A Practical Approach to Reducing Cardiovascular Risk Factors

Gregg C. Fonarow, MD, FACC

Ahmanson-UCLA Cardiomyopathy Center, UCLA Preventive Cardiology Program, UCLA Division of Cardiology, Los Angeles, CA

Despite overwhelming evidence supporting the benefits of cardiovascular protective therapies and risk reduction in patients with or at risk for coronary heart disease, these strategies remain underutilized in clinical practice. Preventive cardiology guidelines from the American Heart Association, the American College of Cardiology, and others focus on primary and secondary prevention with the use of medications, risk factor control measures, and lifestyle modification. Still, a "treatment gap" remains between the guidelines and their actualization. A systematic approach including both inpatient and outpatient measures is necessary. This article discusses the current guidelines and addresses ways to increase implementation of evidence-based, guideline-recommended treatment by healthcare providers caring for at-risk patients.
[Rev Cardiovasc Med. *2007;8(suppl 4):S25-S36*]

Key words: Coronary heart disease • Preventive cardiology guidelines • Lipids • Diabetes • Hypertension

There is consistent and compelling scientific evidence that cardiovascular protective therapies and therapeutic lifestyle changes reduce the risk of cardiovascular events and improve survival in patients with atherosclerotic vascular disease (secondary prevention).[1,2] The benefits of cardiovascular protective therapies are cumulative, and, as a result, substantial risk reduction occurs when evidence-based, guideline-recommended therapies are applied in clinical practice. Similar potential benefits exist for risk reduction in patients

without established coronary heart disease (CHD) (primary prevention).[3] Clinical trials demonstrate that significant decreases in cardiovascular events can be achieved by aggressive reduction of risk factors in high-risk patients who have not yet manifested CHD. Furthermore, certain risk-reducing strategies can prevent or delay the onset of type 2 diabetes. However, the risk status of persons without CHD varies greatly, and this variability mandates a range in the intensity of interventions.[3] Primary prevention requires an effective assessment of risk to categorize patients for selection of appropriate interventions.

The scientific evidence for primary and secondary prevention has served as the basis for preventive cardiology guidelines from the National Cholesterol Educational Program (NCEP), the American Heart Association (AHA), the American College of Cardiology (ACC), and the American Diabetes Association.[2-4] These guidelines aim to provide healthcare professionals with a comprehensive approach to reducing the cardiovascular and metabolic risks of patients across a wide spectrum of risk and multiple cardiovascular risk factors. These guidelines have focused on primary as well as secondary prevention. The application of these guidelines into routine clinical practice would be expected to result in major reductions in cardiovascular morbidity and mortality.

Although the various preventive cardiology guidelines have the potential to improve the primary and secondary prevention of CHD as well as reduce the rates of diabetes, the reality of undertreatment has greatly limited their impact. Indeed, recent studies in both the United States and Europe have highlighted a significant "treatment gap" between the risk-reducing objectives published in international and national guidelines and current clinical practice.[5-7]

This article will review the studies documenting the underuse of guideline-recommended risk-factor–reducing therapy in clinical practice. Effective strategies and systems to improve evidence-based, guideline-recommended treatment implementation will be discussed, highlighting successful programs that have been demonstrated to improve treatment rates and clinical outcomes in different patient risk groups. Other approaches to help reduce risk factors to goal levels and new therapies in clinical development will also be reviewed. Healthcare professionals can play an essential role in bridging the "prevention and treatment gap" and allowing guidelines to fulfill their potential.

Primary and Secondary Prevention Guidelines

Primary prevention guidelines that highlight effective strategies for reducing first cardiovascular events have been released.[4] They discuss recommendations for smoking cessation, blood pressure control, lipid management, physical activity, and weight management. This approach stresses the importance of population-based interventions as critical components of primary prevention. The AHA/ACC guidelines for comprehensive risk reduction in patients with coronary and other vascular diseases provide a concise summary of the recommendations of evidence-based risk-reduction therapies for secondary prevention. The guidelines were first released in 1995 and revised in 2001.[1,2] They support aggressive risk reduction in patients with established atherosclerosis, using a multifaceted approach, including cardiovascular protective medications, risk factor control, and lifestyle modification.[1,2]

The components of comprehensive secondary prevention include exercise, smoking cessation, and management of dyslipidemia, hypertension, diabetes, and weight.[2] Goals for frequency of exercise, body mass index, blood pressure, and lipid levels are provided for patients with documented atherosclerosis. Combinations of cardiovascular protective medications are recommended in appropriate patients without contraindications or documented intolerance.[2] These recommended cardiovascular medications include aspirin, beta blockers, angiotensin-converting enzyme (ACE) inhibitors, and lipid-lowering medications.[2] Cardiovascular risk reduction is far more effective when multiple, modifiable risk factors are addressed and a combination of cardiovascular protective medications are used, rather than when a single risk factor is addressed in isolation.

The NCEP Adult Treatment Panel (ATP-III)[3] remains focused on the importance of providing effective lipid-lowering strategies. One of the fundamental changes made to the ATP-III guidelines was the inclusion within the secondary prevention category of a wider range of individuals who may be at risk of developing cardiovascular events within the next 10 years.[3] In addition to preexisting CHD, other forms of atherosclerotic vascular disease, such as peripheral arterial disease and symptomatic carotid arterial disease, are considered CHD risk equivalents. Another risk equivalent is diabetes mellitus, even without established CHD, because these patients have a high risk of developing macrovascular disease if left untreated.[8] The additional inclusion of patients with a 10-year global risk exceeding 20%, calculated based on the presence of multiple risk factors, presents a challenging new group for

healthcare providers to identify and aggressively treat. Furthermore, the lowest limit for high-density lipoprotein cholesterol (HDL-C) has been raised from < 35 mg/dL in ATP-II to < 40 mg/dL in both men and women in ATP-III.[3,9] This change was warranted because low HDL-C level is a strong independent risk factor for the development of CHD.[10]

The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-7)[11] has provided updated guidelines that simplify the classification and revise the nomenclature of blood pressure categories in an effort to achieve better population levels of blood pressure. Whereas the prior version of the guidelines identified categories of optimal, normal, and high-normal for levels below that defining hypertension, normal is now defined as < 120/80 mm Hg, and the previously defined normal and high-normal levels are combined into a category called "prehypertension" (120 to 139 mm Hg systolic or 80 to 89 mm Hg diastolic). This latter revision is an effort to alert the large number of persons in this category to the importance of lifestyle management to prevent the likely progression of blood pressure to hypertensive levels. Furthermore, the former stages 2 and 3 are now combined into a single stage 2 to reflect levels of significant hypertension (at least 160 mm Hg systolic or at least 100 mm Hg diastolic). Patients with target organ damage are classified as high-risk and in need of more intensive blood pressure reduction to < 130/85 mm Hg, or, in those with chronic kidney disease, even lower to < 125/75 mm Hg. The customary nominal treatment goal is < 140/90 mm Hg.

Obesity is associated with increased risk of diabetes, CHD, and cardiovascular mortality. Excess body weight is also an independent risk factor for the development of diabetes and contributes to other risk factors, such as hypertension and dyslipidemia. Guidelines recommend that measures should be taken to achieve and maintain a normal body weight (body mass index < 25 kg/m^2).

The Gap in Applying Guideline-Recommended Care

Utilization of Lipid-Lowering Treatment

There is overwhelming scientific evidence that therapy to reduce low-density lipoprotein cholesterol (LDL-C) decreases the risk of recurrent cardiovascular events and improves survival in patients after an acute coronary event.[12-15] The benefits of lipid-lowering medications have been proven to apply to men and women, patients older and younger than 65 years, and diabetic as well as nondiabetic patients.[16-28] Virtually all patients with atherosclerosis, in the absence of contraindications or intolerance, would be expected to be appropriate candidates for lipid-lowering medical therapy.[22]

Despite both the ability of lipid-lowering therapy to alter subsequent cardiovascular mortality and the widespread dissemination of national treatment guidelines, a number of studies show relatively low treatment rates in patients with established coronary artery disease, including high-risk patients after acute coronary events.[5-7,25-27] The use of lipid-lowering medication in patients hospitalized for acute myocardial infarction in the United States was assessed in an analysis of 138,001 patients from 1470 hospitals in the National Registry of Myocardial Infarction 3 from July 1998 to June 1999.[25] Upon discharge, only 31.7% of these patients had been prescribed a lipid-lowering medication. Among patients with a history of coronary artery disease, revascularization procedures, or diabetes, less than half were discharged on treatment. Elderly patients, independent of associated comorbidities, were more likely to be discharged without lipid-lowering therapy. Women were also less likely to be discharged with lipid-lowering medications.[25] A variety of other clinical, demographic, treatment, and process-of-care factors that significantly influenced use of lipid-lowering medications were also identified. Other studies have shown similar underutilization of lipid-lowering therapy in high-risk hospitalized patients.[26-29]

In the outpatient setting, this treatment gap for statin therapy in post–acute coronary syndrome patients persists. The Quality Assurance Project analyzed treatment rates in 48,586 outpatients with documented CHD (29% with prior history of myocardial infarction) from 140 medical practices (80% cardiology).[6] Only 39% of these patients were treated with lipid-lowering medications, and only 11% were documented to have an LDL-C level of ≤ 100 mg/dL. In the third National Health and Nutrition Examination Survey (NHANES III), lipid-lowering medication was used in only about 11% of participants with a history of myocardial infarction.[30] In the Lipid Treatment Assessment Project (L-TAP) study, only 18% of outpatients with CHD treated for hyperlipidemia had LDL-C levels < 100 mg/dL.[7] This low rate was not attributable to lack of provider awareness, since 95% of the surveyed physicians reported that they were knowledgeable about the NCEP guidelines, and 65% reported that they follow the guidelines for most patients.[7]

The ACA Evaluation of Preventive Therapeutics (ACCEPT) study, which evaluated 6875 patients from 55 US centers, showed that 6 months after cardiac hospitalization, despite prospective monitoring, only 28% of patients were at goal for LDL-C.[27] A significant treatment gap for statin therapy use in patients after cardiovascular hospitalizations has also been documented in 47 centers in 15 European countries that participated in the European Action on Secondary Prevention through Intervention to Reduce Events (EUROASPIRE) II study.[5]

The documented treatment gap also involves the issue of patient adherence. When statin therapy is initiated on an outpatient basis after an acute coronary event, studies have shown that the adherence rate to statin treatment is remarkably poor. Among 22,379 patients receiving a statin prescription on an outpatient basis after an acute coronary syndrome, the 2-year adherence rate with statin therapy was only 40.1%.[31] Other studies also have shown that when initiation of therapy is delayed until after hospital discharge, the adherence rate for statin therapy is poor.[32] This low rate of patient adherence to therapy undoubtedly is a significant contributor to the large number of patients not being treated with this evidence-based therapy on an outpatient basis.

Together, these studies demonstrate that under conventionally guided management, regardless of the healthcare delivery system, an unacceptably large number of high-risk patients are left untreated and undertreated with lipid-lowering therapy. The underuse of lipid-lowering therapy in patients with atherosclerotic vascular disease represents a major clinical practice and public health issue.[25,33] Given the substantial number of patients at risk and the benefits of therapy, there is an urgent need to adopt effective strategies that will improve the number of CHD and CHD risk–equivalent patients who are being effectively treated with statins and other lipid-lowering therapy.[33]

Utilization of Hypertension Treatment and Awareness of Guidelines

Despite significant evidence regarding the efficacy of hypertension treatment in prevention of cardiovascular events, a significant gap still remains between the guidelines and actual practice. Targets for blood pressure control in uncomplicated cases and patients with diabetes or decreased renal function were set by the sixth JNC several years ago, but only about 25% of hypertensive patients, 11% of diabetic patients, and 3% to 5% of patients with decreased renal function have achieved adequate blood pressure control.[34]

Data from NHANES III compared treatment rates in 1988 through 1991 with treatment rates in 1999 through 2000. The rates among patients with hypertension remained inadequate, improving significantly in men (from 44.5% to 54.3%; $P < .001$), but not in women (60.1% to 62.0%; $P = .24$).[35] Rates of treatment improved significantly in non-Hispanic whites and non-Hispanic blacks, but only marginally in Mexican Americans. Significant improvement in control of hypertension, both among those treated and among all those with hypertension, were seen in men, but not in women. In 1999 through 2000, approximately 60% of men being treated had their hypertension controlled to $< 140/90$ mm Hg, compared with less than 50% of women. The improvement in control rates for men was due exclusively to substantial improvements in control in non-Hispanic white men, without any significant change in men of other racial/ethnic groups.[35] In a practice-based setting (a specialty hypertension clinic), systolic and diastolic blood pressure goals of $< 140/90$ mm Hg were achieved by 59% of all patients, but by fewer patients with diabetes: 52% achieved $< 140/90$ mm Hg, 22% reached the goal of $< 130/85$ mm Hg, and 15% reached $< 130/80$ mm Hg.[34]

A report of randomly selected records of Medicaid recipients diagnosed with hypertension but not hospitalized showed that, in 1999, 48% of patients received therapies that did not comply with JNC recommendations.[36] Also, in an Italian study that gathered data during a specialist visit from 228 consecutive patients with recently diagnosed hypertension, 71% were on treatment, but only 19% had achieved a blood pressure level of $< 140/90$ mm Hg. A complete clinical and laboratory evaluation as suggested by the guidelines had been carried out in only 10% of the patients; most laboratory assessments were done only about half the time.[37]

With regard to patient-related reasons for noncompliance, a study examining patient-perceived problems and outcomes of hypertension treatment showed that two thirds of respondents experienced 1 or more problems, most commonly symptoms and adverse drug effects. Those with 3 or more problems were nearly 5 times more likely to have modified their dosage instructions and twice as likely not to have achieved goal blood pressure levels.[38]

Compliance With Diabetes and Weight Management Guidelines

Treatment of 3 clinical indicators—hemoglobin A_{1c}, blood pressure, and LDL-C level—has been shown to reduce the morbidity and mortality

associated with type 2 diabetes mellitus. However, numerous studies document a large treatment gap in patients with established diabetes. In an evaluation of compliance with clinical practice guidelines for patients with type 2 diabetes mellitus, data from 368 patients in northern Alberta, Canada, were collected from patient interviews, drug histories, physical and laboratory assessments, and other sources.

Although the overall average hemoglobin A_{1c} level was 7.25%, the average blood pressure was 131.7/76.2 mm Hg and the average LDL-C level was 105.2 mg/dL. Only 10% of patients reached targets for all 3 recommended measures and, of those not at target levels, 14%, 28%, and 87% had received no therapy for hyperglycemia, hypertension, and dyslipidemia, respectively. Also, only 22% were taking aspirin. These findings showed that significant treatment gaps exist.[39] In a retrospective review of charts among patients with diabetes in a university-based family medicine teaching practice, 58% of patients met NCEP II goals for LDL-C level, 38% were in compliance with standards for systolic and diastolic blood pressure, and only 22% had hemoglobin A_{1c} levels $< 7\%$, suggesting that more aggressive therapy is needed to achieve optimal compliance with treatment goals.[40]

The percentage of Americans who are overweight or obese has increased rapidly over the past 25 years. Nearly two thirds (64%) of US adults, 20 years or older, met the criteria for overweight or obesity in 1999 to 2000, and 30.5% qualified as obese. There are thus millions of patients falling outside of guideline recommendations for optimal body weight.

Compliance With Smoking Cessation

Insufficient documentation in the medical record of tobacco use and advice for quitting remains a major problem in cardiovascular guideline compliance. In a study conducted at HealthPartners, a large, network-model health plan in Minnesota, records of nearly 15,000 ambulatory adult patients from 1996 to 1999 showed that during this period, overall tobacco use identification increased from 49% to 73%, and advice to quit increased from 32% to 53% (both, $P < .01$). Still, only a small proportion of medical groups achieved the benchmark of identifying tobacco status in more than 80% of visits and providing advice to quit to over 80% of tobacco users.[41]

Compliance With Acute Coronary Syndrome/Myocardial Infarction Guidelines

A recent study using Quebec administrative data on all elderly survivors of acute myocardial infarction over a 3-year period (1996 to 1998) showed that rates of discharge medications were 65% for aspirin, 54% for beta blockers, 45% for ACE inhibitors, and only 21% for lipid-lowering drugs. Although these levels were suboptimal, 1-year compliance and persistence rates were high, with at least three fourths of patients continuing to take each of the prescribed agents.[42]

Barriers to Treatment and Contributing Factors

A number of barriers to implementing risk factor modification were highlighted at the 27th ACA Bethesda Conference.[43] They included focus of the physicians on acute problems, time constraints and lack of incentives, lack of training, and limited resources and outpatient facilities (Table 1). It has more recently been recognized that the setting in which treatment is initiated may be an important factor influencing treatment rates.[44]

Early treatment guidelines and algorithms, such as the NCEP I and II, had recommended that baseline lipid assessment and lipid-lowering treatment be delayed until 6 weeks after acute coronary event presentation. This recommendation was made in recognition of the fact that the acute-phase response triggered by acute myocardial infarction and coronary artery bypass grafting can substantially lower total cholesterol and LDL-C levels.[9] As a result, the first opportunity for initiating lipid-lowering medications and other secondary prevention strategies was delayed to a time when the patient may no longer feel at risk for recurrent events. Patients who did not receive lipid-lowering therapy and

Table 1
Barriers to Implementing Risk-Reducing Therapies

- Physicians focused on acute problems
- Time constraints and lack of incentives, including lack of reimbursement
- Lack of physician training, including inadequate knowledge of benefits and lack of prescription experience
- Insufficient resources and facilities
- Lack of specialist-generalist communication, passing on responsibility
- Costs of therapy, inadequate prescription medication benefits, restrictive formularies
- Guidelines that call for delaying initiation of therapy and outline multiple steps, time points, and treatment options

other cardiovascular therapies when hospitalized may have inadvertently concluded, along with their family members and primary care physicians, that their cardiologists and other inpatient physicians did not endorse the treatment.[45] Frequently, fewer resources are available in the outpatient setting than in the inpatient setting, and coordination of care between cardiologists and generalists may be more difficult.

The studies assessing utilization of risk-reducing therapy in patients after acute coronary events have consistently identified a variety of clinical, demographic, treatment, and process-of-care factors that significantly influenced treatment use.[6,28] This conclusion would seem to indicate that cardiovascular protective therapy use is affected by physician education and the process-of-care in place within the healthcare delivery system and, thus, could be favorably affected by educational initiatives, quality improvement programs, and treatment systems.

Impact of In-Hospital Initiation of Preventive Therapies

Institution of lipid-lowering therapy in the inpatient setting for patients hospitalized with acute coronary events and/or for a cardiovascular procedure has a number of advantages.[44] Measurement of baseline lipid levels can be systematically integrated into the diagnostic testing performed during cardiovascular hospitalization through the use of preprinted orders and care maps. The finding that lipid panels obtained in the first 12 to 24 hours of hospital admission reasonably reflect steady-state lipid levels at 6 weeks removes a perceived barrier to initiating lipid-lowering medications in the hospital setting.[45,46]

The structured setting within the hospital can facilitate the initiation of lipid-lowering medications through the use of physician prompts and reminders such as preprinted order sets, discharge forms, and involvement of other healthcare professionals.[25] Hospital-based initiation of therapy may help to alleviate patient concerns regarding medication tolerability and side effects. Linking the initiation of lipid-lowering therapy and other secondary prevention measures to the patient's cardiovascular hospitalization conveys the message that this therapy is essential for the prevention of recurrent events and is an important part of the patient's long-term treatment.[47]

Studies in other patient populations, such as those with heart failure, have demonstrated that initiation of ACE inhibitors at the time of hospitalization as part of a disease management program results in higher utilization rates at 6 months compared with rates in conventionally managed outpatients.[48] Initiation of interventions for smoking cessation while patients are hospitalized with acute myocardial infarction has been shown to result in higher cessation rates than initiation in the outpatient setting.[49] There have been substantially higher utilization rates shown 1 year after hospital discharge for therapies, such as aspirin and beta blockers, that are initiated before hospital discharge as compared with therapies, such as lipid-lowering medications, that are conventionally initiated on an outpatient basis.[50]

Hospital-based initiation of therapy may help to alleviate patient concerns regarding medication tolerability and side effects.

Proof of concept that in-hospital initiation of lipid-lowering therapy and other secondary prevention measures improves treatment rates and long-term patient compliance was provided by the University of California, Los Angeles, Cardiovascular Hospitalization Atherosclerosis Management Program (CHAMP).[50] This program, initiated in a university hospital setting in 1994, focused on initiation of aspirin, statin (irrespective of baseline LDL-C level, dosed to achieve LDL-C levels of < 100 mg/dL), beta blocker, and ACE inhibitor therapy in conjunction with dietary and exercise counseling in patients with established CHD before hospital discharge. Preprinted admission orders, critical pathways, discharge forms, physician/nursing education, and treatment utilization reports were employed to facilitate program implementation.[25] Algorithms for both hospitalization and outpatient phases of care were used.

Statin therapy use at the time of discharge increased from 6% before initiation of the program to 86% immediately after CHAMP was implemented ($P < .001$) (Table 2). Improved utilization of aspirin, beta blockers, and ACE inhibitors was also observed. Importantly, the in-hospital initiation of statin therapy had a dramatic effect on long-term treatment rates and patient compliance.[50] With CHAMP, 1 year after hospital discharge, 91% of CHD patients were treated with statins and 58% were documented to have LDL-C levels < 100 mg/dL, compared with 10% and 6%, respectively, with conventional management before CHAMP was implemented ($P < .01$). This improved use of statin therapy, along with other cardiovascular protective therapies, was associated with a significant

Table 2
Treatment Rates at Hospital Discharge and at 1-Year Follow-up With the Cardiovascular Hospitalization Atherosclerosis Management Program (CHAMP)[50]

	Pre-CHAMP (n = 256)		Post-CHAMP (n = 302)	
Therapy	Discharge	1 Year	Discharge	1 Year
Aspirin	78%	68%	92%	94%
Beta blocker	12%	18%	61%	57%
ACE inhibitor	4%	16%	56%	48%
Statin	6%	10%	86%	91%
LDL-C < 100 mg/dL	–	6%	–	58%

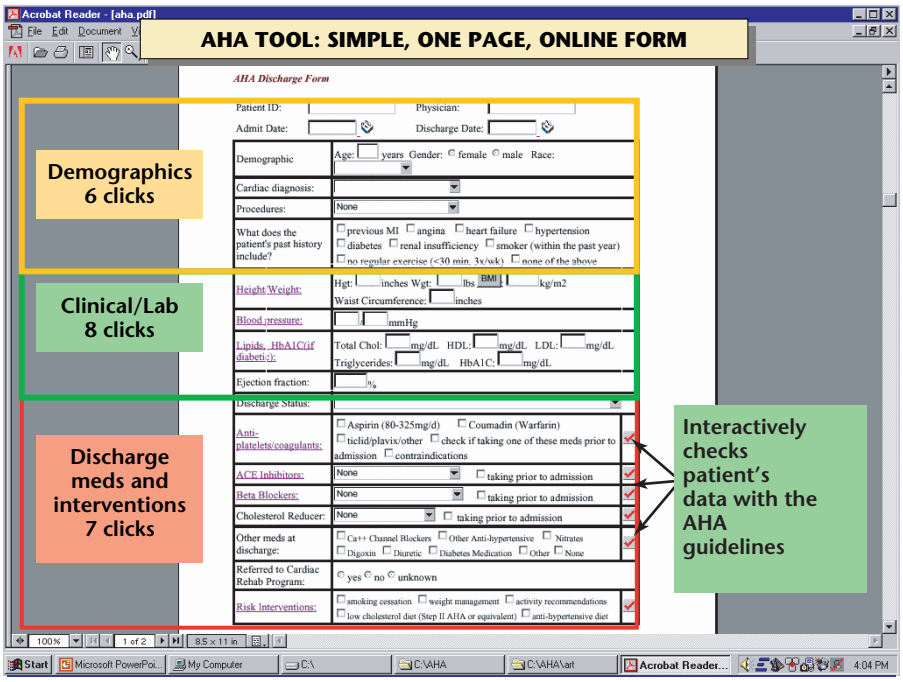
ACE, angiotensin-converting enzyme; LDL-C, low-density lipoprotein cholesterol.
Reprinted with permission from Fonarow GC et al.[50]

reduction in clinical events the first year after discharge: the death and nonfatal myocardial infarction rate decreased from 14.8% to 6.4% (odds ratio, 0.43; $P < .01$).[50] These improved treatment rates have been sustained since the inception of the program. More recently, other studies have demonstrated that a high rate of lipid-lowering medication initiation can be achieved with hospital-based systems.[51-53]

The AHA has recently launched a national program called Get With the Guidelines (GWTG), based in part on the University of California, Los Angeles CHAMP program.[54] This program uses an Internet-based interactive patient management tool. The GWTG program is implemented by AHA volunteers working in conjunction with hospital teams, using a collaborative implementation model. Within the hospital, a healthcare provider to champion implementation of the program should first be identified. Optimal outcome is seen with the use of a feedback system of continuous quality improvement that includes cycling of the following stages: assessment of treatment rates, evaluation, protocol refinement, and implementation of the refined protocol. Program implementation is facilitated by interactive conferences, teleconferences, and hospital tools, including preprinted order sets and a Web-based tool that allows for recording of treatments prescribed at discharge (Figure 1).

In a pilot phase conducted in 24 New England hospitals during 2000, the use of lipid-lowering therapy increased from 54% preintervention to 78% postintervention ($P < .01$).[54] More than 1000 hospitals are currently participating in GWTG. In the ACC's Guideline Application into Practice project performed in 10 hospitals in Michigan, the use of lipid-lowering therapy in ideal candidates increased from 68% preintervention to 92% postintervention in the subgroup of hospitals that used the program's tool kit.[55] Hospital-based systems for implementing cardiovascular protective therapy have been successful in settings such as university and community, teaching and nonteaching, and urban and rural. These and other studies demonstrate that programs for in-hospital initiation of cardiovascular protective medications can substantially

Figure 1. *Web-based tool for recording medical discharge treatments in the American Heart Association's Get With the Guidelines program. Reprinted with permission from the American Heart Association (AHA).[67]*



improve treatment rates in patients with atherosclerotic vascular disease.

Outpatient Systems to Improve Guideline Implementation

Outpatient disease management and preventive cardiology programs have also been shown to facilitate lipid treatment (Table 3). Various clinic-based systems have been developed to provide cardiovascular risk reduction services in both primary and secondary prevention.[56] Many of these programs have employed nurses to coordinate the services of a multidisciplinary team. The program teams frequently include dietitians, pharmacists, social workers, exercise physiologists, and psychologists. The success of these programs is attributed largely to the availability of defined protocols for management of medication regimens, the development of comprehensive and well-defined treatment plans, weekly team meetings, individualized education of patients, and coordinated care (eg, pre-appointment reminders, use of home health agencies).[56] To improve adherence, it is often necessary to address psychosocial problems and coordinate a multitude of other comorbidities and medical problems.

A physician-directed, nurse-managed, home-based case management system has been shown to result in lower LDL-C levels compared with usual care in patients discharged after myocardial infarction (107 mg/dL vs 132 mg/dL).[24] The need to hire additional medical personnel, such as specialty-trained nurses, may limit the application of this type of system outside of health maintenance organizations. The use of an electronic medical record system to create a virtual lipid clinic in a large community outpatient cardiology practice setting increased the percentage of CHD patients with LDL-C levels < 100 mg/dL from 22% at baseline to 65% postintervention.[57] Other studies have demonstrated improved treatment-to-goal rates in specialty lipid clinics, pharmacist-guided interventions, and cardiac rehabilitation programs.[44,58,59] Some of these programs have been associated with improved patient outcomes. However, little research has been done in evaluating the cost-effectiveness of the various types of outpatient programs.[60] Despite the reported success of these programs, the vast majority of patients with atherosclerosis will not be referred to them.

Table 3
Strategies for Initiating and Optimizing Cardiovascular and Metabolic Risk–Reducing Therapies

- Outpatient and hospital-based performance improvement systems
- In-hospital initiation of cardiovascular protective therapies
- Nurse- or pharmacist-managed outpatient disease management programs
- Preventive cardiology and cardiac rehabilitative programs
- Virtual prevention clinics using electronic medical record systems
- Use of performance measures
- Combination of cardiovascular protective therapies
- Development of new, more efficacious cardiovascular risk-reducing therapies that target multiple risk factors and/or common underlying processes

Compliance With Other Therapies

Although antihypertensive treatment has been shown to be highly effective in reducing cardiovascular morbidity, high rates of noncompliance still exist and may contribute to poorer outcomes. In a large, retrospective cohort study of 4068 elderly enrollees of the New Jersey Medicaid program, patients filled prescriptions for about half the prescribed duration (179 out of 365 days) on average. Good compliance (80% or greater) was associated with advanced age and white race, but not gender.[61] Researchers have shown that monitoring compliance with the use of electronic pill dispensers may improve it, as shown by lower blood pressure levels.[62] Data from a German multicenter study showed that the predominant reasons for noncompliance, as assessed by patients, were forgetfulness (40%), adverse effects (9.6%), and irregular lifestyle (6.5%).[63] Doctors noted that changes in therapy were primarily a result of inadequate blood pressure control, followed by adverse effects, patient dissatisfaction, and noncompliance. Although cost was not a major issue in this study, it may not be an insignificant problem in the United States.[63]

In the case of diabetes preventive care guidelines, implementation of a computer-generated reminder system was assessed in a randomized controlled study in outpatient clinics serving internal medicine residents at the University of Utah and Salt Lake Veterans Affairs Hospitals. After 6 months, both computerized patient-specific reports and nonspecific reports resulted in significantly greater improvements in compliance with guidelines.[64]

Finally, in a survey examining the physician characteristics that are associated with compliance with adult preventive care guidelines, factors

independently related to compliance included physician's female sex, knowledge of preventive care guidelines, and perceived effectiveness in changing patient behavior. After controlling for these factors, researchers found that variables such as lack of time, lack of reminder systems, attitudes about prevention, and amount of formal preventive care education were not related to self-reported compliance with guidelines.[65]

Primary Prevention Approaches

The imperative to prevent the first episode of CHD or stroke or the development of peripheral arterial disease is strong because of the high rate of first cardiovascular events that are fatal or disabling.[4] The evidence that most cardiovascular disease (CVD) is preventable continues to grow. Clearly, the majority of the causes of CVD are known and modifiable. Preventive efforts are most effective when they target each major cardiovascular risk factor.[4] The major and independent risk factors for CHD are cigarette smoking of any amount, elevated blood pressure, elevated serum total cholesterol and LDL-C levels, low serum HDL-C level, diabetes mellitus, obesity, and advancing age. The quantitative relationship between these risk factors and CHD risk has been elucidated by the Framingham Heart Study and other studies.[10] These studies show that the major risk factors are additive in predictive power. Any major risk factor, if left untreated for many years, has the potential to produce CVD.

The summation of contributions of individual risk factors can be a valuable first step in planning a risk-reduction strategy for individual patients.[4] Modest weight loss has been demonstrated to reduce cardiovascular risk factors such as hypertension, dyslipidemia, and type 2 diabetes mellitus. Weight reduction, often achieved by the combination of reduced caloric intake, increased physical activity, and other approaches, has been shown to affect cardiovascular risk factors, decrease insulin resistance, and prevent or delay the onset of diabetes.

Clinical trials demonstrate that significant risk reduction can be achieved by aggressive strategies in high-risk patients.[13,14] Clinical trials have shown that excess risk can be reduced by approximately 33% to 50% in 5 years,[4] particularly when risk-reduction strategies include lipid-lowering medications, aspirin, blood pressure–lowering agents, and smoking cessation. The gap between the evidence-based primary prevention interventions that are recommended and those that are implemented in routine clinical practice remains large.[7] Preventive cardiology guidelines, even when based on the best available scientific evidence from randomized, placebo-controlled clinical trials, cannot be successfully implemented without acceptance by the entire healthcare team, including physicians, nurses, and other healthcare professionals. A lasting healthcare provider–patient partnership should be created. A global risk assessment should be performed and carefully communicated to the patient.[4] A preventive action plan should be developed with the patient. A variety of tools for healthcare providers are available to foster this partnership, such as the AHA's Heart Profilers™. Information for the public on CVD and stroke risk factors is available on the AHA Web site (www.americanheart.org).

Preventive efforts are most effective when they target each major cardiovascular risk factor.

The challenge for healthcare professionals is to engage greater numbers of patients, at an earlier stage of their disease, in comprehensive cardiovascular risk reduction with the use of interventions that are designed to circumvent or alleviate barriers to participation and adherence, so that many more patients may realize the benefits that primary prevention can provide. It has been recommended that the healthcare professional should create an environment supportive of risk factor change, including long-term reinforcement of adherence to lifestyle and drug interventions.[4] Practice-based systems for risk factor monitoring, reminders, and support services need to be established, reimbursed, and otherwise supported by managed care organizations and third-party payers. Primary prevention, by its very nature, requires a lifetime of interactions that virtually define successful provider-patient relationships.[4]

Performance Measures

Performance measures are increasingly employed to monitor the quality of care being provided in the inpatient and outpatient setting. These measures allow comparison of individual providers and different healthcare delivery systems. Disease management programs frequently integrate the monitoring of quality of care measures into their formal structure. Performance measures are discrete parameters for structure, process, or outcome, the attainment of which define good quality care.[60]

Important attributes for performance measurements include the following:

- The performance measure must be meaningful. Any potential performance measure must either be a meaningful outcome to patients or have a close link to such an outcome.
- The measure must be valid and reliable. To successfully quantify healthcare quality, the structure, process, or outcome of interest must be reliably and accurately measurable.
- The measure can account for patient variability. Although this factor is more relevant to process and outcome measures, it is important that the results of potential performance measures are adjustable so that differences observed among providers are attributable to the care provided rather than to the patients treated.
- The measure can be modified by improvements in the healthcare system. To be useful for facilitating change, performance measures must be amenable to improvement by motivated providers. This attribute requires that the potential measure have variability (eg, some systems do well when judged by the measure, and others do not) and that evidence supports the feasibility of institutions or practitioners improving their performance over time.
- The measure is feasible. Quantifying healthcare quality can be complex and costly. Proposed performance measures should be sensitive to the logistical and fiscal implications of assessing quality.[60]

Measurement of treatment rates with lipid-lowering therapy in patients with atherosclerosis or diabetes is increasingly being viewed as an appropriate quality-of-care performance indicator.[60] The frequency of lipid measurement and of treatment-to-goal in patients hospitalized with an acute coronary event and/or for a revascularization procedure were added to the Health Plan Employer and Data Information Set 2000 quality-of-care measures.[66]

Conclusion

It has been clearly documented that not enough has been done to ensure the use of cardiovascular protective therapy in patients at risk. A review of the evidence from recent trials and clinical studies provides a compelling argument for implementing cardiovascular protective medications as part of a systematic approach to addressing the patient's cardiovascular and metabolic risk factors.[33] With optimal use of cardiovascular protective therapies, a substantial number of cardiovascular events could be prevented and lives could be saved every year.[33]

References

1. Smith SC Jr, Blair SN, Criqui MH, et al. Preventing heart attack and death in patients with atherosclerotic cardiovascular disease. *Circulation*. 1995;92:2-4.
2. Smith SC Jr, Blair SN, Bonow RO, et al. AHA/ACC Guidelines for preventing heart attack and death in patients with atherosclerotic cardiovascular disease: 2001 update. *Circulation*. 2001;104:1577-1579.
3. Adult Treatment Panel III. Executive summary of the third report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. *JAMA*. 2001;285: 2486-2497.
4. Grundy SM, Balady GJ, Criqui MH, et al. Guide to primary prevention of cardiovascular disease. A statement for healthcare professionals from the Task Force on Risk Reduction. American Heart Association Science Advisory and Coordinating Committee. *Circulation*. 1997;95: 2329-2331.
5. EUROASPIRE II Study Group. Lifestyle and risk factor management and use of drug therapies in coronary patients from 15 countries; principal results from EUROASPIRE II Euro Heart Survey Program. *Eur Heart J*. 2001;22:554-572.
6. Sueta CA, Chowdhury M, Boccuzzi SJ, et al. Analysis of the degree of undertreatment of hyperlipidemia and congestive heart failure secondary to coronary artery disease. *Am J Cardiol*. 1999;83:1303-1307.
7. Pearson TA, Laurora I, Chu H, Kafonek S. The Lipid Treatment Assessment Project (L-TAP): a

Main Points

- Cardiovascular and metabolic risk factors remain highly prevalent and contribute to the high rate of cardiovascular events and mortality.
- Despite compelling scientific evidence of the benefits of primary and secondary prevention therapies, a substantial proportion of patients are not receiving treatment with evidence-based, guideline-recommended therapies.
- Increased efforts to develop and apply effective strategies to improve use of and adherence to primary prevention therapies are clearly needed.
- A systematic approach to ensure initiation and maintenance of cardiovascular protective therapies has been demonstrated to improve treatment rates, long-term patient compliance, and clinical outcomes.
- By initiating a management plan that includes therapies that modify cardiovascular and metabolic risk factors along with patient education, physicians and nurses can make a vital contribution to the elimination of the "treatment gap" and dramatically reduce the death and disability caused by atherosclerotic vascular disease and diabetes.

multicenter survey to evaluate the percentages of dyslipidemic patients receiving lipid-lowering therapy and achieving low-density lipoprotein cholesterol goals. *Arch Intern Med*. 2000; 160:459-467.
8. Haffner SM, Lehto S, Ronnemaa T, et al. Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction. *N Engl J Med*. 1998;339:229-234.
9. National Cholesterol Education Program. Second report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel II). *Circulation*. 1994;89:1329-1445.
10. Castelli WP, Garrison RJ, Wilson PW, et al. Incidence of coronary heart disease and lipoprotein cholesterol levels. The Framingham Study. *JAMA*. 1986;256:2835-2838.
11. Chobanian AV, Bakris GL, Black HR, et al. The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 Report. *JAMA*. 2003;289:2560-2572.
12. Scandinavian Simvastatin Survival Study Group. Randomised trial of cholesterol lowering in 4444 patients with coronary heart disease: the Scandinavian Simvastatin Survival Study (4S). *Lancet*. 1994;344:1383-1389.
13. Sacks FM, Pfeffer MA, Moye LA, et al, for the Cholesterol And Recurrent Events Trial Investigators. The effect of pravastatin on coronary events after myocardial infarction in patients with average cholesterol levels. *N Engl J Med*. 1996;335:1001-1009.
14. The Long-term Intervention with Pravastatin in Ischaemic Disease (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;339:1349-1357.
15. MRC/BHF Heart Protection Study of cholesterol lowering with simvastatin in 20,536 high-risk individuals: a randomised placebo-controlled trial. Heart Protection Study Collaborative Group. *Lancet*. 2002;360:7-22.
16. Grundy SM, Cleeman JI, Rifkind BM, et al. Cholesterol lowering in the elderly population. *Arch Intern Med*. 1999;159:1670-1678.
17. Mosca L, Grundy SM, Judelson D, et al. Guide to Preventive Cardiology for Women. AHA/ACC Scientific Statement Consensus panel statement. *Circulation*. 1999;99:2480-2484.
18. Grundy SM, Benjamin IJ, Burke GL, et al. Diabetes and cardiovascular disease: a statement for healthcare professionals from the American Heart Association. *Circulation*. 1999;100:1134-1146.
19. Hunninghake DB, Stein EA, Dujovne CA, et al. The efficacy of intensive dietary therapy alone or combined with lovastatin in outpatients with hypercholesterolemia. *N Engl J Med*. 1993;328:1213-1219.
20. Ramsay LE, Yeo WW, Jackson PR. Dietary reduction of serum cholesterol concentration: time to think again. *BMJ*. 1991;303:953-957.
21. 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;120:721-729.
22. Fonarow GC, Gawlinski A. Rationale and design of the Cardiac Hospitalization Atherosclerosis Management Program at the University of California Los Angeles. *Am J Cardiol*. 2000;85:10A-17A.
23. American Heart Association. *2003 Heart and Stroke Statistical Update*. Dallas, TX: American Heart Association; 2002.
24. Murray CJL, Lopez AD. Alternative visions of the future: projecting mortality and disability, 1990-2020. In: Murray CJL, Lopez AD, eds. *The Global Burden of Disease*, Vol 1. Cambridge, MA: Harvard University Press; 1996:325-396.
25. Fonarow GC, French WJ, Parsons LS, et al. Use of lipid-lowering medications at discharge in patients with acute myocardial infarction: data from the National Registry of Myocardial Infarction 3. *Circulation*. 2001;103:38-44.
26. Aronow HD, Topol EJ, Roe MT, et al. Effect of lipid-lowering therapy on early mortality after acute coronary syndromes: an observational study. *Lancet*. 2001;357:1063-1068.
27. Pearson TA, Peters TD, Feury D, et al. The American College of Cardiology Evaluation of Preventative Therapeutics (ACCEPT) study: attainment of goals for comprehensive risk reduction in patients with coronary disease in the US. *J Am Coll Cardiol*. 1998;31(suppl 1):186A.
28. Stenestrand U, Wallentin L, for the Swedish Register of Cardiac Intensive Care (RIKS-HIA). Early statin treatment following acute myocardial infarction and 1-year survival. *JAMA*. 2001;285:430-436.
29. Newby LK, Kristinsson A, Bhapkar MV, et al. Early statin initiation and outcomes in patients with acute coronary syndromes. *JAMA*. 2002;287:3087-3095.
30. Jacobson TA, Griffiths GG, Varas C, et al. Impact of evidence-based "clinical judgment" on the number of American adults requiring lipid-lowering drug therapy based on updated NHANES III data. *Arch Intern Med*. 2000;160: 1361-1369.
31. Jackevicius CA, Mamdani M, Tu JV. Adherence with statin therapy in elderly patients with and without acute coronary syndromes. *JAMA*. 2002;288:462-467.
32. Muhlestein JB, Horne BD, Bair TL, et al. Usefulness of in-hospital prescription of statin agents after angiographic diagnosis of coronary artery disease in improving continued compliance and reduced mortality. *Am J Cardiol*. 2001;87: 257-261.
33. Fonarow GC. Treating to goal: new strategies for initiating and optimizing lipid-lowering therapies in patients with atherosclerosis. *Vasc Med*. 2002;7:187-194.
34. Singer GM, Munavvar I, Black HR. Guidelines for hypertension: are quality-assurance measures on target? *Hypertension*. 2004;43:198-202.
35. Hajjar I, Kotchen TA. Trends in prevalence, awareness, treatment, and control of hypertension in the United States, 1988-2000. *JAMA*. 2003;290:199-206.
36. Clause SL, Hamilton RA. Medicaid prescriber compliance with Joint National Committee VI hypertension treatment guidelines. *Ann Pharmacother*. 2002;36:1501-1511.
37. Cuspidi C, Michev I, Lonati L, et al. Compliance to hypertension guidelines in clinical practice: a multicenter pilot study in Italy. *J Hum Hypertens*. 2002;16:699-703.
38. Enlund H, Jokisalo E, Wallenius S. Patient-perceived problems, compliance, and the outcome of hypertension treatment. *Pharm World Sci*. 2001;23:60-64.
39. Toth EL, Majumdar SR, Guirguios LM, et al. Compliance with clinical practice guidelines for type 2 diabetes in rural patients: treatment gaps and opportunities for improvement. *Pharmacotherapy*. 2003;23:659-665.
40. Kirk JK, Poirier JE, Mattox MG, et al. Compliance with national guidelines in patients with diabetes in a family practice clinic. *Pharmacotherapy*. 2002;22:1541-1546.
41. Amundson G, Solberg LI, Reed M, et al. Paying for quality improvement: compliance with tobacco cessation guidelines. *Jt Comm J Qual Saf*. 2003;29:59-65.
42. Simpson E, Beck C, Richard H, et al. Drug prescriptions after acute myocardial infarction: dosage, compliance, and persistence. *Am Heart J*. 2003;145:438-444.
43. Pearson TA, McBride PE, Miller NH, et al. 27th Bethesda Conference: matching the intensity of risk factor management with the hazard for coronary disease events. Task Force 8. Organization of preventive cardiology service. *J Am Coll Cardiol*. 1996;27:1039-1047.
44. Fonarow GC, Ballantyne CM. In-hospital initiation of lipid-lowering therapy for patients with coronary heart disease: the time is now. *Circulation*. 2001;103:2768-2770.
45. McCall M, Elmfeldt D, Vedin A, et al. Influence of a myocardial infarction on blood pressure and serum cholesterol. *Acta Med Scand*. 1979;206:477-481.
46. Rosenson RS. Myocardial injury: the acute phase response and lipoprotein metabolism. *J Am Coll Cardiol*. 1993;22:933-940.
47. Fonarow GC, Stevenson LW, Walden JA, et al. Impact of a comprehensive heart failure management program on hospital readmission and functional status of patients with advanced heart failure. *J Am Coll Cardiol*. 1997;30: 725-732.
48. Taylor CB, Houston-Miller N, Killen JD, et al. Smoking cessation after acute myocardial infarction: effects of a nurse-managed intervention. *Ann Intern Med*. 1990;113:118-123.
49. Marciniak TA, Ellerbeck EF, Radford MJ, et al. Improving the quality of care for Medicare patients with acute myocardial infarction: results from the Cooperative Cardiovascular Project. *JAMA*. 1998;279:1351-1357.
50. 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;87:819-822.
51. Birtcher KK, Bowden C, Ballantyne CM, et al. Strategies for implementing lipid-lowering therapy: pharmacy-based approach. *Am J Cardiol*. 2000;85:30A-35A.
52. Cannon CP, McCabe CH, Bentley J, et al. Early statin therapy is associated with markedly lower mortality in patients with acute coronary syndromes: observations from OPUS-TIMI-16. *J Am Coll Cardiol*. 2001;37:334A.
53. Akosah KO, Larson DE, Brown WM, et al. Using a systemwide care path to enhance compliance with guidelines for acute myocardial infarction. *Jt Comm J Qual Saf*. 2003;29:248-259.
54. McCarthy M. US heart-guidelines program makes a promising start. *Lancet*. 2001;358:1618.

55. Mehta RH, Montoye CK, Gollogly M, et al. Improving quality of care for acute myocardial infarction. The guidelines applied into practice (GAP) initiative. *JAMA*. 2002;287:1269-1276.
56. Ades PA, Kottke TE, Miller NH, et al. Task force #3—getting results: who, where, and how? 33rd Bethesda Conference. *J Am Coll Cardiol*. 2002;40:615-630.
57. Kinn JW, Brown AS. Cardiovascular risk management in clinical practice: the midwest heart specialists experience. *Am J Cardiol*. 2002; 89(suppl):23C-29C.
58. 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; 89:975-990.
59. Blair TP, Bryant FJ, Bocuzzi S. Treatment of hypercholesterolemia by a clinical nurse using a stepped-care protocol in a nonvolunteer population. *Arch Intern Med*. 1988;148:1046-1048.
60. Spertus JA, Radford MJ, Every NR, et al. Challenges and opportunities in quantifying the quality of care for acute myocardial infarction: summary from the Acute Myocardial Infarction Working Group of the American Heart Association/American College of Cardiology First Scientific Forum on Quality of Care and Outcomes Research in Cardiovascular Disease and Stroke. *Circulation*. 2003;107:1681-1691.
61. Monana M, Bohn RL, Gurwitz JH. Compliance with antihypertensive therapy among elderly Medicaid enrollees: the roles of age, gender, and race. *Am J Public Health*. 1996;86:1805-1808.
62. Waeber B, Vetter W, Darioli R, et al. Improved blood pressure control by monitoring compliance with antihypertensive therapy. *Int J Clin Pract*. 1999;53:37-38.
63. Dusing R, Weisser B, Mengden T, Vetter H. Changes in antihypertensive therapy—the role of adverse effects and compliance. *Blood Pressure*. 1998;7:313-315.
64. Nilasena DS, Lincoln MJ. A computer-generated reminder system improves physician compliance with diabetes preventive care guidelines. *Proc Annu Symp Comput Appl Med Care*. 1995;640-645.
65. Ely JW, Goerdt CJ, Bergus GR, et al. The effect of physician characteristics on compliance with adult preventive care guidelines. *Fam Med*. 1998;30:34-39.
66. Lee TH, Cleeman JI, Grundy SM, et al. Clinical goals and performance measures for cholesterol management in secondary prevention of coronary heart disease. *JAMA*. 2000;283: 94-98.
67. American Heart Association. *Get With the Guidelines Program*. Dallas, TX: American Heart Association. Available at: http://www.americanheart.org/presenter.jhtml?identifier=1165. Accessed May 22, 2006.