

## ACCF/ASNC APPROPRIATENESS CRITERIA

# ACCF/ASNC Appropriateness Criteria for Single-Photon Emission Computed Tomography Myocardial Perfusion Imaging (SPECT MPI)

A Report of the American College of Cardiology Foundation  
Quality Strategic Directions Committee Appropriateness Criteria  
Working Group and the American Society of Nuclear Cardiology

*Endorsed by the American Heart Association*

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## ABSTRACT

Under the auspices of the American College of Cardiology Foundation (ACCF) and the American Society of Nuclear Cardiology (ASNC), an appropriateness review was conducted for radionuclide cardiovascular imaging (RNI), specifically gated single-photon emission computed tomography myocardial perfusion imaging (SPECT MPI). The review assessed the risks and benefits of the imaging test for several indications or clinical scenarios and scored them based on a scale of 1 to 9, where the upper range (7 to 9) implies that the test is generally acceptable and is a reasonable approach, and the lower range (1 to 3) implies that the test is generally not acceptable and is not a reasonable approach. The mid range (4 to 6) implies that the test may be generally acceptable and may be a reasonable approach for the indication. The indications for this review were primarily drawn from existing clinical practice guidelines and modified based on discussion by the ACCF Appropriateness Criteria Working Group and the Technical Panel members who rated the indications. The method for this review was based on the RAND/UCLA approach for evaluating appropriateness, which blends scientific evidence and practice experience. A modified Delphi technique was used to obtain first- and second-round ratings of 52 clinical indications. The ratings were done by a Technical Panel with diverse membership, including nuclear cardiologists, referring physicians (including an echocardiographer), health services researchers, and

a payer (chief medical officer). These results are expected to have a significant impact on physician decision making and performance, reimbursement policy, and future research directions. Periodic assessment and updating of criteria will be undertaken as needed.

## PREFACE

This report is the first in a series of technical documents that critically and systematically document, review, and categorize appropriateness criteria of cardiovascular diagnostic tests and procedures utilized by cardiologists in their everyday clinical practice. Both the ACCF and ASNC believe that a careful blending of evidence-based information and clinical experience can help guide a more efficient and equitable allocation of health care resources. The ultimate objective of these reviews is to improve patient care and health outcomes in a cost-effective manner, without constraining the crucial role of physician judgment in the face of diverse clinical presentations and varying patient characteristics.

The appropriateness criteria in this report serve as a guide for the responsible use of SPECT MPI and related resources. Our approach is not to diminish the acknowledged uncertainty of clinical decision making by statistical means or consensus techniques, but to recognize that real differences in clinical opinion are grounds for more research and for even more careful deliberation of each indication and patient. Also, not doing a study that is deemed appropriate may be a correct decision in light of unique patient and clinical information.

This document would not have been possible without the dedicated effort of the Technical Panel, comprising 12 experts in cardiovascular care, some with special background in nuclear cardiology and others with impeccable credentials in general cardiovascular medicine, echocardiography, and health services cardiovascular research. This diversity made for a wide range of scoring for each indication. It is much easier to “game” or “bias” the scoring process by limiting panel membership solely to specialists of the particular procedure being evaluated for appropriateness. Such specialists would have a natural tendency to rate each indication higher than would nonspecialists of a given test or procedure. Thus, it would appear to be more grounded and responsible to have a professional group with a wider range of skills and insights to balance the deliberations, as reflected in the background of the Technical Panel shown in Appendix C.

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*Ralph Brindis, MD, MPH, FACC  
 Chair, Appropriateness Criteria Working Group*

## INTRODUCTION

Improvements in cardiovascular imaging technology and their application, coupled with increasing therapeutic options for cardiovascular disease, have led to an increase in cardiovascular imaging. In 2002, some 9.3 million myocardial perfusion procedures were performed (1,2). Diagnostic imaging services reimbursed under Medicare's physician fee schedule grew more rapidly than any other type of physician service from 1999 to 2003 (3,4). At the same time, the armamentarium of noninvasive diagnostic tools expanded with innovations in new contrast agents, molecular radionuclide imaging, perfusion echocardiography, computed tomography for coronary angiography and calcium score, and magnetic resonance imaging (MRI) for myocardial structure and viability. As the field of cardiovascular radionuclide nuclear imaging continues to advance along with other imaging modalities, the health care community needs to understand how to best incorporate these technologies into daily clinical care.

In an effort to respond to this need, the ACCF, in conjunction with ASNC, undertook a process to determine the appropriate indications for cardiovascular RNI. The ACCF/ASNC Appropriateness Criteria for Single-Photon Emission Computed Tomography Myocardial Perfusion Imaging (SPECT MPI) project was initiated to support the delivery of quality cardiovascular care and to ensure the effective use of advanced diagnostic imaging tools. This project, which focuses on the use of gated SPECT MPI for adults, is part of an ongoing effort by the ACCF to rigorously examine the appropriateness of all established imaging modalities.

## METHODS

The method for this review was based on the RAND/UCLA approach for evaluating appropriateness, which blends scientific evidence and practice experience (5). A modified Delphi technique was used to obtain first- and second-round ratings of 52 clinical indications or scenarios by a specially constituted Technical Panel. This 12-member Technical Panel had diverse membership comprising nuclear cardiologists, referring physicians (including an echocardiographer), health services researchers, and a payer representative (chief medical officer) (see Appendix C). Specialists in nuclear cardiology accounted for only 58% of the Technical Panel membership. This diversity ensured a balanced composition and the necessary expertise of the panel.

The 52 indications that were rated encompass the majority of cases seen in cardiovascular nuclear testing. All were modified based on discussion by the Appropriateness Criteria Working Group and the Technical Panel that rated the indications. Although not comprehensive, the indications are characteristic of the average practice and were developed based on existing clinical practice guidelines and expert opinion. Criteria were drafted for each indication to be as specific as possible for each patient population addressed (the development of indications is discussed in Appendix A). As discussed

in Appendix B, they include aspects such as the pre-test likelihood of coronary artery disease (CAD) for symptomatic patients and Framingham risk criteria to determine the risk of coronary heart disease for asymptomatic patients (6).

The ratings assessed whether the use of SPECT MPI for each indication was appropriate, uncertain, or inappropriate. In rating each indication, the Technical Panel was asked to use the following definition of appropriateness:

An appropriate imaging study is one in which the expected incremental information, combined with clinical judgment, exceeds the expected negative consequences\* by a sufficiently wide margin for a specific indication that the procedure is generally considered acceptable care and a reasonable approach for the indication.

The Technical Panel scored each indication as follows:

*Median score 7 to 9:* Appropriate test for that specific indication (test is generally acceptable and is a reasonable approach for the indication).

*Median score 4 to 6:* Uncertain or possibly appropriate test for that specific indication (test may be generally acceptable and may be a reasonable approach for the indication). (Uncertainty also implies that more research and/or patient information is needed to classify definitively the indication as appropriate and to update the criteria.)

*Median score 1 to 3:* Inappropriate test for that specific indication (test is not generally acceptable and is not a reasonable approach for the indication).

Appendices A and B provide details about the methods and definitions used in this report. Discussion of the methodological issues involved in the development of appropriateness criteria is also found in the report entitled, "ACCF Proposed Method for Evaluating the Appropriateness of Cardiovascular Imaging" (7).

## RESULTS OF RATINGS

Tables 1 through 9 sequentially list the 52 indications by purpose, clinical scenario, and their ratings, as obtained from the second-round rating sheets. In addition, Tables 10 through 12 arrange the indications into three main scoring categories—those that were rated as inappropriate (I, median score of 1 to 3), uncertain or possibly appropriate (U, median score of 4 to 6), and appropriate (A, median score of 7 to 9), respectively.

Table 10 lists the 13 indications that were rated as inappropriate (i.e., the imaging test is not generally acceptable and is not a reasonable approach for the indication). This does not preclude, however, the performance of the test if justifiable because of special clinical and patient

\*Expected negative consequences include the risks of the procedure (i.e., radiation or contrast exposure) and the downstream impact of poor test performance such as delay in diagnosis (false negatives) or inappropriate diagnosis (false positives).

circumstances. It is likely that reimbursement for the test will require a documented exception from the physician.

Table 11 lists the 27 indications that were rated as appropriate (the imaging test is generally acceptable and is a reasonable approach for the indication). It is recommended that these indications will receive reimbursement. However, appropriateness does not necessarily imply that the test being rated is the initial clinical approach to be taken.

Table 12 lists the 12 indications that were rated as uncertain (i.e., the imaging test may be generally acceptable and may be a reasonable approach for the indication). Additional data and research are required before these indications can be rated definitively as appropriate. These indications should be reimbursed. The clinical community does not necessarily consider uncertain indications as those that should not be performed—many may be the standard of care in specific regions of the U.S.

Other tables, including documentation of the mean absolute deviation from the median and level of agreement for each indication, are found in the online appendix at [www.acc.org](http://www.acc.org). Unless otherwise noted, a succession of bullets

for a specific indication implies that all are required components of that indication. Abbreviations used in the tables and the text of this report are listed below.

#### *Abbreviations*

ACS	acute coronary syndromes
CABG	coronary artery bypass grafting surgery
CAD	coronary artery disease
CHD	coronary heart disease
ECG	electrocardiogram
HF	heart failure
MPI	myocardial perfusion imaging
METs	estimated metabolic equivalents of exercise
NSTEMI	non-ST-segment elevation myocardial infarction
PCI	percutaneous coronary intervention
RNA	radionuclide angiography
RNI	radionuclide cardiovascular imaging (in this report, SPECT MPI)
SPECT MPI	single-photon emission computed tomography myocardial perfusion imaging
STEMI	ST-segment elevation myocardial infarction
UA	unstable angina

**Table 1. Detection of CAD: Symptomatic**

Indication		Appropriateness Criteria (Median Score)
<b>Evaluation of Chest Pain Syndrome</b>		
1.	<ul style="list-style-type: none"> <li>• Low pre-test probability of CAD</li> <li>• ECG interpretable AND able to exercise</li> </ul>	I (2.0)
2.	<ul style="list-style-type: none"> <li>• Low pre-test probability of CAD</li> <li>• ECG uninterpretable OR unable to exercise</li> </ul>	U* (6.5)
3.	<ul style="list-style-type: none"> <li>• Intermediate pre-test probability of CAD</li> <li>• ECG interpretable AND able to exercise</li> </ul>	A (7.0)
4.	<ul style="list-style-type: none"> <li>• Intermediate pre-test probability of CAD</li> <li>• ECG uninterpretable OR unable to exercise</li> </ul>	A (9.0)
5.	<ul style="list-style-type: none"> <li>• High pre-test probability of CAD</li> <li>• ECG interpretable AND able to exercise</li> </ul>	A (8.0)
6.	<ul style="list-style-type: none"> <li>• High pre-test probability of CAD</li> <li>• ECG uninterpretable OR unable to exercise</li> </ul>	A (9.0)
<b>Acute Chest Pain (in Reference to Rest Perfusion Imaging)</b>		
7.	<ul style="list-style-type: none"> <li>• Intermediate pre-test probability of CAD</li> <li>• ECG – no ST elevation AND initial cardiac enzymes negative</li> </ul>	A (9.0)
8.	<ul style="list-style-type: none"> <li>• High pre-test probability of CAD</li> <li>• ECG – ST elevation</li> </ul>	I (1.0)
<b>New-Onset/ Diagnosed Heart Failure With Chest Pain Syndrome</b>		
9.	<ul style="list-style-type: none"> <li>• Intermediate pre-test probability of CAD</li> </ul>	A (8.0)

\*Median scores of 3.5 and 6.5 are rounded to the middle (Uncertain). Note: I (Inappropriate), U (Uncertain), and A (Appropriate).

**Table 2. Detection of CAD: Asymptomatic (Without Chest Pain Syndrome)**

Indication		Appropriateness Criteria (Median Score)
<b>Asymptomatic</b>		
10.	<ul style="list-style-type: none"> <li>• Low CHD risk (Framingham risk criteria)</li> </ul>	I (1.0)
11.	<ul style="list-style-type: none"> <li>• Moderate CHD risk (Framingham)</li> </ul>	U (5.5)
<b>New-Onset or Diagnosed Heart Failure or LV Systolic Dysfunction Without Chest Pain Syndrome</b>		
12.	<ul style="list-style-type: none"> <li>• Moderate CHD risk (Framingham)</li> <li>• No prior CAD evaluation AND no planned cardiac catheterization</li> </ul>	A (7.5)
<b>Valvular Heart Disease Without Chest Pain Syndrome</b>		
13.	<ul style="list-style-type: none"> <li>• Moderate CHD risk (Framingham)</li> <li>• To help guide decision for invasive studies</li> </ul>	U (5.5)
<b>New-Onset Atrial Fibrillation</b>		
14.	<ul style="list-style-type: none"> <li>• Low CHD risk (Framingham)</li> <li>• Part of the evaluation</li> </ul>	U* (3.5)
15.	<ul style="list-style-type: none"> <li>• High CHD risk (Framingham)</li> <li>• Part of the evaluation</li> </ul>	A (8.0)
<b>Ventricular Tachycardia</b>		
16.	<ul style="list-style-type: none"> <li>• Moderate to high CHD risk (Framingham)</li> </ul>	A (9.0)

\*Median scores of 3.5 and 6.5 are rounded to the middle (Uncertain). Note: I (Inappropriate), U (Uncertain), and A (Appropriate).

**Table 3. Risk Assessment: General and Specific Patient Populations**

Indication		Appropriateness Criteria (Median Score)
<b>Asymptomatic</b>		
17.	• Low CHD risk (Framingham)	I (1.0)
18.	• Moderate CHD risk (Framingham)	U (4.0)
19.	• Moderate to high CHD risk (Framingham) • High-risk occupation (e.g., airline pilot)	A (8.0)
20.	• High CHD risk (Framingham)	A (7.5)

Note: I (Inappropriate), U (Uncertain), and A (Appropriate).

**Table 4. Risk Assessment With Prior Test Results**

Indication		Appropriateness Criteria (Median Score)
<b>Asymptomatic OR Stable Symptoms Normal Prior SPECT MPI Study</b>		
21.	• Normal initial RNI study • High CHD risk (Framingham) • Annual SPECT MPI study	I (3.0)
22.	• Normal initial RNI study • High CHD risk (Framingham) • Repeat SPECT MPI study after 2 years or greater	A (7.0)
<b>Asymptomatic OR Stable Symptoms Abnormal Catheterization OR Prior SPECT MPI Study</b>		
23.	• Known CAD on catheterization OR prior SPECT MPI study in patients who have not had revascularization procedure • Asymptomatic OR stable symptoms • Less than 1 year to evaluate worsening disease	I (2.5)
24.	• Known CAD on catheterization OR prior SPECT MPI study in patients who have not had revascularization procedure • Greater than or equal to 2 years to evaluate worsening disease	A (7.5)
<b>Worsening Symptoms Abnormal Catheterization OR Prior SPECT MPI Study</b>		
25.	• Known CAD on catheterization OR prior SPECT MPI study	A (9.0)
<b>Asymptomatic CT Coronary Angiography</b>		
26.	• Stenosis of unclear significance	U* (6.5)
<b>Asymptomatic Prior Coronary Calcium Agatston Score</b>		
27.	• Agatston score greater than or equal to 400	A (7.5)
28.	• Agatston score less than 100	I (1.5)
<b>UA/NSTEMI, STEMI, or Chest Pain Syndrome Coronary Angiogram</b>		
29.	• Stenosis of unclear significance	A (9.0)
<b>Duke Treadmill Score</b>		
30.	• Intermediate Duke treadmill score • Intermediate CHD risk (Framingham)	A (9.0)

\*Median score of 3.5 and 6.5 are rounded to the middle (Uncertain). Note: I (Inappropriate), U (Uncertain), and A (Appropriate).

**Table 5. Risk Assessment: Preoperative Evaluation for Non-Cardiac Surgery**

Indication		Appropriateness Criteria (Median Score)
<b>Low-Risk Surgery</b>		
31.	<ul style="list-style-type: none"> <li>• Preoperative evaluation for non-cardiac surgery risk assessment</li> </ul>	I (1.0)
<b>Intermediate-Risk Surgery</b>		
32.	<ul style="list-style-type: none"> <li>• Minor to intermediate perioperative risk predictor</li> <li>• Normal exercise tolerance (greater than or equal to 4 METS)</li> </ul>	I (3.0)
33.	<ul style="list-style-type: none"> <li>• Intermediate perioperative risk predictor OR</li> <li>• Poor exercise tolerance (less than 4 METS)</li> </ul>	A (8.0)
<b>High-Risk Surgery</b>		
34.	<ul style="list-style-type: none"> <li>• Minor perioperative risk predictor</li> <li>• Normal exercise tolerance (greater than or equal to 4 METS)</li> </ul>	U (4.0)
35.	<ul style="list-style-type: none"> <li>• Minor perioperative risk predictor</li> <li>• Poor exercise tolerance (less than 4 METS)</li> </ul>	A (8.0)
36.	<ul style="list-style-type: none"> <li>• Asymptomatic up to 1 year post normal catheterization, non-invasive test, or previous revascularization</li> </ul>	I (3.0)

Note: I (Inappropriate), U (Uncertain), and A (Appropriate).

**Table 6. Risk Assessment: Following Acute Coronary Syndrome**

Indication		Appropriateness Criteria (Median Score)
<b>STEMI—Hemodynamically Stable</b>		
37.	<ul style="list-style-type: none"> <li>• Thrombolytic therapy administered</li> <li>• Not planning to undergo catheterization</li> </ul>	A (8.0)
<b>STEMI—Hemodynamically Unstable, Signs of Cardiogenic Shock, or Mechanical Complications</b>		
38.	<ul style="list-style-type: none"> <li>• Thrombolytic therapy administered</li> </ul>	I (1.0)
<b>UA/NSTEMI—No Recurrent Ischemia or No Signs of HF</b>		
39.	<ul style="list-style-type: none"> <li>• Not planning to undergo early catheterization</li> </ul>	A (8.5)
<b>ACS—Asymptomatic Post Revascularization (PCI or CABG)</b>		
40.	<ul style="list-style-type: none"> <li>• Routine evaluation prior to hospital discharge</li> </ul>	I (1.0)

Note: I (Inappropriate), U (Uncertain), and A (Appropriate).

**Table 7. Risk Assessment: Post-Revascularization (PCI or CABG)**

Indication		Appropriateness Criteria (Median Score)
<b>Symptomatic</b>		
41.	• Evaluation of chest pain syndrome	A (8.0)
<b>Asymptomatic</b>		
42.	• Asymptomatic prior to previous revascularization • Less than 5 years after CABG	U (6.0)
43.	• Symptomatic prior to previous revascularization • Less than 5 years after CABG	U (4.5)
44.	• Asymptomatic prior to previous revascularization • Greater than or equal to 5 years after CABG	A (7.5)
45.	• Symptomatic prior to previous revascularization • Greater than or equal to 5 years after CABG	A (7.5)
46.	• Asymptomatic prior to previous revascularization • Less than 1 year after PCI	U* (6.5)
47.	• Symptomatic prior to previous revascularization • Less than 1 year after PCI	I (3.0)
48.	• Asymptomatic prior to previous revascularization • Greater than or equal to 2 years after PCI	U* (6.5)
49.	• Symptomatic prior to previous revascularization • Greater than or equal to 2 years after PCI	U (5.5)

\*Median scores of 3.5 and 6.5 are rounded to the middle (Uncertain). Note: I (Inappropriate), U (Uncertain), and A (Appropriate).

**Table 8. Assessment of Viability/Ischemia**

Indication		Appropriateness Criteria (Median Score)
<b>Ischemic Cardiomyopathy Assessment of Viability/Ischemia (Includes SPECT Imaging for Wall Motion and Ventricular Function)</b>		
50.	• Known CAD on catheterization • Patient eligible for revascularization	A (8.5)

Note: I (Inappropriate), U (Uncertain), and A (Appropriate).

**Table 9. Evaluation of Ventricular Function**

Indication		Appropriateness Criteria (Median Score)
<b>Evaluation of Left Ventricular Function</b>		
51.	• Non-diagnostic echocardiogram	A (9.0)
<b>Use of Potentially Cardiotoxic Therapy (e.g., Doxorubicin)</b>		
52.	• Baseline and serial measurements	A (9.0)

Note: I (Inappropriate), U (Uncertain), and A (Appropriate).

**Table 10. Inappropriate Indications (Median Rating of 1 to 3)**

Indication		Appropriateness Criteria (Median Score)
<b>Detection of CAD: Symptomatic—Evaluation of Chest Pain Syndrome</b>		
1.	<ul style="list-style-type: none"> <li>• Low pre-test probability of CAD</li> <li>• ECG interpretable AND able to exercise</li> </ul>	I (2.0)
<b>Detection of CAD Symptomatic—Acute Chest Pain (in Reference to Rest Perfusion Imaging)</b>		
8.	<ul style="list-style-type: none"> <li>• High pre-test probability of CAD</li> <li>• ECG: ST elevation</li> </ul>	I (1.0)
<b>Detection of CAD: Asymptomatic (Without Chest Pain Syndrome)</b>		
10.	<ul style="list-style-type: none"> <li>• Low CHD risk (Framingham risk criteria)</li> </ul>	I (1.0)
<b>Risk Assessment: General and Specific Patient Populations—Asymptomatic</b>		
17.	<ul style="list-style-type: none"> <li>• Low CHD risk (Framingham)</li> </ul>	I (1.0)
<b>Risk Assessment With Prior Test Results: Asymptomatic OR Stable Symptoms—Normal Prior SPECT MPI Study</b>		
21.	<ul style="list-style-type: none"> <li>• Normal initial RNI study</li> <li>• High CHD risk (Framingham)</li> <li>• Annual SPECT MPI study</li> </ul>	I (3.0)
<b>Risk Assessment With Prior Test Results: Asymptomatic OR Stable Symptoms—Abnormal Catheterization OR Prior SPECT MPI Study</b>		
23.	<ul style="list-style-type: none"> <li>• Known CAD on catheterization OR prior SPECT MPI study in patients who have not had revascularization procedure</li> <li>• Asymptomatic OR stable symptoms</li> <li>• Less than 1 year to evaluate worsening disease</li> </ul>	I (2.5)
<b>Risk Assessment With Prior Test Results: Asymptomatic—Prior Coronary Calcium Agatston Score</b>		
28.	<ul style="list-style-type: none"> <li>• Agatston score less than 100</li> </ul>	I (1.5)
<b>Risk Assessment: Preoperative Evaluation for Non-Cardiac Surgery—Low-Risk Surgery</b>		
31.	<ul style="list-style-type: none"> <li>• Preoperative evaluation for non-cardiac surgery risk assessment</li> </ul>	I (1.0)
<b>Risk Assessment: Preoperative Evaluation for Non-Cardiac Surgery—Intermediate-Risk Surgery</b>		
32.	<ul style="list-style-type: none"> <li>• Minor to intermediate perioperative risk predictor</li> <li>• Normal exercise tolerance (greater than or equal to 4 METS)</li> </ul>	I (3.0)
<b>Risk Assessment: Preoperative Evaluation for Non-Cardiac Surgery—High Risk Surgery</b>		
36.	<ul style="list-style-type: none"> <li>• Asymptomatic up to 1 year post normal catheterization, non-invasive test, or previous revascularization</li> </ul>	I (3.0)
<b>Risk Assessment: Following Acute Coronary Syndrome STEMI—Hemodynamically Unstable, Signs of Cardiogenic Shock, or Mechanical Complications</b>		
38.	<ul style="list-style-type: none"> <li>• Thrombolytic therapy administered</li> </ul>	I (1.0)
<b>Risk Assessment: Following Acute Coronary Syndrome—Asymptomatic Post-Revascularization (PCI or CABG)</b>		
40.	<ul style="list-style-type: none"> <li>• Routine evaluation prior to hospital discharge</li> </ul>	I (1.0)
<b>Risk Assessment: Post-Revascularization (PCI or CABG)—Asymptomatic</b>		
47.	<ul style="list-style-type: none"> <li>• Symptomatic prior to previous revascularization</li> <li>• Less than 1 year after PCI</li> </ul>	I (3.0)

Note: I (Inappropriate), U (Uncertain), and A (Appropriate).

**Table 11. Appropriate Indications (Median Rating of 7 to 9)**

Indication		Appropriateness Criteria (Median Score)
<b>Detection of CAD: Symptomatic— Evaluation of Chest Pain Syndrome</b>		
3.	<ul style="list-style-type: none"> <li>• Intermediate pre-test probability of CAD</li> <li>• ECG interpretable AND able to exercise</li> </ul>	A (7.0)
4.	<ul style="list-style-type: none"> <li>• Intermediate pre-test probability of CAD</li> <li>• ECG uninterpretable OR unable to exercise</li> </ul>	A (9.0)
5.	<ul style="list-style-type: none"> <li>• High pre-test probability of CAD</li> <li>• ECG interpretable AND able to exercise</li> </ul>	A (8.0)
6.	<ul style="list-style-type: none"> <li>• High pre-test probability of CAD</li> <li>• ECG uninterpretable OR unable to exercise</li> </ul>	A (9.0)
<b>Detection of CAD: Symptomatic— Acute Chest Pain (in Reference to Rest Perfusion Imaging)</b>		
7.	<ul style="list-style-type: none"> <li>• Intermediate pre-test probability of CAD</li> <li>• ECG: no ST elevation AND initial cardiac enzymes negative</li> </ul>	A (9.0)
<b>Detection of CAD: Symptomatic— New-Onset/Diagnosed Heart Failure With Chest Pain Syndrome</b>		
9.	<ul style="list-style-type: none"> <li>• Intermediate pre-test probability of CAD</li> </ul>	A (8.0)
<b>Detection of CAD: Asymptomatic— New-Onset or Diagnosed Heart Failure or LV Systolic Dysfunction Without Chest Pain Syndrome</b>		
12.	<ul style="list-style-type: none"> <li>• Moderate CHD risk (Framingham)</li> <li>• No prior CAD evaluation AND no planned cardiac catheterization</li> </ul>	A (7.5)
<b>Detection of CAD: Asymptomatic (Without Chest Pain Syndrome)— New-Onset Atrial Fibrillation</b>		
15.	<ul style="list-style-type: none"> <li>• High CHD Risk (Framingham)</li> <li>• Part of the evaluation</li> </ul>	A (8.0)
<b>Detection of CAD: Asymptomatic (Without Chest Pain Syndrome)— Ventricular Tachycardia</b>		
16.	<ul style="list-style-type: none"> <li>• Moderate to high CHD risk (Framingham)</li> </ul>	A (9.0)
<b>Risk Assessment: General and Specific Patient Populations— Asymptomatic</b>		
19.	<ul style="list-style-type: none"> <li>• Moderate to high CHD risk (Framingham)</li> <li>• High-risk occupation (e.g., airline pilot)</li> </ul>	A (8.0)
20.	<ul style="list-style-type: none"> <li>• High CHD risk (Framingham)</li> </ul>	A (7.5)
<b>Risk Assessment With Prior Test Results: Asymptomatic OR Stable Symptoms— Normal Prior SPECT MPI Study</b>		
22.	<ul style="list-style-type: none"> <li>• Normal initial RNI study</li> <li>• High CHD risk (Framingham)</li> <li>• Repeat SPECT MPI study after 2 years or greater</li> </ul>	A (7.0)
<b>Risk Assessment With Prior Test Results: Asymptomatic OR Stable Symptoms— Abnormal Catheterization or Prior SPECT MPI Study</b>		
24.	<ul style="list-style-type: none"> <li>• Known CAD on catheterization OR prior SPECT MPI study in patients who have not had revascularization procedure</li> <li>• Greater than or equal to 2 years to evaluate worsening disease</li> </ul>	A (7.5)
<b>Risk Assessment With Prior Test Results: Worsening Symptoms— Abnormal Catheterization OR Prior SPECT MPI Study</b>		
25.	<ul style="list-style-type: none"> <li>• Known CAD on catheterization OR prior SPECT MPI study</li> </ul>	A (9.0)

Continued on next page

**Table 11 Continued**

Indication		Appropriateness Criteria (Median Score)
<b>Risk Assessment With Prior Test Results: Asymptomatic— Prior Coronary Calcium Agatston Score</b>		
27.	• Agatston score greater than or equal to 400	A (7.5)
<b>Risk Assessment With Prior Test Results: UA/NSTEMI, STEMI, or Chest Pain Syndrome—Coronary Angiogram</b>		
29.	• Stenosis of unclear significance	A (9.0)
<b>Risk Assessment With Prior Test Results— Duke Treadmill Score</b>		
30.	• Intermediate Duke treadmill score • Intermediate CHD risk (Framingham)	A (9.0)
<b>Risk Assessment: Preoperative Evaluation for Non-Cardiac Surgery— Intermediate-Risk Surgery</b>		
33.	• Intermediate perioperative risk predictor OR • Poor exercise tolerance (less than 4 METS)	A (8.0)
<b>Risk Assessment: Preoperative Evaluation for Non-Cardiac Surgery— High-Risk Surgery</b>		
35.	• Minor perioperative risk predictor AND • Poor exercise tolerance (less than 4 METS)	A (8.0)
<b>Risk Assessment: Following Acute Coronary Syndrome— STEMI-Hemodynamically Stable</b>		
37.	• Thrombolytic therapy administered • Not planning to undergo catheterization	A (8.0)
<b>Risk Assessment: Following Acute Coronary Syndrome— UA/NSTEMI—No Recurrent Ischemia OR No Signs of HF</b>		
39.	• Not planning to undergo early catheterization	A (8.5)
<b>Risk Assessment: Post-Revascularization (PCI or CABG)— Symptomatic</b>		
41.	• Evaluation of chest pain syndrome	A (8.0)
<b>Risk Assessment: Post-Revascularization (PCI or CABG)— Asymptomatic</b>		
44.	• Asymptomatic prior to previous revascularization • Greater than or equal to 5 years after CABG	A (7.5)
45.	• Symptomatic prior to previous revascularization • Greater than or equal to 5 years after CABG	A (7.5)
<b>Assessment of Viability/Ischemia: Ischemic Cardiomyopathy (Includes SPECT Imaging for Wall Motion and Ventricular Function)</b>		
50.	• Known CAD on catheterization • Patient eligible for revascularization	A (8.5)
<b>Evaluation of Left Ventricular Function</b>		
51.	• Non-diagnostic echocardiogram	A (9.0)
<b>Evaluation of Ventricular Function: Use of Potentially Cardiotoxic Therapy (e.g., Doxorubicin)</b>		
52.	• Baseline and serial measurements	A (9.0)

Note: I (Inappropriate), U (Uncertain), and A (Appropriate).

**Table 12. Uncertain Indications (Median Rating of 4 to 6) (possibly appropriate indications that should be reimbursed, but additional research and/or patient information is required during updates of the criteria in order to rate them definitively as being appropriate)**

Indication		Appropriateness Criteria (Median Score)
<b>Detection of CAD: Symptomatic— Evaluation of Chest Pain Syndrome</b>		
2.	<ul style="list-style-type: none"> <li>• Low pre-test probability of CAD</li> <li>• ECG uninterpretable OR unable to exercise</li> </ul>	U* (6.5)
<b>Detection of CAD: Asymptomatic (Without Chest Pain Syndrome)</b>		
11.	<ul style="list-style-type: none"> <li>• Moderate CHD risk (Framingham)</li> </ul>	U (5.5)
<b>Detection of CAD: Asymptomatic— Valvular Heart Disease Without Chest Pain Syndrome</b>		
13.	<ul style="list-style-type: none"> <li>• Moderate CHD risk (Framingham)</li> <li>• To help guide decision for invasive studies</li> </ul>	U (5.5)
<b>Detection of CAD: Asymptomatic (Without Chest Pain Syndrome)— New-Onset Atrial Fibrillation</b>		
14.	<ul style="list-style-type: none"> <li>• Low CHD risk (Framingham)</li> <li>• Part of the evaluation</li> </ul>	U* (3.5)
<b>Risk Assessment: General and Specific Patient Populations— Asymptomatic</b>		
18.	<ul style="list-style-type: none"> <li>• Moderate CHD risk (Framingham)</li> </ul>	U (4.0)
<b>Risk Assessment With Prior Test Results: Asymptomatic— CT Coronary Angiography</b>		
26.	<ul style="list-style-type: none"> <li>• Stenosis of unclear significance</li> </ul>	U* (6.5)
<b>Risk Assessment: Preoperative Evaluation for Non-Cardiac Surgery— High-Risk Surgery</b>		
34.	<ul style="list-style-type: none"> <li>• Minor perioperative risk predictor</li> <li>• Normal exercise tolerance (greater than or equal to 4 METS)</li> </ul>	U (4.0)
<b>Risk Assessment: Post-Revascularization (PCI or CABG)— Asymptomatic</b>		
42.	<ul style="list-style-type: none"> <li>• Asymptomatic prior to previous revascularization</li> <li>• Less than 5 years after CABG</li> </ul>	U (6.0)
43.	<ul style="list-style-type: none"> <li>• Symptomatic prior to previous revascularization</li> <li>• Less than 5 years after CABG</li> </ul>	U (4.5)
<b>Risk Assessment: Post-Revascularization (PCI or CABG)— Asymptomatic</b>		
46.	<ul style="list-style-type: none"> <li>• Asymptomatic prior to previous revascularization</li> <li>• Less than 1 year after PCI</li> </ul>	U* (6.5)
48.	<ul style="list-style-type: none"> <li>• Asymptomatic prior to previous revascularization</li> <li>• Greater than or equal to 2 years after PCI</li> </ul>	U* (6.5)
49.	<ul style="list-style-type: none"> <li>• Symptomatic prior to previous revascularization</li> <li>• Greater than or equal to 2 years after PCI</li> </ul>	U (5.5)

\*Median scores of 3.5 and 6.5 are rounded to the middle (Uncertain). Note: I (Inappropriate), U (Uncertain), and A (Appropriate).

## DISCUSSION

The ACCF/ASNC appropriateness review of SPECT MPI resulted in the following distribution of criteria:

- Inappropriate—13 indications (25%)
- Appropriate—27 indications (52%)
- Uncertain—12 indications (23%)

The indications rated as appropriate were derived more often from existing clinical practice guidelines (89%) than was the case for uncertain (67%) or inappropriate indications (62%). The mean absolute deviation from the median was higher for uncertain indications (1.7), somewhat lower for appropriate indications (1.4), and much lower for indications rated as inappropriate (0.7). Of the 27 indications rated as appropriate, 6 (22%) had a mean absolute deviation from the median of 1.5 or greater (see online appendix). For those indications, it is clear that there was strong disagreement among the panelists as to the final rating of appropriateness—a median score in any of the three rating ranges does not necessarily imply that each panelist endorses the final recommendation.

Indications contained in this report were constructed and selected to cover a wide variety of common presentations and scenarios for which a nuclear cardiology study might be ordered. Indications vary by several factors, including risk (e.g., CHD and preoperative risk), test results, exercise ability, and duration since prior testing (see Appendices A and B). Factors are specific to the condition and population being considered, and the different clinical information contained in each indication has been crafted to be helpful to the physician faced with a specific patient scenario. The indications do not correspond directly to ICD-9 codes as they convey more information than found in the ICD-9 classification system. However, it is recognized that the 52 indications that are listed are not exhaustive of every possible use in cardiology, nor is every indication written with enough specificity to apply to every patient who presents for evaluation. In addition, a rating of appropriate for an indication does not necessarily mean that the use of SPECT MPI would be the first choice of testing for a particular patient profile.

There may be medical reasons that would preclude the application of the appropriateness criteria to a specific case, and clinician judgment should be used at all times in the application of these criteria. Furthermore, the local availability or quality of equipment or personnel may influence the selection of appropriate imaging procedures. Appropriateness criteria, in other words, are not substitutes for sound clinical judgment and practice experience with each patient and clinical presentation. For example, the rating of an indication as inappropriate should not preclude a provider from performing nuclear cardiology procedures when there are patient- and condition-specific data to support that decision. Conversely, not doing a study that is deemed appropriate may be a correct decision in light of unique patient and clinical information.

The primary objective of this report is to provide guidance regarding the perceived suitability of SPECT MPI for diverse clinical scenarios. Although consensus is desirable, complete agreement among the diverse membership of the Technical Panel was believed to be artificial and not necessarily of clinical value. Two rounds of rating with intervening discussion, following the RAND/UCLA method (5), did lead to some consensus among the panelists. It was believed, however, that further attempts to motivate consensus could artificially dilute differences in opinion among panelists and reduce real uncertainty.

The appropriateness criteria in this report are expected to be useful for clinicians, health care facilities, and third-party payers in the delivery of quality cardiovascular care. For example, individual clinicians could use the ratings as a supportive decision or educational tool when ordering a SPECT MPI or providing a referral to another qualified physician. The criteria also may be used to respond to a referring physician who has ordered a SPECT MPI for an inappropriate indication. Facilities and payers can use the criteria either prospectively in the design of protocols and pre-authorization procedures or retrospectively for quality reports. It is also expected that appropriate indications will receive reimbursement. In contrast, inappropriate indications will likely require additional documentation to justify payment because of unique circumstances or the clinical profile of the patient. An uncertain rating implies possible appropriateness and should not be used to deny reimbursement.

When used for accountability, appropriateness criteria should be employed in conjunction with systems that support quality improvement. Prospective pre-authorization procedures, for example, may be used most effectively once a retrospective review has identified a pattern of potential inappropriate use. Because the criteria are based on current scientific evidence and the deliberations of the Technical Panel, they can be used to help resolve *future* reimbursement cases or appeals but should not be applied to cases completed before issuance of this report.

The linking of indications rated as generally acceptable practice with analysis of related patient outcomes, and a review of what is “necessary” care\*, will improve understanding of regional variations in imaging and the potential for ensuring the equitable and efficient allocation of resources for diagnostic studies. Moreover, appropriateness reviews of other noninvasive modalities will make more information available to guide the selection among alternative tests and the assessment of their incremental effectiveness. Further exploration of the indications that are rated as “uncertain” or possibly appropriate will generate new empirical research and the data required to further define the appropriateness of SPECT MPI. Finally, periodic assessment and updating of indications and criteria will be required as new data and field experience become available.

\*A necessity review of appropriate indications can be done to ascertain the nature and level of care that is essential (i.e., is of such consequence in terms of net benefits that it should be made available to all population groups across regions).

## APPENDIX A: Methodological Details

### Panel Selection

An initial list of potential Technical Panel members was generated based on a Call for Nominations issued to all relevant parties in February 2005. Panel members were selected by the Appropriateness Criteria Working Group in a manner that ensured an appropriate balance with respect to expertise in the specific modality, academic versus private practice, research, and specialty training. Specialists in nuclear cardiology were limited to 58% of panelists.

### Development of Indications

The process for creating a first-round set of indications involved outside review and careful reference to relevant ACC/AHA clinical practice guidelines. The indications capture the major scenarios faced by nuclear cardiologists or referring physicians, but they are not meant to be inclusive of all potential indications for which a SPECT MPI study might be performed. Review was done by the ACCF/ASNC Appropriateness Criteria Working Group, including additional comments from an external reviewer in the field of nuclear cardiology. As a result of the meeting of the Technical Panel before the second-round of rating, the indications were clarified and modified. A final set of 52 indications comprised the list of possible clinical scenarios that were rated for appropriateness by the panelists and compiled for this report.

### Assumptions

All indications were considered with the following important assumptions:

1. Panel members were to assume that *all techniques* with specifically different radiopharmaceuticals and imaging protocols were available for each indication, and that each was performed in a manner similar to that found in the published literature.
2. Unless otherwise noted, *all* indications referred to gated SPECT MPI. *All* radionuclide perfusion imaging indications also assume gated SPECT MPI determination of global ventricular function (i.e., left ventricular ejection fraction) and regional wall motion as part of the evaluation.
3. For all stress imaging, the mode of stress testing was assumed to be exercise for patients able to exercise. For patients unable to exercise, pharmacologic stress testing was assumed to be used. Further background on the rationale for the assumption of exercise testing is available in the ACC/AHA 2002 Guideline Update for Exercise Testing (8).

### Rating Process

The Technical Panel was instructed to follow the RAND/UCLA appropriateness method, including a modified Delphi process involving two rounds of ratings, which included a

face-to-face meeting (5). The appropriateness method combines expert clinical judgment with the scientific literature in evaluating the benefits and risks of medical procedures. Ratings of the net benefits and risks of performing medical procedures for a comprehensive array of potential patient indications or scenarios are obtained from a multidisciplinary panel of expert clinicians. Each panel member has equal weight in producing the final result, and the method does not force consensus. The RAND Web site (<http://www.rand.org/publications/MR/MR1269/index.html>) provides details of the RAND/UCLA method (5).

The first round of ratings was completed individually with no interaction among panel members. The panel was then convened for a face-to-face meeting that was facilitated by a moderator. The goal of the meeting was to focus discussion on indications for which the first-round scores of the panel were widely divergent and to allow all views to be heard. The second-round ratings were conducted individually subsequent to the face-to-face meeting. The second-round ratings were used to determine the final appropriateness score based on the median score for each indication.

A measure of the level of disagreement was applied to each score. This project employed the BIOMED Concerted Action on Appropriateness definition for a panel size of 11 to 13 members. As defined in the RAND/UCLA manual (5), the BIOMED rule for agreement (+) is that no more than three panelists rate the indication outside the 3-point region containing the median; for disagreement (–), at least four panelists rate in each extreme rating region (i.e., 1 to 3 and 7 to 9). Measures of agreement and the dispersion of ratings (mean absolute deviation from the median) may highlight areas where definitions are not clear or ratings are inconsistent, where panelist perceptions of the “average” patient might differ, or where various specialty groups or individual panelists may have differences of clinical opinion. The measures are not meant to force consensus but to achieve better understanding of the results.

At the face-to-face meeting, each panelist received a personalized rating form that indicated his or her rating for each indication and the distribution of ratings of other members of the panel, but without personal identification. In addition, the moderator received a summary rating form with similar information (including panelist identification), along with other statistics that measured the level of agreement among panel members. This additional information helped to identify panelists who rated very differently from the rest of the panel. These additional measures or statistics were not shared with panelists.

In cases of obvious disagreement or outlier scores, the indication was highlighted in a summary table and identification of the outlier raters brought to the attention of the moderator. This information was used by the moderator to guide the panel's discussion.

Because the Technical Panel for this appropriateness review had 12 members, the median score is the arithmetic mean of the two middle most ratings. As a result, median scores such as

3.5 and 6.5 can result, which are just outside the range of the rating scale for inappropriate and appropriate, respectively. In this report, the 3.5 and 6.5 median scores were rounded to the middle or the uncertain scale: 4 to 6. This is a conservative approach that recognizes that inadequate scientific knowledge, or need for further clarification of the indication, possibly precludes assignment of the indication as appropriate or inappropriate. The general tendency to assign a 6.5 score to an appropriate range or a 3.5 score to the inappropriate range was deemed secondary to the caution necessary in protecting the best interests of the patient. In addition, the RAND/UCLA method requires that *any* score with disagreement be denoted as "uncertain" (5).

Panel members were asked to incorporate scientific evidence in their ratings, including relevant clinical practice guideline recommendations. All indications were evaluated based on the available medical literature and the prevailing practice for the *average* physician in the *average* clinical setting. Where available, both the guideline class of recommendation and level of evidence for a specific clinical indication were presented in the rating tables.

As set out in the RAND/UCLA Appropriateness Method User's Manual (5), costs were not explicitly considered in the ratings. Panelists, however, *implicitly* assessed a wide constellation of factors in their ratings, including patient expectations, cost reimbursement options, and the nature and level of clinical capacity. In the future, costs may be considered explicitly in *subsequent* stages of review and analysis, after the initial appropriateness review is completed. A review of the ratings that are in the uncertain range can help to guide the development of new empirical research required to expand the evidence base for future ratings. Finally, publication of the criteria merits discussion about how to evaluate the impact of the appropriateness criteria on health care practice and reimbursement policy.

### **Relationships With Industry**

The ACCF and its partnering organizations rigorously avoid any actual, perceived, or potential conflicts of interest that might arise as a result of an outside relationship or personal interest of a member of the Working Group and Technical Panel. Specifically, all members are asked to provide disclosure statements of all relationships that might be perceived as real or potential conflicts of interest. These statements were reviewed by the ACCF Quality Strategic Directions Committee, discussed with all members at each meeting, and updated and reviewed as changes occur. A table of disclosures by each member of the ACCF/ASNC Appropriateness Criteria Working Group and Technical Panel can be found in Appendix C.

### **Literature Review**

Technical Panel members were asked to review relevant guidelines and literature when completing their ratings. Each member was provided with access to the relevant ACC/AHA clinical practice guidelines along with an updated literature

search for relevant studies since the publication of the ACC/AHA/ASNC 2003 Guideline Update for the Clinical Use of Cardiac Radionuclide Imaging (9). A medical librarian and a cardiovascular fellow conducted independent literature searches, and they then compared the retrieved references to produce a comprehensive literature search. In addition, a special table was provided to the raters that documented the specific section and wording of the clinical practice guidelines relevant to the indications. Readers interested in further understanding the evidence base and rationale related to the use of SPECT MPI are encouraged to read the guidelines listed below. A copy of the annotated literature search and the table of correspondence between indications and clinical guideline recommendations that were provided to the Technical Panel are available in the online appendix at [www.acc.org](http://www.acc.org). The following ACC/AHA guidelines were referenced in this appropriateness review:

- ACC/AHA/ASNC Guidelines for the Clinical Use of Cardiac Radionuclide Imaging (9)
- ACC/AHA 2002 Guideline Update for Exercise Testing (8)
- ACC/AHA 2005 Guideline Update for the Diagnosis and Management of Chronic Heart Failure in the Adult (10)
- ACC/AHA 2002 Guideline Update for Perioperative Cardiovascular Evaluation for Noncardiac Surgery (11)
- ACC/AHA Guidelines for the Management of Patients With ST-Elevation Myocardial Infarction (12)
- ACC/AHA 2002 Guideline Update for Management of Patients With Chronic Stable Angina (13)
- ACC/AHA 2002 Guideline Update for Management of Patients With Unstable Angina and Non-ST-Segment Elevation Myocardial Infarction (14)
- ACC/AHA Practice Guidelines for Management of Patients With Valvular Heart Disease (15)

## **APPENDIX B: Definitions and Processes for Determining Likelihood of Disease and Risk**

### ***Determining Pre-Test Probability of Coronary Artery Disease***

**Chest pain syndrome.** This is any constellation of symptoms that the physician believes may represent a complaint consistent with obstructive CAD. Examples of such symptoms include, but are not exclusive to, chest pain, chest tightness, burning, dyspnea, shoulder pain, and jaw pain.

**Pre-test probability of coronary artery disease (CAD).** Once the physician determines the presence of symptoms that may represent obstructive CAD (chest pain syndrome present), then the pre-test probability of CAD should be determined.

Although several methods exist for determining pre-test probability of CAD (6,16), the method assumed for this report is a modification of a literature review (17) recommended by the ACC/AHA 2002 Guideline Update for

**Table B1.** Pre-Test Probability of CAD by Age, Gender, and Symptoms

Age (yrs)	Gender	Typical/Definite Angina Pectoris	Atypical/Probable Angina Pectoris	Nonanginal Chest Pain	Asymptomatic
30–39	Men	Intermediate	Intermediate	Low	Very low
	Women	Intermediate	Very low	Very low	Very low
40–49	Men	High	Intermediate	Intermediate	Low
	Women	Intermediate	Low	Very low	Very low
50–59	Men	High	Intermediate	Intermediate	Low
	Women	Intermediate	Intermediate	Low	Very low
60–59	Men	High	Intermediate	Intermediate	Low
	Women	High	Intermediate	Intermediate	Low

**High:** Greater than 90% pre-test probability; **Intermediate:** Between 10% and 90% pre-test probability; **Low:** Between 5% and 10% pre-test probability; **Very Low:** Less than 5% pre-test probability.

Reproduced with permission from ACC/AHA 2002 Guideline Update for Exercise Testing (8).

Exercise Testing (8) and ACC/AHA 2002 Guideline Update for Management of Patients With Chronic Stable Angina (13). The reader should refer to the definitions of angina and Table B1.

**Angina.** As defined by the ACC/AHA 2002 Guideline Update on Exercise Testing (8):

- **Typical angina (definite):** 1) Substernal chest pain or discomfort that is 2) provoked by exertion or emotional stress and 3) relieved by rest and/or nitroglycerin.
- **Atypical angina (probable):** Chest pain or discomfort that *lacks one* of the characteristics of definite or typical angina.
- **Non-anginal chest pain:** Chest pain or discomfort that *meets one or none* of the typical angina characteristics.

#### Determining Pre-Test Risk Assessment for Risk Stratification

**Risk assessment.** The rating sheets on risk assessment include indications in patients with suspected CAD.

It is assumed that clinicians will use radionuclide studies in addition to standard methods of risk assessment as presented in the AHA/ACC Scientific Statement: Assessment of Cardiovascular Risk by Use of Multiple-Risk-Factor Assessment Equations (18). Numerous discussions of the Framingham risk score calculation can be found online, including at the NHLBI Web site (<http://www.nhlbi.nih.gov/about/framingham/riskabs.htm>).

#### Coronary heart disease (CHD) risk.\*

- **CHD risk—low.** Defined by the age-specific risk level that is below average. In general, low risk will correlate with a 10-year absolute CHD risk less than 10%.
- **CHD risk—moderate.** Defined by the age-specific risk level that is average or above average. In general, moderate risk will correlate with a 10-year absolute CHD risk between 10% to 20%.

\*No data exist for patients less than 30 or greater than 69 years, but it can be assumed that prevalence of CAD increases with age. In a few cases, patients with ages at the extremes of the decades listed may have probabilities slightly outside the high or low range.

- **CHD risk—high.** Defined as the presence of diabetes mellitus or the 10-year absolute CHD risk of greater than 20%.

#### Evaluating Perioperative Risk for Non-Cardiac Surgery

**Method for determining perioperative risk.** Perioperative risk was determined for this report using a “Stepwise Approach to Preoperative Cardiac Assessment,” found in ACC/AHA 2002 Guideline Update for Perioperative Cardiovascular Evaluation for Noncardiac Surgery (11). Based on that algorithm, once it is determined that the patient does not require urgent surgery, and that there has not been revascularization within the last five years, the clinician should determine the patient’s perioperative risk predictors (see the definitions in the following text). If major risk predictors are present, coronary angiography and the postponement or cancellation of non-cardiac surgery should be considered. Once perioperative risk predictors are assessed based on the algorithm, then the surgical risk and patient’s functional status should be used to establish the need for noninvasive testing.

#### Perioperative risk predictors.†

- **Major risk predictors.** Unstable coronary syndromes, decompensated heart failure (HF), significant arrhythmias, and severe valve disease.
- **Intermediate risk predictors.** Mild angina, prior myocardial infarction (MI), compensated or prior HF, diabetes, or renal insufficiency.
- **Minor risk predictors.** Advanced age, abnormal electrocardiogram (ECG), rhythm other than sinus, low functional capacity, history of cardiovascular accident (CVA), and uncontrolled hypertension.

#### Surgical risk categories.†

- **High-risk surgery—cardiac death or MI greater than 5%.** Emergent major operations (particularly in the elderly), aortic

†As defined by the ACC/AHA 2002 Guideline Update for Perioperative Cardiovascular Evaluation for Noncardiac Surgery (10).

and peripheral vascular surgery, prolonged surgical procedures associated with large fluid shifts and/or blood loss.

- **Intermediate-risk surgery—cardiac death or MI = 1% to 5%.** Carotid endarterectomy, head and neck surgery, surgery of the chest or abdomen, orthopedic surgery, prostate surgery.
- **Low-risk surgery—cardiac death or MI less than 1%.** Endoscopic procedures, superficial procedures, cataract surgery, breast surgery.

#### **ECG—Uninterpretable**

This refers to ECGs with resting ST-segment depression (greater than or equal to 0.10 mV), complete left bundle-branch block, pre-excitation (Wolf-Parkinson-White Syndrome), or paced rhythm.

### **APPENDIX C: ACCF Appropriateness Criteria Working Group and Technical Panel**

#### **Participants**

##### **ACCF Appropriateness Criteria Working Group**

- Ralph G. Brindis, MD, MPH, FACC, Chair and Technical Panel Moderator—Regional Senior Advisor for Cardiovascular Diseases, Oakland Kaiser Medical Center and Clinical Professor of Medicine, University of California at San Francisco, CA
- Pamela S. Douglas, MD, FACC, FAHA—President, ACC and Ursula Geller Professor of Research in Cardiovascular Disease, Duke University Medical Center, Durham, NC
- Robert C. Hendel, MD, FACC, FAHA—Co-Moderator of the Technical Panel—Midwest Heart Specialists, Fox River Grove, IL
- Eric D. Peterson, MD, FACC, FAHA—Associate Professor of Medicine and Director, Cardiovascular Outcomes, Duke University Medical Center, Durham, NC
- Michael J. Wolk, MD, FACC—Immediate Past President, ACC and Clinical Professor of Medicine, Weill Medical College of Cornell University, New York, NY
- Joseph M. Allen, MA—Director, Clinical Decision Support, American College of Cardiology, Bethesda, MD
- Manesh R. Patel, MD—Fellow in Training, Duke University Medical Center, Durham, NC

Ira E. Raskin, PhD—Senior Specialist, Appropriateness Criteria, American College of Cardiology, Bethesda, MD

#### **Technical Panel**

- Timothy M. Bateman, MD, FACC, FAHA—Co-Director of Cardiovascular Radiology, and Associate Professor of Medicine, Cardiovascular Consultants, Kansas City, MO
- Manuel D. Cerqueira, MD, FACC, FAHA—Chairman, Department of Molecular and Functional Imaging and Professor of Medicine and Radiology, Cleveland Clinic Foundation, Cleveland, OH
- Raymond J. Gibbons, MD, FACC, FAHA—Professor of Medicine and Co-Director, Nuclear Cardiology Lab, Mayo Clinic, Rochester, MN
- Linda D. Gillam, MD, FACC, FAHA—Director, Echocardiography Lab and Associate Professor of Medicine, Hartford Hospital, Hartford, CT
- John A. Gillespie, MD, FACC—Chief Medical Officer, Blue Cross Blue Shield of Western New York, Buffalo, NY
- Robert C. Hendel, MD, FACC, FAHA—Co-Moderator of the Technical Panel – Midwest Heart Specialists, Fox River Grove, IL
- Ami E. Iskandrian, MD, FACC, FAHA—Distinguished Professor of Medicine and Radiology Section Chief, Nuclear Cardiology Division CV Diseases, University of Alabama at Birmingham, Birmingham, AL
- Scott D. Jerome, DO, FACC—Co-Director, Cardiac Imaging, Midatlantic Cardiovascular Association, Westminster, MD
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