2015 ACC/AHA/SCAI Focused Update on Primary Percutaneous Coronary Intervention for Patients With ST-Elevation Myocardial Infarction: An Update of the 2011 ACCF/AHA/SCAI Guideline for Percutaneous Coronary Intervention and the 2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Society for Cardiovascular Angiography and Interventions

Endorsed by the Latin American Society of Interventional Cardiology

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*Writing committee members are required to recuse themselves from voting on sections to which their specific relationships with industry may apply; see Appendixes 1 and 2 for detailed information. †ACC/AHA Representative. ‡SCAI Representative. §ACC/AHA Task Force on Clinical Practice Guidelines Liaison. ‖Dr. Deborah D. Ascheim accepted a position at Capricor Therapeutics in August 2015, after the writing effort was completed. In accordance with ACC/AHA policy, she recused herself from the final voting process. ¶ACP Representative. #ACEP Representative. **Former Task Force member; current member during the writing effort.

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Preamble

To ensure that guidelines reflect current knowledge, available treatment options, and optimum medical care, existing clinical practice guideline recommendations are modified and new recommendations are added in response to new data, medications or devices. To keep pace with evolving evidence, the American College of Cardiology (ACC)/American Heart Association (AHA) Task Force on Clinical Practice Guidelines ("Task Force") has issued this focused update to revise guideline recommendations on the basis of recently published data. This update is not based on a complete literature review from the date of previous guideline publications, but it has been subject to rigorous, multilevel review and approval, similar to the full guidelines. For specific focused update criteria and additional methodological details, please see the ACC/AHA guideline methodology manual.[1]

Modernization

In response to published reports from the Institute of Medicine[2,3] and ACC/AHA mandates,[4–7] processes have changed leading to adoption of a "knowledge byte" format. This entails delineation of recommendations addressing specific clinical questions, followed by concise text, with hyperlinks to supportive evidence. This approach better accommodates time constraints on busy clinicians, facilitates easier access to recommendations via electronic search engines and other evolving technology (eg, smart phone apps), and supports the evolution of guidelines as "living documents" that can be dynamically updated as needed.

Intended Use

Practice guidelines provide recommendations applicable to patients with or at risk of developing cardiovascular disease. The focus is on medical practice in the United States, but guidelines developed in collaboration with other organizations may have a broader target. Although guidelines may inform regulatory or payer decisions, they are intended to improve quality of care in the interest of patients.

Class of Recommendation and Level of Evidence

The Class of Recommendation (COR) and Level of Evidence (LOE) are derived independently of one another according to established criteria. The COR indicates the strength of recommendation, encompassing the estimated magnitude and certainty of benefit of a clinical action in proportion to risk. The LOE rates the quality of scientific evidence supporting the intervention on the basis of the type, quantity, and consistency of data from clinical trials and other sources (Table 1).[1,7,8]

Relationships With Industry and Other Entities

The ACC and AHA sponsor the guidelines without commercial support, and members volunteer their time. The Task Force zealously avoids actual, potential, or perceived conflicts of interest that might arise through relationships with industry or other entities (RWI). All Guideline Writing Committee (GWC) members and reviewers are required to disclose current industry relationships or personal interests from 12 months before initiation of the writing effort. Management of RWI involves selecting a balanced GWC and assuring that the chair and a majority of committee members have no relevant RWI (Appendixes 1 and 2). Members are restricted with regard to writing or voting on sections to which their RWI apply. For transparency, members' comprehensive disclosure information is available online. Comprehensive disclosure information for the Task Force is also available online. The Task Force strives to avoid bias by selecting experts from a broad array of backgrounds representing different geographic

regions, sexes, ethnicities, intellectual perspectives/biases, and scopes of clinical practice, and by inviting organizations and professional societies with related interests and expertise to participate as partners or collaborators.

Related Issues

For additional information pertaining to the methodology for grading evidence, assessment of benefit and harm, shared decision making between the patient and clinician, structure of evidence tables and summaries, standardized terminology for articulating recommendations, organizational involvement, peer review, and policies for periodic assessment and updating of guideline documents, we encourage readers to consult the ACC/AHA guideline methodology manual.[1]

The recommendations in this focused update represent the official policy of the ACC and AHA until superseded by published addenda, statements of clarification, focused updates, or revised full-text guidelines. To ensure that guidelines remain current, new data are reviewed biannually to determine whether recommendations should be modified. In general, full revisions are posted in 5-year cycles.[1]

Jonathan L. Halperin, MD, FACC, FAHA
Chair, ACC/AHA Task Force on Clinical Practice Guidelines

1. Introduction

The scope of this focused update is limited to considerations relevant to multivessel percutaneous coronary intervention (PCI) and thrombus aspiration in patients with ST-elevation myocardial infarction (STEMI) undergoing primary PCI.

1.1. Methodology and Evidence Review

Clinical trials presented at the major cardiology organizations' 2013 to 2015 annual scientific meetings and other selected reports published in a peer-reviewed format through August 2015 were reviewed by the 2011 PCI and 2013 STEMI GWCs and the Task Force to identify trials and other key data that might affect guideline recommendations. The information considered important enough to prompt updated recommendations is included in evidence tables in the Online Data Supplement.

Consult the full-text versions of the 2011 PCI and 2013 STEMI guidelines[9,10] for recommendations in clinical areas not addressed in the focused update. The individual recommendations in this focused update will be incorporated into future revisions or updates of the full-text guidelines.

1.2. Organization of the GWC

For this focused update, representative members of the 2011 PCI and 2013 STEMI GWCs were invited to participate. Members were required to disclose all RWI relevant to the topics under consideration. The entire membership of both GWCs voted on the revised recommendations and text. The latter group was composed of experts representing cardiovascular medicine, interventional cardiology, electrophysiology, heart failure, cardiac surgery, emergency medicine, internal medicine, cardiac rehabilitation nursing, and pharmacy. The GWC included representatives from the ACC, AHA, American College of Physicians, American College of Emergency Physicians, and Society for Cardiovascular Angiography and Interventions (SCAI).

1.3. Review and Approval

This document was reviewed predominantly by the prior reviewers from the respective 2011 and 2013 guidelines. These included 8 official reviewers jointly nominated by the ACC and AHA, 4 official/organizational reviewers nominated by SCAI, and 25 individual content reviewers. Reviewers' RWI information was distributed to the GWC and is published in this document (Appendix 3).

This document was approved for publication by the governing bodies of the ACC, the AHA, and the SCAI and was endorsed by the Latin American Society of Interventional Cardiology.

2. Culprit Artery–Only Versus Multivessel PCI

(See Section 5.2.2.2 of 2011 PCI guideline and Section 4.1.1 of 2013 STEMI guideline for additional recommendations.)

Approximately 50% of patients with STEMI have multivessel disease.[25,26] PCI options for patients with STEMI and multivessel disease include: 1) culprit artery–only primary PCI, with PCI of nonculprit arteries only for spontaneous ischemia or intermediate- or high-risk findings on predischarge noninvasive testing; 2) multivessel PCI at the time of primary PCI; or 3) culprit artery–only primary PCI followed by staged PCI of nonculprit arteries. Observational studies, randomized controlled trials (RCTs), and meta-analyses comparing culprit artery–only PCI with multivessel PCI have reported conflicting results,[11,12,14–24,27,28] likely because of differing inclusion criteria, study protocols, timing of multivessel PCI, statistical heterogeneity, and variable endpoints (Data Supplement).

Previous clinical practice guidelines recommended against PCI of nonculprit artery stenoses at the time of primary PCI in hemodynamically stable patients with STEMI.[9,10] Planning for routine, staged PCI of noninfarct artery stenoses on the basis of the initial angiographic findings was not addressed in these previous guidelines, and noninfarct artery PCI was considered only in the limited context of spontaneous ischemia or high-risk findings on predischarge noninvasive testing. The earlier recommendations were based in part on safety concerns, which included increased risks for procedural complications, longer procedural time, contrast nephropathy, and stent thrombosis in a prothrombotic and proinflammatory state,[9,10] and in part on the findings from many observational studies and meta-analyses of trends toward or statistically significant worse outcomes in those who underwent multivessel primary PCI.[12–16,21–23]

Four RCTs have since suggested that a strategy of multivessel PCI, either at the time of primary PCI or as a planned, staged procedure, may be beneficial and safe in selected patients with STEMI[17,18,24,27] (Data Supplement). In the PRAMI (Preventive Angioplasty in Acute Myocardial Infarction) trial (n=465),[24] the composite primary outcome of cardiac death, nonfatal myocardial infarction (MI), or refractory angina occurred in 21 patients (9%) treated with multivessel primary PCI, compared with 53 patients (22%) treated with culprit

Table 1. Applying Class of Recommendation and Level of Evidence to Clinical Strategies, Interventions, Treatments, or Diagnostic Testing in Patient Care* (Updated August 2015)

CLASS (STRENGTH) OF RECOMMENDATION

CLASS I (STRONG) — **Benefit >>> Risk**

Suggested phrases for writing recommendations:
- Is recommended
- Is indicated/useful/effective/beneficial
- Should be performed/administered/other
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is recommended/indicated in preference to treatment B
  - Treatment A should be chosen over treatment B

CLASS IIa (MODERATE) — **Benefit >> Risk**

Suggested phrases for writing recommendations:
- Is reasonable
- Can be useful/effective/beneficial
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is probably recommended/indicated in preference to treatment B
  - It is reasonable to choose treatment A over treatment B

CLASS IIb (WEAK) — **Benefit ≥ Risk**

Suggested phrases for writing recommendations:
- May/might be reasonable
- May/might be considered
- Usefulness/effectiveness is unknown/unclear/uncertain or not well established

CLASS III: No Benefit (MODERATE) — **Benefit = Risk**
(Generally, LOE A or B use only)

Suggested phrases for writing recommendations:
- Is not recommended
- Is not indicated/useful/effective/beneficial
- Should not be performed/administered/other

CLASS III: Harm (STRONG) — **Risk > Benefit**

Suggested phrases for writing recommendations:
- Potentially harmful
- Causes harm
- Associated with excess morbidity/mortality
- Should not be performed/administered/other

LEVEL (QUALITY) OF EVIDENCE‡

LEVEL A
- High-quality evidence‡ from more than 1 RCT
- Meta-analyses of high-quality RCTs
- One or more RCTs corroborated by high-quality registry studies

LEVEL B-R (Randomized)
- Moderate-quality evidence‡ from 1 or more RCTs
- Meta-analyses of moderate-quality RCTs

LEVEL B-NR (Nonrandomized)
- Moderate-quality evidence‡ from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies
- Meta-analyses of such studies

LEVEL C-LD (Limited Data)
- Randomized or nonrandomized observational or registry studies with limitations of design or execution
- Meta-analyses of such studies
- Physiological or mechanistic studies in human subjects

LEVEL C-EO (Expert Opinion)

Consensus of expert opinion based on clinical experience

COR and LOE are determined independently (any COR may be paired with any LOE).

A recommendation with LOE C does not imply that the recommendation is weak. Many important clinical questions addressed in guidelines do not lend themselves to clinical trials. Although RCTs are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

* The outcome or result of the intervention should be specified (an improved clinical outcome or increased diagnostic accuracy or incremental prognostic information).

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

‡ The method of assessing quality is evolving, including the application of standardized, widely used, and preferably validated evidence grading tools; and for systematic reviews, the incorporation of an Evidence Review Committee.

COR indicates Class of Recommendation; EO, expert opinion; LD, limited data; LOE, Level of Evidence; NR, nonrandomized; R, randomized; and RCT, randomized controlled trial.

artery–only PCI (HR: 0.35; 95% CI: 0.21 to 0.58; $P<0.001$). In the CvLPRIT (Complete Versus Culprit-Lesion Only Primary PCI) trial,[18] 296 patients were randomized to culprit artery–only or multivessel PCI during the index hospitalization (72% underwent multivessel primary PCI). The composite primary outcome of death, reinfarction, heart failure, and ischemia-driven revascularization at 12 months occurred in 15 patients (10%) who underwent multivessel PCI, compared with 31 patients (21%) receiving culprit artery–only PCI (HR: 0.49; 95% CI: 0.24 to 0.84; $P=0.009$). In the DANAMI 3 PRIMULTI (Third Danish Study of Optimal Acute Treatment of Patients with ST-segment Elevation Myocardial Infarction) trial,[17] the composite primary outcome of all-cause death, nonfatal MI, or ischemia-driven revascularization of non-culprit artery disease occurred in 40 of 314 patients (13%) who underwent multivessel staged PCI guided by angiography and fractional flow reserve before discharge, versus 68 of 313 patients (22%) treated with culprit artery–only PCI (HR: 0.56; 95% CI: 0.38 to 0.83; $P=0.004$). In the PRAGUE-13 (Primary Angioplasty in Patients Transferred From General Community Hospitals to Specialized PTCA Units With or Without Emergency Thrombolysis) trial,[27] 214 patients with

2013 Recommendation	2015 Focused Update Recommendation	Comment
Class III: Harm PCI should not be performed in a noninfarct artery at the time of primary PCI in patients with STEMI who are hemodynamically stable.[11–13] (*Level of Evidence: B*)	***Class IIb*** PCI of a noninfarct artery may be considered in selected patients with STEMI and multivessel disease who are hemodynamically stable, either at the time of primary PCI or as a planned staged procedure.[11–24] *(Level of Evidence: B-R)*	Modified recommendation (changed class from "III: Harm" to "IIb" and expanded time frame in which multivessel PCI could be performed).

PCI indicates percutaneous coronary intervention; and STEMI, ST-elevation myocardial infarction.

STEMI were randomized to staged (3 to 40 days after the index procedure) revascularization of all ≥70% diameter stenosis noninfarct lesions or culprit-only PCI. Preliminary results at 38 months' mean follow-up showed no between-group differences in the composite primary endpoint of all-cause death, nonfatal MI, and stroke.

On the basis of these findings,[17,18,24,27] the prior Class III (Harm) recommendation with regard to multivessel primary PCI in hemodynamically stable patients with STEMI has been upgraded and modified to a Class IIb recommendation to include consideration of multivessel PCI, either at the time of primary PCI or as a planned, staged procedure. The writing committee emphasizes that this change should not be interpreted as endorsing the *routine* performance of multivessel PCI in all patients with STEMI and multivessel disease. Rather, when considering the indications for and timing of multivessel PCI, physicians should integrate clinical data, lesion severity/complexity, and risk of contrast nephropathy to determine the optimal strategy.

The preceding discussion and recommendations apply to the strategy of *routine* PCI of noninfarct related arteries in hemodynamically stable patients. Recommendations in the 2013 STEMI guideline with regard to PCI of a non–infarct-related artery at a time separate from primary PCI in patients who have spontaneous symptoms and myocardial ischemia or who have intermediate- or high-risk findings on noninvasive testing (Section 6.3 of that guideline) remain operative.

Although several observational studies[19,20] and a network meta-analysis[13] have suggested that multivessel staged PCI may be associated with better outcome than multivessel primary PCI, there are insufficient observational data and no randomized data at this time to inform a recommendation with regard to the optimal timing of nonculprit vessel PCI. Additional trial data that will help further clarify this issue are awaited. Issues related to the optimal method of evaluating nonculprit lesions (eg, percent diameter stenosis, fractional flow reserve) are beyond the scope of this focused update.

3. Aspiration Thrombectomy

(See Section 5.5.2 of the 2011 PCI guideline and Section 4.2 of the 2013 STEMI guideline for additional recommendations.)

The 2011 PCI and 2013 STEMI guidelines'[9,10] Class IIa recommendation for aspiration thrombectomy before primary PCI was based on the results of 2 RCTs[29,31,32] and 1 meta-analysis[30] and was driven in large measure by the results of TAPAS (Thrombus Aspiration During Primary Percutaneous Coronary Intervention in Acute Myocardial Infarction Study), a single-center study that randomized 1071 patients with STEMI to aspiration thrombectomy before primary PCI or primary PCI only.[29,32] Three multicenter trials, 2 of which enrolled significantly more patients than prior aspiration thrombectomy trials, have prompted reevaluation of this recommendation. In the INFUSE-AMI (Intracoronary Abciximab and Aspiration Thrombectomy in Patients With Large Anterior Myocardial Infarction) trial[37] of 452 patients with anterior STEMI due to proximal or mid-left anterior descending occlusion, infarct size was not reduced by aspiration thrombectomy before primary PCI. The TASTE (Thrombus Aspiration During ST-Segment Elevation Myocardial Infarction) trial (n=7244) incorporated a unique design that allowed randomization within an existing national registry, resulting in enrollment of a remarkably high proportion of eligible patients.[34,36] No significant 30-day or 1-year differences were found between the group that received aspiration thrombectomy before primary PCI and the group that received primary PCI only with regard to death, reinfarction, stent thrombosis, target lesion revascularization, or a composite of major adverse cardiac events. The TOTAL (Trial of Routine Aspiration Thrombectomy With PCI Versus PCI Alone in Patients With STEMI) trial randomized 10,732 patients with STEMI to aspiration thrombectomy before primary PCI or primary PCI only.[35] Bailout thrombectomy was performed in 7.1% of the primary PCI–only group, whereas the rate of crossover from aspiration thrombectomy before primary PCI to primary PCI only was 4.6%. There were no differences between the 2 treatment groups, either in the primary composite endpoint of cardiovascular death, recurrent MI, cardiogenic shock, or New York Heart Association class IV heart failure at 180 days, or in the individual components of the primary endpoint, stent thrombosis, or target-vessel revascularization. There was a small but statistically significant increase in the rate of stroke in

2011/2013 Recommendation	2015 Focused Update Recommendations	Comments
Class IIa Manual aspiration thrombectomy is reasonable for patients undergoing primary PCI.[29–32] (*Level of Evidence: B*)	***Class IIb*** The usefulness of selective and bailout aspiration thrombectomy in patients undergoing primary PCI is not well established.[33–37] (*Level of Evidence: C-LD*)	Modified recommendation (Class changed from "IIa" to "IIb" for selective and bailout aspiration thrombectomy before PCI).
	Class III: No Benefit *Routine* aspiration thrombectomy before primary PCI is not useful.[33–37] (*Level of Evidence: A*)	New recommendation ("Class III: No Benefit" added for *routine* aspiration thrombectomy before PCI).

PCI indicates percutaneous coronary intervention; and LD, limited data.

the aspiration thrombectomy group. An updated meta-analysis that included these 3 trials among a total of 17 trials (n=20960) found no significant reduction in death, reinfarction, or stent thrombosis with routine aspiration thrombectomy. Aspiration thrombectomy was associated with a small but nonsignificant increase in the risk of stroke.[33]

Several previous studies have found that higher thrombus burden in patients with STEMI is independently associated with higher risks of distal embolization, no-reflow phenomenon, transmural myocardial necrosis, major adverse cardiac events, stent thrombosis, and death.[38–42] However, subgroup analyses from the TASTE and TOTAL trials did not suggest relative benefit from aspiration thrombectomy before primary PCI in patients with higher thrombus burden or in patients with initial Thrombolysis in Myocardial Infarction (TIMI) flow grade 0–1 or left anterior descending artery/anterior infarction.[34,35]

On the basis of the results of these studies, the prior Class IIa recommendation for aspiration thrombectomy has been changed. *Routine* aspiration thrombectomy before primary PCI is now not recommended (Class III: No Benefit, LOE A). There are insufficient data to assess the potential benefit of a strategy of selective or bailout aspiration thrombectomy (Class IIb, LOE C-LD). "Bailout" aspiration thrombectomy is defined as thrombectomy that was initially unplanned but was later used during the procedure because of unsatisfactory initial result or procedural complication, analogous to the definition of "bailout" glycoprotein IIb/IIIa use.

It should be noted that the preceding recommendations and text apply only to aspiration thrombectomy; no clinical benefit for routine rheolytic thrombectomy has been demonstrated in patients with STEMI undergoing primary PCI.[30,43,44]

Presidents and Staff

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KEY WORDS: AHA Scientific Statements ■ culprit vessel ■ focused update ■ multivessel ■ myocardial infarction ■ primary PCI ■ thrombectomy

Appendix 1. Author Relationships With Industry and Other Entities (Relevant)—2015 ACC/AHA/SCAI Focused Update on Primary Percutaneous Coronary Intervention for Patients With ST-Elevation Myocardial Infarction (Percutaneous Coronary Intervention Writing Committee) (November 2014)

Committee Member	Employer/Title	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational or Other Financial Benefit	Expert Witness	Voting Recusals by Section*
Glenn N. Levine, Chair	Baylor College of Medicine—Professor of Medicine; Director, Cardiac Care Unit	None	None	None	None	None	None	None
Eric R. Bates, Vice Chair	University of Michigan—Professor of Medicine	• Merck • Sanofi-aventis	None	None	None	None	None	2 and 3
James C. Blankenship, Vice Chair	Geisinger Medical Center—Director of Cardiology and Cardiac Catheterization Laboratories	None	None	None	• Abbott Vascular† • Abiomed† • Boston Scientific† • Volcano†	None	None	2 and 3
Steven R. Bailey	University of Texas Medical Center—Professor of Medicine and Radiology	None	None	None	None	None	None	None
John A. Bittl	Munroe Heart—Interventional Cardiologist	None	None	None	None	None	None	None
Bojan Cercek	Cedars-Sinai Medical Center—Director, Coronary Care Unit	None	None	None	None	None	None	None
Charles E. Chambers	Penn State Milton S. Hershey Medical Center—Professor of Medicine and Radiology	None	None	None	None	None	None	None
Stephen G. Ellis	Cleveland Clinic Foundation—Section Head, Invasive and Interventional Cardiology	• Abbott • Boston Scientific • Medtronic	None	None	None	None	None	2 and 3
Robert A. Guyton	Emory Clinic, Inc.—Professor and Chief, Division of Cardiothoracic Surgery	• Medtronic‡	None	None	None	None	None	2 and 3
Steven M. Hollenberg	Cooper Medical School of Rowan University—Professor of Medicine	None	None	None	None	None	None	None
Umesh N. Khot	Cleveland Clinic—Vice Chairman, Department of Cardiovascular Medicine	• AstraZeneca	None	None	None	None	None	None
Richard A. Lange	Texas Tech University Health Sciences Center El Paso—President	None	None	None	None	None	None	None
Laura Mauri	Brigham & Women's Hospital—Associate Professor of Medicine, Harvard Medical School	• Medtronic • St. Jude Medical	None	None	None	• Abbott‡ • Boston Scientific‡ • Bristol-Myers Squibb‡ • Cordis‡ • Medtronic Cardiovascular‡ • Sanofi-aventis‡	None	2 and 3
Roxana Mehran	Columbia University Medical Center—Associate Professor of Medicine; Director, Data Coordinating Analysis Center	• Abbott Vascular • Boston Scientific • Janssen (Johnson & Johnson)‡ • Merck • Sanofi-aventis‡	None	None	• BMS/ Sanofi-aventis‡ • Regado • STENTYS†	None	None	2 and 3
Issam D. Moussa	University of Central Florida College of Medicine—Professor of Medicine; First Coast Cardiovascular Institute—Chief Medical Officer	None	None	None	None	None	None	None

(*Continued*)

Appendix 1. Continued

Committee Member	Employer/Title	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational or Other Financial Benefit	Expert Witness	Voting Recusals by Section*
Debabrata Mukherjee	Texas Tech University—Chief, Cardiovascular Medicine	None	None	None	None	None	None	None
Henry H. Ting	New York–Presbyterian Hospital, The University Hospital of Columbia and Cornell—Senior Vice President and Chief Quality Officer	None	None	None	None	None	None	None

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*Writing group members are required to recuse themselves from voting on sections to which their specific relationships with industry and other entities may apply.

†No financial benefit.

‡Significant relationship.

ACC indicates American College of Cardiology; AHA, American Heart Association; and SCAI, Society for Cardiovascular Angiography and Interventions.

Appendix 2. Author Relationships With Industry and Other Entities (Relevant)—2015 ACC/AHA/SCAI Focused Update on Primary Percutaneous Coronary Intervention for Patients With ST-Elevation Myocardial Infarction (ST-Elevation Myocardial Infarction Writing Committee) (February 2014)

Committee Member	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational or Other Financial Benefit	Expert Witness	Voting Recusals by Section*
Patrick T. O'Gara, Chair	Harvard Medical School—Professor of Medicine	None	None	None	None	None	None	None
Frederick G. Kushner, Vice Chair	Tulane University School of Medicine—Clinical Professor of Medicine; Heart Clinic of Louisiana—Medical Director	None	None	None	None	None	None	None
Deborah D. Ascheim†	Mount Sinai School of Medicine—Associate Professor; InCHOIR—Clinical Director of Research	None	None	None	None	None	None	None
Ralph G. Brindis	UCSF Philip R. Lee Institute for Health Policy Studies—Clinical Professor of Medicine	None	None	None	None	None	None	None
Donald E. Casey, Jr.	Thomas Jefferson College of Population Health—Adjunct Faculty; Alvarez & Marsal IPO4Health—Principal and Founder	None	None	None	None	None	None	None
Mina K. Chung	Cleveland Clinic Foundation—Professor of Medicine	• Boston Scientific§ • Medtronic§ • St. Jude Medical§	None	None	• Biosense Webster§ • Boston Scientific§ • Medtronic§ • St. Jude Medical‡	None	None	2 and 3
James A. de Lemos	UT Southwestern Medical Center—Professor of Medicine	• Abbott Diagnostics • Novo Nordisc • St. Jude Medical	None	None	• Abbott Diagnostics‡	None	None	2 and 3
Deborah B. Diercks	UT Southwestern Medical Center—Audre and Bernard Rapoport Distinguished Chair in Clinical Care and Research; Department of Emergency Medicine—Professor and Chair	None	None	None	None	None	None	None

(*Continued*)

Appendix 2. Continued

Committee Member	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational or Other Financial Benefit	Expert Witness	Voting Recusals by Section*
James C. Fang	University of Utah—Cardiovascular Division	• Boston Scientific	None	None	None	None	None	2 and 3
Barry A. Franklin	William Beaumont Hospital—Director, Cardiac Rehabilitation and Exercise Laboratories	None	None	None	None	None	None	None
Christopher B. Granger	Duke Clinical Research Institute—Director, Cardiac Care Unit; Professor of Medicine	None	None	None	• Medtronic Foundation‡ • Merck‡	None	None	2 and 3
Harlan M. Krumholz	Yale University School of Medicine—Professor of Epidemiology and Public Health	None	None	None	• Johnson & Johnson‡ • Medtronic‡	None	None	2 and 3
Jane A. Linderbaum	Mayo Clinic—Assistant Professor of Medicine	None	None	None	None	None	None	None
David A. Morrow	Harvard Medical School—Professor of Medicine	• Abbott • Merck	None	None	• Abbott‡ • GlaxoSmithKline‡ • Johnson & Johnson‡ • Merck‡	None	None	2 and 3
L. Kristin Newby	Duke University Medical Center, Division of Cardiology—Professor of Medicine	• Philips	None	None	• Merck‡	None	None	2 and 3
Joseph P. Ornato	Department of Emergency Medicine Virginia Commonwealth University—Professor and Chairman	None	None	None	None	None	None	None
Narith Ou	Mayo Clinic—Pharmacotherapy Coordinator, Cardiology	None	None	None	None	None	None	None
Martha J. Radford	NYU Langone Medical Center—Chief Quality Officer; NYU School of Medicine—Professor of Medicine (Cardiology)	None	None	None	None	None	None	None
Jacqueline E. Tamis-Holland	Mount Sinai Saint Luke's Hospital and The Icahn School of Medicine—Program Director, Interventional Cardiology Fellowship Program	None	None	None	None	None	None	None
Carl L. Tommaso	Skokie Hospital—Director of Catheterization Laboratory; NorthShore University HealthSystems—Partner	None	None	None	None	None	None	None
Cynthia M. Tracy	George Washington University Medical Center—Associate Director, Division of Cardiology	None	None	None	None	None	None	None
Y. Joseph Woo	Stanford University—Professor and Chair, Cardiothoracic Surgery	None	None	None	None	None	None	None
David X. Zhao	Wake Forest Baptist Health—Professor of Medicine, Heart and Vascular Center of Excellence Director	None	None	None	• St. Jude Medical§ • Medtronic§	None	None	2 and 3

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*Writing group members are required to recuse themselves from voting on sections to which their specific relationships with industry and other entities may apply.

†Dr. Deborah D. Ascheim accepted a position at Capricor Therapeutics in August 2015, after the writing effort was completed. According to policy, she recused herself from the final voting process.

‡Significant relationship.

§No financial benefit.

ACC indicates American College of Cardiology; AHA, American Heart Association; NYU, New York University; UCSF, University of California San Francisco; and UT, University of Texas.

Appendix 3. Reviewer Relationships With Industry and Other Entities (Relevant)—2015 ACC/AHA/SCAI Focused Update on Primary Percutaneous Coronary Intervention for Patients With ST-Elevation Myocardial Infarction (Combined Peer Reviewers From 2011 PCI and 2013 STEMI Guidelines)

Reviewer	Representation	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational or Other Financial Benefit	Expert Witness
Elliott M. Antman	Official Reviewer—AHA	Harvard Medical School—Professor of Medicine, Associate Dean for Clinical and Translational Research	None	None	None	None	None	None
Deepak L. Bhatt	Official Reviewer—AHA	Harvard Medical School—Professor; Interventional Cardiovascular Programs—Executive Director	None	None	None	• Bristol-Myers Squibb* • Ischemix* • Medtronic* • St. Jude Medical	• Regado Biosciences†	None
Christopher P. Cannon	Official Reviewer—AHA	Harvard Medical School—Professor of Medicine; Brigham and Women's Hospital—Senior Investigator, TIMI Study Group, Cardiovascular Division	• Bristol-Myers Squibb • Merck • Regeneron/ Sanofi-aventis*	None	None	• Merck*	None	None
Joaquin E. Cigarroa	Official Reviewer—ACC/AHA Task Force on Clinical Practice Guidelines	Oregon Health & Science University—Clinical Professor of Medicine	None	None	None	None	None	None
George Dangas	Official Reviewer—ACC Board of Trustees	Icahn School of Medicine—Professor of Cardiology and Vascular Surgery; Mount Sinai Medical Center—Director, Cardiovascular Innovation	• Abbott • Biosensors • Boston Scientific • Johnson & Johnson* • Merck • Osprey Medical* • Regado Biosciences	None	None	None	• Abbott • Medtronic • Osprey	None
Charles J. Davidson	Official Reviewer—SCAI	Northwestern University Feinberg School of Medicine—Professor of Medicine, Director of Cardiac Catheterization Lab	None	None	None	• Baxter International†	None	None
Kirk N. Garratt	Official Reviewer—SCAI	Hofstra University Medical School—Associate Chair of Quality and Research; Professor of Medicine	• Abbott • Boston Scientific • The Medicines Company • Daiichi-Sankyo/ Eli Lilly • AstraZeneca	None	• LifeCuff Technologies • Global Delivery Systems	None	• Boston Scientific	None
Steven L. Goldberg	Official Reviewer—SCAI	University of Washington Medical Center—Cath Lab Director	• Terumo†	None	None	None	None	None
G. B. John Mancini	Official Reviewer—ACC Board of Governors	Vancouver Hospital Research Pavilion—Professor of Medicine	• Merck • Sanofi-aventis/ Regeneron	None	None	None	None	None
Jonathan M. Tobis	Official Reviewer—SCAI	University of California Los Angeles—Professor of Medicine and Cardiology	• St. Jude Medical	None	None	None	None	None
Jeffrey L. Anderson	Content Reviewer—ACC/AHA Task Force on Clinical Practice Guidelines	Intermountain Medical Center—Associate Chief of Cardiology	None	None	None	None	None	None
Thomas M. Bashore	Content Reviewer	Duke University—Professor of Medicine	None	None	None	None	None	None
James A. Burke	Content Reviewer—ACC Interventional Scientific Council	Lehigh Valley Heart Specialists—Associate Chief, Division of Cardiology	None	None	None	None	None	None
Jeffrey J. Cavendish	Content Reviewer—ACC Prevention of Cardiovascular Disease Committee	Kaiser Permanente Cardiology—Interventional Cardiologist	None	None	None	None	• Abbott	None

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Appendix 3. Continued

Reviewer	Representation	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational or Other Financial Benefit	Expert Witness
Gregory J. Dehmer	Content Reviewer—ACC Appropriate Use Criteria	Texas A&M College of Medicine—Professor of Medicine; Scott & White Healthcare	None	None	None	None	None	None
John S. Douglas, Jr.	Content Reviewer	Emory University Hospital—Professor of Medicine	None	None	None	• Abbott • Medtronic	None	None
John P. Erwin III	Content Reviewer—ACC/AHA Task Force on Performance Measures	Texas A&M College of Medicine—Associate Professor; Scott & White Healthcare—Vice Chair of the Department of Medicine	None	None	None	None	None	None
T. Bruce Ferguson	Content Reviewer—ACC Surgeons' Scientific Council	East Carolina Institute Brody School of Medicine—Professor of Surgery and Physiology	None	None	None	None	None	None
Anthony Gershlick	Content Reviewer	University Hospitals of Leicester, Department of Cardiology	• Abbott • Boston Scientific • Cordis • Medtronic	• Abbott†	None	None	None	None
Jonathan L. Halperin	Content Reviewer—ACC/AHA Task Force on Clinical Practice Guidelines	Mt. Sinai Medical—Professor of Medicine	• Bayer Healthcare • Boston Scientific • Johnson & Johnson • Medtronic	None	None	None	None	None
Howard C. Herrmann	Content Reviewer	University of Pennsylvania Perelman School of Medicine—Professor of Medicine, Director of Interventional Cardiology Program	• Seimens Medical • St. Jude Medical	None	None	• Abbott* • Medtronic • Siemens Medical* • St. Jude Medical	None	None
Morton J. Kern	Content Reviewer	University of California Irvine—Professor of Medicine, Associate Chief of the Division of Cardiology	• Acist Medical • Merit Medical*	• St. Jude Medical*	None	None	None	None
Fred M. Kosumoto	Content Reviewer	Mayo Clinic—Director, Pacing and Electrophysiology Service	None	None	None	None	None	None
David J. Maron	Content Reviewer	Stanford University School of Medicine—Professor of Medicine and Emergency Medicine	None	None	None	None	None	None
Douglass A. Morrison	Content Reviewer	University of Arizona—Professor of Medicine; Southern Arizona VA Health Care System—Cardiac Catheterization Laboratories, Director	None	None	None	None	None	None
Manesh R. Patel	Content Reviewer—ACC Appropriate Use Criteria	Duke University Medical Center—Associate Professor of Medicine	• Bayer Healthcare* • Janssen Pharmaceuticals*	None	None	• Johnson & Johnson*	None	None
M. Eugene Sherman	Content Reviewer—ACC Board of Governors	Aurora Denver Cardiology	None	None	None	None	• Bristol-Myers Squibb* • Hospira*	None
Daniel I. Simon	Content Reviewer	University Hospitals Case Medical Center—Professor of Cardiovascular Research	• Cordis/Johnson & Johnson* • Janssen Pharmaceuticals/ Johnson & Johnson • Medtronic Vascular • Merck	• Abbott	None	None	None	None

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Appendix 3. Continued

Reviewer	Representation	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational or Other Financial Benefit	Expert Witness
Richard W. Snyder	Content Reviewer—ACC Board of Governors	HeartPlace	None	None	None	None	None	None
William A. Tansey III	Content Reviewer	Summit Medical Group—Cardiologist	None	None	None	None	None	None
David D. Waters	Content Reviewer	San Francisco General Hospital—Chief, Division of Cardiology	None	None	None	None	• Merck	None
Patrick L. Whitlow	Content Reviewer	Cleveland Clinic Foundation—Director, Interventional Cardiology	None	None	None	• Abbott	• Medtronic*	
David O. Williams	Content Reviewer	Harvard Medical School—Professor of Medicine; Brigham and Women's Hospital	None	None	None	None	None	None
Clyde W. Yancy	Content Reviewer—ACC/AHA Task Force on Practice Guidelines	Northwestern University Feinberg School of Medicine—Vice Dean for Diversity and Inclusion, Chief of Medicine-Cardiology, Professor	None	None	None	None	None	None
Yerem Yeghiazarians	Content Reviewer	University of California San Francisco—Associate Professor	None	None	None	None	None	None

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*Significant relationship.

†No financial benefit.

ACC indicates American College of Cardiology; AHA, American Heart Association; HF, heart failure; SCAI, Society for Cardiovascular Angiography and Interventions; STEMI, ST-elevation myocardial infarction; PCI, percutaneous coronary interventions; TIMI, Thrombolysis In Myocardial Infarction; and VA, Veterans Affairs.