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PRACTICE GUIDELINES

# 2010 ACCF/AHA Guideline for Assessment of Cardiovascular Risk in Asymptomatic Adults: Executive Summary

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

*Developed in Collaboration With the American Society of Echocardiography, American Society of Nuclear Cardiology, Society of Atherosclerosis Imaging and Prevention, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society for Cardiovascular Magnetic Resonance*

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## Preamble

It is essential that the medical profession play a central role in critically evaluating the evidence related to drugs, devices, and procedures for the detection, management, or prevention of disease. Properly applied, rigorous, expert analysis of the available data documenting absolute and relative benefits and risks of these therapies and procedures can improve the effectiveness of care, optimize patient outcomes, and favorably affect the cost of care by focusing resources on the most effective strategies. One important use of such data is the production of clinical practice guidelines that, in turn, can provide a foundation for a variety of other applications,

such as performance measures, appropriate use criteria, clinical decision support tools, and quality improvement tools.

The American College of Cardiology Foundation (ACCF) and the American Heart Association (AHA) have jointly engaged in the production of guidelines in the area of cardiovascular disease since 1980. The ACCF/AHA Task Force on Practice Guidelines (Task Force) is charged with developing, updating, and revising practice guidelines for cardiovascular diseases and procedures, and the Task Force directs and oversees this effort. Writing committees are charged with assessing the evidence as an independent group of authors to develop, update, or revise recommendations for clinical practice.

Experts in the subject under consideration have been selected from both organizations to examine subject-specific data and write guidelines in partnership with representatives from other medical practitioner and specialty groups. Writing committees are specifically charged to perform a formal literature review; weigh the strength of evidence for or against particular tests, treatments, or procedures; and include estimates of expected health outcomes where data exist. Patient-specific modifiers, comorbidities, and issues of patient preference that may influence the choice of tests or therapies are considered. When available, information from studies on cost is considered, but data on efficacy and clinical outcomes constitute the primary basis for recommendations in these guidelines.

In analyzing the data and developing recommendations and supporting text, the writing committee used evidence-based methodologies developed by the Task Force that are described elsewhere (1). The committee reviewed and ranked evidence supporting current recommendations, with the weight of evidence ranked as Level A if the data were derived from multiple randomized clinical trials or meta-analyses. The committee ranked available evidence as Level B when data were derived from a single randomized trial or nonrandomized studies. Evidence was ranked as Level C when the primary source of the recommendation was consensus opinion, case studies, or standard of care. In the narrative portions of these guidelines, evidence is generally presented in chronological order of development. Studies are identified as observational, retrospective, prospective, or randomized when appropriate. For certain conditions for which inadequate data are available, recommendations are based on expert consensus and clinical experience and ranked as Level C. An example is the use of penicillin for pneumococcal pneumonia, where there are no randomized trials and treatment is based on clinical experience. When recommendations at Level C are supported by historical clinical data, appropriate references (including clinical reviews) are cited if available. For issues where sparse data are available, a survey of current practice among the clinicians on the writing committee was the basis for Level C recommendations and no references are cited. The schema for Classification of Recommendations (COR) and Level of Evidence (LOE) is summarized in Table 1, which also illustrates how the grading system provides an estimate of the size as well as the certainty of the treatment effect. A new addition to the ACCF/AHA methodology is a separation of the Class III recommendations to delineate whether the recommendation is determined to be of "no benefit" or associated with "harm" to the patient. In addition, in view of the increasing number of comparative effectiveness studies, comparator verbs and suggested phrases for writing recommendations for the comparative effectiveness of one treatment/strategy with respect to another for COR I and IIa, LOE A or B only, have been added.

The Task Force makes every effort to avoid actual, potential, or perceived conflicts of interest that may arise as a result of industry relationships or personal interests among the writing committee. Specifically, all members of the writing committee, as well as peer reviewers of the document, are asked to disclose all relevant relationships and those existing 24 months before initiation of the writing effort. All guideline recommendations require a confidential vote by the writing committee and must be approved by a consensus of the members voting. Members who were recused from voting are noted on the title page of this document and in Appendix 1. Members must recuse themselves from voting on any recommendation to which their relationships with industry and other entities (RWI) applies. Any writing committee member who develops new RWI during his or her tenure is required to notify guideline staff in writing. These statements are reviewed by the Task Force and all members during each conference call and meeting of the writing committee and are updated as changes occur. For detailed information about guideline policies and procedures, please refer to the ACCF/AHA methodology and policies manual (1). Authors' and peer reviewers' RWI pertinent to this guideline are disclosed in Appendixes 1 and 2, respectively. In addition, to ensure complete transparency, writing committee members' *comprehensive disclosure information*—including RWI not pertinent to this document—is available online as a supplement to this document. Disclosure information for the ACCF/AHA Task Force on Practice Guidelines is also available online at www.cardiosource.org/ACC/About-ACC/Leadership/Guidelines-and-Documents-Task-Forces.aspx. The work of the writing committee was supported exclusively by the ACCF and AHA without commercial support. Writing committee members volunteered their time for this effort.

The ACCF/AHA practice guidelines address patient populations (and health care providers) residing in North America. As such, drugs that are not currently available in North America are discussed in the text without a specific COR. For studies performed in large numbers of subjects outside of North America, each writing committee reviews the potential impact of different practice patterns and patient populations on the treatment effect and the relevance to the ACCF/AHA target population to de-

**Table 1. Applying Classification of Recommendations and Level of Evidence**

SIZE OF TREATMENT EFFECT →

ESTIMATE OF CERTAINTY (PRECISION) OF TREATMENT EFFECT

| | CLASS I<br>*Benefit >>> Risk*<br>Procedure/Treatment **SHOULD** be performed/ administered | CLASS IIa<br>*Benefit >> Risk*<br>*Additional studies with focused objectives needed*<br>**IT IS REASONABLE** to perform procedure/administer treatment | CLASS IIb<br>*Benefit ≥ Risk*<br>*Additional studies with broad objectives needed; additional registry data would be helpful*<br>Procedure/Treatment **MAY BE CONSIDERED** | CLASS III *No Benefit* or CLASS III *Harm*<br>Procedure/Test / Treatment<br>COR III: No benefit — Not Helpful / No Proven Benefit<br>COR III: Harm — Excess Cost w/o Benefit or Harmful / Harmful to Patients |
|---|---|---|---|---|
| **LEVEL A**<br>Multiple populations evaluated*<br>Data derived from multiple randomized clinical trials or meta-analyses | ■ Recommendation that procedure or treatment is useful/effective<br>■ Sufficient evidence from multiple randomized trials or meta-analyses | ■ Recommendation in favor of treatment or procedure being useful/effective<br>■ Some conflicting evidence from multiple randomized trials or meta-analyses | ■ Recommendation's usefulness/efficacy less well established<br>■ Greater conflicting evidence from multiple randomized trials or meta-analyses | ■ Recommendation that procedure or treatment is not useful/effective and may be harmful<br>■ Sufficient evidence from multiple randomized trials or meta-analyses |
| **LEVEL B**<br>Limited populations evaluated*<br>Data derived from a single randomized trial or nonrandomized studies | ■ Recommendation that procedure or treatment is useful/effective<br>■ Evidence from single randomized trial or nonrandomized studies | ■ Recommendation in favor of treatment or procedure being useful/effective<br>■ Some conflicting evidence from single randomized trial or nonrandomized studies | ■ Recommendation's usefulness/efficacy less well established<br>■ Greater conflicting evidence from single randomized trial or nonrandomized studies | ■ Recommendation that procedure or treatment is not useful/effective and may be harmful<br>■ Evidence from single randomized trial or nonrandomized studies |
| **LEVEL C**<br>Very limited populations evaluated*<br>Only consensus opinion of experts, case studies, or standard of care | ■ Recommendation that procedure or treatment is useful/effective<br>■ Only expert opinion, case studies, or standard of care | ■ Recommendation in favor of treatment or procedure being useful/effective<br>■ Only diverging expert opinion, case studies, or standard of care | ■ Recommendation's usefulness/efficacy less well established<br>■ Only diverging expert opinion, case studies, or standard of care | ■ Recommendation that procedure or treatment is not useful/effective and may be harmful<br>■ Only expert opinion, case studies, or standard of care |
| Suggested phrases for writing recommendations† | should<br>is recommended<br>is indicated<br>is useful/effective/beneficial | is reasonable<br>can be useful/effective/beneficial<br>is probably recommended or indicated | may/might be considered<br>may/might be reasonable<br>usefulness/effectiveness is unknown/unclear/uncertain or not well established | COR III: No Benefit: is not recommended; is not indicated; should not be done; is not useful/beneficial/effective<br>COR III: Harm: potentially harmful; causes harm; associated with excess morbidity/mortality; should not be done |
| Comparative effectiveness phrases† | treatment/strategy A is recommended/indicated in preference to treatment B<br>treatment A should be chosen over treatment B | treatment/strategy A is probably recommended/indicated in preference to treatment B<br>it is reasonable to choose treatment A over treatment B | | |

*Data available from clinical trials or registries about the usefulness/efficacy in different subpopulations, such as gender, age, history of diabetes, history of prior myocardial infarction, history of heart failure, and prior aspirin use. A recommendation with Level of Evidence B or C does not imply that the recommendation is weak. Many important clinical questions addressed in the guidelines do not lend themselves to clinical trials. Even though randomized trials are not available, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

†For comparative effectiveness recommendations (Class I and IIa; Level of Evidence A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.

termine whether the findings should inform a specific recommendation.

The ACCF/AHA practice guidelines are intended to assist health care providers in clinical decision making by describing a range of generally acceptable approaches to the diagnosis, management, and prevention of specific diseases or conditions. These practice guidelines represent a consensus of expert opinion after a thorough and systematic review of the available current scientific evidence and are intended to improve patient care. The guidelines attempt to define practices that meet the needs of most patients in most situations. The ultimate judgment regarding care of a particular patient must be made by the health care provider and patient in light of all the circumstances presented by that patient. Thus, there are circumstances in which deviations from these guidelines may be appropriate. Clinical decision making should consider the quality and availability of expertise in the area where care is provided. When these guidelines are used as the basis for regulatory or payer decisions, the goal should be improvement in quality of care. The Task Force recognizes that situations arise in which additional data are needed to better inform patient care; these areas will be identified within each respective guideline when appropriate.

Prescribed courses of treatment in accordance with these recommendations are effective only if they are followed.

Because lack of patient understanding and adherence may adversely affect outcomes, physicians and other health care providers should make every effort to engage the patient's active participation in prescribed medical regimens and lifestyles.

The guidelines will be reviewed annually by the Task Force and considered current until they are updated, revised, or withdrawn from distribution. The full-text guideline is e-published in the *Journal of the American College of Cardiology*, *Circulation*, and the *Journal of Cardiovascular Computed Tomography*.

*Alice K. Jacobs, MD, FACC, FAHA*
*Chair, ACCF/AHA Task Force on Practice Guidelines*

## 1. Introduction

### 1.1. Methodology and Evidence Review

The recommendations listed in this document are, whenever possible, evidence based. An extensive evidence review was conducted for the period beginning March 2008 through April 2010. Searches were limited to studies, reviews, and other evidence conducted in human subjects and published in English. Key search words included, but were not limited to, *African Americans, Asian Americans, albuminuria, asymptomatic, asymptomatic screening and brachial artery reactivity, atherosclerosis imaging, atrial fibrillation, brachial artery testing for atherosclerosis, calibration, cardiac tomography, compliance, carotid intima-media thickness, coronary calcium, coronary computed tomography angiography, C-reactive protein (CRP), detection of subclinical atherosclerosis, discrimination, endothelial function, family history, flow-mediated dilation, genetics, genetic screening, guidelines, Hispanic Americans, hemoglobin A, glycosylated, meta-analysis, Mexican Americans, myocardial perfusion imaging (MPI), noninvasive testing, noninvasive testing and type 2 diabetes, outcomes, patient compliance, peripheral arterial tonometry, peripheral tonometry and atherosclerosis, lipoprotein-associated phospholipase A2, primary prevention of coronary artery disease, proteinuria, cardiovascular risk, risk scoring, receiver operating characteristics curve, screening for brachial artery reactivity, stress echocardiography, subclinical atherosclerosis, subclinical and Framingham, subclinical and Multi-Ethnic Study of Atherosclerosis (MESA), and type 2 diabetes.* Additionally, the writing committee reviewed documents related to the subject matter previously published by the ACCF and AHA, American Diabetes Association, European Society of Cardiology, and the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC) 7. References selected and published in this document are representative and not all-inclusive.

To provide clinicians with a comprehensive set of data, whenever deemed appropriate or when published in the article, data from the clinical trial will be used to calculate the absolute risk difference and number needed to treat or harm; data related to the relative treatment effects will also be provided, such as odds ratio, relative risk, hazard ratio, or incidence rate ratio, along with confidence interval when available.

The focus of this guideline is the initial assessment of the apparently healthy adult for risk of developing cardiovascular events associated with atherosclerotic vascular disease. The goal of this early assessment of cardiovascular risk in an asymptomatic individual is to provide the foundation for targeted preventive efforts based on that individual's predicted risk. It is based on the long-standing concept of targeting the intensity of drug treatment interventions to the severity of the patient's risk (2). This clinical approach serves as a complement to the population approach to prevention of cardiovascular disease (CVD), in which population-wide strategies are used regardless of an individual's risk.

This guideline pertains to initial assessment of cardiovascular risk in the asymptomatic adult. Although there is no clear age cut point for defining the onset of risk for CVD, elevated risk factor levels and subclinical abnormalities can be detected in adolescents as well as young adults. To maximize the benefits of prevention-oriented interventions, especially those involving lifestyle changes, the writing committee advises that these guidelines be applied in asymptomatic persons beginning at age 20 years. The writing committee recognizes that the decision about a starting point is an arbitrary one.

This document specifically excludes from consideration patients with a diagnosis of CVD or a coronary event, for example, angina or anginal equivalent, myocardial infarction, or revascularization with percutaneous coronary intervention or coronary artery bypass graft surgery. It also excludes testing for patients with known peripheral artery disease and cerebral vascular disease. This guideline is not intended to replace other sources of information on cardiovascular risk assessment in specific disease groups or in higher-risk groups such as those with known hypertension or diabetes who are receiving treatment.

### 1.2. Organization of the Writing Committee

The committee was composed of physicians and other experts in the field of cardiology. The committee included representatives from the American Society of Echocardiography, American Society of Nuclear Cardiology, Society of Atherosclerosis Imaging and Prevention, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society for Cardiovascular Magnetic Resonance.

### 1.3. Document Review and Approval

This document was reviewed by 2 outside reviewers nominated by the ACCF and 2 outside reviewers nominated by

the AHA, as well as 2 reviewers each from the American Society of Echocardiography, American Society of Nuclear Cardiology, Society of Atherosclerosis Imaging and Prevention, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society for Cardiovascular Magnetic Resonance, and 23 individual content reviewers (including members from the ACCF Appropriate Use Criteria Task Force, ACCF Cardiac Catheterization Committee, ACCF Imaging Council, and ACCF Prevention of Cardiovascular Disease Committee). All reviewer RWI information was collected and distributed to the writing committee and is published in this document (Appendix 2).

This document was approved for publication by the governing bodies of the ACCF and AHA and endorsed by the American Society of Echocardiography, American Society of Nuclear Cardiology, Society of Atherosclerosis Imaging and Prevention, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society for Cardiovascular Magnetic Resonance.

### 1.4. Magnitude of the Problem of Cardiovascular Risk in Asymptomatic Adults

Atherosclerotic CVD is the leading cause of death for both men and women in the United States (3). It is estimated that if all forms of major CVD were eliminated, life expectancy would rise by almost 7 years (4). Coronary heart disease (CHD) has a long asymptomatic latent period, which provides an opportunity for early preventive interventions. One aim of this guideline is to provide an evidence-based approach to risk assessment in an effort to lower this high burden of coronary deaths in asymptomatic adults.

### 1.5. Assessing the Prognostic Value of Risk Factors and Risk Markers

Many risk factors have been proposed as predictors of CHD (5,6). New risk factors or markers are frequently identified and evaluated as potential additions to standard risk assessment strategies. The AHA has published a scientific statement on appropriate methods for evaluating the predictive value of new risk factors or risk markers (7). The scientific statement endorsed previously published guidelines for proper reporting of observational studies in epidemiology (8) but also went beyond those guidelines to specifically address criteria for evaluation of established and "new" risk markers.

For any new risk marker to be considered a useful candidate for risk prediction, it must, at the very least, have an independent statistical association with risk after accounting for established readily available and inexpensive risk markers. This independent statistical association should be based on studies that include large numbers of outcome events. Traditionally, reports of novel risk markers have only gone this far, reporting adjusted hazard ratios with confidence intervals and p values (9). Although this level of basic statistical association is often regarded by researchers as meaningful in prediction of a particular outcome of interest, the AHA scientific statement called for considerably more rigorous assessments that include analysis of the calibration, discrimination, and reclassification of the predictive model (7). Many of the tests reviewed in this guideline fail to provide these more comprehensive measures of test evaluation, and for this reason, many tests that are statistically associated with clinical outcomes cannot be judged to be useful beyond a standard risk assessment profile. In the absence of this evidence of "additive predictive information," the writing committee generally concluded that a new risk marker was not ready for routine use in risk assessment.

Calibration and discrimination are 2 separate concepts that do not necessarily track with each other. Calibration refers to the ability to correctly predict the proportion of subjects within any given group who will experience disease events. Among patients predicted to be at higher risk, there will be a higher number of events, whereas among patients identified as being at lower risk, there will be fewer events. For example, if a diagnostic test or a multivariable model splits patients into 3 groups with predicted risks of 5%, 10%, and 15% within each group, calibration would be considered good if in a separate group of cohorts with similar predicted risks, the actual rates of events were close to 5%, 10%, and 15%. Calibration is best presented by displaying observed versus expected event rates across quantiles of predicted risk for models that do and do not include the new risk marker.

Discrimination is a different concept that refers to the probability of a diagnostic test or a risk prediction instrument to distinguish between patients who are at higher compared with lower risk. For example, a clinician sees 2 random patients, 1 of whom is ultimately destined to experience a clinical event. A diagnostic test or risk model discriminates well if it usually correctly predicts which of the 2 subjects is at higher risk for an event. Mathematically this is described by calculating a C index or C statistic, parameters that are analogous to the area under the receiver operating characteristics curve. These statistics define the probability that a randomly selected person from the "affected group" will have a higher test score than a randomly selected person from the "nonaffected group." A test with no discrimination would have a C statistic of 0.50 and a perfect test would have a C statistic of 1.0. Throughout this document, C statistic information is cited where available.

Some investigators have called for evaluating the number of subjects reclassified into other risk categories based on models that include the new risk marker (10). One problem with this approach is that not all reclassification is necessarily clinically useful. If a patient is deemed to be at intermediate risk and is then reclassified as being at high or low risk, the clinician might find that information helpful. It may not be known, however, whether or not these reclassifications are correct for individual subjects. Two new

**Table 2. Comparison of a Sample of Global Coronary and Cardiovascular Risk Scores**

| | Framingham | SCORE | PROCAM (Men) | Reynolds (Women) | Reynolds (Men) |
|---|---|---|---|---|---|
| Sample size | 5,345 | 205,178 | 5,389 | 24,558 | 10,724 |
| Age (y) | 30 to 74; M: 49 | 19 to 80; M: 46 | 35 to 65; M: 47 | >45; M: 52 | >50; M: 63 |
| Mean follow-up (y) | 12 | 13 | 10 | 10.2 | 10.8 |
| Risk factors considered | Age, sex, total cholesterol, HDL cholesterol, smoking, systolic blood pressure, antihypertensive medications | Age, sex, total-HDL cholesterol ratio, smoking, systolic blood pressure | Age, LDL cholesterol, HDL cholesterol, smoking, systolic blood pressure, family history, diabetes, triglycerides | Age, HbA1C (with diabetes), smoking, systolic blood pressure, total cholesterol, HDL cholesterol, hsCRP, parental history of MI at <60 y of age | Age, systolic blood pressure, total cholesterol, HDL cholesterol, smoking, hsCRP, parental history of MI at <60 y of age |
| Endpoints | CHD (MI and CHD death) | Fatal CHD | Fatal/nonfatal MI or sudden cardiac death (CHD and CVD combined) | MI, ischemic stroke, coronary revascularization, cardiovascular death (CHD and CVD combined) | MI, stroke, coronary revascularization, cardiovascular death (CHD and CVD combined) |
| URLs for risk calculators | http://hp2010.nhlbihin.net/atpiii/calculator.asp?usertype=prof | http://www.heartscore.org/pages/welcome.aspx | http://www.chd-taskforce.com/coronary_risk_assessment.html | http://www.reynoldsriskscore.org/ | http://www.reynoldsriskscore.org/ |

CHD indicates coronary heart disease; CVD, cardiovascular disease; HbA1C, hemoglobin A1C; HDL, high-density lipoprotein; hsCRP, high-sensitivity C-reactive protein; LDL, low-density lipoprotein; M, mean; MI, myocardial infarction; PROCAM, Münster Heart Study; and SCORE, Systematic Coronary Risk Evaluation.

approaches to risk reclassification have been introduced, namely "net reclassification improvement" and "integrated discrimination improvement," which provide quantitative estimates of correct reclassifications (11). Correct reclassifications are associated with higher predicted risks for cases and lower predicted risks for noncases.

### 1.6. Usefulness in Motivating Patients or Guiding Therapy

Patients deemed to be at low risk for clinical events are unlikely to gain substantial benefits from pharmaceutical interventions and therefore might best be managed with lifestyle modifications. Conversely, patients deemed to be at high risk for events are more likely to benefit from pharmacologic interventions and therefore are appropriate candidates for intensive risk factor modification efforts. Among patients at intermediate risk, further testing may be indicated to refine risks and assess the need for treatment.

### 1.7. Economic Evaluation of Novel Risk Markers

The progressively rising costs of medical care have increased interest in documenting the economic effects of new tests and therapies. The most basic goal is to estimate the economic consequences of a decision to order a new test. The ultimate goal is to determine whether performing the test provides sufficient value to justify its use.

In general, testing strategies such as those assessed in this document have not included evaluations of the costs and cost-effectiveness of the tests. The writing committee was generally unable to find evidence to support the cost-effectiveness of any of the tests and testing approaches discussed here. Where exceptions were identified, cost-related information is included.

## 2. Recommendation for Global Risk Scoring

**CLASS I**

1. Global risk scores (such as the Framingham Risk Score) that use multiple traditional cardiovascular risk factors should be obtained for risk assessment in all asymptomatic adults without a clinical history of CHD. These scores are useful for combining individual risk factor measurements into a single quantitative estimate of risk that can be used to target preventive interventions (12). *(Level of Evidence: B)*

Table 2 summarizes a sample of published global risk score instruments that take into account modifiable risk markers that are also appropriate evidence-based targets for preventive interventions.

## 3. Recommendation for Family History

**CLASS I**

1. Family history of atherothrombotic CVD should be obtained for cardiovascular risk assessment in all asymptomatic adults (13,14). *(Level of Evidence: B)*

## 4. Recommendation for Genomic Testing

**CLASS III: NO BENEFIT**

1. Genotype testing for CHD risk assessment in asymptomatic adults is not recommended (15,16). *(Level of Evidence: B)*

## 5. Recommendation for Lipoprotein and Apolipoprotein Assessments

**CLASS III: NO BENEFIT**

1. Measurement of lipid parameters, including lipoproteins, apolipoproteins, particle size, and density, beyond a standard fasting

lipid profile is not recommended for cardiovascular risk assessment in asymptomatic adults (17). *(Level of Evidence: C)*

## 6. Recommendation for Measurement of Natriuretic Peptides

**CLASS III: NO BENEFIT**

1. Measurement of natriuretic peptides is not recommended for CHD risk assessment in asymptomatic adults (18). *(Level of Evidence: B)*

## 7. Recommendations for Measurement of C-Reactive Protein

**CLASS IIa**

1. In men 50 years of age or older or women 60 years of age or older with low-density lipoprotein cholesterol less than 130 mg/dL; not on lipid-lowering, hormone replacement, or immunosuppressant therapy; without clinical CHD, diabetes, chronic kidney disease, severe inflammatory conditions, or contraindications to statins, measurement of CRP can be useful in the selection of patients for statin therapy (19). *(Level of Evidence: B)*

**CLASS IIb**

1. In asymptomatic intermediate-risk men 50 years of age or younger or women 60 years of age or younger, measurement of CRP may be reasonable for cardiovascular risk assessment (14,20). *(Level of Evidence: B)*

**CLASS III: NO BENEFIT**

1. In asymptomatic high-risk adults, measurement of CRP is not recommended for cardiovascular risk assessment (21). *(Level of Evidence: B)*
2. In low-risk men younger than 50 years of age or women 60 years of age or younger, measurement of CRP is not recommended for cardiovascular risk assessment (14,20). *(Level of Evidence: B)*

## 8. Recommendation for Measurement of Hemoglobin A1C

**CLASS IIb**

1. Measurement of hemoglobin A1C may be reasonable for cardiovascular risk assessment in asymptomatic adults without a diagnosis of diabetes (22–27). *(Level of Evidence: B)*

## 9. Recommendations for Testing for Microalbuminuria

**CLASS IIa**

1. In asymptomatic adults with hypertension or diabetes, urinalysis to detect microalbuminuria is reasonable for cardiovascular risk assessment (28–30). *(Level of Evidence: B)*

**CLASS IIb**

1. In asymptomatic adults at intermediate risk without hypertension or diabetes, urinalysis to detect microalbuminuria might be reasonable for cardiovascular risk assessment (31). *(Level of Evidence: B)*

## 10. Recommendation for Lipoprotein-Associated Phospholipase A2

**CLASS IIb**

1. Lipoprotein-associated phospholipase A2 might be reasonable for cardiovascular risk assessment in intermediate-risk asymptomatic adults (32–35). *(Level of Evidence: B)*

## 11. Recommendations for Resting Electrocardiogram

**CLASS IIa**

1. A resting electrocardiogram (ECG) is reasonable for cardiovascular risk assessment in asymptomatic adults with hypertension or diabetes (36,37). *(Level of Evidence: C)*

**CLASS IIb**

1. A resting ECG may be considered for cardiovascular risk assessment in asymptomatic adults without hypertension or diabetes (38–40). *(Level of Evidence: C)*

## 12. Recommendations for Transthoracic Echocardiography

**CLASS IIb**

1. Echocardiography to detect left ventricular hypertrophy may be considered for cardiovascular risk assessment in asymptomatic adults with hypertension (41,42). *(Level of Evidence: B)*

**CLASS III: NO BENEFIT**

1. Echocardiography is not recommended for cardiovascular risk assessment of CHD in asymptomatic adults without hypertension. *(Level of Evidence: C)*

## 13. Recommendation for Measurement of Carotid Intima-Media Thickness

**CLASS IIa**

1. Measurement of carotid artery intima-media thickness is reasonable for cardiovascular risk assessment in asymptomatic adults at intermediate risk (43,44). Published recommendations on required equipment, technical approach, and operator training and experience for performance of the test must be carefully followed to achieve high-quality results (44). *(Level of Evidence: B)*

## 14. Recommendation for Brachial/Peripheral Flow-Mediated Dilation

**CLASS III: NO BENEFIT**

1. Peripheral arterial flow-mediated dilation studies are not recommended for cardiovascular risk assessment in asymptomatic adults (45,46). *(Level of Evidence: B)*

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## 15. Recommendation for Specific Measures of Arterial Stiffness

**CLASS III: NO BENEFIT**

1. Measures of arterial stiffness outside of research settings are not recommended for cardiovascular risk assessment in asymptomatic adults. *(Level of Evidence: C)*

## 16. Recommendation for Measurement of Ankle-Brachial Index

**CLASS IIa**

1. Measurement of ankle-brachial index is reasonable for cardiovascular risk assessment in asymptomatic adults at intermediate risk (47). *(Level of Evidence: B)*

## 17. Recommendation for Exercise Electrocardiography

**CLASS IIb**

1. An exercise ECG may be considered for cardiovascular risk assessment in intermediate-risk asymptomatic adults (including sedentary adults considering starting a vigorous exercise program), particularly when attention is paid to non-ECG markers such as exercise capacity (48–50). *(Level of Evidence: B)*

## 18. Recommendation for Stress Echocardiography

**CLASS III: NO BENEFIT**

1. Stress echocardiography is not indicated for cardiovascular risk assessment in low- or intermediate-risk asymptomatic adults. (Exercise or pharmacologic stress echocardiography is primarily used for its role in advanced cardiac evaluation of symptoms suspected of representing CHD and/or estimation of prognosis in patients with known coronary artery disease or the assessment of patients with known or suspected valvular heart disease.) *(Level of Evidence: C)*

## 19. Recommendations for Myocardial Perfusion Imaging

**CLASS IIb**

1. Stress MPI may be considered for advanced cardiovascular risk assessment in asymptomatic adults with diabetes or asymptomatic adults with a strong family history of CHD or when previous risk assessment testing suggests high risk of CHD, such as a coronary artery calcium (CAC) score of 400 or greater. *(Level of Evidence: C)*

**CLASS III: NO BENEFIT**

1. Stress MPI is not indicated for cardiovascular risk assessment in low- or intermediate-risk asymptomatic adults (Exercise or pharmacologic stress MPI is primarily used and studied for its role in advanced cardiac evaluation of symptoms suspected of representing CHD and/or estimation of prognosis in patients with known coronary artery disease.) (51). *(Level of Evidence: C)*

## 20. Recommendations for Calcium Scoring Methods

**CLASS IIa**

1. Measurement of CAC is reasonable for cardiovascular risk assessment in asymptomatic adults at intermediate risk (10% to 20% 10-year risk) (52,53). *(Level of Evidence: B)*

**CLASS IIb**

1. Measurement of CAC may be reasonable for cardiovascular risk assessment in persons at low to intermediate risk (6% to 10% 10-year risk) (53–55). *(Level of Evidence: B)*

**CLASS III: NO BENEFIT**

1. Persons at low risk (<6% 10-year risk) should not undergo CAC measurement for cardiovascular risk assessment (52,53,56). *(Level of Evidence: B)*

## 21. Recommendation for Coronary Computed Tomography Angiography

**CLASS III: NO BENEFIT**

1. Coronary computed tomography angiography is not recommended for cardiovascular risk assessment in asymptomatic adults (57). *(Level of Evidence: C)*

## 22. Recommendation for Magnetic Resonance Imaging of Plaque

**CLASS III: NO BENEFIT**

1. Magnetic resonance imaging for detection of vascular plaque is not recommended for cardiovascular risk assessment in asymptomatic adults. *(Level of Evidence: C)*

## 23. Recommendations for Patients With Diabetes Mellitus

**CLASS IIa**

1. In asymptomatic adults with diabetes, 40 years of age and older, measurement of CAC is reasonable for cardiovascular risk assessment (58–61). *(Level of Evidence: B)*

**CLASS IIb**

1. Measurement of hemoglobin A1C may be considered for cardiovascular risk assessment in asymptomatic adults with diabetes (62). *(Level of Evidence: B)*
2. Stress MPI may be considered for advanced cardiovascular risk assessment in asymptomatic adults with diabetes or when previous risk assessment testing suggests a high risk of CHD, such as a CAC score of 400 or greater. *(Level of Evidence: C)*

## 24. Recommendations for Special Considerations In Women

**CLASS I**

1. A global risk score should be obtained in all asymptomatic women (14,63). *(Level of Evidence: B)*

2. Family history of CVD should be obtained for cardiovascular risk assessment in all asymptomatic women (13,14). *(Level of Evidence: B)*

## 25. Clinical Implications of Risk Assessment: Concluding Comments

The assessment of risk for development of clinical manifestations of atherosclerotic CVD is designed to aid the clinician in informed decision making about lifestyle and pharmacologic interventions to reduce such risk. Patients are broadly categorized into low-, intermediate-, and high-risk subsets, and level of intensity and type of treatments are based on these differing assessments of risk.

The initial step in risk assessment in individual patients involves the ascertainment of a global risk score (Framingham, Reynolds, etc.) and the elucidation of a family history of atherosclerotic CVD. These Class I recommendations, which are simple and inexpensive, determine subsequent strategies to be undertaken. Persons at low risk do not require further testing for risk assessment, as more intensive interventions are considered unwarranted, and those already documented to be at high risk (established CHD or coronary risk equivalents) are already candidates for intensive preventive interventions, so that added testing will not provide incremental benefit.

For the intermediate-risk patient, this guideline should help the clinician select appropriate test modalities that can further define risk status. Tests classified as Class IIa are those shown to provide benefit that exceeds costs and risk. Selection among these will vary with local availability and expertise, decisions regarding cost, and potential risks such as radiation exposure, etc. Tests classified as Class IIb have less robust evidence for benefit but may prove helpful in selected patients. Tests classified as Class III are not recommended for use in that there is no, or rather limited, evidence of their benefit in incrementally adding to the assessment of risk; therefore, these tests fail to contribute to changes in the clinical approach to therapy. In addition, a number of Class III tests discussed in this guideline require additional efforts to standardize the measurement or make the test more commonly available on a routine clinical basis. Furthermore, some of the Class III tests also pose potential harm (radiation exposure or psychological distress in the absence of a defined treatment strategy) and are therefore to be avoided for cardiovascular risk assessment purposes in the asymptomatic adult. Until additional research is accomplished to justify the addition of Class III tests, the writing committee recommends against their use for cardiovascular risk assessment.

## APPENDIX 1. AUTHOR RELATIONSHIPS WITH INDUSTRY AND OTHER ENTITIES: 2010 ACCF/AHA GUIDELINE FOR ASSESSMENT OF CARDIOVASCULAR RISK IN ASYMPTOMATIC ADULTS: EXECUTIVE SUMMARY

| Committee Member | Employer | Consultant | Speaker | Ownership/ Partnership/ Principal | Personal Research | Institutional, Organizational, or Other Financial Benefit | Expert Witness |
|---|---|---|---|---|---|---|---|
| Philip Greenland, Chair | Northwestern University Feinberg School of Medicine—Professor of Preventive Medicine and Professor of Medicine; Director, Northwestern University Clinical and Translational Sciences Institute | • GE/Toshiba<br>• Pfizer | None | None | None | • NHLBI (MESA) | None |
| Joseph S. Alpert | University of Arizona—Professor of Medicine; Head, Department of Medicine | • Bayer<br>• Bristol-Myers Squibb<br>• Exeter CME<br>• Johnson & Johnson<br>• King Pharmaceuticals<br>• Merck<br>• Novartis<br>• Roche Diagnostics<br>• Sanofi-aventis | None | None | None | None | None |
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| Matthew J. Budoff‡§ | Los Angeles Biomedical Research Institute—Program Director, Division of Cardiology | None | • GE Healthcare | None | None | • CDC<br>• NIH/NHLBI<br>• MESA | None |
| Zahi A. Fayad | Mount Sinai School of Medicine—Professor of Radiology and Medicine (Cardiology) | • BG Medicine<br>• Merck<br>• Roche<br>• VIA Pharmaceuticals | None | None | • Merck<br>• Roche<br>• Siemens | None | None |
| Elyse Foster | University of California San Francisco—Professor of Clinical Medicine and Anesthesia; Director, Echocardiography Laboratory | None | None | None | • Boston Scientific<br>• Evalve<br>• EBR Systems | None | None |
| Mark A. Hlatky§‖ | Stanford University School of Medicine—Professor of Health Research and Policy; Professor of Medicine (Cardiovascular Medicine) | • BCBS Technology Evaluation Center Medical Advisory Panel*<br>• California Pacific Medical Center*<br>• CV Therapeutics<br>• GE Medical*<br>• The Medicines Company | None | None | • Aviir | None | None |
| John McB. Hodgson‡§‖ | Geisinger Health System—Chairman of Cardiology | • Volcano* | • Boston Scientific<br>• GE Medical<br>• Pfizer<br>• Volcano* | • Volcano* | • Boston Scientific*<br>• FAME<br>• GE Medical*<br>• RADI Medical*<br>• Volcano* | None | None |
| Frederick G. Kushner†¶ | Tulane University Medical Center—Clinical Professor of Medicine; Heart Clinic of Louisiana—Medical Director | None | • Abbott<br>• Bristol-Myers Squibb<br>• CV Therapeutics | None | • AstraZeneca<br>• Atherogenics<br>• Cogentus<br>• Eli Lilly<br>• NIH<br>• Novartis<br>• Pfizer | • FDA Science Board Member | None |
| Michael S. Lauer | NHLBI, NIH—Director, Division of Cardiovascular Sciences | None | None | None | None | None | None |
| Leslee J. Shaw | Emory University School of Medicine—Professor of Medicine | None | None | None | • GE Healthcare* | None | None |

| Committee Member | Employer | Consultant | Speaker | Ownership/ Partnership/ Principal | Personal Research | Institutional, Organizational, or Other Financial Benefit | Expert Witness |
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| Allen J. Taylor | Washington Hospital Center, Cardiology Section—Director, Advanced Cardiovascular Imaging, Cardiovascular Research Institute | • Abbott<br>• Merck<br>• Pfizer | None | None | • Abbott | • SAIP<br>• SCCT | None |
| William S. Weintraub | Christiana Care Health System—Section Chief, Cardiology | • Bristol-Myers Squibb<br>• Gilead<br>• Eli Lilly<br>• Sanofi-aventis | None | None | • Abbott*<br>• AstraZeneca*<br>• Bristol-Myers Squibb*<br>• Gilead*<br>• Otsuka*<br>• Sanofi-aventis* | • AstraZeneca*<br>• Bayer*<br>• Pfizer* | • Quetiapine case, defense, 2008<br>• Celebrex case, defense, 2008 |
| Nanette K. Wenger | Emory University School of Medicine—Professor of Medicine (Cardiology) | • Abbott<br>• AstraZeneca<br>• Boston Scientific<br>• Genzyme<br>• Gilead*<br>• LCIC<br>• Medtronic<br>• Merck<br>• Pfizer<br>• Sanofi-aventis<br>• Schering-Plough* | None | None | • Gilead*<br>• Eli Lilly*<br>• Merck*<br>• NHLBI*<br>• Pfizer*<br>• Sanofi-aventis* | None | None |

This table represents the relationships of committee members with industry and other entities that were reported by authors to be relevant to this document. These relationships were reviewed and updated in conjunction with all meetings and/or conference calls of the writing committee during the document development process. The table does not necessarily reflect relationships with industry at the time of publication. A person is deemed to have a significant interest in a business if the interest represents ownership of 5% or more of the voting stock or share of the business entity, or ownership of $10,000 or more of the fair market value of the business entity; or if funds received by the person from the business entity exceed 5% of the person's gross income for the previous year. A relationship is considered to be modest if it is less than significant under the preceding definition. Relationships in this table are modest unless otherwise noted. *Significant relationship; †Recused from voting on Section 10, Lipoprotein-Associated Phospholipase A2; ‡Recused from voting on Section 21, Coronary Computed Tomography Angiography; §Recused from voting on Section 23, Diabetes Mellitus; ‖Recused from voting on Section 20, Calcium Scoring Methods; ¶Recused from voting on Section 5, Lipoprotein and Apolipoprotein Assessments; #Recused from voting on Section 7, Measurement of C-Reactive Protein.

ACCF indicates American College of Cardiology Foundation; AHA, American Heart Association; BCBS, Blue Cross Blue Shield; BSP, Biological Signal Processing; CDC, Centers for Disease Control; CME, continuing medical education; DSMB, Data Safety Monitoring Board; FAME, Fractional flow reserve (FFR) vs. Angiography in Multivessel Evaluation; FDA, Food and Drug Administration; LCIC, Leadership Council for Improving Cardiovascular Care; MESA, Multiethnic Study of Atherosclerosis; NHLBI, National Heart, Lung, and Blood Institute; NIA, National Institute on Aging; NIH, National Institutes of Health; SAIP, Society of Atherosclerosis Imaging and Prevention; and SCCT, Society of Cardiovascular Computed Tomography.

## APPENDIX 2. REVIEWER RELATIONSHIPS WITH INDUSTRY AND OTHER ENTITIES: 2010 ACCF/AHA GUIDELINE FOR ASSESSMENT OF CARDIOVASCULAR RISK IN ASYMPTOMATIC ADULTS: EXECUTIVE SUMMARY

| Peer Reviewer | Representation | Consultant | Speaker | Ownership/ Partnership/ Principal | Personal Research | Institutional, Organizational, or Other Financial Benefit | Expert Witness |
|---|---|---|---|---|---|---|---|
| Frederick G. Kushner | Official Reviewer—ACCF/AHA Task Force on Practice Guidelines | None | • Abbott<br>• Bristol-Myers Squibb<br>• CV Therapeutics | None | • AstraZeneca<br>• Atherogenics<br>• Cogentus<br>• Eli Lilly<br>• NIH<br>• Novartis<br>• Pfizer | None | None |
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| Peer Reviewer | Representation | Consultant | Speaker | Ownership/ Partnership/ Principal | Personal Research | Institutional, Organizational, or Other Financial Benefit | Expert Witness |
|---|---|---|---|---|---|---|---|
| Thomas C. Piemonte | Official Reviewer—ACCF Board of Governors | None | None | None | None | • Medtronic* | None |
| Paul Poirier | Official Reviewer—AHA | None | None | None | • CDA*<br>• CIHR*<br>• FRSQ* | None | None |
| Jane E. Schauer | Official Reviewer—ACCF Board of Trustees | None | None | None | • NIH | None | None |
| Daniel S. Berman | Organizational Reviewer—American Society of Nuclear Cardiology | • Astellas<br>• Bracco<br>• Cedars-Sinai Medical Center*<br>• Flora Pharma<br>• Lantheus*<br>• Magellan<br>• Spectrum Dynamics* | None | None | • Astellas*<br>• GE/Amersham<br>• Siemens | None | None |
| Roger S. Blumenthal | Organizational Reviewer—Society of Atherosclerosis Imaging and Prevention | None | None | None | None | None | None |
| Robin P. Choudhury | Organizational Reviewer—Society for Cardiovascular Magnetic Resonance | None | None | None | None | None | None |
| David A. Cox | Organizational Reviewer—Society for Cardiovascular Angiography and Interventions | • Abbott Vascular<br>• Boston Scientific | • Abbott Vascular<br>• Boston Scientific | None | None | None | None |
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| Peer Reviewer | Representation | Consultant | Speaker | Ownership/ Partnership/ Principal | Personal Research | Institutional, Organizational, or Other Financial Benefit | Expert Witness |
|---|---|---|---|---|---|---|---|
| Gregory S. Thomas | Organizational Reviewer—American Society of Nuclear Cardiology | • Astellas<br>• GE Medical | • Abbott<br>• Astellas* | None | • Astellas*<br>• GE Medical<br>• Isis Pharmaceuticals*<br>• Siemens | • Past President, American Society of Nuclear Cardiology | None |
| Szilard Voros | Organizational Reviewer—Society for Cardiovascular Magnetic Resonance | None | • Merck Schering-Plough* | None | • Abbott Vascular*<br>• CardioDx*<br>• Merck Schering-Plough*<br>• Vital Images*<br>• Volcano* | None | None |
| Karthikeyan Ananthasubramaniam | Content Reviewer—ACCF Imaging Council | None | • Astellas Global Pharma | None | • Astellas Global Pharma* | None | None |
| Jeffrey L. Anderson | Content Reviewer—ACCF/AHA Task Force on Practice Guidelines | None | None | None | None | None | None |
| Vera Bittner | Content Reviewer—ACCF Prevention of Cardiovascular Disease Committee | None | None | None | • CV Therapeutics*<br>• GlaxoSmithKline*<br>• NHLBI*<br>• NIH/Abbott*<br>• Roche | None | None |
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| Peer Reviewer | Representation | Consultant | Speaker | Ownership/ Partnership/ Principal | Personal Research | Institutional, Organizational, or Other Financial Benefit | Expert Witness |
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| Jerome L. Hines | Content Reviewer—ACCF Imaging Council | None | None | None | None | None | None |
| Judith S. Hochman | Content Reviewer—ACCF/AHA Task Force on Practice Guidelines | • Eli Lilly<br>• Millennium Pharmaceuticals and Schering-Plough Research Institute (TIMI 50) | None | None | None | • GlaxoSmithKline | None |
| Christopher M. Kramer | Content Reviewer—ACCF Imaging Council | • Siemens | None | None | • Astellas*<br>• GlaxoSmithKline*<br>• NHLBI*<br>• Merck Schering-Plough*<br>• Siemens Medical Solutions* | None | None |
| Donald M. Lloyd-Jones | Content Reviewer | None | None | None | None | None | None |
| Pamela B. Morris | Content Reviewer—ACCF Prevention of Cardiovascular Disease Committee | None | • Abbott<br>• AstraZeneca<br>• Merck<br>• Merck Schering-Plough<br>• Takeda | None | None | None | None |
| Srihari S. Naidu | Content Reviewer—ACCF Cardiac Catheterization Committee | None | None | None | None | None | None |
| Vasan S. Ramachandran | Content Reviewer | None | None | None | • NIH* | None | None |
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| Peer Reviewer | Representation | Consultant | Speaker | Ownership/ Partnership/ Principal | Personal Research | Institutional, Organizational, or Other Financial Benefit | Expert Witness |
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| Carl L. Tommaso | Content Reviewer—ACCF Interventional Council | None | None | None | None | None | None |
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| Kim A. Williams | Content Reviewer—ACCF Imaging Council | • Astellas*<br>• GE Healthcare*<br>• King Pharmaceuticals* | • Astellas*<br>• GE Healthcare* | None | • GE Healthcare*<br>• Molecular Insight Pharmaceuticals* | • Molecular Insight Pharmaceuticals* | None |

This table represents the relevant relationships with industry and other entities that were disclosed at the time of peer review. It does not necessarily reflect relationships with industry at the time of publication. A person is deemed to have a significant interest in a business if the interest represents ownership of 5% or more of the voting stock or share of the business entity, or ownership of $10,000 or more of the fair market value of the business entity; or if funds received by the person from the business entity exceed 5% of the person's gross income for the previous year. A relationship is considered to be modest if it is less than significant under the preceding definition. Relationships in this table are modest unless otherwise noted. Names are listed in alphabetical order within each category of review. *Significant relationship.

ACCF indicates American College of Cardiology Foundation; AHA, American Heart Association; CDA, Canadian Diabetes Association; CIHR, Canadian Institutes of Health; FDA, Food and Drug Administration; FRSQ, Fonds de la recherche en santé du Québec; NHLBI, National Heart, Lung, and Blood Institute; NIH, National Institutes of Health; JAMA, Journal of the American Medical Association; and TIMI, Thrombolysis In Myocardial Infarction.

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**Key Words:** ACCF/AHA practice guidelines ■ asymptomatic adults ■ cardiovascular risk assessment ■ cardiovascular screening of asymptomatic adults ■ detection of coronary artery disease ■ risk factor assessment ■ subclinical coronary artery disease.