This is an emerging concept not only in the setting of CV risk and CVD prevention but also in genetic research as a whole. Research examining gene-gene and gene-environment interactions will certainly guide future CVD prevention efforts at a local and global level. However, it remains to be seen exactly how this promising modality will manifest itself in the field of CVD prevention as researchers address some of the remaining questions surrounding consent, ethics, and benefit sharing.

Conclusion

Cardiovascular disease is attributable to both genetic and environmental factors that share a closely intertwined relationship. Community-based programs providing culturally and socioeconomically relevant guidance that focuses on diet modification, physical activity, and smoking cessation are key to changing environmental factors that link local and global populations to CVD. Several large-scale successful models have been outlined including the AHA's guide for improving CV health at the community level and the International Heart Health Network's policy framework for population approaches. All health care professionals, local workforces, faith-based organizations, and nurse managed risk reduction programs are important to the development and implementation of community-based programs. Given the target audience of this article, it should be noted that nurses in particular have the opportunity to become community leaders in CV health promotion. Equipped with knowledge and specialized training in health promotion, nurses are perfectly positioned to direct, guide, and implement these community initiatives. Nurses must demand policy change and involve themselves in implementing diet modification, smoking cessation, and increasing physical activity among all age groups within their communities. Ultimately, the goal of all health care professionals should be to penetrate the places people work, socialize, and spend their free time with education and guidance regarding a lifestyle that will positively affect their health and is the first step to changing CVD risk and ultimately the mortality of an entire community.

Summary and Implications

This manuscript addresses community-based and public health prevention initiatives. Specifically addressed are initiatives for CVD prevention at the community level, community policy changes needed to promote CVD prevention, CBPR, and CVD risk stratification models. Each of these initiatives poses a "call to action for nurses and nursing" and will involve specific nursing activities, strategies, and nursing research to address better outcomes in CVD prevention.

Acknowledgment

The authors thank Isabel Cruz, PhD, RN, Fluminense Federal University, Rio de Janeiro, Brazil, for her suggestions in this manuscript.

REFERENCES

1. Pearson TA, Bazzarre TL, Daniels SR, et al. American Heart Association guide for improving cardiovascular health at the community level: a statement for public health practitioners, healthcare providers, and health policy makers from the American Heart Association Expert Panel on Population and Prevention Science. *Circulation*. 2003;107(4):645–651.
2. Milani RV, Lavie CJ. Impact of worksite wellness intervention on cardiac risk factors and one-year health care costs. *Am J Cardiol*. 2009;104:1389–1392.
3. Lightwood JM, Glantz SA. Declines in acute myocardial infarction after smoke-free laws and individual risk attributable to secondhand smoke. *Circulation*. 2009;120(14):1373–1379.
4. Dawber TR, Meadors GF, Moore FE Jr. Epidemiological approaches to heart disease: the Framingham Study. *Am J Public Health*. 1951;41(3):279–281.
5. Anderson KM, Wilson PWF, Odell PM, Kannel WB. An updated coronary risk profile. A statement for health professionals. *Circulation*. 1991;83(1):356–362.
6. Wilson PW, D'Agostino RB, Levy D, et al. Prediction of coronary heart disease using risk factor categories. *Circulation*. 1998;97(18):1837–1847.
7. D'Agostino R, Russell H, Huse D, et al. Primary and subsequent coronary risk appraisal: new results from the Framingham Study. *Am Heart J*. 2000;139(2 part 1):272–281.
8. D'Agostino RB, Vasan RS, Pencina MJ, et al. General cardiovascular risk profile for use in primary care: the Framingham Heart Study. *Circulation*. 2008;117(6):743–753.
9. Goodman A. President Obama's health plan and community–based prevention. *Am J Public Health*. 2009;99(10):1736–1738.

10. Glasgow R, Klesges R, Cleges L, Somes G. Variables associated with participation and outcome in a worksite smoking control program. *J Consult Clin Psych*. 1988;56(4):617–620.
11. Krummel D, Koffman D, Browner Y, et al. Cardiovascular health interventions in women: what works? *J Womens Health Gend-Based Med*. 2001;10(2):117–136.
12. DeHaven M, Hunter IB, Wilder L, Walton J, Berry J. Health programs in faith-based organizations: are they effective? *Am J Public Health*. 2004;94(6):1030–1036.
13. Anderson C. The delivery of health care in faith-based organization: parish nurses as promoters of health. *Health Commun*. 2004;16(1):117–128.
14. Moore-Harrison T, Johnson M, Quinn M, Cress M. An evidence-based exercise program implemented in congregate-meal sites. *J Phys Act Health*. 2009;6(2):247–251.
15. Froelicher E. Women's initiative for non smoking (WINS): design and methods. *Heart Lung*. 2000;29(6):429–437.
16. Landis D, Georgiou A, Apple J, Durand J. Cardiovascular risk reduction at United Healthcare of North Carolina: the first 12 months. *J Clin Outcomes Mgmt*. 2002;7(4):40–43.
17. Mc Pherson C, Swenson K, Pine D, Leimer L. A nurse-based pilot program to reduce cardiovascular risk factors in a primary care setting. *Am J Manag Care*. 2002;8(6): 543–555.
18. Ferdinand K. Lessons learned from Healthy Heart Community Project in reaching the African American population. *J Health Care Poor Underserved*. 1997;8(3):366–371.
19. Plescia M, Herrick H, LaTonya C. Improving health behaviors in an African American Community: the Charlotte Racial and Ethnic Approaches to Community Health Project. *Am J Public Health*. 2008;98(9):1678–1684.
20. Blank R, Brunton S. Managing multiple cardiovascular risk factors. *J Fam Pract*. 2008;57(3):S1–S8.
21. Blanton M, Maddox T, Rushing O, Mensah G. Disparities in cardiac care: rising to the challenge of Healthy People 2010. *JACC*. 2004;44(3):503–508.
22. Gibbons R, Jones D, Gardner T, Goldstein L, Moller J, Yancy C. The American Heart Association's 2008 statement of principles of healthcare reform. *Circulation*. 2008;108(21): 2209–2218.
23. Viadro C. Taking stock of WISEWOMAN. *J Womens Health*. 2004;13(5):480–483.
24. Mosca L, Banka C, Benjamin E, et al. Evidence-based guidelines for cardiovascular disease prevention in women: 2007 update. *Circulation*. 2007;115(11):1481–1501.
25. Will J, Farris R, Sanders C, Stockmyer C, Finkelstein E. Health promotion interventions for disadvantaged women: overview of the WISEWOMAN Projects. *J Womens Health*. 2004;13(5):484–502.
26. Leung MW, Yen IH, Minkler M. Community-based participatory research: a promising approach for increasing epidemiology's relevance in the 21st century. *Int J Epidemiol*. 2004;33(3):499–506.
27. Green LW, Mercer SL. Participatory research: can public health agencies reconcile the push from funding bodies and the pull from communities? *Am J Public Health*. 2001; 91(12):1926.
28. Wallerstein N, Duran B. The conceptual, historical and practice roots of community based participatory research and related participatory traditions. In: Minkler M, Wallerstein N, eds. *Community-based Participatory Research for Health*. San Francisco, CA: Jossey-Bass; 2003:27–52.
29. Israel BA, Schulz AJ, Parker EA, Becker AB. Review of community-based research: assessing partnership approaches to improve public health. *Annu Rev Public Health*. 1998;19: 173–202.
30. Horowitz CR, Robinson M, Seifer S. Community-based participatory research from the margin to the mainstream: are researchers prepared? *Circulation*. 2009;119(19):2633–2642.
31. Pazoki R, Nabipour I, Seyednezami N, Imami SR. Effects of a community-based healthy heart program on increasing healthy women's physical activity: a randomized controlled trial guided by community-based participatory research (CBPR). *BMC Public Health*. 2007;7:216.
32. Boyer BB, Mohatt BV, Lardon C, et al. Building a community-based participatory research center to investigate obesity and diabetes in Alaska natives. *Int J Circumpolar Health*. 2005; 64(3):281–290.
33. Mohatt GV, Plaetke R, Klejka J, et al; the CANHR Research team. The Center for Alaska Native Health Research Study: a community-based participatory research study of obesity and chronic disease-related protective and risk factors. *Int J Circumpolar Health*. 2007;66(1):8–18.
34. Levy SR, Anderson EE, Issel LM, et al. Using multilevel, multisource needs assessment data for planning community interventions. *Health Promot Pract*. 2004;5(1):59–68.
35. Kannan S, Schulz A, Israel B, et al. A community-based participatory approach to personalized, computer-generated nutrition feedback reports: the Healthy Environments partnership. *Prog Community Health Partnersh*. 2008;2(1):41–53.
36. Kalra P, Srinivasan S, Ivey S, Greenlund K. Knowledge and practice: the risk of cardiovascular disease among Asian Indians: results from focus groups conducted in Asian Indian communities in Northern California. *Ethn Dis*. 2004;14(4): 497–504.
37. Higgins JW, Young L, Cunningham S, Naylor PJ. Out of the mainstream: low-income, lone mothers' life experiences and perspectives on heart health. *Health Promot Pract*. 2006; 7(2):221–233.
38. Grigg-Saito D, Och S, Liang S, Toof R, Silka L. Building on the strengths of a Cambodian Refugee community through community-based outreach. *Health Promot Pract*. 2008; 9(4):415–425.
39. Ebbesen LS, Heath S, Naylor PJ, Anderson D. Issues in measuring health promotion capacity in Canada: a multi-province perspective. *Health Promotion Int*. 2004;19(1):85–94.
40. Wilcox W, Laken M, Bopp M, et al. Increasing physical activity among church members: community-based participatory research. *Am J Prev Med*. 2007;32(2):131–138.
41. Allen JK, Scott LB. Alternative models in the delivery of primary and secondary prevention programs. *J Cardiovasc Nurs*. 2003;18(2):150–156.
42. Arthur HM, Wright DM, Smith KM. Women and heart disease: the treatment may end but the suffering continues. *Can J Nurs Res*. 2001;33(3):7–29.
43. Schulz AJ, Kannan S, Dvonch JT, et al. Social and physical environments and disparities in risk for cardiovascular disease: the Healthy Environments Partnership conceptual model. *Environ Health Perspect*. 2005;113(12):1817–1825.
44. Chotibang J, Fongkaew W, Mo-suwan L, Meininger JC, Klunklin P. Development of a family and school collaborative (FASC) program to promote healthy eating and physical activity among school-age children. *Thai J Nurs Res*. 2009; 13(2):133–147.
45. Cashman SB, Adeky S, Allen AJ, et al. The power and the promise: working with communities to analyze data, interpret findings, and get to outcomes. *Am J Public Health*. 2008;98(8):1407–1417.
46. Frazier L, Meininger J, Lea DH, Boerwinkle E. Genetic discoveries and nursing implications for complex disease prevention and management. *J Profess Nurs*. 2004;20(4):222–229.
47. Arking DE, Chakravarti A. Understanding cardiovascular disease through the lens of genome-wide association studies. *Trends Genet*. 2009;25(9):387–394.

48. Gong G, Kosoko-Lasaki S, Haynatzki G, Cook C, O'Brien RL, Houtz LE. Ethical, legal, and social issues of genetic studies with African immigrants as research subjects. *J Nat Med Assoc*. 2008;100(9):1073–1077.
49. Hutchinson JF, Sharp R. Karma, reincarnation, and medicine: Hindu perspectives on biomedical research. *Genomic Med*. 2008;2(3–4):107–111.
50. Bussey-Jones J, Henderson G, Garrett J, Moloney M, Blumenthal C, Corbie-Smith G. Asking the right questions: views on genetic variation research among black and white research participants. *J Gen Intern Med*. 2008;24(3):299–304.
51. Bonham VL, Citrin T, Modell SM, Franklin TH, Bleicher EWB, Fleck LM. Community-based dialogue: engaging communities of color in the United States' genetics policy conversation. *J Health Polit Policy Law*. 2009;34(3):325–359.
52. McCarty CA, Chapman-Stone D, Derfus T, Giampietro PF, Fost N, and the Marshfield Clinic PMRP Community Advisory Group. Community consultation and communication for a population-based DNA biobank: the Marshfield Clinic Personalized Medicine Research Project. *Am J Med Genet A*. 2009;146A(23):3026–3033.
53. Israel BA, Lichtenstein R, Lantz P, et al. The Detroit-Academic Urban Research Center: development implementation and evaluation. *J Public Health Manag Pract*. 2001; 7(5):1–19.
54. Frazier L, Sparks E, Sanner JE, Henderson M. Biobanks and biomarker research in cardiovascular disease. *J Cardiovasc Nurs*. 2008;23(2):153–158.
55. McGuire AL, Gibbs RA. No longer de-identified. *Science*. 2006;312(5772):370–371.
56. Lin Z, Owen AB, Altman RB. Genetic research and human subject privacy. *Science*. 2004;305(5681):183.
57. Cuticchia AJ. Applying existing ethical principles to personalized medicine. *Internet J Law Healthc Ethics*. 2009;6(1): 1–10.
58. Murphy J, Scott J, Kaufman D, Geller G, LeRoy L, Hudson K. Public perspectives on informed consent for biobanking. *Am J Public Health*. 2009;99(12):2128–2134.
59. Beskow LM, Dean E. Informed consent for biorepositories: assessing prospective participants' understanding and opinions. *Cancer Epidemiol Biomarkers Prev*. 2008;17(6): 1440–1451.
60. Mfutso-Bengo J, Ndebele P, Masiye F. Disseminating research results to research participants and their communities. *Malawi Med J*. 2008;20(2):64–66.
61. Mello MM, Wolf LE. The Havasupal Indian tribe case—lessons for research involving stored biologic samples [published online ahead of print]. *N Engl J Med*. http://content.nejm.org/cgi/content/extract/NEJMp1005203v1. Accessed June 29, 2010.
62. Ndebele P, Musesengwa R. Will developing countries benefit from their participation in genetics research? *Malawi Med J*. 2008;20(2):67–69.
63. Goering S, Holland S, Fryer-Edwards K. Transforming genetic research practices with marginalized communities: a case for responsive justice. *Hastings Cent Rep*. 2008;38(2): 43–53.
64. Ogilvie D, Craig P, Griffin S, Macintyre S, Wareham NJ. A translational framework for public health research. *BMC Public Health*. 2009;9:116.
65. Booth SL, Mayer J, Sallis JF, et al. Environmental and societal factors affect food choice and physical activity: rationale, influences, and leverage points. *Nutr Rev*. 2009; 59(3):521–539.
66. Riley BL, Taylor SM, Elliot SJ. Determinants of implementing heart health. Promotion activities in Ontario public health units: a social ecological perspective. *Health Ed Res*. 2001;16(4):425–441.
67. Lanktree MB, Hegele RA. Gene-gene and gene-environment interactions: new insights into the prevention, detection and management of coronary artery disease. *Genome Med*. 2009;1(2):28.

Journal of Cardiovascular Nursing
Vol. 26, No. 4S, pp S46–S55 | Copyright © 2011 Wolters Kluwer Health | Lippincott Williams & Wilkins

Nurse-Based Models for Cardiovascular Disease Prevention

From Research to Clinical Practice

Kathy Berra, MSN, RN, ANP, FAHA, FPCNA, FAAN; Nancy Houston Miller, BSN, RN, FPCNA, FAHA; Catriona Jennings, BA, RN, FESC

The worldwide personal and societal costs related to diseases of the vascular system are enormous. International research efforts have focused on discovering ways to implement prevention strategies shown to be both effective and cost-efficient. Teams comprising health care professionals with expertise in nursing, dietetics, physical activity, and behavioral skills have shown high levels of success in preventive efforts, particularly in high-risk and vulnerable populations. Used appropriately, team-based, nurse-directed case management has the potential to effect positive change in both primary and secondary prevention of cardiac and other vascular diseases.

KEY WORDS: case management models of care, CVD prevention, nurse-based case management

The worldwide epidemic of cardiovascular disease (CVD) poses a significant challenge to the implementation of interventions shown to improve patient outcomes.[1] Initiation of and adherence to lifesaving therapies is complex and challenging for medical care systems, health care professionals, and patients. To improve patient outcomes through adherence to national guidelines, a multidisciplinary team-based approach has been proposed.[2–4] Significant evidence exists supporting a systematic approach to CVD risk reduction through team-based, nurse-directed case management.[5–8] A team-based approach requires the expertise of multiple health care professionals, including nurses, nutritionists, physicians, pharmacists, psychologists, social workers, and other allied health care professionals.

The Role of Nurses

Nurses are ideal health care professionals to direct the CVD risk reduction team and to deliver multifactorial risk reduction in hospital settings, outpatient clinics, and community-based facilities. The ideal nurse case manager has an in-depth knowledge of medicine, psychology, and behavior change. Most importantly, a skilled nurse case manager must have an interest in and commitment to the unique differences in patient populations based on age, race, ethnicity, culture, sociodemographics, and literacy. Bodenheimer and colleagues,[9–11] in their evaluation of ways to improve primary care in the United States, called attention to the pivotal role of nurses in the health care reform necessary to address the growing needs of chronic disease management and in improving care for chronic diseases.

In a meta-analysis of secondary CVD prevention programs, Clark and colleagues[12] demonstrated a reduction in all-cause mortality and acute myocardial infarction (MI). Of note, 45% of the studies included in the analysis were nurse led or nurse managed. In the early 1990s, the Stanford Coronary Risk Intervention Study (SCRIP) assessed whether nurse-directed, multifactorial risk reduction could improve cardiovascular outcomes compared with usual care in men and women with baseline coronary artery disease (CAD) documented by angiography. The primary outcome was angiographic progression of CAD from baseline to 4 years following the intervention; secondary outcomes were all CVD events. Following a nurse-directed team-based case management protocol, after 4 years, 45% fewer clinical events and a regression in angiographically measured atherosclerosis was seen in the intervention group compared with control.[5] The MULTIFIT study, also undertaken by investigators at Stanford University, was designed to determine the effect of modifying

Kathy Berra, MSN, RN, ANP, FAHA, FPCNA, FAAN
Clinical Director, Stanford Heart Network, Stanford Prevention Research Center, Stanford University School of Medicine, Palo Alto, California.
Nancy Houston Miller, BSN, RN, FPCNA, FAHA
Associate Director, Stanford Cardiac Rehabilitation Program, Stanford University School of Medicine, Palo Alto, California.
Catriona Jennings, BA, RN, FESC
Cardiovascular Specialist Research Nurse, Department of Cardiovascular Medicine and International Center for Circulatory Health, Imperial College of London, United Kingdom.

The authors have no conflicts of interest to report.

Correspondence
Kathy Berra, MSN, RN, ANP, FAHA, FPCNA, FAAN, Stanford Prevention Research Center, Stanford University School of Medicine, 1070 Arastradero Rd, Suite 100, Palo Alto, CA 94304-1334 (kberra@stanford.edu).

DOI: 10.1097/JCN.0b013e318213ef5c

multiple risk factors in post-MI patients.[6] Operating primarily by telephone, nurse case managers offered education and counseling and titrated medications under guideline-based protocols. At the end of 1 year, significant changes in dietary scores, lipid levels, functional status as measured by exercise testing, and biochemically confirmed smoking cessation rates were superior in patients assigned to the treatment arm, compared with usual care.

In 2004, the Cardiac Hospitalization Atherosclerosis Management Program undertaken at the University of California at Los Angeles focused on the initiation of guideline-based therapies for CVD risk reduction in hospitalized patients with CAD.[8] The Cardiac Hospitalization Atherosclerosis Management Program demonstrated a significant reduction in morbidity and mortality ($P < .05$) in patients receiving nurse-directed case management compared with usual care 1 year after hospital discharge. This trial became the cornerstone for the American Heart Association's "Get With the Guidelines" national initiative.[13] More recently, a major study undertaken in Europe demonstrated that a nurse-directed program for multifactor risk reduction improved blood pressure (BP) and lipid goals compared with usual care in high-risk hospitalized coronary heart disease patients and those seen in general practice.[7] In hospitalized patients, statin use increased from 80% at baseline to 86% at 12 months ($P = .04$) compared with no change in usual care. Findings were similar in general practice patients: statin use increased from 15% to 38% at 1 year ($P = .03$), and usual care also increased, from 18% to 23% (not statistically significant). Both statins and hypertension medications were prescribed suboptimally in general-practice high-risk patients.[7]

Nurse-directed case management has been shown to be effective not only in individuals with multiple risk factors, but also in treating single risk factors in young and older populations, in diverse ethnic groups, and in individuals with comorbidities.[14] The greater than 10 million nurses worldwide represent the largest group of health care providers with the requisite education and position in their communities required to take on the role of case managers for CVD risk reduction.[15] Nurses are highly respected and valued by patients, patients' families, and the health care community and thus are ideal to fill this important role.

Successful Models of Care—An International Perspective

Although the scientific evidence for CVD prevention in clinical practice is compelling, translating that evidence into effective models of care remains a challenge. The nurse-led case management approach is characterized by individual goal setting between the patient and nurse to achieve lifestyle change. In addition, adherence to national guidelines for medical management by nurse case managers has been shown to be effective in lowering blood lipids, BP, blood glucose, and smoking cessation.[2,5,7,8] Key principles for an effective practice model are proposed, based on supporting evidence from successful case management trials (Figure).[5,7,16,17] These studies were selected because they applied a multifactorial approach, were undertaken in different parts of the world, and lend support for understanding key concepts critical to nurse-led case management.

Key Principles of a Nurse-Led Case Management Approach

1. Preventive care should be implemented according to evidence-based guidelines for CVD prevention.

Evidence-based guidelines should be locally adapted for everyday clinical practice in the country where they are to apply, and goals for treatment should be set to reduce global CVD risk. The SCRIP program (Table) chose to use a stricter approach than the National Cholesterol Education Program in the United States by setting its low-density lipoprotein cholesterol goal lower and using more aggressive guidelines for saturated fat and dietary cholesterol intake.[5] In the MULTIFIT program (Table), the goal for low-density lipoprotein cholesterol was based on the mean post-treatment level achieved in clinical trials. Both the Extensive Lifestyle Management Intervention (ELMI) and EUROACTION studies (Table) aimed to demonstrate in everyday clinical practice that evidence-based guidelines can be implemented.[7,16] The primary outcomes of the EUROACTION study were the European lifestyle, risk factor, and therapeutic goals for CVD prevention in clinical practice.[7]

2. Preventive efforts should be targeted at those who will benefit the most, that is, patients with vascular disease, those at high risk of developing disease, and the close family members of these patients, and should take into account groups in which the prevalence of CVD and risk factors is highest.

Targeting those at risk and with vascular disease is known as a high-risk strategy, but it can also accompany a strategy for CVD risk reduction that includes a population approach. Population strategies have the potential to achieve substantially larger reductions in risk in an entire population as the result of relatively small modifications in risk factors by many individuals, not just those at highest risk.

All of the selected studies shown in the Table targeted patients with coronary disease for secondary prevention: those with angiographically determined atherosclerosis, those immediately post-MI, those who completed a cardiac

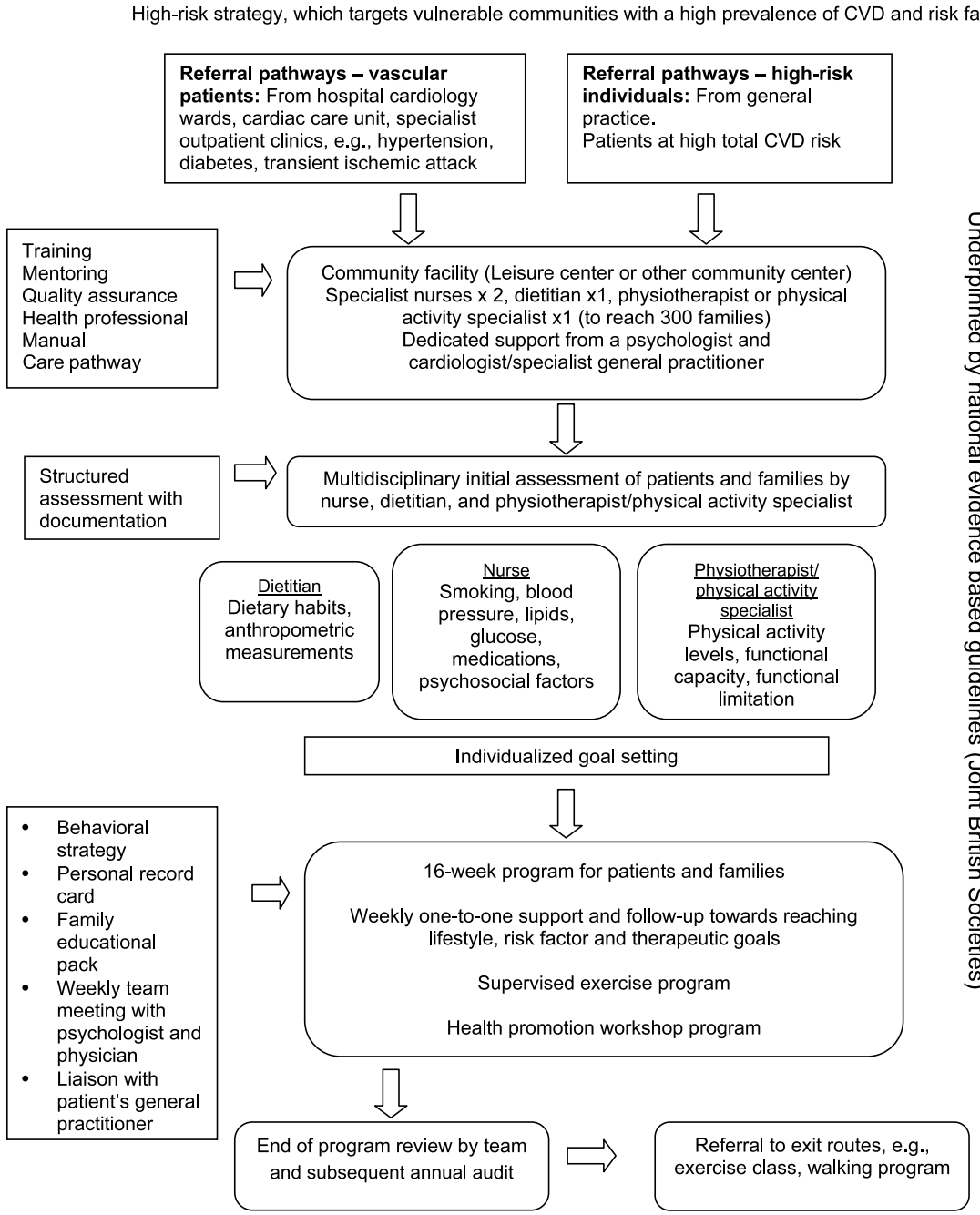


FIGURE. *An example of a model for practice.*

rehabilitation program, and those with heart disease seen in primary care clinics.[5–7,16,17] The EUROACTION study addressed all priority groups for CVD prevention as defined by the Joint European Societies at the time—such as those with established coronary disease and those at high risk of developing CVD. Thus, the EUROACTION study embraced primary as well as secondary prevention.[7,18]

To reach those at highest risk in general practice, the EUROACTION primary care study used the European SCORE risk estimation charts and electronic HeartScore risk estimation and management system, which uses European regional mortality data to predict the probability of a fatal cardiovascular event over a 10-year period.[19]

3. The families of high-risk patients should be included in preventive efforts and not just the patient alone.

Close family members of vascular and high-risk patients are at increased risk of developing CVD due, in part, to genetic factors, but principally to a shared family lifestyle and in spouses, to assortative mating.[20–24]

TABLE Selected Successful Nurse-Led Case Management Studies

Study Mean Age (MA), % male (% M)	Year	Country	Location	Patient Population	Number Randomized	Multifactorial Approach	Primary Outcomes
EUROACTION[7] (hospital arm), MA 63 y, 63% M	2008	Europe (UK, Sweden, France, Italy, Spain, Poland)	Hospital	Acute MI, unstable angina, stable angina	3088 (cluster randomization)	Smoking, diet, physical activity, weight, waist, BP, lipids and glucose, HRQoL, illness, and risk perception	INT vs UC: hospitalized with CHD: reached goal for: BP (65% vs 55%[a]); LDL-C (81% vs 74%; NS); BMI (27% vs 21%; NS); waist circumference (31% vs 21%)
EUROACTION[7] (general practice arm), MA 62 y, 53% M	2008	Europe (UK, Denmark, the Netherlands, Poland, Italy, Spain)	General practice	High multifactorial risk, on treatment for BP lowering, lipid modification, and diabetes	2317 (cluster randomization)	Smoking, diet, physical activity, weight, waist, BP, lipids and glucose, HRQoL, illness and risk perception	GP high-risk: reached goal for: BP (58% vs 41%[a]); LDL-C (45% vs 35%); BMI (23% vs 22%); waist circumference (23% vs 15%; NS); significant improvements in diet[a] and physical activity[a] INT (both groups) vs UC
ELMI[16] (Extensive Lifestyle Management Intervention), MA 64 y, 83% M	2006	Canada	Hospital	Patients with ischemic heart disease post–cardiac rehabilitation	302	Smoking, diet, physical activity, weight, waist, BP, lipids and glucose, quality of life	4.1 y of follow-up: significant reduction in global risk including TC, LDL-C, and BP
Campbell -Nurses primary care study,[17] MA 66 y, 83% M	1998	Scotland	General practice	Working diagnosis of CHD	1343	Smoking, diet, physical activity, BP and lipids	1 y: INT vs UC, improved use of aspirin (81.0% vs 66.4%[b]); lipids (96.5% vs 87.9%[b]); BP (96.5% vs 87.9%[b]); INT vs UC overall OR, 0.55[b]; 4.7 y: total mortality INT vs UC (14.5% vs 18.9%[a])
MULTIFIT,[6] MA 57 y, 79% M	1994	United States	Hospital	Post-AMI	585	Smoking, diet, exercise, and lipids	INT vs UC: improved: smoking cessation (70% vs 53%[c]), functional capacity (9.3 vs 8.4 METs[b]) LDL-C (107 vs 132 mg/dL[b])
SCRIP[5] (Stanford Coronary Risk Intervention Project), MA 56 y, 83% M	1994	United States	Hospital	Angiographically defined coronary atherosclerosis	300	Smoking, diet, physical activity, weight, BP, lipids, glucose	47% less CAD progression by arteriography, INT vs UC (0.0024 vs 0.045[a]); INT vs UC: LDL-C −0.95 vs −0.16 mmol/L[b]; TG −0.34 vs −0.01[c]; increase in lipid-lowering medications 80.7% vs 24.4%[b]; fewer no. of primary cardiac events INT vs UC (OR = 0.57[a])

Abbreviations: AMI, acute myocardial infarction; BP, blood pressure; CHD, coronary heart disease; HRQoL, health-related quality of life; INT, intervention; LDL-C, low density cholesterol; NS, not statistically significant; OR, odds ratio; TC, total cholesterol; UC, usual care.

[a] $P < .05$.

[b] $P \leq .001$.

[c] $P \leq .01$.

The EUROACTION study included partners and close relatives in the prevention program and actively managed cardiovascular risk in these family members.[7] Partners made lifestyle changes in the same direction as patients. Significant concordance for change was seen between patients and partners participating in the intervention arm of the hospital study for body mass index (r = 0.21), waist circumference (r = 0.22), BP (systolic BP: r = 0.13, and diastolic BP: r = 0.15), and total cholesterol (r = 0.21), which reflected the dietary and physical activity changes these couples made together.

4. Preventive programs should have an appropriate setting and a flexible approach that allows easy access to the people from the community targeted for the intervention, especially when that community includes vulnerable and deprived groups.

Among the selected studies in the Table, 4 were hospital-based programs, one was based in general practice, and one had both hospital and general practice programs.[5–7,16,17] Three of the hospital-based programs (SCRIP, MULTIFIT, and ELMI) adopted a flexible approach using primarily mail and telephone contact with patients.[5,6,16] In addition, both the SCRIP and MULTIFIT programs utilized a home-based exercise program, further reducing the need for attendance at a specialized center.[5,6] All 3 programs achieved participation rates between 82% to 86% of eligible patients. However, even though the EUROACTION hospital program required more frequent attendance over a shorter period, it also achieved a participation rate of nearly 90%.[7]

Although the EUROACTION hospital program was offered to 67% of all eligible consecutively identified patients, making it better than reported survey data of one-third in 15 countries in Europe, it was even better for high-risk individuals in the EUROACTION general practice program, at 94%.[7] Many patients who chose not to participate in the EUROACTION hospital program reported distance from their home (29.5%) and time required (25.5%) as limiting factors.

A new nurse-led case management approach called MYACTION,[25] which evolved from EUROACTION, locates programs in the community, using leisure facilities or other community centers. This model addresses health inequalities by targeting deprived and vulnerable populations, where the prevalence of CVD and risk factors can be high.

5. The focus of preventive efforts should be on promoting healthy lifestyle habits to address total cardiovascular risk.

Cardiovascular risk is driven by poor dietary habits, sedentary behavior, and tobacco smoking. These risk factors lead to overweight and central obesity, increased BP, abnormal lipid levels, and diabetes. The long-term effects of these risk factors are seen in higher rates of CAD, stroke, peripheral arterial disease, cancer, and lung diseases. Addressing and managing complex lifestyle behaviors require expertise from a variety of health care professionals. Preventive efforts should therefore be based on a lifestyle program that incorporates the expertise of the disciplines of nursing, medicine, dietetics, physical activity, and psychology.

A defined behavioral strategy is essential and will determine the quality and impact of an intervention, together with intensity and frequency of contact and the involvement of health care professionals. A behavioral strategy characterized by a theoretical framework, individualized goal setting, and intensive support from health care professionals is described for each of the study programs included in the Table. For example, in the MULTIFIT program, the behavioral intervention was derived from social learning theory, which is designed to improve perceptions of self-efficacy by teaching self-management and enhancing motivation.[26] For example, when setting goals, nurse case managers and patients initially set attainable subgoals, whereas recommended study goals remained the final, optimal end point. Regular follow-up by the case managers allowed feedback on progress. In the ELMI and EUROACTION programs, self-monitoring of progress was facilitated by the use of a patient-held personal record card to track progress at every contact with a nurse or other member of the program team.[7,16] The EUROACTION program also incorporated motivational interviewing techniques into its behavioral strategy.[27] These techniques included using appropriate tools to assess motivation, for example, asking patients and partners to rate the importance of changing a particular behavior to stopping smoking. Their confidence in the ability to achieve the change was measured. Decisional balance was assessed and provided the means to promote motivation and explore ambivalence toward addressing a particular behavior change. The health professionals involved were trained to avoid rigidly dichotomizing patients into isolated stages of change as defined by the Transtheoretical Model, but rather to use this model to tailor the use of motivational techniques. The family approach adopted by the EUROACTION program added an important source of social support for behavior change.

In addition to being trained to understand and apply behavioral strategies, health care professionals involved in the delivery of a multifactor program need expert knowledge and training in smoking cessation, implementing a cardioprotective diet, adapting physical activity and exercise (taking functional capacity and physical limitation into account), and reducing weight. To achieve this, dedicated time to provide follow-up and support is critical. In the MULTIFIT program, the nurse case managers had 80 hours of multidisciplinary

training from specialists, which covered exercise testing and training, diet and drug management of hyperlipidemia, smoking cessation, and psychosocial interventions.[6] The intervention required approximately 9 hours per patient throughout the year of the program, of which 6 were direct patient contact, usually by telephone or mail; the rest were allocated to liaison with primary care, hospital and study center personnel. This is in contrast to the Grampian study of secondary prevention in primary care, which used existing nursing personnel in 19 practices, fitting the program into usual work routines.[17] In Grampian, nurses received a day and a half of training in clinic protocols and techniques to facilitate behavior change. The program lasted 1 year for each patient and included an initial visit of 45 minutes and subsequent 20-minute follow-up visits (number not specified). Both studies reported reductions in self-reported fat intake at 1 year. In the Grampian study, an additional 7.5% of patients adopted a low-fat diet in intervention, compared with no increase in patients receiving usual care, as measured by the Dietary Instrument for Nutrition Education questionnaire.[17,28] In the MULTIFIT study, there was a reduction from 322 to 124 in a food frequency score for a diet low in saturated fat and dietary cholesterol, compared with a reduction from 307 to 140 in usual care; both of these surpassed the National Cholesterol Education Program Step 2 goal of a score between 160 and 210.[6] In the Grampian study, 4.4% of patients became more physically active, compared with −1.1% of patients in usual care.[17] In the MULTIFIT study, self-reported increases in physical activity and adherence to a home-based exercise program were validated by exercise treadmill testing of functional capacity, which was significantly higher in intervention (9.3 METs) compared with usual care (8.4 METs) ($P = .001$). This measure of functional capacity in the MULTIFIT study represents a rigorous validation of the increase in physical activity, superior to self-report.[6]

Of note is the highly significant smoking cessation result in the MULTIFIT study, 70% in intervention compared with 53% in usual care, compared with the absence of any effect in the Grampian study.[6,17] However, MULTIFIT recruited patients 3 days after MI and focused primarily on relapse prevention, whereas the Grampian study recruited patients with a diagnosis of coronary heart disease from the practice registers, regardless of the date of their acute event. The authors point out that it is possible that coronary patients who continue to smoke in the weeks, months, and years following their event may be more resistant to change. Although nicotine replacement therapy was available to support smoking cessation at that time, it was not widely used, and no other options, such as bupropion or varenicline, were available.

Each EUROACTION hospital program had a dedicated multidisciplinary team of specialist nurses (1.75 full-time equivalents [FTEs]), a dietitian (0.5 FTE), and a physiotherapist or physical activity expert (0.5 FTE).[7] This team had 40 hours of training from a central multidisciplinary team. The training included how to carry out an individualized assessment, deliver smoking cessation, perform dietary management, run a supervised exercise program, and advise on appropriate physical activity. Lifestyle interventions were based on national guidelines as well as patient-specific physical limitations. Team members were available at the weekly program sessions, which lasted 2 to 3 hours and included one-on-one tracking of progress toward attainment of lifestyle (smoking cessation, adoption of a cardioprotective diet, increasing physical activity, working toward achieving a healthy weight and shape) and risk factor management goals. In the general practice program, a full-time dedicated nurse was trained by the same central team to deliver all aspects of the lifestyle program (see above) and to follow risk factor management protocols. The EUROACTION primary care program structure was more flexible than the hospital program, which required attendance for the 16-week program. Patients and partners in the primary care program were enrolled for 1 year and were managed by the nurse on a one-to-one basis, attending meetings when required.

In the ELMI study, despite quite a large investment in a lifestyle intervention, a 4-year program, and intensive support, the results for diet, physical activity, and weight management were disappointing. However, patients in both intervention and usual care had been through an initial cardiac rehabilitation program, thus reducing the study's potential to show a difference.[16]

The duration of the programs under examination varied from 16 weeks for EUROACTION (hospital program)[7] to 4 years for SCRIP and ELMI.[5,16] Is duration important, and if so, how do we decide on the optimum length for a program? It could be argued that support and follow-up should be provided indefinitely, although this may be realistic only in a primary care setting, where people register with a general practitioner for all their chronic disease management. The results of the 4-year studies are in many ways similar to studies whose programs lasted between 16 weeks and 1 year. However, are the immediate results of these programs sustained? In the case of the EUROACTION 16-week hospital program, the published results are at 1 year after the program started, representing results sustained without the support of the team for an 8-month period.[7] The Grampian study authors demonstrated in their 4-year follow-up study of a 1-year program that lifestyle and risk-factor changes were sustained, with the exception of physical activity.[28] If the aim of such initiatives is to promote self-management,

then expanding programs for longer-term duration may be an unnecessary burden on health care services.

6. There should be an effective mechanism for prescribing cardioprotective medications, and protocols should be available to facilitate the management of BP, lipids, and diabetes to achieve guideline-based goals.

High-risk patients often require adjunctive drug therapies in addition to lifestyle interventions to optimize the management of risk factors. All the studies in the Table had some degree of success in modifying risk factors. All were characterized by a goal-oriented approach, with protocols in place to facilitate and guide management. In the MULTIFIT program, nurse case managers prescribed lipid-lowering medications under protocols.[6]

In the EUROACTION program, the hospital team and the nurse in general practice met weekly with a physician who had dedicated time for the program to prescribe and titrate cardioprotective medications. Nurses did not prescribe, as legislation in all of the European countries involved in the study at the time did not support nurse prescribing.[7] Since the completion of the study, the United Kingdom has introduced legislation to support independent nurse prescribing (2005), and this is a feature of the newly evolved MYACTION model.[25]

There were no differences in the percentage of BP-lowering medications prescribed between intervention and usual care in the hospital arm of the EUROACTION study (β-blockers: 76% in intervention compared with 80% in usual care; angiotensin-converting enzyme inhibitors/angiotensin receptor blockers [ARBs]: 52% in intervention compared with 56% in usual care), yet BP control was superior in the intervention arm compared with usual care (proportions reaching goal 65% in intervention compared with 55% in usual care $P = .04$).[7] A number of possible explanations for this include (1) a professional lifestyle program that included a dietitian and physical activity specialist who focused on assessing diet and physical activity and negotiating tailored changes. These tailored changes positively influenced BP by reducing salt, increasing fruit and vegetable consumption, increasing activity levels, and managing weight loss; (2) improved compliance with medication; and (3) correct doses. Although prescribing in the general practice arm for individuals at high risk of developing CVD was generally much lower than in the hospital arm, there were significant increases in prescribing for angiotensin-converting enzyme inhibitors/ARBs (29% in intervention compared with 20% in usual care), diuretics (32.5% in intervention compared with 18.3% in usual care), and statins (37.7% in intervention compared with 22.1% in usual care).[7]

In the ELMI study, significant changes between baseline and 4 years were seen in mean systolic BP (128 to 126 mm Hg in intervention, compared with 125 to 131 mm Hg in usual care) and mean total cholesterol (4.43 to 4.21 mmol/L in intervention, compared with no change from 4.54 mmol/L in usual care).[16] In this program, the nurse case managers consulted a dedicated cardiologist who recommended prescriptions to general practitioners of participating patients. Forty-four percent of these recommendations were acted upon, resulting in significant increases in prescribing of diuretics from 16% to 28% and in ARBs from 3% to 12%.

A few key principles have been identified that can be applied to a working model for practice. An example of such a model is shown in the Figure. This model reflects the MYACTION community-based model of vascular prevention and embraces both primary and secondary prevention, eliminating the artificial barrier between the two.[25] Asymptomatic individuals with at high CVD risk require the same preventive care as symptomatic patients who have already developed vascular disease, and so do their families. These families are also likely to be at a high CVD risk and will thus benefit from a program as shown in the EUROACTION study.[7]

The Success of Nurse Case Managers

As indicated by the models shown in the Table, nurse case managers have helped to educate and motivate individuals to manage numerous lifestyle changes pertinent to CVD prevention. The majority of programs of case management for CVD risk reduction have been shown to be effective in improving overall patient care.[29] Effectiveness has been measured by an improvement in the achievement of goals such as BP, smoking cessation, and dyslipidemia; improvement in quality of life; an increase in short-term adherence; and reductions in medical resource utilization, including fewer emergency room visits and hospitalizations for some populations.[30]

A review of educational interventions for CVD risk reduction conducted by Mullen and colleagues[31] in the early 1990s found that the success of education programs was more highly related to skill building rather than simply imparting knowledge. Two- thirds of the programs evaluated were directed by nurses who used a range of behavioral skills such as contracting, goal-setting, self-monitoring, feedback, and problem solving to facilitate change.[31] Theories such as stages of change, social learning theory, and relapse prevention training have guided nurses' efforts to provide education and behavioral interventions to patients.[27,32,33] The success of nurse case managers has resulted from designing educational interventions specific to the

needs of patients, such as audio, video, or written materials. In addition, a wide variety of formats such as face-to-face education and counseling, education by telephone, and home visits were designed for those in greatest need.[34] Nurses' success in intervening with large populations attempting to change multiple cardiovascular risk factors is dependent on providing more intensive education and counseling for those who need to make the greatest changes and those who lack motivation to adhere without such support.[35]

Nurse case managers have also played a significant role in helping individuals to manage pharmacological therapies for primary and secondary prevention of CVD. Guidelines developed by international organizations represent only a starting point for key decisions about pharmacotherapy. They are currently insufficient to support the mission of managing dose titration and long-term adherence. Implementation of guideline based treatment protocols (eg, such as drug choice and dose titration tables) by nurse practitioners and nurses under nurse practice acts has supported physicians' efforts to manage all aspects of pharmacological therapy. A major focus for nurse case managers is helping individuals adhere to well-known lifesaving pharmacotherapies.

Having additional time devoted to counseling during office visits or through telephone contacts or the Internet with a focus on tailoring interventions to the needs of patients has enabled nurse case managers to help individuals with acquisition of lifesaving behavioral skills. Developing skills such as prompting and cueing, reminders, and enlisting the support of family members to support medication-taking behaviors provides a basis for successful change.[29]

Self-care is essential for lifelong success in reducing cardiovascular risk and managing chronic conditions such as diabetes and heart failure. Self-care has been defined as a naturalistic decision-making approach that patients use in the choice of behaviors that maintain physiological stability (symptom monitoring and treatment adherence) and the response to symptoms when they occur.[36,37] Unlike adherence, self-care involves the tactical and situational skills for managing various disease conditions.[37] Acquisition of skills to modify behaviors is often gained through involvement and support from family members and friends and practice over time. However, nurses can assist individuals in acquiring skills to perform routine behaviors such as meal preparation and can teach them how to order various diets in restaurants to master changes in their diet. It is important to convey an understanding that self-care involves the tactical (eg, how to) and situational skills (eg, what to do when) for managing the risk factors and disease conditions. For example, following a low-salt diet for BP control requires the skills of reading labels, preparing foods, menu planning, and perhaps managing multiple diets. Identifying deficiencies, finding trusted resources for support, and role playing are helpful in focusing on skill building. Although nurses in some settings, such as cardiac rehabilitation programs, offer unique support by facilitating tactical skills training, additional research is needed to guide the activities of nurses and other health care professionals in supporting individuals to succeed with self-care.

Challenges for Nurse Case Managers and Future Research

Many challenges confront nurses involved in care management. One is the nurses' ability to simultaneously manage multiple risk factors and comorbid diseases in patients at risk for or with established CVD. This challenge is confounded by barriers associated with language and literacy, especially in individuals who may be at highest risk for CVD. Defining specific roles (such as ensuring the availability of staff with language skills and cultural knowledge/sensitivity) of all health care providers and identifying programs with high success rates that can be easily disseminated are critical in supporting implementation of nurse case management programs. Although fewer programs of nurse case management in lower-literacy individuals have been conducted to date, early analysis suggests that risk factors have been improved and appropriate outcomes achieved in these populations.[38,39]

Additional challenges relate to the choice of intervention components and the length of follow-up. Large variations in the frequency of contact, the type of content, the information provided, and the length of follow-up to ensure ongoing maintenance of risk-factor changes exist in multiple risk factor intervention programs. Few programs involving nurses have prioritized the various components of their programs or combinations of components within programs or settings. Programs already found to be successful in achieving improved CVD outcomes need to be replicated and disseminated. Additional studies are needed to determine not only the cost-effectiveness of such programs but also how these programs influence overall quality of life.

Electronic communication provides the opportunity for nurses to manage larger numbers of patients over an extended period, yet reimbursement in the United States remains based primarily on face-to-face visits. Reimbursement is needed to support time spent by nurses in education, counseling, and follow-up of individuals at high risk. This is particularly important in those who experience difficulty with adherence and those faced with managing multiple risk factors and chronic medical conditions. Addressing these issues will require changes in the way both physicians and nurses are reimbursed. It is very likely that future innovations

Clinical Pearls

- Nurse case management has been shown to be effective in improving outcomes for persons with complex medical conditions such as CVD.
- Nurse case managers improve initiation and adherence to lifesaving therapies for CVD prevention.
- Nurse case managers influence patient behaviors by understanding differences in patient populations based on age, culture, sociodemographics, and literacy levels.
- Cardiovascular disease is a family and community affair. Preventive efforts should be targeted to family members of patients with CVD and should take into account groups in which the prevalence of CVD and risk factors is highest.

in technology will support the dissemination of nurse case management systems of care. Electronic medication monitoring, home BP monitors, blood glucose meters, and voice-recognition technology all facilitate the data-gathering process for health care professionals. Real-time online analysis of data linked to patient reminders will enable case managers to individualize care. Future research is needed to determine the best approach for integrating and using technology in the management of patients who would benefit from case management for CVD risk reduction.

In summary, a significant role exists for nurses as leaders in CVD prevention. Research has documented that nurse case management improves cardiovascular risk factors, lifestyle, and, most importantly, outcomes. Although continued research is needed, the time is now for an international expansion of nurse-based CVD prevention to reduce death and disability from this worldwide epidemic.

REFERENCES

1. Yusuf S, Hawken S, Ounpuu S, et al; INTERHEART Study Investigators. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet*. 2004; 364(9438):937–952.
2. Fletcher B, Berra K, Ades P, et al. Managing abnormal blood lipids: a collaborative approach. *Circulation*. 2005;112(20): 3184–3209.
3. Hayman LL, Meininger JC, Daniels SR, et al. Primary prevention of CVD in nursing practice: focus on children and youth. *Circulation*. 2007;116(3):344–357.
4. The 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 [ATP III]). *Circulation*. 2004;110: 227–239.
5. Haskell WL, Alderman EL, Fair JM, et al. Effects of intensive multiple risk factor reduction on coronary atherosclerosis and clinical cardiac events in men and women with coronary artery disease. The Stanford Coronary Risk Intervention Project (SCRIP). *Circulation*. 1994;89(3): 975–990.
6. DeBusk RF, Miller NH, Superko HR, et al. A case-management system for coronary risk factor modification after acute myocardial infarction. *Ann Intern Med*. 1994;120(9):721–729.
7. Wood DA, Kotseva K, Connolly S, et al. Nurse-coordinated multidisciplinary, family-based cardiovascular disease prevention programme (EUROACTION) for patients with coronary heart disease and asymptomatic individuals at high risk of cardiovascular disease: a paired, cluster-randomised controlled trial. *Lancet*. 2008;371(9629):1999–2012.
8. Fonarow GC, Gawlinski A, Moughrabi S, Tillisch JH. Improved treatment of coronary heart disease by implementation of a Cardiac Hospitalization Atherosclerosis Management Program (CHAMP). *Am J Cardiol*. 2001;87(7): 819–822.
9. Bodenheimer T, Wagner EH, Grumbach K. Improving primary care for patients with chronic illness. *JAMA*. 2002; 288(14):1775–1779.
10. Bodenheimer T, Wagner EH, Grumbach K. Improving primary care for patients with chronic illness: the chronic care model. Part 2, *JAMA*. 2002;288(15):1909–1914.
11. Bodenheimer T, MacGregor K, Stothart N. Nurses as leaders in chronic care. *BMJ*. 2005;330(7492):612–613.
12. Clark AM, Hartling L, Vandermeer B, McAlister FA. Meta-analysis: secondary prevention programs for patients with coronary artery disease. *Ann Intern Med*. 2005;143(9): 659–672.
13. Xian Y, Pan W, Peterson ED, Heidenreich PA, Cannon CP, Hernandez AF, Friedman B, Holloway RG, Fonarow GC; GWTG Steering Committee and Hospitals. Are quality improvements associated with the Get With the Guidelines-Coronary Artery Disease (GWTG-CAD) program sustained over time? A longitudinal comparison of GWTG-CAD hospitals versus non-GWTG-CAD hospitals. *Am Heart J*. 2010;159(2):207–214.
14. Berra K, Miller NH, Fair JM. Cardiovascular disease prevention and disease management: a critical role for nursing. *J Cardiopulm Rehabil*. 2006;26(4):197–206.
15. World Health Organization. Global Atlas. http://www.who.int/globalatlas. Accessed June 18, 2010.
16. Lear SA, Spinelli JJ, Linden W, et al. The Extensive Lifestyle Management Intervention (ELMI) after cardiac rehabilitation: a 4-year randomized controlled trial. *Am Heart J*. 2006;152(2): 333–339.
17. Campbell NC, Ritchie LD, Thain J, Deans HG, Rawles JM, Squair JL. Secondary prevention in coronary heart disease: a randomized trial of nurse led clinics in primary care. *Heart*. 1998;80(5):447–452.
18. Wood D, DeBacker G, Faergeman O, Graham I, Mancia G, Pyörälä K. Prevention of coronary heart disease in clinical practice. Recommendations of the Second Joint Task Force of European and other Societies on Coronary Prevention. *Eur Heart J*. 1998;19:1434–1503.
19. Conroy RM, Pyörälä K, Fitzgerald AP, et al. Estimation of ten-year risk of fatal cardiovascular disease in Europe: the SCORE project. *Eur Heart J*. 2003;24(11):987–1003.
20. Knuiman MW, Divitini ML, Welborn TA, Bartholomew HC. Familial correlations, cohabitation effects, and heritability for cardiovascular risk factors. *Ann Epidemiol*. 1996; 6(3):188–194.
21. Sackett DL, Anderson GD, Milner R, Feinleib M, Kannel WB. Concordance for coronary risk factors among spouses. *Circulation*. 1975;52(4):589–595.
22. Wood D, Roberts T, Campbell M. Women married to men with myocardial infarction are at increased risk of coronary heart disease. *J Cardiovasc Risk*. 1997;4(1):7–11.

23. Pyke S, Wood DA, Kinmonth AL, Thompson S. Concordance of changes in coronary risk and risk factor levels in couples following lifestyle intervention in the British Family Heart Study. *Arch Fam Med*. 1997;6(4):354–360.
24. Kolonel LN, Lee J. Husband-wife correspondence in smoking, drinking, and dietary habits. *Am J Clin Nutr*. 1981; 34:99–104.
25. My Action for our hearts. http://www.myaction.org.uk. Accessed June 21, 2010.
26. Bandura A. *Social Learning Theory*. Englewood Cliffs, NJ: Prentice Hall; 1977.
27. Miller W, Rollnick S. *Motivational Interviewing*. London: Guildford UK; 2002.
28. Murchie P, Campbell NC, Ritchie LD, Simpson JA, Thain J. Secondary prevention clinics for coronary heart disease: four year follow up of a randomized controlled trial in primary care. *BMJ*. 2003;326(7380):84.
29. Miller NH, Sivarajan ES. Disease management models for cardiovascular care. In: *Cardiovascular Nursing*. 5th Edition. Philadelphia, PA: Lippincott, Williams and Wilkins; 2005: 986–996.
30. Ades PA, Kottke T, Houston Miller N, Record B, Record S. American College of Cardiology 33rd Bethesda Conference Task Force Report 3: getting results: who, where and how? *JACC*. 2002;40:579–651.
31. Mullen PD, Mains DA, Velez R. A meta-analysis of controlled trials of cardiac patient education. *Patient Educ Couns*. 1992;19(2):143–162.
32. Prochaska JO, DiClemente CC. Stages and processes of self-change of smoking: toward an integrative model of change. *J Consult Clin Psychol*. 1983;51(3):390–395.
33. Marlatt GA, Gordon JR. Relapse prevention. In: *Maintenance Strategies in the Treatment of Addiction*. New York: Guilford Press; 1985.
34. Stafford RS, Berra K. Critical factors in case management: practical lessons from a cardiac case management program. *Dis Manag*. 2007;10(4):197–207.
35. Stewart S, Horowitz J, Pearson S. Effects of a home-based intervention among patients with congestive heart failure discharged from acute hospital care. *Arch Intern Med*. 1998; 158(10):1067–1072.
36. Dickson VV, Riegel B. Are we teaching what patients need to know? Building skills in heart failure self-care. *Heart Lung*. 2009;38(3):253–261.
37. Riegel B, Moser DK, Anker SD, et al; on behalf of the American Heart Association Council on Cardiovascular Nursing, Council on Clinical Cardiology Council on Nutrition, Physical Activity, and Metabolism, and Interdisciplinary Council on Quality of Care and Outcomes Research. *Circulation*. 2009;120:1141–1163.
38. Hebert PL, Sisk JE, Wang JJ, et al. Cost-effectiveness of nurse-led disease management for heart failure in an ethnically diverse urban community. *Ann Intern Med*. 2008;149(8):540–548.
39. Ma J, Berra K, Haskell WL, et al. Case management to reduce risk of cardiovascular disease in a county health care system. *Arch Intern Med*. 2009;169(21):1988–1995.

Journal of Cardiovascular Nursing
Vol. 26, No. 4S, pp S56–S63 | Copyright © 2011 Wolters Kluwer Health | Lippincott Williams & Wilkins

Preparing Nurses for Leadership Roles in Cardiovascular Disease Prevention

Dorothy M. Lanuza, PhD, RN, FAHA, FAAN; Patricia M. Davidson, PhD, RN, FRCNA, Med; Sandra B. Dunbar, DSN, RN, FAHA, FAAN; Suzanne Hughes, MSN, RN, FAHA, FPCNA; Sabina De Geest, PhD, RN, FAAN, FRCN, FAHA

Cardiovascular disease (CVD) is a critical global health issue, and cardiovascular nurses play a vital role in decreasing the global burden and contributing to improving outcomes in individuals and communities. Cardiovascular nurses require the knowledge, skills, and resources that will enable them to function as leaders in CVD. This article addresses the education, training, and strategies that are needed to prepare nurses for leadership roles in preventing and managing CVD. Building on the World Health Organization core competencies for 21st-century health care workers, the specific competencies of cardiovascular nurses working in prevention are outlined. These can be further strengthened by investing in the development of cultural, system change and leadership competencies. Mentorship is proposed as a powerful strategy for promoting the cardiovascular nursing role and equipping individual nurses to contribute meaningfully to health system reform and community engagement in CVD risk reduction.

KEY WORDS: cardiovascular disease, competencies, evidence-based practice, leadership, mentorship, prevention

Cardiovascular disease (CVD) is a major contributor to global morbidity and mortality; it is extremely costly and places a significant burden on individuals and communities. Cardiovascular nurses can play a key role in combating the increasing burden of CVD, which, similar to other chronic diseases, accompanies the demographic and epidemiologic transitions occurring worldwide.[1,2] This article addresses the education and skills needed to prepare nurses for a leadership role in CVD prevention. Such a role often means challenging the status quo, lobbying for health system reform, and motivating and inspiring other health professionals to engage in a shared vision for improving health and well-being. For purposes of this article, the term *cardiovascular disease* will be used to encompass all cardiovascular conditions, including stroke.

The importance of leadership is crucial for effective preventive cardiovascular nursing. To provide a dynamic and sustainable workforce in CVD prevention, a range of competencies and skills is required. In addition to expert knowledge in cardiovascular care, cardiovascular nurses need to evaluate and implement evidence-based practice (EBP) within culturally appropriate frameworks. Developing clinical, research, and cultural competencies and engaging in the policy sphere are crucial for improving CVD outcomes.

Building and elaborating on the World Health Organization (WHO) core competencies for health care professionals in the 21st century,[3,4] we propose specific competencies that should drive the preparation of preventive cardiovascular nurses. We further emphasize the importance of investing in leadership development,[5] cultural,[6] and system change[7] competencies. In addition, we propose purposeful mentoring[8] as a key strategy to drive the acquisition of these competencies, keeping in mind that interprofessional education[9] is, or will be, the context for learning.

Dorothy M. Lanuza, PhD, RN, FAHA, FAAN
Professor Emeritus, School of Nursing, University of Wisconsin–Madison.
Patricia M. Davidson, PhD, RN, FRCNA, Med
Professor of Cardiovascular & Chronic Care, Curtin University and St Vincent's Hospital, Sydney, Australia.
Sandra B. Dunbar, DSN, RN, FAHA, FAAN
Charles Howard Candler Professor of Cardiovascular Nursing, Nell Hodgson Woodruff School of Nursing, Emory University, Atlanta, Georgia.
Suzanne Hughes, MSN, RN, FAHA, FPCNA
Director, System Population Health, Summa Health System, Akron, Ohio.
Sabina De Geest, PhD, RN, FAAN, FRCN, FAHA
Professor of Nursing and Director, Institute of Nursing Science, Faculty of Medicine, University of Basel, Basel, Switzerland.

The authors have no conflicts of interest to report.

Correspondence
Dorothy M. Lanuza, PhD, RN, FAHA, FAAN, School of Nursing, CSC, K6/328, University of Wisconsin–Madison, 600 Highland Ave, Madison, WI 53792-2455 (dlanuza@wisc.edu).

DOI: 10.1097/JCN.0b013e31821485be

Leadership

Effective nurse leaders are needed to play key roles in shaping a health care delivery system that addresses CVD prevention within a population's myriad health care needs. Leadership is not synonymous to management. Where management is characterized by planning, organization, and control, leadership influences and engages individuals in a shared vision that often challenges existing systems and processes. Leadership, although it may include management skills, is oriented towards achieving goals and is closely related with group dynamics and team processes.[10,11] Leadership potential can be found at any organizational level[12]; the challenge is to recognize and develop it.

A transformational leader has been defined as one who "will provide the skills for the profession to stretch its boundaries and be innovative in the way in which problems are viewed and solved."[13] Qualities of a transformational leader include charisma (ie, the ability to instill faith and respect), individual consideration (ie, treating each employee as an individual), intellectual stimulation (ie, the ability to arouse innovative ways of problem solving), idealized influence (ie, the ability to transmit values and ethical principles), and inspirational role (ie, the ability to provide challenging goals and communicate a vision of the future).[14] Maximizing the effects of leadership calls for a good mix between effective management and transformational leadership, to realize improvements in clinical care processes.[15] The quality of leadership is a system factor that influences outcomes for both nurses and patients.[16] Transformational leadership styles have been linked with positive outcomes for nurses, such as nurse satisfaction and retention, as shown in a comprehensive systematic review.[17]

Leadership development is thus an important aspect of the professional growth of cardiovascular nurses at all levels of health care system involvement. It is important for nurses to seek and receive mentorship for leadership, whether they are delivering patient care or doing policy work, conducting basic science research or translating research into practice, managing a hospital unit or a community agency, or holding a key membership position on policy-governing bodies nationally and internationally.[5]

Mentoring: Strategy for Leadership Development

Mentoring is a term widely used in the literature to indicate a reciprocal learning relationship between an individual who is experienced in an area and one who is a relative novice in that area. The *mentoring in nursing* construct was developed through a concept analysis conducted by Stewart and Krueger,[18] who defined it as "a teaching-learning process acquired through personal experience within a one-to-one, reciprocal, career development relationship between 2 individuals diverse in age, personality, life cycle, professional status, and/or credentials." Most research in nursing and other fields has shown that mentorship relationships have very favorable personal and professional outcomes,[8,19,20] although negative outcomes can also occur.[8,21] Similar to leadership, mentorship should engage all levels of nursing. The characteristics of good mentors that have been reported in the academic and clinical health care literature include competence (ie, knowledge, experience, and the ability to command the respect of others), self-confidence (eg, successful, yet willing to share credit for achievements and provide access to a professional network of contacts), and commitment (ie, willing to invest time, energy, knowledge, and experiences to assist in another's professional development).[20,22]

Barondess[22] suggested that good mentors must be trustworthy, honest, caring and have a positive attitude. Because mentorship involves a dynamic interaction between the mentor and mentee, characteristics of good mentees include being motivated, competent, willing to take responsibility for their learning, committed to their personal and professional growth, able to receive constructive feedback, and possessing good communication skills.[19–21]

Mentorship can take place in almost any setting and within and between disciplines.[8,19] In the clinical area, mentoring often occurs when an experienced cardiovascular staff nurse or advanced nurse practitioner acts as a preceptor for a less experienced cardiovascular nurse or nursing student. Similarly, cardiovascular nurse researchers or educators may assist less experienced researchers or educators. Often the mentoring process is done on a short-term basis and without the mentor and mentee making a conscious decision to establish a mentorship relationship with mutually agreed-upon purposes, plans, and goals. In this article, we advocate intentionally establishing mentorship relationships with identifiable objectives and plans for achieving the goals. This is especially relevant in relation to preparing cardiovascular nurses for leadership.

Mentorship programs have been shown to work long distance within a country,[21] as well as internationally between countries.[20] *Transcultural* or *intercultural mentorship* is a term used to explicitly acknowledge that mentoring activities between countries may occur in the context of 2 distinct cultures.[20,23] These countries may have vastly different health care, political, social, and economic realities, with differences in perspectives, belief systems, language, customs, and behaviors that need to be considered and addressed.[20,23]

Professional organizations often provide a strong environment for promoting mentorship activities. For example, the American Heart Association (AHA) sponsors 2 mentoring programs that include nurses. One is an International Mentoring Program for young scientists outside the United States[24] to promote collaboration and the professional growth of young scientists. The other is a Minority Mentoring Program[25] for United States–based underrepresented minority scientists and clinicians who are early in their careers. In both programs, communication is primarily conducted by e-mail with opportunities for the mentor and mentee to meet face-to-face at the annual AHA Scientific Sessions. In addition, the AHA has developed a Mentoring Handbook[26] to serve as a guide for mentorship relationships. Another example of an organization facilitating cardiovascular nurse mentoring was the 2008 pilot test of an international mentorship project jointly sponsored by the AHA Council on Cardiovascular Nursing and the Council on Cardiovascular Nursing and Allied Professions of the European Society of Cardiology. A US nurse researcher mentor was matched with a European nurse mentee who had similar interests. This mentorship pilot project was beneficial to both parties, but, unlike the AHA International Mentoring Program, this joint project included travel and other costs that proved to be too expensive to allow these organizations to continue their sponsorship. In the future, new communication technologies (eg, SKYPE video and/or teleconferences) will offer innovative and relatively inexpensive ways for developing long distance and international mentorship opportunities for cardiovascular nurses.

Core Competencies of Health Care Workers in the 21st Century

Major challenges for health care in the 21st century are the demographic and epidemiologic imperatives resulting from an aging population and the dramatic increase in the number of people living with 1 or more chronic illnesses. A large proportion of the burden of chronic illness is caused by CVD. This calls for action.[1,2,27] Care for the chronically ill requires a proactive interdisciplinary team with the necessary competencies to successfully develop, implement, and operate chronic care models[3,4] that incorporate prevention as an important building block.[27]

The WHO[3,4] proposed 5 core competencies that should drive the curricula of all health professions: (1) patient-centered care, (2) partnering, (3) quality improvement, (4) information and communication technology, and (5) a public health perspective.[3,4] These competencies should form the overarching structure of any curricula or postgraduate training of cardiovascular nursing education and thereby provide a solid basis from which nurses and other health care workers can become effective agents in the health care system.

Patient-centered care refers to health care institutions and care patterns being organized to better accommodate the experience of illness from the patient's perspective. Partnering reflects the ability to join with patients, other providers, and communities for effective care. Quality improvement requires being clear about the outcomes to be achieved, adhering to evidence-based guidelines, knowing what changes would lead to improvements, and being able to evaluate these efforts. Information and communication technology competencies refer to acquiring skills to use available technologies to support patient care. And finally, the public health perspective is linked to shifting the perspective from caring for 1 patient at a time to planning care for populations of patients. This last competency is also linked to system thinking,[3,4] which requires shifting the focus away from the individual patient, as is commonly seen in many curricula. Using these core competencies as a basic framework from which to drive all health care curricula, specific competencies can be added that are linked to specific health professional profiles, such as CVD-prevention nurses.

Specific Competencies for Preventive Cardiovascular Nurses

To prepare cardiovascular nurses for leadership in preventive cardiovascular practice, it is important to identify the specific educational and clinical competencies that nurses need. Three recent documents address requisite competencies for the field of CVD prevention.

1. In 2006, a group of experts from subspecialty cardiovascular nursing organizations was convened by the American College of Cardiology to draft an update of the Scope and Standards of Practice of cardiovascular nursing.[28] The purpose of this document, the previous iteration of which had been published in 1981, was to define cardiovascular nursing and describe its knowledge base, "providing a framework for the development of an educational curriculum."[28] The contents of this document, although broad in scope, provide a template outlining the practice of cardiovascular nursing. The educational requirements for cardiovascular nurses proposed in this document include a broad knowledge base in anatomy, physiology, pharmacology, nutrition, psychology, and developmental theory.[28]
2. In 2001, the American Nurses Credentialing Center, which serves as the credentialing arm of the American Nurses Association, launched a certification examination for cardiac/vascular nurses. The

certification is directed toward those who provide "…comprehensive nursing care to individuals diagnosed with cardiac/vascular disease and identified as at risk for cardiac/vascular events. These services are provided in a variety of settings, including acute, ambulatory care, community-based, worksite, and school-based programs. Cardiac/vascular nursing practice promotes achievement and maintenance of optimal cardiac vascular wellness."[29] This certification represents the merger of the previous cardiac rehabilitation examination and the vascular nursing examination. The content of this "hybrid" examination acknowledges the evolution of cardiac rehabilitation programs into secondary prevention clinics and further acknowledges the systemic nature of atherosclerosis and the appropriateness of global risk reduction. The test content outline includes pathophysiology of cardiac and vascular disease, communication, provision of care, patient and family-caregiver education, psychosocial aspects of cardiac and vascular disease, leadership, and legal and ethical issues.[30] The current certification was developed for registered nurses with basic educational preparation and serves to validate nursing knowledge and competency. A corresponding certification process at the graduate level is not yet available. Such a certification process for advanced practice nurses would serve to drive curriculum development in this content area.

3. The American College of Cardiology Foundation, the AHA, and the American College of Physicians formed a task force on clinical competence, and under its auspices, in 2009 a multidisciplinary group of stakeholders was convened to draft recommendations for competence and training for prevention of CVD. Nursing was represented in the writing group, and the recommendations were designed to be relevant for "shared responsibility among all health care professionals involved in the care of people at risk of developing CVD."[31] The authors noted the suboptimal delivery of cardiovascular risk reduction in clinical practice, referenced the challenges of operationalizing the prevention of CVD posed by rapidly expanding knowledge, and addressed obstacles related to patient and provider adherence to recommendations. The topic areas referenced in these recommendations[31] are synthesized in the following list for their relevance to nursing and to this document.

- Vascular biology–pathophysiology of atherothrombosis: Evidence-based cardiovascular preventive strategies are developed based on the pathophysiology of atherothrombosis. The nurse should have a working knowledge of the pathophysiologic process from early fatty streak to endothelial dysfunction, plaque formation, and plaque rupture. The recognition that diabetes is a CVD and an understanding of insulin resistance as it impacts risk for CVD are included.
- Epidemiology and research concepts: An understanding of population-based health concepts is integral to translating the large body of information (both clinical trial and observational findings) into clinical practice and to communicating complex information to the lay public in the clinical and community health settings.
- Pharmacology: The nurse requires a detailed knowledge of the large armamentarium of pharmacologic agents directed to cardiovascular risk reduction. Whether or not the nurse holds prescriptive authority, a strong understanding of pharmacology provides credibility in coaching patients on long-term persistence with therapy. A knowledge base of pharmacology in the management of dyslipidemia, hypertension, diabetes, heart failure, thrombosis, and tobacco addiction is required. In addition, knowledge of pharmacological agents that may increase cardiovascular risk is required.
- Gene-environment interaction: Knowledge of the gene-environment interaction provides the basis for the assessment and modification of risk. At minimum, the nurse requires a familiarity with the spectrum of inherited disorders that increase risk for CVD and basic skills in eliciting a thorough family history.
- Behavioral, psychosocial issues, and adherence to recommendations: Psychosocial factors such as depression contribute both to the pathophysiology of atherothrombosis and to behavioral adaptations to CVD management and risk reduction. One of the major challenges facing health care professionals is the development of skills in working with patients on long-term behavior change. These skills are particularly critical in the areas of smoking cessation and obesity management.
- Advanced risk assessment and assessment of subclinical disease: Although the Framingham risk score remains the recommended basic assessment tool, multiple tools for advanced risk assessment, particularly in the area of dyslipidemia, are available. Nurses should have an understanding of the complex area of novel risk factors for atherothrombosis, including markers of inflammation and measurement of lipoprotein particle size and density. In addition, knowledge of the evidence underlying various imaging modalities, including the measurement of carotid intima-media thickness and of coronary artery calcium, is needed, to advise patients of the usefulness of these strategies as risk assessment tools.
- Nutrition and exercise advice: A multidisciplinary approach to CVD risk reduction that leverages

colleagues' knowledge and skills in nutrition and exercise physiology is optimal. However, limited resources and issues related to reimbursement often dictate that advice about dietary modification and physical activity "defaults" to nursing. Key elements include knowledge of the concepts of caloric balance; dietary recommendations for patients with hypertension, dyslipidemia, diabetes, and overweight; food label comprehension; and the role of functional foods.

Clearly, there exists a spectrum of competence levels required for staff nurse roles versus nurses in advanced practice or defined leadership roles, but the areas identified can serve as a useful common template. The other factor evident from these competencies is that cardiovascular nurses need to be prepared to work within an interprofessional context using skills and knowledge from the biomedical and social sciences. All nurses will benefit from the incorporation of core leadership skills to assume key roles in championing preventive strategies across the globe.

Cultural Competency

In addition to developing leadership potential, nurses must develop cultural competency to be able to deliver quality care to increasingly diverse patient populations. The risks of CVD and health outcomes are influenced by environmental, social, economic, and biological factors.[32] Although cardiovascular nurses are well situated to address these factors, models to prevent CVD in racial and ethnic minority populations are limited. This is partially due to the challenges in engaging individuals who are not part of the dominant culture. The limited information available to cardiovascular nurses is also due to a lack of sufficient research on underrepresented populations because of methodological challenges associated with undertaking research in diverse populations.

Furthermore, the complex and multifaceted dimensions of addressing health inequity and increased costs due to the need for interpreters and translated material in cross-cultural research also diminish the capacity to engage vulnerable and marginalized groups.[33,34]

To achieve equitable outcomes, cardiovascular nurses must adapt to a range of cultural and social circumstances. The terms *culture* and *ethnicity* refer to the socioeconomic, religious, and political qualities of groups of individuals. These characteristics may refer to factors such as language, diet, dress, customs, kinship systems, and historical or territorial identity.[35] For example, in indigenous populations, these considerations are crucial in engaging individuals and communities.

Behavior change is a critical element for ensuring that interventions and health care services are acceptable and appropriate to a diverse range of perspectives. Competence implies that the health practitioner has the capacity to function effectively with a culturally diverse group.[36] Proctor and Davis[6] identify 3 characteristics required for practitioners to become culturally competent. First, health professionals need to be aware of their own beliefs and attitudes about racial and ethnic minorities, not to impose their feelings on clinical interactions that may adversely impact patients. Second, they need to appreciate the views of patients and interact in a nonjudgmental manner. Third, health professionals must be able to use cultural competency skills in clinical interactions. Becoming culturally competent not only impacts clinical practice at the individual level, but also affects administration and leadership, policy-making and governing boards, clinical standards and guidelines, and organizational vision and mission.[6]

The prevalence and magnitude of risk factors for CVD vary across different cultural, ethnic, and racial groups, necessitating targeted strategies and increased awareness.[37,38] To prepare cardiovascular nurses for service in multicultural environments, curricula in undergraduate, postgraduate, and professional development settings must warrant cultural competence and understanding of diverse perspectives. Cardiovascular nurse leaders should mentor nurses from culturally and linguistically diverse groups to maximize participation of individuals so that cardiovascular nursing services reflect the cultural composition of the wider community.

System Change Competencies and Evidence-Based Practice

Improving quality of preventive care and advancing patient care goals are accomplished by translating evidence into practice. Integration of research findings in practice is essential for improving the quality and outcomes of care and is integral to leadership activities of cardiovascular nurses.[39] Yet, adoption of EBP has been slow and varied.

Competency in this area involves the integration of multiple sources of knowledge and the current best practice evidence into health care practice approaches.[40] Knowledge and evidence arise from clinical trial data, clinical experiences, patient circumstances, and quality improvement efforts.[3] For nurses to make an impact on reducing the global burden of CVD through prevention, preventive EBP must be developed that demonstrates effectiveness within the population of interest. Generation of evidence-based protocols and guidelines is essential. Evidence may be used to help inform a nurse's understanding of a specific preventive situation, to direct a specific approach, or to persuade others in decision-making positions about the need to make changes in policies or practices.[41] For example,

Clinical Pearls

- Increasing our efforts to educate and mentor cardiovascular nurses to become leaders is crucial to combating the global burden of CVD.
- World Health Organization competencies for the education and training of health professions and the specific CVD competencies (identified in this article) should guide our efforts as well as research translated into practice.
- To prepare cardiovascular nurses for service in multicultural environments, curricula in undergraduate, postgraduate, and professional development settings must warrant cultural competence and understanding of diverse perspectives.

evidence about the preventive cardiovascular benefits of moving from sedentary status to increased physical activity[42] might be used to incorporate physical activity assessment and counseling for every primary care patient, tailoring the advice to the age, sex, and ethnicity of the patient,[43] and to advocate for reduction of barriers to physical activity in a "developed" environment. As such evidence-based approaches are implemented in specific settings and evaluated, and the results communicated, further evidence generation will occur.

Development of EBP can occur through a number of processes, including systematic reviews of the literature, meta-analyses incorporating a statistical evaluation of available quantitative research, and review of available evidence reports, as well as published clinical practice guidelines. Several models provide useful guidance on how to develop and test evidence-based approaches. Although the models have some innate differences, each begins with a focused definition of a problem to be solved or clinical improvement foci, followed by assessment of existing evidence (ie, a research critique)[44]; determination of the effect, size, or magnitude; the potential risks and benefits of adopting the practice; appropriateness of the evidence for the population and environment of interest; and the costs and potential cost-savings associated with the change. Incorporation of the patient's values is important as well. Additional key steps would include a plan for implementing the change, garnering organizational and interdisciplinary support, and evaluating and sharing the outcomes.[45]

Developing skills related to using EBP can also be achieved through formal and informal educational approaches. Ross and colleagues[46] outline a creative approach for incorporating EBP skills in undergraduate nursing education based on increasing complexity of the tasks. Key EBP competencies are formulating questions about how to improve practice and outcomes, finding relevant sources of data and information, and integrating the information acquired into patient care.[3] To make significant strides in implementing EBP, mentors at all levels who can guide the development and be actively involved at the point of care are needed.[39] In addition to individual nurses' skills, EBP requires organizational leadership for EBP[45] and technological support for access to resources and data.[47]

Strategies for Acquiring Clinical Competencies and Developing Leadership Skills

The purpose of this article was to address issues related to the education and training needed for leadership roles in CVD prevention. We identified mentorship as a key strategy and discussed the educational, leadership, cultural, and research (eg, EBP) competencies needed to prepare nurses for leadership roles in reducing the rates of occurrence of CVD. It is crucial to promote mentoring relationships at every nursing level, including academic, clinical, administrative, research, and across disciplines. The WHO competencies for the education of health professionals should guide our efforts, as well as research translated into practice. Development of cultural competency is also a critical component of nursing programs, and clinical sites should be designed to develop future nurses and nurse leaders. Membership and active participation in relevant professional organizations provide a rich source for dissemination of information, networking, and mentorship relationships. Nurse leaders in professional organizations can ensure that mentoring activities among the nurse members are promoted and supported. This pool of future leaders will support cardiovascular nurses in future leadership roles in CVD prevention.

In both developed and developing countries, the aging population, global economic crisis, and the growing shortage of nurses presents great challenges for nurses to continue to provide quality nursing care and good patient outcomes. Nurses need to take a leadership role in shaping health care and social policy, as well as in advocating for vulnerable and marginalized communities. Increasing our efforts to educate and mentor cardiovascular nurses to become leaders is crucial to combating the global burden of CVD.

Acknowledgments

The authors thank Kathleen Freimuth for her editorial assistance and Klara Remund and Lut Berben for their assistance with the formatting and reference management of the article.

REFERENCES

1. Beaglehole R, Ebrahim S, Reddy S, Voute J, Leeder S. Prevention of chronic diseases: a call to action. *Lancet*. 2007; 370(9605):2152–2157.

2. Caring for people with chronic conditions. In: Nolte E, McKee M, eds. A *Health Care Systems Perspective*. Berkshire, England: University Press; 2008.
3. World Health Organization. Preparing a workforce for the 21st century. *The Challenge of Chronic Conditions*. Geneva, Switzerland: World Health Organization; 2004.
4. Pruitt SD, Epping-Jordan JE. Preparing the 21st century global healthcare workforce. *BMJ*. 2005;330(7492): 637–639.
5. Registered Nurses' Association of Ontario. Healthy work environments best practice guidelines. *Developing and Sustaining Nursing Leadership*. Ontario, Canada: Registered Nurses' Association of Ontario; 2006:1–136. http://www.rnao.org/Storage/69/6395_RNAO_HWE_REF_GUIDE.pdf. Accessed July 19, 2010.
6. Proctor EK, Davis LE. The challenge of racial difference: skills for clinical practice. *Soc Work*. 1994;39(3):314–323.
7. White DB. The identification of best practices in teaching quality competencies for preparing future health care leaders. *J Health Adm Educ*. 2005;22(3):321–344.
8. Ehrich LC, Hansford B, Tennent L. Formal mentoring programs in education and other professions: a review of the literature. *Educ Adm Q*. 2004;40(4):518–540.
9. Hammick M, Freeth D, Koppel I, Reeves S, Barr H. A best evidence systematic review of interprofessional education: BEME guide no. 9. *Med Teach*. 2007;29(8):735–751.
10. Bryman A. Leadership in organizations. In: Clegg SR, Hardy C, Nord WR, eds. *Handbook of Organizational Studies*. Thousand Oaks, CA: Sage Publications; 1996.
11. Northouse PG. *Leadership: Theory and Practice*. London: Sage Publications; 2001.
12. Faugier K, Woolnough H. National nursing leadership programme. *Learn Disabil Pract*. 2002;5(10):32–37.
13. Sofarelli D, Brown D. The need for nursing leadership in uncertain times. *J Nurs Manag*. 1998;6(4):201–207.
14. Bass BM. *Leadership and Performance Beyond Expectation*. New York: Free Press; 1985.
15. Millward LJ, Bryan K. Clinical leadership in health care: a position statement. *Int J Health Care Qual Assur Inc Leadersh Health Serv*. 2005;18(2–3):xiii–xxv.
16. McClure M, Poulin M, Sovie M, Wandelt M. Magnet hospitals: attraction and retention of professional nurses. In: McClur M, Hinshaw A, eds. *Magnet Hospitals Revisited*. Washington, DC: American Academy of Nurses; 2002.
17. Pearson A, Laschinger H, Porritt K, Jordan Z, Tucker D, Long L. *A Comprehensive Systematic Review of Evidence on Developing and Sustaining Nursing Leadership That Fosters a Healthy Work Environment in Health Care*. Adelaide, Australia: The Joanna Briggs Institute; 2004.
18. Stewart BM, Krueger LE. An evolutionary concept analysis of mentoring in nursing. *J Prof Nurs*. 1996;12(5):311–321.
19. McCloughen A, O'Brien L, Jackson D. Esteemed connection: creating a mentoring relationship for nurse leadership. *Nurs Inq*. 2009;16(4):326–336.
20. Morales-Mann ET, Higuchi KA. Transcultural mentoring: an experience in perspective transformation. *J Nurs Educ*. 1995;34(6):272–277.
21. Owens BH, Herrick CA, Kelley JA. A prearranged mentorship program: can it work long distance? *J Prof Nurs*. 1998;14(2):78–84.
22. Barondess JA. On mentoring. *J R Soc Med*. 1997;90(6): 347–349.
23. Koskinen L, Tossavainen K. Characteristics of intercultural mentoring–a mentor perspective. *Nurse Educ Today*. 2003;23(4):278–285.
24. American Heart Association. *International Mentoring Program*. http://www.americanheart.org/presenter.jhtml?identifier=3040709. Accessed June 22, 2010.
25. American Heart Association. *Minority Mentoring Program*. http://www.americanheart.org/presenter.jhtml?identifier=3050133. Accessed June 22, 2010.
26. American Heart Association. *Mentoring Handbook*. 2nd ed. http://www.americanheart.org/presenter.jhtml?identifier=3016094. Accessed June 22, 2010.
27. Yach D. *Innovative Care for Chronic Conditions—Building Blocks for Action*. Geneva, Switzerland: World Health Organization; 2002.
28. American College of Cardiology Foundation, American Nurses Association. *Cardiovascular Nursing: Scope and Standards of Practice*. Silver Spring, MD: Nursebooks.Org; 2008.
29. American Nurses Credentialing Center. Testing Information. Certification Application Form. Cardiac Vascular Nurse. http://www.nursecredentialing.org/Documents/Certification/Application/NursingSpecialty/CardiacVascularApplication.aspx. Accessed July 19, 2010.
30. American Nurses Credentialing Center. Cardiac Vascular Nurse Board Certification Test Content Outline http://www.nursecredentialing.org/Documents/Certification/TestContentOutlines/CardiacVascularNurseTCO.aspx. Accessed June 22, 2010.
31. Bairey Merz CN, Alberts MJ, Balady GJ, et al. ACCF/AHA/ACP 2009 competence and training statement: a curriculum on prevention of cardiovascular disease: a report of the American College of Cardiology Foundation/American Heart Association/American College of Physicians Task Force on Competence and Training (Writing Committee to Develop a Competence and Training Statement on Prevention of Cardiovascular Disease): developed in collaboration with the American Academy of Neurology; American Association of Cardiovascular and Pulmonary Rehabilitation; American College of Preventive Medicine; American College of Sports Medicine; American Diabetes Association; American Society of Hypertension; Association of Black Cardiologists; Centers for Disease Control and Prevention; National Heart, Lung, and Blood Institute; National Lipid Association; and Preventive Cardiovascular Nurses Association. *Circulation*. 2009;120(13):e100–e126.
32. Toronto (South Region) Health Heart Partnership. Multicultural heart health partnership exploring best practices for heart health with culturally diverse. Ontario Council of Agencies Serving Immigrants. September 2001. http://atwork.settlement.org/downloads/Heart_Health_Best_Practices.pdf. Accessed June 22, 2010.
33. Malhotra NK, Agarwal J. Methodological issues in cross-cultural marketing research. *Int Mark Rev*. 1996;13(5): 7–43.
34. Rust G, Cooper LA. How can practice-based research contribute to the elimination of health disparities? *J Am Board Fam Med*. 2007;20(2):105–114.
35. Lee SS, Mountain J, Koenig BA. The meanings of "race" in the new genomics: implications for health disparities research. *Yale J Health Policy Law Ethics*. 2001;1(spring): 33–75.
36. Brisbane FL, Epstein LG, Pacheco G, Quinlan JW. Cultural competence for health care professionals working with African-American communities: theory and practice. United States Department of Health & Human Services. ftp://ftp.hrsa.gov/bphc/docs/1999PALS/PAL99-10.PDF. Accessed June 22, 2010.
37. Chyun DA, Amend AM, Newlin K, Langerman S, Melkus GD. Coronary heart disease prevention and lifestyle interventions: cultural influences. *J Cardiovasc Nursing*. 2003; 18(4):302–318.

38. Mosca L, Appel LJ, Benjamin EJ, et al. AHA. Evidence-based guidelines for cardiovascular disease prevention in women. *JACC*. 2004;43(5):900–921.
39. Shirey MR. Evidence-based practice: how nurse leaders can facilitate innovation. *Nurs Adm Q*. 2006;30(3):252–265.
40. Fineout-Overholt E, Melnyk BM, Schultz A. Transforming health care from the inside out: advancing evidence-based practice in the 21st century. *J Prof Nurs*. 2005;21(6):335–344.
41. Polit DF, Beck CT, eds. *Nursing Research: Generating and Asessing Evidence for Nursing Practice*. 8th ed. Philadelphia, PA: Wolters Kluewer Lippincott Williams & Wilkins; 2008.
42. Pearson TA, Blair SN, Daniels SR, et al. AHA Guidelines for Primary Prevention of Cardiovascular Disease and Stroke: 2002 update: consensus panel guide to comprehensive risk reduction for adult patients without coronary or other atherosclerotic vascular diseases. American Heart Association Science Advisory and Coordinating Committee. *Circulation*. 2002;106(3):388–391.
43. Mosca L, Banka CL, Benjamin EJ, et al. Expert Panel/Writing Group; American Heart Association; American Academy of Family Physicians; American College of Obstetricians and Gynecologists; American College of Cardiology Foundation; Society of Thoracic Surgeons; American Medical Women's Association; Centers for Disease Control and Prevention; Office of Research on Women's Health; Association of Black Cardiologists; American College of Physicians; World Heart Federation; National Heart, Lung, and Blood Institute; American College of Nurse Practitioners. Evidence-based guidelines for cardiovascular disease prevention in women: 2007 update. *Circulation*. 2007;115(11):1481–1501.
44. Stevens K. Critically appraising quantitative evidence. In: Melnyk B, Fineout-Overholt E, eds. *Evidence-Based Practice in Nursing and Healthcare: A Guide to Best Practice*. Philadelphia, PA: Lippincott Williams and Wilkins; 2005.
45. Melnyk BM, Fineout-Overholt E, Stillwell SB, Williamson KM. Evidence-based practice: step by step: the seven steps of evidence-based practice. *Am J Nurs*. 2010;110(1):51–53.
46. Ross AM, Noone J, Luce LL, Sideras SA. Spiraling evidence-based practice and outcomes management concepts in an undergraduate curriculum: a systematic approach. *J Nurs Educ*. 2009;48(6):319–326.
47. Pochciol JM, Warren JI. An information technology infrastructure to enable evidence-based nursing practice. *Nurs Adm Q*. 2009;33(4):317–324.