Patient Selection and Appropriate Use Criteria

6

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Introduction

The American College of Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Thoracic Surgeons, and American Association for Thoracic Surgery, and other societies, developed and published appropriate use criteria (AUC) for coronary revascularization initially in 2009 [1, 2]. The AUC were updated in 2012, and more recently in 2017. The primary purpose of the AUC is to provide a framework to assess clinical practice patterns, expand physician decision-making, and improve the quality of care [1]. Since the publication of the AUC for coronary revascularization in 2009, the volume of nonacute PCI has significantly decreased [3, 4]. Moreover, the proportion of nonacute PCIs classified as inappropriate has also declined [3].

AUC are either evidence-based or are expert consensus opinion (when evidence is lacking), and are approved by ACC and the American Heart Association (AHA). AUC are not intended to diminish the complexity or uncertainty of clinical decision-making, and are not to replace thoughtful clinical judgment [1].

Appropriate Use Criteria for Stable Ischemic Heart Disease

The AUC guidelines assume patients are receiving all indicated therapies for secondary prevention of cardiovascular disease with pharmacotherapy at doses that adequately control patients' symptoms or are maximally tolerated [1]. AUC does

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not evaluate all patient conditions/variables which may affect the strategies used to manage patients with CAD. Examples of such conditions/variables include [1]:

- Severe chronic kidney disease.
- Severe peripheral vascular disease.
- Known malignancies.
- Poor lung function.
- Advanced liver disease.
- Advanced dementia.
- Other comorbidities that have excluded patients from clinical trials that provide the evidence base for coronary revascularization.

In developing these AUC for coronary revascularization in patients with stable ischemic heart disease (SIHD), a panel of experts scored each indication using the following definition of appropriate use*: A coronary revascularization 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*. The panel scored each indication on a scale from one to nine based on their level of agreement with the definition of appropriate use for that indication as follows [1]:

- Score 1 to 3: Rarely appropriate care (risks > benefit).
- Score 4 to 6: May be appropriate care (potential benefit).
- Score 7 to 9: Appropriate care (risk < benefit).

In patients with SIHD, AUC indications for coronary revascularization were developed considering several variables [1]:

- Clinical presentation/ischemic symptoms.
- Use of antianginal medications (Beta-blockers, Calcium channel blockers, Long-acting nitrates, Ranolazine).
- Results of noninvasive tests to evaluate the presence and severity of myocardial ischemia (Table 6.1).
- Presence of other confounding factors and comorbidities such as diabetes.
- Extent and complexity of anatomic coronary artery disease.
- Prior coronary artery bypass surgery.
- Invasive testing such as intravascular ultrasound (IVUS) and invasive physiology such as fractional flow reserve (FFR).

Per AUC, significant coronary stenosis in SIHD was defined as [1]:

- ≥70% luminal diameter narrowing of epicardial stenosis, measured by visual assessment in the "worst view" angiographic projection.
- ≥50% luminal diameter narrowing of left main stenosis, measured by visual assessment in the "worst view" angiographic projection.
- 40% to 70% luminal narrowing of epicardial stenosis, measured by visual assessment in the "worst view" angiographic projection with an abnormal FFR (abnormal if ≤0.80).

Refer to Figs. 6.1, 6.2, and 6.3 for a summary of AUC for SIHD.

Table 6.1 Noninvasive risk stratification

High risk (>3% annual death or MI)
1. Severe resting LV dysfunction (LVEF <35%) not readily explained by noncoronary causes
2. Resting perfusion abnormalities in ≥10% of the myocardium in patients without prior history or evidence of MI
3. Stress ECG findings including ≥2 mm of ST-segment depression at low workload or persisting into recovery, exercise-induced ST-segment elevation, or exercise-induced VT/VF
4. Severe stress-induced LV dysfunction (peak exercise LVEF <45% or drop in LVEF with stress ≥10%)
5. Stress-induced perfusion abnormalities encumbering ≥10% myocardium or stress segmental scores indicating multiple vascular territories with abnormalities
6. Stress-induced LV dilation
7. Inducible wall motion abnormality (involving >2 segments or 2 coronary beds)
8. Wall motion abnormality developing at low dose of dobutamine (≤10 mg/kg/min) or at a low heart rate (<120 beats/min)
9. CAC score > 400 Agatston units
10. Multivessel obstructive CAD (≥70% stenosis) or left main stenosis (≥50% stenosis) on CCTA
Intermediate risk (1% to 3% annual death or MI)
1. Mild/moderate resting LV dysfunction (LVEF 35% to 49%) not readily explained by noncoronary causes
2. Resting perfusion abnormalities in 5% to 9.9% of the myocardium in patients without a history or prior evidence of MI
3. ≥ 1 mm of ST-segment depression occurring with exertional symptoms
4. Stress-induced perfusion abnormalities encumbering 5% to 9.9% of the myocardium or stress segmental scores (in multiple segments) indicating 1 vascular territory with abnormalities but without LV dilation
5. Small wall motion abnormality involving 1 to 2 segments and only 1 coronary bed
6. CAC score 100 to 399 Agatston units
7. One vessel CAD with ≥70% stenosis or moderate CAD stenosis (50% to 69% stenosis) in ≥2 arteries on CCTA
Low risk (<1% annual death or MI)
1. Low-risk treadmill score (score ≥ 5) or no new ST segment changes or exercise-induced chest pain symptoms; when achieving maximal levels of exercise
2. Normal or small myocardial perfusion defect at rest or with stress encumbering <5% of the myocardium[a]
3. Normal stress or no change of limited resting wall motion abnormalities during stress
4. CAC score < 100 Agaston units
5. No coronary stenosis >50% on CCTA

[a]Although the published data are limited; patients with these findings will probably not be at low risk in the presence of either a high-risk treadmill score or severe resting LV dysfunction (LVEF <35%). CAC = coronary artery calcium; CAD = coronary artery disease; CCTA = coronary computed tomography angiography; LV = left ventricular; LVEF = left ventricular ejection fraction; and MI = myocardial infarction

Adapted from Patel et al. [1] with permission from Springer Nature

a

Appropriate Use Socre (1-9)

One-Vessel Disease

		Asymptomatic				Ischemic Symptoms			
		Not on AA Therapy or With AA Therapy		Not on AA Therapy		On 1 AA Drug (BB Preferred)		On ≥2 AA Drugs	
	Indication	PCI	CABG	PCI	CABG	PCI	CABG	PCI	CABG
No Proximal LAD or Proximal Left Dominant LCX Involvement									
1.	■ Low-risk findings on noninvasive testing	R (2)	R (1)	R (3)	R (2)	M (4)	R (3)	A (7)	M (5)
2.	■ Intermediate- or high-risk findings on noninvasive testing	M (4)	R (3)	M (5)	M (4)	M (6)	M (4)	A (8)	M (6)
3.	■ No stress test performed or, if performed, results are indeterminate ■ FFR ≤0.80*	M (4)	R (2)	M (5)	R (3)	M (6)	M (4)	A (8)	M (6)
Proximal LAD or Proximal Left Dominant LCX Involvement Present									
4.	■ Low-risk findings on noninvasive testing	M (4)	R (3)	M (4)	M (4)	M (5)	M (5)	A (7)	A (7)
5.	■ Intermediate- or high-risk findings on noninvasive testing	M (5)	M (5)	M (6)	M (6)	A (7)	A (7)	A (8)	A (8)
6.	■ No stress test performed or, if performed, results are indeterminate ■ FFR ≤0.80	M (5)	M (5)	M (6)	M (6)	M (6)	M (6)	A (8)	A (7)

b

Two-Vessel Disease

		Asymptomatic				Ischemic Symptoms			
		Not on AA Therapy or With AA Therapy		Not on AA Therapy		On 1 AA Drug (BB Preferred)		On ≥2 AA Drugs	
	Indication	PCI	CABG	PCI	CABG	PCI	CABG	PCI	CABG
No Proximal LAD Involvement									
7.	■ Low-risk findings on noninvasive testing	R (3)	R (2)	M (4)	R (3)	M (5)	M (4)	A (7)	M (6)
8.	■ Intermediate- or high-risk findings on noninvasive testing	M (5)	R (4)	M (6)	M (5)	M (6)	M (4)	A (8)	M (8)
9.	■ No stress test performed or, if performed, results are indeterminate ■ FFR ≤0.80* in both vessels	M (5)	R (4)	M (6)	M (4)	M (7)	M (5)	A (8)	M (8)
Proximal LAD Involvement and No Diabetes Present									
10.	■ Low-risk findings on noninvasive testing	M (4)	M (4)	M (5)	M (5)	M (6)	M (6)	A (7)	A (7)
11.	■ Intermediate- or high-risk findings on noninvasive testing	M (6)	M (6)	A (7)	A (7)	A (7)	A (7)	A (8)	A (8)
12.	■ No stress test performed or, if performed, results are indeterminate ■ FFR ≤0.80 in both vessels	M (6)	M (6)	M (6)	M (6)	A (7)	A (7)	A (8)	A (8)
Proximal LAD Involvement With Diabetes Present									
13.	■ Low-risk findings on noninvasive testing	M (4)	M (5)	M (4)	M (6)	M (6)	A (7)	A (7)	A (8)
14.	■ Intermediate- or high-risk findings on noninvasive testing	M (5)	A (7)	M (6)	A (7)	A (7)	A (8)	A (8)	A (9)
15.	■ No stress test performed or, if performed, results are indeterminate ■ FFR ≤0.80 in both vessels*	M (5)	M (6)	M (6)	A (7)	A (7)	A (8)	A (7)	A (8)

Fig. 6.1 (**a**) AUC for one vessel disease. (**b**) AUC for two-vessel disease. (**c**) AUC for three-vessel disease. (**d**) AUC for left main coronary artery stenosis. (Adapted from Patel et al. [1] with permission from Springer Nature). The number in parentheses next to the rating reflects the median score for that indication. *Substitution of a newer coronary pressure ratio that does not require hyperemia for FFR may be considered provided the appropriate reference values are used. A = appropriate; AA = antianginal; BB = beta-blockers; CABG = coronary artery bypass graft; FFR = fractional flow reserve; LAD = left anterior descending coronary artery; LCX = left circumflex artery; LMCA = left main coronary artery; M = may be appropriate; PCI = percutaneous coronary intervention; R = rarely appropriate; and SYNTAX = Synergy between PCI with Taxus and Cardiac Surgery trial)

c

Three-Vessel Disease

		Asymptomatic				Ischemic Symptoms			
		Not on AA Therapy or With AA Therapy		Not on AA Therapy		On 1 AA Drug (BB Preferred)		On ≥2 AA Drugs	
	Indication	PCI	CABG	PCI	CABG	PCI	CABG	PCI	CABG
	Low Disease Complexity (e.g., Focal Stenoses, SYNTAX ≤22)								
16.	■ Low-risk findings on noninvasive testing ■ No diabetes	M (4)	M (5)	M (5)	M (5)	M (5)	M (6)	A (6)	A (7)
17.	■ Intermediate- or high-risk findings on noninvasive testing ■ No diabetes	M (6)	A (7)	A (7)	A (7)	A (7)	A (8)	A (8)	A (8)
18.	■ Low-risk findings on noninvasive testing ■ Diabetes present	M (4)	M (6)	M (5)	M (6)	M (6)	A (7)	A (7)	A (8)
19.	■ Intermediate- or high-risk findings on noninvasive testing ■ Diabetes present	M (6)	A (7)	M (6)	A (8)	A (7)	A (8)	A (7)	A (9)
	Intermediate or High Disease Complexity (e.g. Multiple Features of Complexity as Noted Previously, SYNTAX >22)								
20.	■ Low-risk findings on noninvasive testing ■ No diabetes	M (4)	M (6)	M (4)	A (7)	M (5)	A (7)	M (6)	A (8)
21.	■ Intermediate- or high-risk findings on noninvasive testing ■ No diabetes	M (5)	A (7)	M (6)	A (7)	M (6)	A (8)	M (6)	A (9)
22.	■ Low-risk findings on noninvasive testing ■ Diabetes present	M (4)	A (7)	M (4)	A (7)	M (5)	A (8)	M (6)	A (9)
23.	■ Intermediate- or high-risk findings on noninvasive testing ■ Diabetes present	M (4)	A (8)	M (5)	A (8)	M (5)	A (8)	M (6)	A (9)

d

Left Main Disease

		Asymptomatic				Ischemic Symptoms			
		Not on AA Therapy or With AA Therapy		Not on AA Therapy		On 1 AA Drug (BB Preferred)		On ≥2 AA Drugs	
	Indication	PCI	CABG	PCI	CABG	PCI	CABG	PCI	CABG
24.	■ Isolated LMCA disease ■ Ostial or midshaft stenosis	M (6)	A (8)	A (7)	A (8)	A (7)	A (9)	A (7)	A (9)
25.	■ Isolated LMCA disease ■ Bifurcation involvement	M (5)	A (8)	M (5)	A (8)	M (5)	A (9)	M (6)	A (9)
26.	■ LMCA disease ■ Ostial or midshaft stenosis ■ Concurrent multivessel disease ■ Low disease burden (e.g., 1-2 additional forcal stenoses, SYNTAX socre ≤22)	M (6)	A (8)	M (6)	A (9)	A (7)	A (9)	A (7)	A (9)
27.	■ Ostial or midshaft stenosis ■ Concurrent multivessel disease ■ Intermediate or high disease burden (e.g., 1-2 additional bifurcation stenosis, long stenoses, SYNTAX socre >22)	M (4)	A (9)	M (4)	A (9)	M (4)	A (9)	M (4)	A (9)
28.	■ LMCA disease ■ Bifurcation involvement ■ Low disease burden in other vessels (e.g., 1-2 additional forcal stenosis, SYNTAX socre ≤22)	M (4)	A (8)	M (5)	A (8)	M (5)	A (9)	M (6)	A (9)
29.	■ LMCA disease ■ Bifurcation involvement ■ Intermediate or high disease burden in other vessels (e.g., 1-2 additional bifurcation stenosis, long stenoses, SYNTAX socre >22)	R (3)	A (8)	R (3)	A (9)	R (3)	A (9)	R (3)	A (9)

Fig. 6.1 (continued)

a

	Indication	Asymptomatic: Not on AA Therapy or With AA Therapy PCI	Asymptomatic: Not on AA Therapy or With AA Therapy CABG	Asymptomatic: Not on AA Therapy PCI	Asymptomatic: Not on AA Therapy CABG	Ischemic Symptoms: On 1 AA Drug (BB Preferred) PCI	Ischemic Symptoms: On 1 AA Drug (BB Preferred) CABG	Ischemic Symptoms: On ≥2 AA Drugs PCI	Ischemic Symptoms: On ≥2 AA Drugs CABG
Stenosis Supplying 1 Territory Disease (Bypass Graft or Native Artery) to Territory Other Than Anterior									
30.	■ Low-risk findings on noninvasive testing	R (3)	R (1)	R (3)	R (2)	M (6)	R (3)	A (7)	M (4)
31.	■ Intermediate- or high-risk findings on noninvasive testing	M (5)	R (3)	M (5)	R (3)	A (7)	M (4)	A (8)	M (5)
32.	■ No stress test performed or, if performed, the results are indeterminate ■ FFR of stenosis ≤0.80*	M (4)	R (3)	M (4)	R (3)	M (6)	M (4)	A (8)	M (5)
Stenoses Supplying 2 Territories (Bypass Graft or Native Artery, Either 2 Separate Vessels or Sequential Graft Supplying 2 Territories) Not Including Anterior Territory									
33.	■ Low-risk findings on noninvasive testing	R (3)	R (2)	M (4)	R (3)	M (6)	R (3)	A (7)	M (5)
34.	■ Intermediate- or high-risk findings on noninvasive testing	M (5)	R (3)	M (5)	M (4)	A (7)	M (5)	A (8)	M (6)

b

	Indication	Asymptomatic: Not on AA Therapy or With AA Therapy PCI	Asymptomatic: Not on AA Therapy or With AA Therapy CABG	Asymptomatic: Not on AA Therapy PCI	Asymptomatic: Not on AA Therapy CABG	Ischemic Symptoms: On 1 AA Drug (BB Preferred) PCI	Ischemic Symptoms: On 1 AA Drug (BB Preferred) CABG	Ischemic Symptoms: On ≥2 AA Drugs PCI	Ischemic Symptoms: On ≥2 AA Drugs CABG
Stenosis Supplying-1 Territory Disease (Bypass Graft or Native Artery)-Anterior (LAD) Territory									
35.	■ Low-risk findings on noninvasive testing	M (4)	R (3)	M (5)	R (3)	M (6)	M (4)	A (7)	M (5)
36.	■ Intermediate- or high-risk findings on noninvasive testing	M (6)	M (4)	M (6)	R (4)	A (7)	M (5)	A (8)	M (6)
37.	■ No stress test performed or, if performed, the results are indeterminate ■ FFR of stenosis ≤0.80*	M (5)	M (4)	M (6)	R (4)	A (7)	M (5)	A (8)	M (6)
Stenoses Supplying 2 Territories (Bypass Graft or Native Artery, Either 2 Separate Vessels or Sequential Graft Supplying 2 Territories) LAD Plus Other Territory									
38.	■ Low-risk findings on noninvasive testing	M (5)	M (4)	M (6)	M (4)	A (7)	M (5)	A (7)	M (6)
39.	■ Intermediate- or high-risk findings on noninvasive testing	M (6)	M (5)	A (7)	M (6)	A (7)	A (7)	A (8)	A (8)
Stenoses Supplying 3 Territories (Bypass Graft or Native Arteries, Separate Vessels, Sequential Grafts, or Combination Thereof) LAD Plus 2 Other Territories									
40.	■ Low-risk findings on noninvasive testing	M (5)	M (5)	M (6)	M (5)	M (6)	M (6)	A (7)	A (7)
41.	■ Intermediate- or high-risk findings on noninvasive testing	A (7)	A (7)	A (7)	A (7)	A (7)	A (7)	A (8)	A (8)

Fig. 6.2 (**a**) AUC for an internal mammary artery to left anterior descending artery patent and without significant stenosis. (**b**) AUC for an internal mammary artery to the left anterior descending artery, not patent. (Adapted from Patel et al. [1] with permission from Springer Nature). The number in parentheses next to the rating reflects the median score for that indication. *Substitution of a newer coronary pressure ratio that does not require hyperemia for FFR may be considered provided the appropriate reference values are used. A = appropriate; AA = Antianginal; BB = beta-blockers; CABG = coronary artery bypass graft; FFR = fractional flow reserve; IMA = internal mammary artery; LAD = left anterior descending coronary artery; M = may be appropriate; PCI = percutaneous coronary intervention; and R = rarely appropriate)

		Asymptomatic				Ischemic Symptoms			
		Not on AA Therapy or With AA Therapy		Not on AA Therapy		On 1 AA Drug (BB Preferred)		On ≥2 AA Drugs	
	Indication	PCI	CABG	PCI	CABG	PCI	CABG	PCI	CABG
Patients Undergoing Renal Transplantation, No Diabetes									
42.	▪ One- or two-vessel CAD, no proximal LAD inclvement, with low-risk noninvasice findings	R (3)	R (2)	M (4)	R (3)	M (6)	M (4)	A (7)	M (5)
43.	▪ One- or two-vessel CAD, no proximal LAD inclvement, with intermediate- or high-risk noninvasice findings	M (5)	M (4)	M (6)	M (4)	A (7)	M (5)	A (8)	M (6)
44.	▪ One- or two-vessel CAD, including proximal LAD, with low-risk noninvasice findings	M (5)	M (4)	M (6)	M (5)	M (6)	M (6)	A (8)	A (7)
45.	▪ One- or two-vessel CAD, including proximal LAD, with intermediate- or high-risk noninvasice findings	M (6)	M (6)	A (7)	A (7)	A (7)	A (7)	A (8)	A (8)
46.	▪ Left main and/or three-vesse; disease, with intermediate- or high-risk noninvasive findings (e.g., SYNTAX ≤22)	M (6)	A (7)	A (7)	A (7)	A (7)	A (7)	A (8)	A (8)
47.	▪ Left main and/or three-vesse; disease, with intermediate- or high-risk noninvasive findings (e.g., SYNTAX >22)	M (5)	A (7)	M (6)	A (8)	M (6)	A (8)	M (6)	A (9)
Patients Undergoing Renal Transplantation, Diabetes Present									
48.	▪ One- or two-vessel CAD, no proximal LAD inclvement, with low-risk noninvasice findings	R (3)	R (3)	M (4)	R (3)	M (5)	M (4)	A (7)	M (6)
49.	▪ One- or two-vessel CAD, no proximal LAD inclvement, with intermediate- or high-risk noninvasice findings	M (5)	M (4)	M (5)	M (4)	A (6)	M (5)	A (7)	A (7)
50.	▪ One- or two-vessel CAD, including proximal LAD, with low-risk noninvasice findings	M (5)	M (5)	M (5)	M (6)	M (5)	A (7)	A (7)	A (7)
51.	▪ One- or two-vessel CAD, including proximal LAD, with intermediate- or high-risk noninvasice findings	M (6)	M (6)	M (6)	A (7)	M (6)	A (7)	A (7)	A (8)
52.	▪ Left main and/or three-vesse; disease, with intermediate- or high-risk noninvasive findings (e.g., SYNTAX ≤22)	M (6)	A (8)	M (6)	A (8)	M (6)	A (8)	A (7)	A (9)
53.	▪ Left main and/or three-vesse; disease, with intermediate- or high-risk noninvasive findings (e.g., SYNTAX >22)	M (5)	A (8)	M (5)	A (8)	M (5)	A (9)	M (5)	A (9)
Patients Who Will Undergo a Percutaneous Valve Procedure (TAVR, MitraClip, Others)									
54.	▪ One- or two-vessel CAD, no proximal LAD inclvement, with low-risk noninvasice findings	M (4)		M (4)		M (6)		A (8)	
55.	▪ One- or two-vessel CAD, no proximal LAD inclvement, with intermediate- or high-risk noninvasice findings	A (7)		A (7)		A (7)		A (8)	
56.	▪ One- or two-vessel CAD, including proximal LAD, with low-risk noninvasice findings	M (6)		M (6)		A (7)		A (8)	
57.	▪ One- or two-vessel CAD, including proximal LAD, with intermediate- or high-risk noninvasice findings	A (7)		A (7)		A (8)		A (9)	
58.	▪ Left main and/or three-vesse; disease, with intermediate- or high-risk noninvasive findings (e.g., SYNTAX ≤22)	A (8)		A (8)		A (8)		A (9)	
59.	▪ Left main and/or three-vesse; disease, with intermediate- or high-risk noninvasive findings (e.g., SYNTAX >22)	A (7)		A (7)		A (8)		A (8)	

Fig. 6.3 AUC for stable ischemic heart disease undergoing procedures for which coronary revascularization may be considered. (Adapted from Patel et al. [1] with permission from Springer Nature). The number in parentheses next to the rating reflects the median score for that indication. A = appropriate; AA = Antianginal; BB = beta-blockers; CABG = coronary artery bypass graft; CAD = coronary artery disease; LAD = left anterior descending coronary artery; M = may be appropriate; PCI = percutaneous coronary intervention; R = rarely appropriate; SYNTAX = Synergy between PCI with Taxus and Cardiac Surgery trial; and TAVR = transcatheter aortic valve replacement)

Appropriate Use Criteria for Acute Coronary Syndrome

In developing these AUC for coronary revascularization in patients with acute coronary syndrome (ACS), a panel of experts scored 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*. The panel scored each indication on a scale from one to nine based on their level of agreement with the definition of appropriate use for that indication as follows [2]:

- Score 1 to 3: Rarely appropriate care (risks > benefit).
- Score 4 to 6: May be appropriate care (potential benefit).
- Score 7 to 9: Appropriate care (risk < benefit).

In patients with ACS, AUC indications for coronary revascularization were developed considering several variables [2]:

- Clinical presentation (STEMI, NSTEMI, or other ACS).
- Time from onset of symptoms.
- 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).
- Prior treatment with fibrinolytics.
- Predicted risk as estimated by the Thrombolysis In Myocardial infarction score.
- Relevant comorbidities.
- Extent of anatomic disease in the culprit and non-culprit arteries.

Determining the significance of coronary stenosis in ACS includes not only the percent luminal diameter narrowing but also the angiographic appearance of the stenosis and distal flow pattern. Per AUC, coronary stenosis in ACS was defined as follows [2]:

- Severe:
  - ≥70% luminal diameter narrowing of epicardial stenosis, measured by visual assessment in the "worst view" angiographic projection.
  - ≥50% luminal diameter narrowing of the left main artery, measured by visual assessment in the "worst view" angiographic projection.
- Intermediate:
  - ≥50% and <70% diameter narrowing of epicardial stenosis, measured by visual assessment in the "worst view" angiographic projection.

Refer to Fig. 6.4 for a summary of AUC for ACS.

a

	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)

Fig. 6.4 (**a**) AUC for STEMI immediate revascularization by PCI. (**b**) AUC for STEMI initial treatment by fibrinolytic therapy. (**c**) AUC for STEMI revascularization of the non-culprit artery (D) AUC for NSTEMI/Unstable angina. (Adapted from Patel et al. [2] with permission from Springer Nature). 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; HF = heart failure; M = may be appropriate; NSTEMI = non–ST-segment elevation myocardial infarction; PCI = percutaneous coronary intervention; R = rarely appropriate; STEMI = ST-segment elevation myocardial infarction; TIMI = Thrombolysis In Myocardial Infarction)

b

Indication	Appropriate Use Score (1-9)
PCI of the Presumed Culprit Artery After Fibrinolsis	
7. ■ Evidence of failed reperfusion after fibrinolysis (e.g., failure of ST-segment resloution, presence of acute severe HF, ongoing myocardial ischemia, or unstable ventriculer 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)

c

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)

d

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)

Fig. 6.4 (continued)

Pearls

- More than one treatment may be considered "Appropriate," "May Be Appropriate," or "Rarely Appropriate" for any clinical indication and a shared decision approach should be undertaken to determine which treatment is suitable.
- Rating of "appropriate care" does not mandate that a revascularization procedure be performed; similarly, a rating of "rarely appropriate care" should not prevent a revascularization procedure from being performed.
- If a clinician decides not to follow the AUC rating, the provider should document case-specific details that are not accounted for, and the rationale for choosing an alternative treatment plan.
- AUC only covers clinical scenarios where the culprit artery and additional non-culprit arteries are treated at the time of primary PCI, or later during the initial hospitalization.
- Consider a heart team evaluation when faced with complex clinical scenarios or patients with severe CAD.

References

1. Patel et al. ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2017 appropriate use criteria for coronary revascularization in patients with stable ischemic heart disease: 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 Society of Thoracic Surgeons. J Nucl Cardiol. 2017 Oct;24(5):1759–1792. https://doi.org/10.1007/s12350-017-0917-9.
2. Patel MR, Calhoon JH, Dehmer GJ, Grantham JA, Maddox TM, Maron DJ, Smith PK. 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. J Nucl Cardiol. 2017;24(2):439–63. https://doi.org/10.1007/s12350-017-0780-8.
3. Desai et al. Appropriate use criteria for coronary revascularization and trends in utilization, patient selection, and appropriateness of percutaneous coronary intervention. JAMA 2015 Nov 17;314(19):2045–2053. https://doi.org/10.1001/jama.2015.13764. PubMed PMID: 26551163.
4. Hannan EL, Samadashvili Z, Cozzens K. et al. Changes in percutaneous coronary interventions deemed 'inappropriate' by appropriate use criteria. J Am Coll Cardiol 2017 Mar 14;69(10):1234–1242. https://doi.org/10.1016/j.jacc.2016.12.025. PubMed PMID: 28279289.