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APPROPRIATE USE CRITERIA

ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2016 Appropriate Use Criteria for Coronary Revascularization in Patients With Acute Coronary Syndromes

A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and the Society of Thoracic Surgeons

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ABSTRACT

The American College of Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Thoracic Surgeons, and American Association for Thoracic Surgery, along with key specialty and subspecialty societies, have completed a 2-part revision of the appropriate use criteria (AUC) for coronary revascularization. In prior coronary revascularization AUC documents, indications for revascularization in acute coronary syndromes (ACS) and stable ischemic heart disease were combined into 1 document. To address the expanding clinical indications for coronary revascularization, and in an effort to align the subject matter with the most current American College of Cardiology/American Heart Association guidelines, the new AUC for coronary artery revascularization were separated into 2 documents addressing ACS and stable ischemic heart disease individually. This document presents the AUC for ACS.

Clinical scenarios were developed to mimic patient presentations encountered in everyday practice and

included information on symptom status, presence of clinical instability or ongoing ischemic symptoms, prior reperfusion therapy, risk level as assessed by noninvasive testing, fractional flow reserve testing, and coronary anatomy. This update provides a reassessment of clinical scenarios that the writing group felt to be affected by significant changes in the medical literature or gaps from prior criteria. The methodology used in this update is similar to the initial document but employs the recent modifications in the methods for developing AUC, most notably, alterations in the nomenclature for appropriate use categorization.

A separate, independent rating panel scored the clinical scenarios on a scale of 1 to 9. Scores of 7 to 9 indicate that revascularization is considered appropriate for the clinical scenario presented. Scores of 1 to 3 indicate that revascularization is considered rarely appropriate for the clinical scenario, whereas scores in the mid-range (4 to 6) indicate that coronary revascularization may be appropriate for the clinical scenario. Seventeen clinical scenarios were developed by a writing committee and scored by the rating panel: 10 were identified as appropriate, 6 as may be appropriate, and 1 as rarely appropriate.

As seen with the prior coronary revascularization AUC, revascularization in clinical scenarios with ST-segment elevation myocardial infarction and non–ST-segment elevation myocardial infarction were considered appropriate. Likewise, clinical scenarios with unstable angina and intermediate- or high-risk features were deemed appropriate. Additionally, the management of nonculprit artery disease and the timing of revascularization are now also rated. The primary objective of the AUC is to provide a framework for the assessment of practice patterns that will hopefully improve physician decision making.

PREFACE

The American College of Cardiology (ACC), in collaboration with the Society for Cardiovascular Angiography and Interventions, Society for Thoracic Surgeons, American Association for Thoracic Surgery, and other societies, developed and published the first version of the appropriate use criteria (AUC) for coronary revascularization in 2009, with the last update in 2012. The AUC are an effort to assist clinicians in the rational use of coronary revascularization in common clinical scenarios found in everyday practice. The new AUC for coronary revascularization was developed as separate documents for acute coronary syndromes (ACS) and stable ischemic heart disease (SIHD). This was done to address the expanding clinical indications for coronary revascularization, include new literature published since the last update, and align the subject matter with the ACC/American Heart Association guidelines An additional goal was to address several of the shortcomings of the initial document that became evident as experience with the use of the AUC accumulated in clinical practice.

The publication of AUC reflects 1 of several ongoing efforts by the ACC and its partners to assist clinicians who are caring for patients with cardiovascular diseases and in support of high-quality cardiovascular care. The ACC/American Heart Association clinical practice guidelines provide a foundation for summarizing evidence-based cardiovascular care and, when evidence is lacking, provide expert consensus opinion that is approved in review by the ACC and American Heart Association. However, in many areas, variability remains in the use of cardiovascular procedures, raising questions of over- or under-use. The AUC provide a practical standard upon which to assess and better understand variability.

We are grateful to the writing committee for the development of the overall structure of the document and clinical scenarios and to the rating panel, a professional group with a wide range of skills and insights, for their thoughtful deliberation of the merits of coronary revascularization for various clinical scenarios. We would also like to thank the parent AUC Task Force and the ACC staff, Joseph Allen, Leah White, and specifically Maria Velasquez, for their skilled support in the generation of this document.

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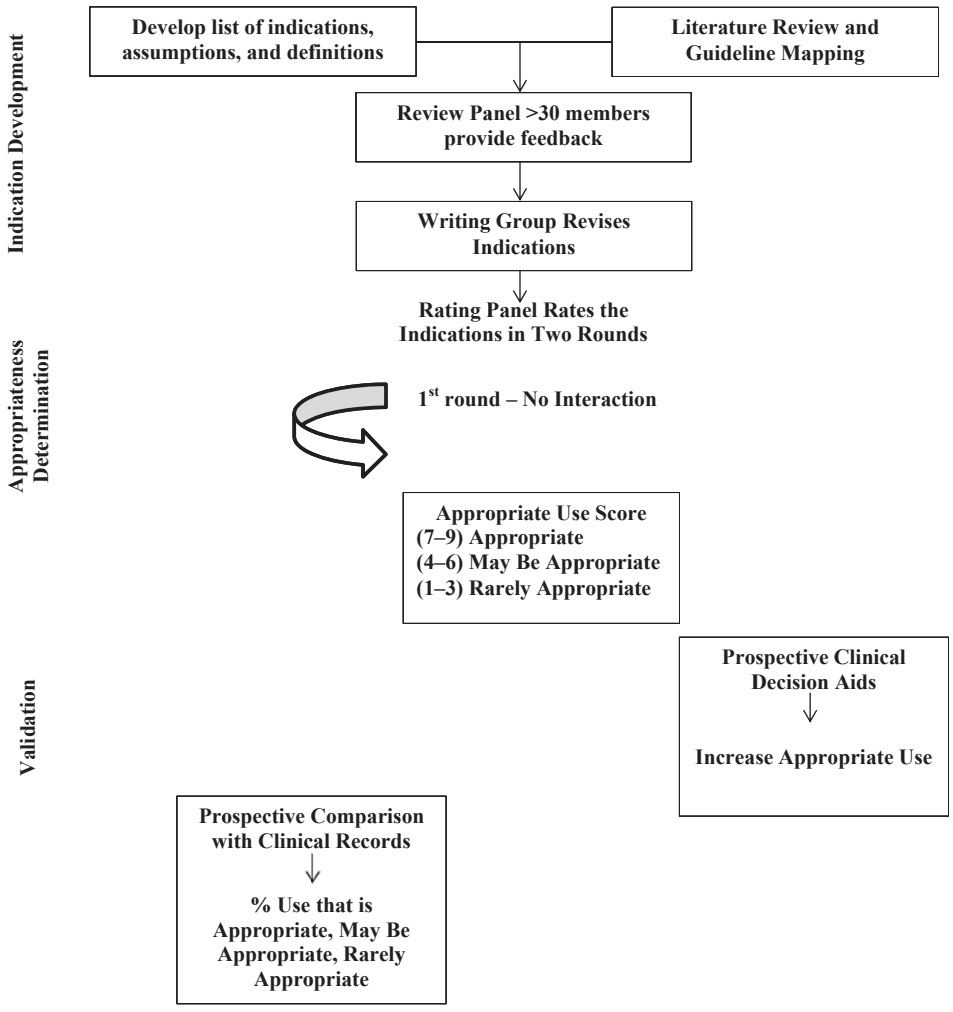
1. INTRODUCTION

In a continuing effort to provide information to patients, physicians, and policy makers, the Appropriate Use Task Force approved this revision of the 2012 coronary revascularization AUC (1). Since publication of the 2012 AUC document, new guidelines for ST-segment elevation myocardial infarction (STEMI) (2) and non–ST-segment elevation myocardial infarction (NSTEMI)/unstable angina (3) have been published with additional focused updates of the SIHD guideline and a combined focused update of the percutaneous coronary intervention (PCI) and STEMI guideline (4,5). New clinical trials have been published extending the knowledge and evidence around coronary revascularization, including trials that challenge earlier recommendations about the timing of nonculprit vessel PCI in the setting of STEMI (6–8). Additional studies related to coronary artery bypass graft surgery, medical therapy, and diagnostic technologies such as

FIGURE 1 AUC Development Process



AUC = appropriate use criteria.

fractional flow reserve (FFR) have emerged as well as analyses from The National Cardiovascular Data Registry (NCDR) on the existing AUC that provide insights into practice patterns, clinical scenarios, and patient features not previously addressed (9-11).

In an effort to make the AUC usable, meaningful, and as up-to-date as possible, the writing group was asked to develop AUC specifically for coronary revascularization in ACS including STEMI to coincide with the recently published focused update of the STEMI guidelines (5). A new separate AUC document specific to SIHD is under preparation and will be forthcoming. The goal of the writing group was to develop clinical indications (scenarios) that reflect typical situations encountered in everyday practice, which are then classified by a separate rating panel using methodology previously described in detail (12) (Figure 1). In addition, step-by-step flow charts are provided to help use the criteria.

2. METHODS

Indication Development

A multidisciplinary writing group consisting of cardiovascular health outcomes researchers, interventional cardiologists, cardiothoracic surgeons, and general cardiologists was convened to review and revise the coronary revascularization AUC.

The revascularization AUC are on the basis of our current understanding of procedure outcomes plus the potential patient benefits and risks of the revascularization

strategies examined. The AUC are developed to identify many of the common clinical scenarios encountered in practice, but cannot possibly include every conceivable patient presentation. (In this document, the phrase "clinical scenario" is frequently used interchangeably with the term "indication.") Some patients seen in clinical practice are not represented in these AUC or have additional extenuating features that would alter the appropriateness of treatment compared with the exact clinical scenarios presented.

AUC documents often contain more detailed clinical scenarios than the more generalized situations covered in clinical practice guidelines, and thus, subtle differences between these documents may exist. Furthermore, because recommendations for revascularization or the medical management of coronary artery disease (CAD) are found throughout several clinical practice guidelines, the AUC ratings herein are meant to unify related clinical practice guidelines and other data sources and provide a useful tool for clinicians. The AUC were developed with the intent to assist patients and clinicians, but are not intended to diminish the acknowledged complexity or uncertainty of clinical decision-making and should not be a substitute for sound clinical judgment. There are acknowledged evidence gaps in many areas where clinical judgement and experience must be blended with patient preferences, and the existing knowledge base must be defined in clinical practice guidelines.

It is important to emphasize that a rating of *appropriate care* does not mandate that a procedure or revascularization strategy be performed, *may be appropriate care* represents reasonable care and can be considered by the patient and provider, and finally, a rating of *rarely appropriate care* should not prevent a therapy from being performed. It is anticipated that there will be some clinical scenarios rated as rarely appropriate where an alternative therapy or performing revascularization may still be in the best interest of a particular patient. Situations where the clinician believes a therapy contrary to the AUC rating is best for the patient may require careful documentation as to the specific patient features not captured in the clinical scenario or the rationale for the chosen therapy. Depending on the urgency of care, obtaining a second opinion may be helpful in some of these settings.

The AUC can be used in several ways. As a clinical tool, the AUC assist clinicians in evaluating possible therapies under consideration and can help better inform patients about their therapeutic options. As an administrative and research tool, the AUC provide a means to compare utilization patterns across a large subset of providers to deliver an assessment of an individual clinician's management strategies with those of similar physicians. It is important to again emphasize that the AUC should be used to measure overall patterns of clinical care rather than to adjudicate the appropriateness of individual cases. The ACC and its collaborators believe that an ongoing review of one's practice using these criteria will help guide more effective, efficient, and equitable allocation of healthcare resources, and ultimately lead to better patient outcomes. Under no circumstances should the AUC be used as the sole means to adjudicate or determine payment for individual patients—rather, the intent of the AUC is to provide a framework to evaluate overall clinical practice and to improve the quality of care.

In developing these AUC for coronary revascularization, the rating panel was asked to rate each indication using the following definition of appropriate use:

> *A coronary revascularization or antianginal therapeutic strategy is appropriate care when the potential benefits, in terms of survival or health outcomes (symptoms, functional status, and/or quality of life) exceed the potential negative consequences of the treatment strategy.*

Although antianginal therapy is mentioned in this definition, the writing committee acknowledges that the focus of this document is revascularization, as it is the dominant therapy for patients with ACS. Medical therapy may have a role in the management of ongoing ischemic symptoms, but not to the extent that it does for SIHD.

The rating panel scored each indication on a scale from 1 to 9 as follows:

Score 7 to 9: Appropriate care

Score 4 to 6: May be appropriate care

Score 1 to 3: Rarely appropriate care

Appropriate Use Definition and Ratings

In rating these criteria, the rating panel was asked to assess whether the use of revascularization for each indication is "appropriate care," "may be appropriate care," or "rarely appropriate care" using the following definitions and their associated numeric ranges.

Median Score 7 to 9: Appropriate Care

An appropriate option for management of patients in this population due to benefits generally outweighing risks; an effective option for individual care plans, although not always necessary depending on physician judgment and patient-specific preferences (i.e., procedure is generally acceptable and is generally reasonable for the indication).

Median Score 4 to 6: May Be Appropriate Care

At times, an appropriate option for management of patients in this population due to variable evidence or agreement regarding the risk-benefit ratio, potential

benefit on the basis of practice experience in the absence of evidence, and/or variability in the population; effectiveness for individual care must be determined by a patient's physician in consultation with the patient on the basis of additional clinical variables and judgment along with patient preferences (i.e., procedure may be acceptable and may be reasonable for the indication).

Median Score 1 to 3: Rarely Appropriate Care

Rarely an appropriate option for management of patients in this population due to the lack of a clear benefit/risk advantage; rarely, an effective option for individual care plans; exceptions should have documentation of the clinical reasons for proceeding with this care option (i.e., procedure is not generally acceptable and is not generally reasonable for the indication).

Scope of Indications

The indications for coronary revascularization in ACS were developed considering the following common variables:

1. The clinical presentation (STEMI, NSTEMI, or other ACS);
2. Time from onset of symptoms;
3. Presence of other complicating factors (severe heart failure or cardiogenic shock; hemodynamic or electrical instability, presence of left ventricular dysfunction, persistent or recurring ischemic symptoms);
4. Prior treatment by fibrinolysis;
5. Predicted risk as estimated by the Thrombolysis In Myocardial Infarction score;
6. Relevant comorbidities; and
7. Extent of anatomic disease in the culprit and nonculprit arteries.

The writing group characterized ACS and their management into the 2 common clinical presentations: STEMI and NSTEMI/unstable angina. The anatomic construct for CAD is on the basis of the presence or absence of important obstructions in the coronary arteries categorized by the number of vessels involved 1-, 2-, and 3-vessel CAD) and the ability to identify the culprit artery responsible for the ACS Although the culprit stenosis is frequently obvious from the coronary angiogram, there are situations where the location of the culprit stenosis is uncertain or where multiple culprit stenoses may exist.

After initial treatment of the patient with an ACS, it may be helpful to categorize the amount of myocardium at risk or affected by ischemia; thus, a minority of scenarios include noninvasive testing. The writing group characterized noninvasive test findings as low-risk versus intermediate- or high-risk, as these terms are routinely used in clinical practice. The use of FFR measurement is increasing in the setting of stable ischemic heart disease, but there are limited data on its utility in the setting of ACS to evaluate nonculprit vessels (6). Nevertheless, the writing group provided some indications with invasive physiology testing (represented by FFR) in nonculprit vessels in patients with ACS.

3. ASSUMPTIONS

General Assumptions

Specific instructions and assumptions used by the rating panel to assist in the rating of clinical scenarios are listed in the following text:

1. Each clinical scenario is intended to provide the key information typically available when a patient presents with an ACS, recognizing that especially in the setting of an STEMI, the need for rapid treatment may prevent a complete evaluation.
2. Although the clinical scenarios should be rated on the basis of the published literature, the writing committee acknowledges that in daily practice, decisions about therapy are required in certain patient populations that are poorly represented in the literature. Therefore, rating panel members were instructed to use their best clinical judgment and experience in assigning ratings to clinical scenarios that have low levels of evidence.
3. In ACS, the percent luminal diameter narrowing of a stenosis may be difficult to assess. Determining the significance of a stenosis includes not only the percent luminal diameter narrowing, but also the angiographic appearance of the stenosis and distal flow pattern. For these clinical scenarios, a coronary stenosis in an artery is defined as:
   - Severe:
     a. A ≥70% luminal diameter narrowing of an epicardial stenosis made by visual assessment in the "worst view" angiographic projection; or
     b. A ≥50% luminal diameter narrowing of the left main artery made by visual assessment, in the "worst view" angiographic projection.
   - Intermediate:
     c. A ≥50% and <70% diameter narrowing of an epicardial stenosis made by visual assessment in the "worst view" angiographic projection.
4. For scenarios reflecting later phases of care for patients with ACS (scenarios during hospitalization), assume that patients are receiving guideline-directed medical therapy for secondary prevention of cardiac events unless specifically noted and efforts to control other risk factors have started (13-17).
5. Operators performing percutaneous or surgical revascularization have appropriate clinical training and experience and have satisfactory outcomes as assessed by quality assurance monitoring (18-20).

6. Revascularization by either percutaneous or surgical methods is performed in a manner consistent with established standards of care at centers with quality/volume standards (18–20).
7. No unusual extenuating circumstances exist in the clinical scenarios such as but not limited to do-not-resuscitate status, advanced malignancy, unwillingness to consider revascularization, technical reasons rendering revascularization infeasible, or comorbidities likely to markedly increase procedural risk.
8. Assume that the appropriateness rating applies only to the specific treatment strategy outlined in the scenario and not additional revascularization procedures that may be performed later in the patient's course. Specifically, additional elective revascularization procedures (so called delayed staged procedures) performed after the hospitalization for ACS are evaluated and rated in the forthcoming AUC document on SIHD. For data collection purposes, this will require documenting that the procedure is staged (either PCI or hybrid revascularization with surgery).
9. As with all previously published clinical policies, deviations by the rating panel from prior published documents were driven by new evidence and/or implementation of knowledge that justifies such evolution. However, the reader is advised to pay careful attention to the wording of an indication in the present document and should avoid making comparisons to prior documents.
10. Indication ratings contained herein supersede the ratings of similar indications contained in previous AUC coronary revascularization documents.

4. DEFINITIONS

Definitions of terms used throughout the indication set are listed here. These definitions were provided to and discussed with the rating panel before the rating of indications. The writing group assumed that noninvasive assessments of coronary anatomy (i.e., cardiac computed tomography, cardiac magnetic resonance angiography) provide anatomic information that is potentially similar to X-ray angiography. However, these modalities do not currently provide information on ischemic burden and are not assumed to be present in the clinical scenarios.

Indication

A set of patient-specific conditions defines an "indication," which is used interchangeably with the phrase "clinical scenario."

Cardiac Risk Factor Modification and Antianginal Medical Therapy

The indications assume that patients are receiving guideline-directed medical therapies for their ACS including antiplatelet and anticoagulant medications, beta-blockers, statins, and other medications as indicated by their clinical condition.

Culprit Stenosis

The phrase "culprit stenosis" is often used interchangeably with "infarct-related artery" to identify the coronary artery stenosis and/or artery responsible for the ACS. In this document, the phrase "culprit stenosis or culprit artery" is preferred, because in the setting of unstable angina there may be a culprit stenosis or culprit artery, but by definition, there is no evidence of a myocardial infarction.

Symptoms of Myocardial Ischemia

For the purposes of the clinical scenarios in this document, the AUC are intended to apply to patients who have the typical underlying pathology of an ACS, not simply an elevated troponin value in the absence of an appropriate clinical syndrome. The symptoms of an ACS may be described as both typical and atypical angina or symptoms felt to represent myocardial ischemia, such as exertional dyspnea, and are captured under the broad term "ischemic symptoms." Although previous AUC had used the Canadian Cardiovascular Society system for anginal classification, the writing group recognized that the broad spectrum of ischemic symptoms may limit patients' functional status in a variety of ways, and capturing the Canadian Cardiovascular Society status in clinical practice may also vary widely. Therefore, the presence or absence of ischemic symptoms are presented without specific scale. Additionally, post-ACS symptoms may persist and/or be easily provoked with minimal activity.

Unstable Angina

The definition of unstable angina is largely on the basis of the clinical presentation. Unstable angina is defined as typical chest pain or other ischemic symptoms occurring at rest or with minimal exertion, and presumed to be related to an acutely active coronary plaque. In contrast to stable angina, unstable angina is often described as severe and as a frank pain. Moreover, unstable angina may be new in onset or occur in a crescendo pattern in a patient with a previous stable pattern of angina. Unstable angina may be associated with new electrocardiographic changes such as transient ST-segment elevation, ST-segment depression, or T-wave inversion, but may be present in the absence of electrocardiographic changes. Several scoring systems exist for determining high-risk patients with ACS (Tables A and B).

Stress Testing and Risk of Findings on Noninvasive Testing

Stress testing and coronary CTA are commonly used for both diagnosis and risk stratification of patients with coronary artery disease or those with suspected ACS.

TABLE A High-Risk Features for Short-Term Risk of Death or Nonfatal MI in Patients With NSTEMI/UA

At least 1 of the following:
- History—accelerating tempo of anginal symptoms in preceding 48 hours
- Character of pain—prolonged ongoing (>20 minutes) rest pain
- Clinical findings
  - Pulmonary edema, most likely due to ischemia
  - New or worsening MR murmur
  - S_3 or new/worsening rales
  - Hypotension, bradycardia, tachycardia
  - Age >75 years
- ECG
  - Transient ST-segment deviation >0.5 mm
  - Bundle-branch block, new or presumed new
  - Sustained ventricular tachycardia
- Cardiac marker
  - Elevated cardiac TnT, TnI, or CK-MB (e.g., TnT or TnI >0.1 ng per ml)

High-risk features were defined as in the ACS guidelines (21).

CK-MB = creatine kinase, MB isoenzyme; ECG = electrocardiogram; MI = myocardial infarction; MR = mitral regurgitation; NSTEMI = non–ST segment elevation myocardial infarction; TnI = troponin I; TnT = troponin T; UA = unstable angina.

Although often contraindicated in ACS, stress testing may be performed for further risk stratification later during the index hospitalization. Risk stratification by noninvasive testing is defined as (4):

Low-risk stress test findings: associated with a <1% per year cardiac mortality rate.

Intermediate-risk stress test findings: associated with a 1% to 3% per year cardiac mortality rate.

High-risk stress test findings: associated with a >3% per year cardiac mortality rate.

The Role of Patient Preference in the AUC

Patients often make decisions about medical treatments without a complete understanding of their options. Patient participation or shared decision-making describes a collaborative approach where patients are provided evidence-based information on treatment choices and are encouraged to use the information in an informed dialogue with their provider to make decisions that not only use the scientific evidence, but also align with their values, preferences, and lifestyle (23-25). The alternative decision paradigm, often referred to as medical paternalism, places decision authority with physicians and gives the patient a more passive role (26).

Shared decision-making respects both the provider's knowledge and the patient's right to be fully informed of all care options with their associated risks and benefits. It also suggests that the healthcare team has educated the patient to the extent the patient desires with regard to the risk and benefits of different treatment options. The patient is given the opportunity to participate in the decision regarding the preferred treatment. Especially regarding primary PCI for STEMI, the need for rapid treatment will often preclude a detailed discussion of the risks and benefits of invasive therapy or other possible treatment decisions. However, patient preferences should be considered when the treatment of a nonculprit stenosis is contemplated later during the hospitalization.

TABLE B Thrombolysis In Myocardial Infarction Risk Score—For Patients With Suspected ACS (22)

Variables (1 point each)
- Age ≥65 years
- ≥3 risk factors (HTN, DM, FH, lipids, smoking)
- Known CAD (stenosis ≥50%)
- Aspirin use in past 7 days
- Severe angina (≥2 episodes within 24 hours)
- ST-segment deviation ≥0.5 mm
- Elevated cardiac markers

Risk of death or ischemic event through 14 days
- Low: 0–2 (<8.3% event rate)
- Intermediate: 3–4 (<19.3% event rate)
- High: 5–7 (41% event rate)

ACS = acute coronary syndrome; CAD = coronary artery disease; DM = diabetes mellitus; FH = family history; HTN = hypertension.

Specific Acute Coronary Syndromes

The writing group developed these clinical scenarios around the common clinical situations in which coronary revascularization is typically considered on the basis of evidence and recommendations from the 2013 STEMI guideline (2) and 2014 NSTEMI/unstable angina guideline (3). Because of 3 recent studies and the 2015 update to the PCI/STEMI guidelines, treatment of nonculprit related arteries at the time of the initial procedure or during the initial hospitalization is also explored (5-8). Previously, treatment of nonculprit stenoses during the initial procedure or during the same hospitalization in the absence of clinical instability or further testing documenting ischemia was assigned a Class III recommendation in guideline documents and is thus considered inappropriate using the original terminology for the AUC. The 3 new randomized studies have challenged this concept, leading to a focused update of the PCI/STEMI guideline and the new Class IIb assignment for treatment of nonculprit stenoses in the setting of primary PCI.

However, the timing of treatment and criteria for nonculprit stenosis treatment varied among these 3 studies as shown in Table C.

In PRAMI (Preventive Angioplasty in Acute Myocardial Infarction Trial), the nonculprit stenosis needed to have a diameter stenosis >50% and be deemed treatable by the operator. There were exclusions to immediate nonculprit PCI, such as left main stenosis, ostial left anterior descending coronary artery and circumflex stenoses, and prior coronary artery bypass graft surgery. Treatment at any time other than during the primary PCI was discouraged. In CvLPRIT (Complete Versus Lesion-Only Primary PCI Trial), the nonculprit stenosis was required to have >70% diameter stenosis in 1 angiographic plane or >50% in 2 planes and in an artery >2 mm suitable for stent implantation. Treatment of the nonculprit stenosis

TABLE C Treatment of Nonculprit Stenoses in the Patient With STEMI

	PRAMI (n = 465)	CvLPRIT (n = 296)	DANAMI3-PRIMULTI (n = 627)
Randomization	After primary PCI	"During" primary PCI	After primary PCI
Lesion criteria	>50% DS	>70% DS or >50% DS in 2 views	>50% DS and FFR <0.80 or >90% DS
Strategy for non-IRA lesions	Immediate—at time of primary PCI	Immediate or staged within index admission	Staged within index admission (average day 2)

CvLPRIT = Complete Versus Lesion-Only Primary PCI Trial; DANAMI3-PRIMULTI = The Third Danish Study of Optimal Acute Treatment of Patients with STEMI: Primary PCI in Multivessel Disease; DS = diameter stenosis; FFR = fractional flow reserve; IRA = infarct-related artery; PCI = percutaneous coronary intervention; PRAMI = Preventive Angioplasty in Acute Myocardial Infarction Trial.

immediately following the primary PCI was encouraged, but could be deferred to later during the same hospitalization. In DANAMI3-PRIMULTI (The Third Danish Study of Optimal Acute Treatment of Patients with STEMI: Primary PCI in Multivessel Disease), nonculprit stenoses were treated if the diameter stenosis was >50% and the FFR <0.80 or if the diameter stenosis alone was >90%. Treatment of the nonculprit stenoses was planned for 2 days after the primary PCI during the index hospitalization. These variations in the criteria for nonculprit stenosis treatment and timing of treatment from these 3 relatively small studies make it challenging to develop clinical scenarios. This is an evolving shift in the treatment paradigm for patients presenting with STEMI that, at present, is incompletely understood. Scenarios were developed to allow the rating panel to evaluate clinical situations that mirror the evidence provided in these new trials.

This AUC only covers clinical scenarios where the culprit artery and additional nonculprit arteries are treated at the time of primary PCI or later during the initial hospitalization. The writing group recognizes there may be circumstances where treatment of a nonculprit artery is deferred beyond the initial hospitalization. That specific circumstance was not studied in the 3 recent trials of nonculprit stenosis treatment. However, if the characteristics of the patient are such that treatment of nonculprit stenoses are deferred beyond the initial hospitalization, it is assumed the patient is clinically stable. These clinical scenarios will be evaluated in the forthcoming SIHD document.

5. ABBREVIATIONS

ACS = acute coronary syndrome

AUC = appropriate use criteria

CAD = coronary artery disease

FFR = fractional flow reserve

NSTEMI = non-ST-segment elevation myocardial infarction

PCI = percutaneous coronary intervention

SIHD = stable ischemic heart disease

STEMI = ST-segment elevation myocardial infarction

6. CORONARY REVASCULARIZATION IN PATIENTS WITH ACS: AUC (BY INDICATION)

Scenarios 1 to 3 in Table 1.1 specifically address treatment of the culprit stenosis at the time intervals and with the

TABLE 1.1 STEMI—Immediate Revascularization by PCI

	Indication	Appropriate Use Score (1-9)
	Revascularization of the Presumed Culprit Artery by PCI (Primary PCI)	
1.	■ Less than or equal to 12 hours from onset of symptoms	**A (9)**
2.	■ Onset of symptoms within the prior 12-24 hours AND ■ Severe HF, persistent ischemic symptoms, or hemodynamic or electrical instability present	**A (8)**
3.	■ Onset of symptoms within the prior 12-24 hours AND ■ Stable without severe HF, persistent ischemic symptoms, or hemodynamic or electrical instability	**M (6)**
	Successful Treatment of the Culprit Artery by Primary PCI Followed by Immediate Revascularization of 1 or More Nonculprit Arteries During the Same Procedure	
4.	■ Cardiogenic shock persisting after PCI of the presumed culprit artery ■ PCI or CABG of 1 or more additional vessels	**A (8)**
5.	■ Stable patient immediately following PCI of the presumed culprit artery ■ One or more additional severe stenoses	**M (6)**
6.	■ Stable patient immediately following PCI of the presumed culprit artery ■ One or more additional intermediate (50%-70%) stenoses	**M (4)**

The number in parenthesis next to the rating reflects the median score for that indication.

A = appropriate; CABG = coronary artery bypass graft; HF = heart failure; M = may be appropriate; PCI = percutaneous coronary intervention; R = rarely appropriate; STEMI = ST-segment elevation myocardial infarction.

TABLE 1.2 STEMI—Initial Treatment by Fibrinolytic Therapy

Indication	Appropriate Use Score (1-9)
PCI of the Presumed Culprit Artery After Fibrinolysis	
7. ■ Evidence of failed reperfusion after fibrinolysis (e.g., failure of ST-segment resolution, presence of acute severe HF, ongoing myocardial ischemia, or unstable ventricular arrhythmias)	**A (9)**
8. ■ Stable after fibrinolysis AND ■ Asymptomatic (no HF, myocardial ischemia, or unstable ventricular arrhythmias) AND ■ PCI performed 3-24 hours after fibrinolytic therapy	**A (7)**
9. ■ Stable after fibrinolysis AND ■ Asymptomatic (no HF, myocardial ischemia, or unstable ventricular arrhythmias) AND ■ PCI >24 hours after onset of STEMI	**M (5)**

The number in parenthesis next to the rating reflects the median score for that indication.

A = appropriate; CABG = coronary artery bypass graft; HF = heart failure; M = may be appropriate; PCI = percutaneous coronary intervention; R = rarely appropriate; STEMI = ST-segment elevation myocardial infarction.

TABLE 1.3 STEMI—Revascularization of Nonculprit Artery During the Initial Hospitalization

Indication	Appropriate Use Score (1-9)
Successful Treatment of the Culprit Artery by Primary PCI or Fibrinolysis Revascularization of 1 or More Nonculprit Arteries During the Same Hospitalization	
Revascularization by PCI or CABG	
10. ■ Spontaneous or easily provoked symptoms of myocardial ischemia ■ One or more additional severe stenoses	**A (8)**
11. ■ Asymptomatic ■ Findings of ischemia on noninvasive testing ■ One or more additional severe stenoses	**A (7)**
12. ■ Asymptomatic (no additional testing performed) ■ One or more additional severe stenoses	**M (6)**
13 ■ Asymptomatic (no additional testing performed) ■ One or more additional intermediate stenoses	**R (3)**
14. ■ Asymptomatic ■ One or more additional intermediate (50%-70%) stenoses ■ FFR performed and ≤0.80	**A (7)**

The number in parenthesis next to the rating reflects the median score for that indication.

A = appropriate; CABG = coronary artery bypass graft; FFR = fractional flow reserve; M = may be appropriate; PCI = percutaneous coronary intervention; R = rarely appropriate; STEMI = ST-segment elevation myocardial infarction.

presence or absence of symptoms as noted. Scenarios 4 to 6 in Table 1.1 specifically address treatment of 1 or more nonculprit stenoses during the same procedure as treatment of the culprit stenosis. Because these scenarios are specific for nonculprit treatment immediately following primary PCI, the criteria for treatment used in DANAMI3-PRIMULTI cannot be applied in this table.

As noted in Table 1.1, treatment of the nonculprit artery can occur at several different times after treatment of the culprit stenosis. Because Table 1.1 covers those scenarios

TABLE 1.4 NSTEMI/Unstable Angina

Indication	Appropriate Use Score (1-9)
Revascularization by PCI or CABG	
15. ■ Evidence of cardiogenic shock ■ Immediate revascularization of 1 or more coronary arteries	**A (9)**
16. ■ Patient stabilized ■ Intermediate- OR high-risk features for clinical events (e.g., TIMI score 3-4) ■ Revascularization of 1 or more coronary arteries	**A (7)**
17. ■ Patient stabilized after presentation ■ Low-risk features for clinical events (e.g., TIMI score ≤2) ■ Revascularization of 1 or more coronary arteries	**M (5)**

The number in parenthesis next to the rating reflects the median score for that indication.

A = appropriate; CABG = coronary artery bypass graft; M = may be appropriate; NSTEMI = non-ST-segment elevation myocardial infarction; PCI = percutaneous coronary intervention; R = rarely appropriate; TIMI = Thrombolysis In Myocardial Infarction.

where nonculprit treatment occurs immediately after the primary PCI, this table is specific for treatment of nonculprit stenoses after the initial procedure, but during the initial hospitalization.

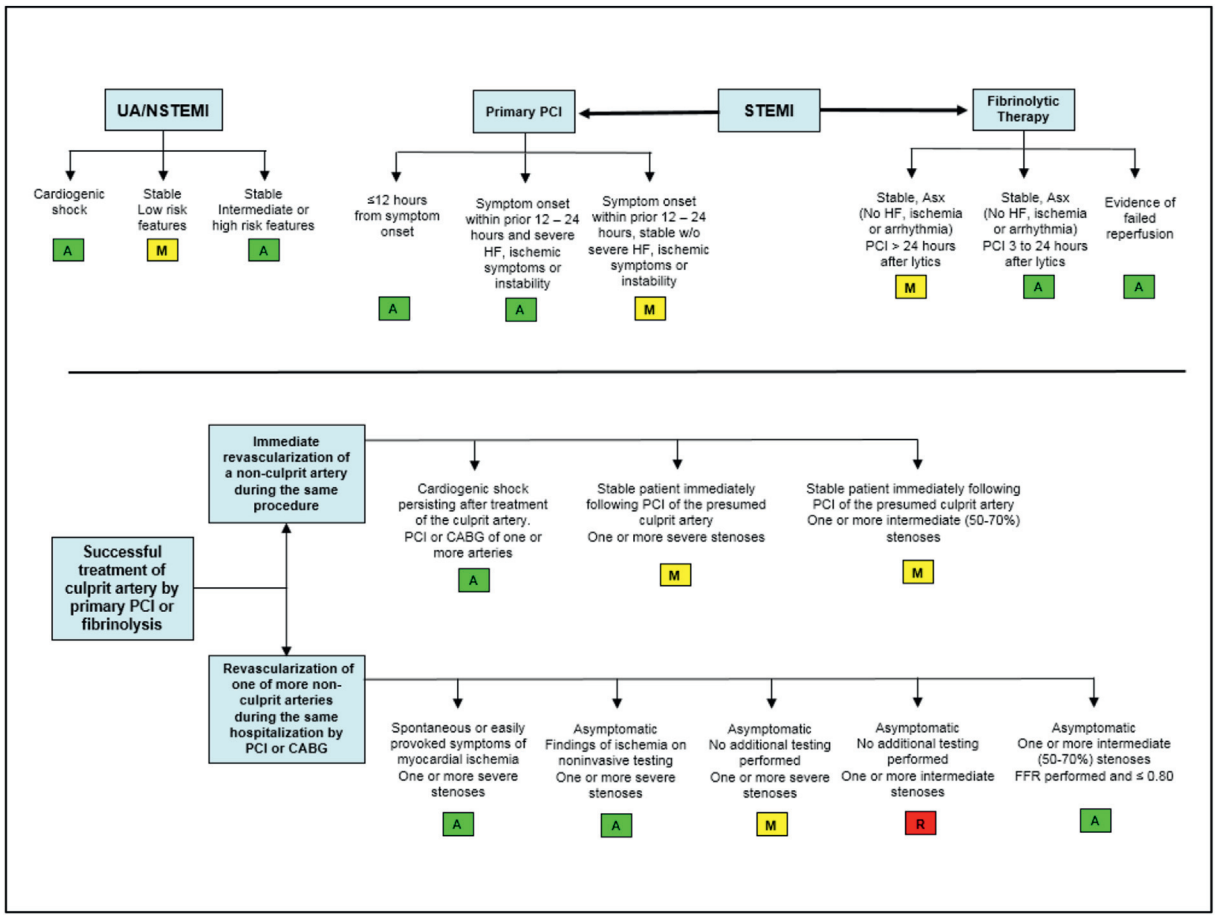
Unstable angina/NSTEMI category—in patients with Thrombolysis In Myocardial Infarction 3 flow and multiple coronary artery stenoses, consideration should be given for heart team evaluation in patients with a high burden of CAD, such as 2-vessel disease with proximal left anterior descending coronary artery stenosis or more severe disease.

7. DISCUSSION

The new AUC ratings for ACS are consistent with existing guidelines for STEMI and NSTEMI-ACS (Figure 2). For patients with ACS, revascularization by either PCI or CABG is the most commonly used therapy, and this is reflected in the ratings of "appropriate care" or "may be appropriate care" for all but 1 of the 17 scenarios presented. Although these AUC ratings do not compare the merits of PCI versus CABG for revascularization in ACS, in clinical practice, patients presenting with STEMI typically are treated by PCI of the culprit stenosis. However, the option of surgical revascularization should be considered for patients with ACS but less acute presentation, especially in those with complex multivessel CAD.

The current AUC rate revascularization as "appropriate care" for patients presenting within 12 hours of the onset of STEMI or up to 24 hours if there is clinical instability. For STEMI patients presenting more than 12 and up to 24 hours from symptom onset but with no signs of clinical instability, revascularization was rated as "may be appropriate," indicating that many on the technical panel

FIGURE 2 Flow Diagram for the Determination of Appropriate Use in Patients With Acute Coronary Syndromes



Asx = asymptomatic; CABG = coronary artery bypass graft; FFR = fractional flow reserve; HF = heart failure; NSTEMI = non–ST-segment elevation myocardial infarction; PCI = percutaneous coronary intervention; STEMI = ST-segment elevation myocardial infarction; UA = unstable angina.

consider it reasonable to revascularize such patients. Furthermore, nonculprit artery revascularization at the time of primary PCI was rated as "may be appropriate," but because this is an emerging concept on the basis of relatively small studies, clinical judgment by the operator is encouraged.

For STEMI patients initially treated with fibrinolysis, revascularization was rated as "appropriate therapy" in the setting of suspected failed fibrinolytic therapy or in stable and asymptomatic patients from 3 to 24 hours after fibrinolysis. In the setting of suspected failed fibrinolysis, the need for revascularization is usually immediate, whereas in stable patients with apparent successful fibrinolysis, revascularization can be delayed for up to 24 hours. For stable patients >24 hours after fibrinolysis, revascularization was rated as "may be appropriate." Revascularization soon after apparent successful fibrinolysis is supported by data and guideline recommendations about the management of patients transferred from centers where PCI is not available.

Nonculprit artery revascularization during the index hospitalization after primary PCI or fibrinolysis was also rated as appropriate and reasonable for patients with 1 or more severe stenoses and spontaneous or easily provoked ischemia or for asymptomatic patients with ischemic findings on noninvasive testing. In the presence of an intermediate-severity nonculprit artery stenosis, revascularization was rated as "appropriate therapy" provided that the FFR was ≤0.80. For patients who are stable and asymptomatic after primary PCI, revascularization was rated as "may be appropriate" for 1 or more severe stenoses even in the absence of further testing. The only "rarely appropriate" rating in patients with ACS occurred for asymptomatic patients with intermediate-severity nonculprit artery stenoses in the absence of any additional testing to demonstrate the functional significance of the stenosis.

For patients with NSTEMI/unstable angina, and consistent with existing guidelines and the available evidence, revascularization was rated as "appropriate care" in the setting of cardiogenic shock or in a patient with intermediate- or high-risk features. For stable patients with low-risk features, revascularization was rated as "may be appropriate." Decisions around the timing of revascularization, management of multivessel disease, and concomitant pharmacotherapy should all be on the basis of evidence from the relevant practice guidelines.

In conclusion, the AUC for ACS are consistent with the large body of evidence and guideline recommendations that support invasive strategies to define anatomy and revascularize patients with STEMI and NSTEMI-ACS. The evolving evidence around nonculprit stenosis revascularization has led to ratings that revascularization may be appropriate after primary PCI in selected asymptomatic patients with severe stenoses, defined herein as ≥70% diameter narrowing, or in patients with intermediate-severity stenosis if FFR testing is abnormal. As in prior versions of the AUC, these revascularization ratings should be used to reinforce existing management strategies and identify patient populations that need more information to identify the most effective treatments.

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KEY WORDS ACC Appropriate Use Criteria, coronary revascularization, imaging, medical therapy, multimodality

APPENDIX A. APPROPRIATE USE CRITERIA FOR CORONARY REVASCULARIZATION IN PATIENTS WITH ACUTE CORONARY SYNDROMES: PARTICIPANTS

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APPENDIX B. RELATIONSHIPS WITH INDUSTRY (RWI) AND OTHER ENTITIES

The College 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 rating panel. Specifically, all panelists 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 Appropriate Use Criteria Task Force, discussed with all members of the rating panel at the face-to-face meeting, and updated and reviewed as necessary. The following is a table of relevant disclosures by the rating panel and oversight working group members. In addition, to ensure complete transparency, a full list of disclosure information—including relationships not pertinent to this document—is available in the Online Appendix.

APPROPRIATE USE CRITERIA FOR CORONARY REVASCULARIZATION IN PATIENTS WITH ACUTE CORONARY SYNDROMES: MEMBERS OF THE WRITING GROUP, RATING PANEL, INDICATION REVIEWERS, AND AUC TASK FORCE—RELATIONSHIPS WITH INDUSTRY AND OTHER ENTITIES (RELEVANT)

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Geoffrey A. Rose	Division of Cardiology, Sanger Heart and Vascular Institute—Chief	None	None	None	None	■ Medtronic	None
Richard J. Shemin	Ronald Reagan UCLA Medical Center, Cardiovascular Center—Director of Cardiac Quality, Robert and Kelly Day Professor, Chief of Cardiothoracic Surgery, Executive Vice Chair of Surgery	■ Edwards Lifesciences ■ Sorin Group	None	None	None	None	None
Jacqueline E. Tamis-Holland	Saint Luke's Hospital, Icahn School of Medicine at Mount Sinai Hospital Mount Sinai—Director, Women's Heart NY, Assistant Professor of Medicine, Director, Interventional Cardiology Fellowship	None	None	None	None	None	None
Carl L. Tommaso	Rush Medical College in Chicago, Skokie Illinois Hospital, part of the Northshore University Health System—Director of the Cardiac Catheterization Laboratory, Associate Professor of Medicine	None	None	None	None	None	None
L. Samuel Wann	Columbia St. Mary's Healthcare—Clinical Cardiologist, Medical Director, Heart Failure Program	■ United Healthcare	None	None	None	None	None
John B. Wong	Tufts University School of Medicine—Chief, Division of Clinical Decision Making, Primary Care Physician, Principal Investigator, Institute for Clinical Research and Health Policy Studies, Professor	None	None	None	None	None	None

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APPENDIX B. CONTINUED

Participant	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational, or Other Financial Benefit	Expert Witness
			Reviewers				
Jeffrey L. Anderson	Intermountain Medical Center—Associate Chief of Cardiology	■ Sanofi-Aventis ■ The Medicines Company	None	None	None	None	None
Jeffrey A. Brinker	Johns Hopkins Hospital—Professor of Medicine	None	None	None	None	None	None
Alexandru I. Costea	University of Cincinnati Medical Center—Associate Professor	None	None	None	None	■ Boston Scientific*	None
Ali E. Denktas	Baylor College of Medicine—Assistant Professor	None	None	None	■ AstraZeneca ■ Edwards Lifesciences	None	None
Lloyd W. Klein	Melrose Park—Professor of Medicine	None	None	None	None	None	None
Frederick G. Kushner	Tulane University Medical Center, Heart Clinic of Louisiana—Clinical Professor, Medical Director	None	None	None	None	None	None
Glenn N. Levine	Baylor College of Medicine, Cardiology—Professor	None	None	None	None	None	None
David J. Maron	Stanford University School of Medicine—Professor of Medicine and Emergency Medicine	None	None	None	None	None	None
James B. McClurken	Temple University, School of Medicine, Richard A Reif Heart Institute, Doylestown Hospital—Director of Thoracic Surgery, Professor of Surgery Emeritus	None	None	None	None	None	None
Robert N. Piana	Vanderbilt University Medical Center—Professor of Medicine, Cardiology	■ Axio Research ■ Harvard Clinical Research Institute ■ W.L. Gore & Associates, Inc.	None	None	None	None	None
John A. Spertus	Washington University School of Medicine—Adjunct Professor of Medicine	■ Amgen ■ Bayer Health-care Pharmaceuticals ■ Janssen ■ Novartis ■ Regeneron	None	■ Health Outcomes Sciences	None	None	None
Raymond F. Stainback	Texas Heart Institute at Baylor St. Luke's Medical Center, Non-Invasive Cardiology—Medical Director	None	None	None	None	None	None
Robert C. Stoler	Cardiology Consultants of Texas—Director of Cardiac Catheterization Laboratory	■ Boston Scientific ■ Medtronic	None	None	None	None	None

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APPENDIX B. CONTINUED

Participant	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational, or Other Financial Benefit	Expert Witness
Todd C. Villines	Cardiology Service at Walter Reed Army Medical Center—Co-Director of Cardiovascular Computed Tomography and Assistant Chief	■ Boehringer Ingelheim†	None	None	None	None	None
David H. Wiener	Jefferson Medical College, Jefferson Heart Institute—Professor of Medicine	None	None	None	None	None	None
		Appropriate Use Criteria Task Force					
Steven R. Bailey	University of Texas Health Sciences Center—Chair, Division of Cardiology, Professor of Medicine and Radiology, Janey Briscoe Distinguished Chair	None	None	None	None	None	None
Nicole M. Bhave	University of Michigan Cardiovascular Center, Department of Internal Medicine, Division of Cardiovascular Medicine—Clinical Assistant Professor	None	None	None	None	None	None
Alan S. Brown	Midwest Heart Disease Prevention Center, Advocate Lutheran General Hospital—Director, Division of Cardiology—Medical Director	None	None	None	None	None	None
Stacie L. Daugherty	University of Colorado School of Medicine, Division of Cardiology, Department of Medicine—Associate Professor	None	None	None	None	None	None
Gregory J. Dehmer	Baylor Scott & White, Central Texas Division, Cardiovascular Services Health—Medical Director	None	None	None	None	None	None
Milind Y. Desai	Cleveland Clinic, Clinical Investigations, Heart and Vascular Institute—Associate Director	None	None	None	None	None	None
John U. Doherty	Thomas Jefferson University, Jefferson Medical College—Professor of Medicine	None	None	None	None	None	None
Claire S. Duvernoy	University of Michigan Health System, Division of Cardiology—Cardiology Section Chief	None	None	None	None	None	None
Linda D. Gillam	Morristown Medical Center, Department of Cardiovascular Medicine—Chair	■ Edwards Lifesciences* ■ Medtronic*	None	None	None	None	None
Robert C. Hendel	Miami University School of Medicine, Division of Cardiology—Director of Cardiac Imaging and Outpatient Services	None	None	None	None	None	None

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APPENDIX B. CONTINUED

Participant	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational, or Other Financial Benefit	Expert Witness
Christopher M. Kramer	University of Virginia Health System—Ruth C. Heede Professor of Cardiology & Radiology, Director, Cardiovascular Imaging Center	None	None	None	None	None	None
Bruce D. Lindsay	Cleveland Clinic Foundation of Cardiovascular Medicine—Professor of Cardiology	None	None	None	None	None	None
Warren J. Manning	Beth Israel Deaconess Medical Center, Division of Cardiology—Professor of Medicine and Radiology	■ Merck	None	None	■ Philips Medical Systems†	None	None
Manesh R. Patel	Duke University Medical Center, Division of Cardiology—Assistant Professor of Medicine	None	None	None	None	None	None
Ritu Sachdeva	Emory University School of Medicine, Children's Health Care of Atlanta, Sibley Heart Center Cardiology, Division of Pediatric Cardiology, Department of Pediatrics—Associate Professor	None	None	None	None	None	None
L. Samuel Wann	Columbia St. Mary's Healthcare—Staff Cardiologist	None	None	None	None	None	None
David E. Winchester	University of Florida, Division of Cardiology—Assistant Professor of Medicine	None	None	None	None	None	None
Joseph M. Allen	American College of Cardiology-Team Leader, Clinical Policy and Pathways	None	None	None	None	None	None

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*No financial benefit.

†Significant relationship.

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