Appropriate Use Criteria for Cardiac Radionuclide Imaging Ratings
Moderator

	Indication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Median	MADM	R	Agree	
Table 1. Detection of CAD: Symptomatic																					
Evaluation of Ischemic Equivalent (Non-Acute)																					
1	• Low pre-test probability of CAD • ECG interpretable AND able to exercise	4	2	1	5	1	3	4	2	1	5	3	2	4	3	3	3	1.1	I		
2	• Low pre-test probability of CAD • ECG uninterpretable OR unable to exercise	9	7	3	9	5	7	6	7	7	8	8	8	7	7	5	7	1.1	A	+	
3	• Intermediate pre-test probability of CAD • ECG interpretable AND able to exercise	9	7	2	8	1	7	3	7	8	8	8	7	7	7	7	7	1.4	A	+	
4	• Intermediate pre-test probability of CAD • ECG uninterpretable OR unable to exercise	9	9	8	9	7	8	9	9	9	9	9	9	9	9	9	9	0.3	A	+	
5	• High pre-test probability of CAD • Regardless of ECG interpretability and ability to exercise	9	9	5	9	5	8	6	8	7	5	8	7	6	8	9	8	1.3	A		
Acute Chest Pain																					
6	• Possible ACS • ECG—no ischemic changes or with LBBB or electronically paced ventricular rhythm • Low-Risk TIMI Score • Peak Troponin: borderline, equivocal, minimally elevated	9	9	8	8	7	8	7	8	3	8	7	8	7	8	6	8	0.9	A	+	
7	• Possible ACS • ECG—no ischemic changes or with LBBB or electronically paced ventricular rhythm • High-Risk TIMI Score • Peak Troponin: borderline, equivocal, minimally elevated	9	8	1	9	2	8	5	8	1	7	7	7	5	8	9	7	2.1	A		
8	• Possible ACS • ECG—no ischemic changes or with LBBB or electronically paced ventricular rhythm • Low-Risk TIMI Score • Negative troponin levels	9	8	9	9	3	7	3	8	8	8	7	8	8	7	4	8	1.3	A	+	
9	• Possible ACS • ECG—no ischemic changes or with LBBB or electronically paced ventricular rhythm • High-Risk TIMI Score • Negative troponin levels	9	9	8	9	7	5	7	9	1	8	6	7	8	8	8	8	1.3	A	+	
10	• Definite ACS	1	1	1	3	1	2	1	1	1	1	1	1	1	2	2	1	0.3	I	+	
Acute Chest Pain (Rest Imaging Only)																					
11	• Possible ACS • ECG—no ischemic changes or with LBBB or electronically paced ventricular rhythm • Initial troponin negative • Recent or on-going chest pain	9	9	7	7	7	2	6	8	9	2	8	6	8	8	6	7	1.5	A		
Table 2. Detection of CAD/Risk Assessment Without Chest Pain Syndrome																					
Asymptomatic																					
12	• Low CHD risk (ATP III risk criteria)	1	1	1	2	1	2	1	1	1	1	1	1	2	1	1	1	0.2	I	+	
13	• Moderate CHD risk (ATP III risk criteria) • ECG uninterpretable	7	3	3	5	1	4	4	3	1	5	1	4	3	3	3	3	1.1	I		
14	• Moderate CHD risk (ATP III risk criteria) • ECG uninterpretable	9	3	7	8	1	4	4	6	1	5	5	7	5	7	6	5	1.8	U		
15	• High CHD risk (ATP III risk criteria)	9	7	9	9	1	7	6	8	3	5	7	7	7	7	7	7	1.3	A	+	
New-Onset or Newly Diagnosed Heart Failure with LV Systolic Dysfunction Without Ischemic Equivalent																					
16	• No prior CAD evaluation AND no planned coronary angiography	9	9	8	9	3	7	7	8	9	8	8	8	8	8	8	8	0.7	A	+	
New-Onset Atrial Fibrillation																					
17	• Part of evaluation when etiology unclear	9	7	4	8	3	5	5	7	3	7	6	7	6	5	7	6	1.4	U		
Ventricular Tachycardia																					
18	• Low CHD risk (ATP III risk criteria)	7	7	8	8	3	4	5	6	8	1	8	7	8	7	7	7	1.4	A		
19	• Moderate or High CHD risk (ATP III risk criteria)	9	8	9	9	3	7	3	8	6	7	8	9	9	9	9	8	1.4	A	+	
Syncope																					
20	• Low CHD risk (ATP III risk criteria)	3	3	5	5	1	5	4	1	5	1	2	5	1	2	3	3	1.4	I		
21	• Moderate or High CHD risk (ATP III risk criteria)	6	8	8	8	3	5	7	7	8	7	8	7	6	8	6	7	1.0	A		

	Indication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Median	MADM	R	Agree	
Elevated Troponin																					
22	• Troponin elevation without additional evidence of acute coronary syndrome	9	8	8	8	7	6	7	8	7	7	7	7	7	7	6	7	0.5	A	+	
Table 3. Risk Assessment With Prior Test Results and/or Known Chronic Stable CAD																					
Asymptomatic OR Stable Symptoms Normal Prior Stress Imaging Study (SPECT or Echocardiography)																					
23	• Low CHD risk (ATP III risk criteria) • Last stress imaging study done less than 2 years ago	5	1	3	2	1	7	2	1	1	1	1	1	2	1	2	1	1.1	I	+	
24	• Intermediate to High CHD risk (ATP III risk criteria) • Last stress imaging study done less than 2 years ago	7	1	3	3	1	6	2	3	1	1	3	4	2	2	6	3	1.5	I	+	
25	• Low CHD risk (ATP III risk criteria) • Last stress imaging study done more than 2 years ago	7	2	6	5	1	3	2	3	1	1	3	3	4	2	3	3	1.3	I	+	
26	• Intermediate to High CHD risk (ATP III risk criteria) • Last stress imaging study done more than 2 years ago	9	5	8	8	1	6	2	7	1	2	3	6	7	6	7	6	2.1	U		-
Asymptomatic OR Stable Symptoms Abnormal Coronary Angiography OR Abnormal Prior Stress Imaging Study, No Prior Revascularization																					
27	• Known CAD on coronary angiography OR prior abnormal stress imaging study • Last stress imaging study done less than 2 years ago	8	2	8	3	1	3	2	5	1	1	2	3	5	4	4	3	1.7	I		
28	• Known CAD on coronary angiography OR prior abnormal stress imaging study • Last stress imaging study done more than or equal to 2 years ago	9	7	9	8	2	3	2	8	1	2	3	5	5	6	7	5	2.4	U		-
Prior non-invasive evaluation																					
29	• Equivocal, borderline, or discordant stress testing where obstructive CAD remains a concern	9	9	8	9	7	7	7	9	8	8	8	8	9	8	7	8	0.6	A	+	
New or Worsening Symptoms																					
30	• Abnormal coronary angiography OR abnormal prior stress imaging study	9	9	2	9	7	7	8	9	9	8	8	8	9	9	9	9	1.0	A	+	
31	• Normal coronary angiography OR normal prior stress imaging study	9	7	5	7	7	5	5	7	8	5	6	5	6	6	6	6	0.9	U		
Coronary Angiography (Invasive or Noninvasive)																					
32	• Coronary stenosis or anatomic abnormality of uncertain significance.	9	9	8	9	9	8	7	9	9	8	7	8	9	9	8	9	0.6	A	+	
Asymptomatic Prior Coronary Calcium Agatston Score																					
33	• Agatston score less than 100	2	2	2	1	1	2	2	1	1	2	1	2	3	1	1	2	0.5	I	+	
34	• High CHD risk (ATP III risk criteria) • Agatston score between 100-400	7	6	7	6	1	4	4	5	1	5	3	6	6	6	4	5	1.5	U		
35	• Low to Intermediate CHD risk (ATP III risk criteria) • Agatston score between 100-400	8	7	7	8	1	6	3	8	2	5	3	7	8	7	7	7	1.7	A		
36	• Agatston score greater than 400	9	8	8	8	3	5	4	9	7	5	7	8	9	7	7	7	1.4	A	+	
Duke Treadmill Score, Asymptomatic																					
37	• Low-Risk Duke treadmill score	4	1	2	2	1	2	2	2	1	2	2	2	2	2	3	2	0.4	I	+	
38	• Intermediate-Risk Duke treadmill score	9	7	7	8	7	4	7	6	7	8	6	8	5	7	7	7	0.8	A	+	
39	• High-Risk Duke treadmill score	8	8	8	9	3	8	7	8	6	2	7	7	8	7	8	8	1.2	A	+	
Table 4. Risk Assessment: Preoperative Evaluation for Non-Cardiac Surgery																					
Low-Risk Surgery, no active cardiac condition																					
40	• Preoperative evaluation for non-cardiac surgery risk assessment	1	1	3	2	1	2	4	1	1	1	1	1	2	1	1	1	0.5	I	+	
Intermediate-Risk Surgery, no active cardiac condition																					
41	• Moderate to Good functional capacity (greater than or equal to 4 METs)	4	1	4	4	1	3	3	3	1	1	2	4	3	3	3	3	0.9	I	+	
42	• No clinical risk factors	1	1	4	2	1	3	3	1	1	1	1	3	3	2	2	2	0.9	I	+	
43	• Greater than or equal to 1 clinical risk factor • Poor or unknown functional capacity (less than 4 METs)	8	8	8	8	4	7	4	8	8	6	6	8	6	7	7	7	1.1	A		
44	• Asymptomatic up to 1 year post normal catheterization, non-invasive test, or previous revascularization	4	1	3	2	1	2	4	1	1	1	1	2	1	2	2	2	0.8	I	+	
Vascular Surgery, no active cardiac condition																					
45	• Moderate to Good functional capacity (greater than or equal to 4 METs)	3	2	5	6	1	4	3	3	4	1	1	4	6	3	3	3	1.2	I		
46	• No clinical risk factors	3	2	4	2	1	1	3	1	1	1	1	3	5	1	2	2	1.0	I	+	
47	• Greater than or equal to 1 clinical risk factor • Poor or unknown functional capacity (less than 4 METs)	9	9	8	9	7	4	7	8	9	8	7	8	8	7	7	8	0.9	A	+	
48	• Asymptomatic up to 1 year post normal catheterization, non-invasive test, or previous revascularization	5	1	3	2	1	3	4	1	1	1	1	2	3	2	2	2	0.9	I	+	

	Indication	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Median	MADM	R	Agree	
Table 5. Risk Assessment: Within 3 Months of an Acute Coronary Syndrome																					
STEMI																					
49	• Primary PCI with complete revascularization • No recurrent symptoms	3	1	1	5	1	2	2	1	1	1	1	2	5	3	4	2	1.1	I	+	
50	• Hemodynamically stable, no recurrent chest pain symptoms or no signs of HF • To evaluate for inducible ischemia • No prior coronary angiography	9	9	9	9	9	5	2	9	8	2	7	9	8	7	7	8	1.7	A	+	
51	• Hemodynamically unstable, signs of cardiogenic shock, or mechanical complications	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	0.1	I	+	
UA/NSTEMI																					
52	• Hemodynamically stable, no recurrent chest pain symptoms or no signs of HF • To evaluate for inducible ischemia • No prior coronary angiography	9	9	9	9	9	7	2	9	8	8	8	9	9	9	2	9	1.3	A	+	
ACS- Asymptomatic Post Revascularization (PCI or CABG)																					
53	• Evaluation prior to hospital discharge	1	1	1	2	1	3	2	1	1	1	2	1	2	1	2	1	0.5	I	+	
Cardiac Rehabilitation																					
54	• Prior to initiation of cardiac rehabilitation (as a stand-alone indication)	7	5	2	7	1	7	2	1	5	1	2	2	3	3	3	3	1.7	I		
Table 6. Risk Assessment: Post-Revascularization (PCI or CABG)																					
Symptomatic																					
55	• Evaluation of ischemic equivalent	9	9	9	9	7	8	7	9	9	8	7	8	9	8	8	8	0.7	A	+	
Asymptomatic																					
56	• Incomplete revascularization • Additional revascularization feasible	8	8	9	8	5	8	5	7	6	8	6	6	9	6	7	7	1.1	A		
57	• Less than 5 years after CABG	7	5	7	5	1	6	4	5	1	1	6	3	3	6	6	5	1.7	U		
58	• Greater than or equal to 5 years after CABG	9	7	9	8	3	6	4	8	1	1	7	6	7	7	8	7	1.9	A		
59	• Less than 2 years after PCI	7	5	3	3	1	6	4	3	1	1	3	2	3	6	5	3	1.5	I		
60	• Greater than or equal to 2 years after PCI	9	7	6	8	3	5	4	7	1	1	7	4	5	7	8	6	2.0	U		
Cardiac Rehabilitation																					
61	• Prior to initiation of cardiac rehabilitation (as a stand-alone indication)	7	5	2	6	1	6	5	1	1	2	2	3	3	5	3	3	1.7	I		
Table 7. Assessment of Viabilitv/Ischemia																					
Ischemic Cardiomyopathy/Assessment of Viability																					
62	• Known severe LV dysfunction • Patient eligible for revascularization	9	9	9	9	7	8	7	9	9	2	8	9	9	9	9	9	0.9	A	+	
Table 8. Assessment of Viability/Ischemia																					
Evaluation of Left Ventricular Function																					
63	• Assessment of LV function with radionuclide angiography (ERNA or FP (first pass) RNA) • In absence of recent diagnostic information regarding ventricular function obtained with another imaging modality	9	8	3	9	7	8	5	9	9	8	8	8	6	9	5	8	1.3	A	+	
64	• Routine use of rest/stress ECG-gating with SPECT or PET myocardial perfusion imaging	9	9	9	9	9	8	9	9	1	9	7	7	6	9	9	9	1.1	A	+	
65	• Routine use of stress FP RNA in conjunction with rest/stress gated SPECT MPI • Detection of multi-vessel CAD	1	1	1	1	3	3	2	5	1	2	3	6	6	3	3	3	1.3	I		
66	• Selective use of stress FP RNA in conjunction with rest/stress gated SPECT MPI • Borderline, mild, or moderate stenoses in three vessels OR moderate or equivocal left main stenosis in left dominant system	7	7	5	7	5	5	2	8	9	6	5	7	6	3	7	6	1.4	U	+	
Use of Potentially Cardiotoxic Therapy (e.g. Doxorubicin)																					
67	• Serial assessment of LV function with radionuclide angiography (ERNA or FP RNA) • Baseline and serial measures after key therapeutic milestones or evidence of toxicity	9	9	9	9	7	7	4	9	7	6	7	9	9	9	8	9	1.1	A	+	

# of Appropriate Indications (INLCUDES TEST)	33
# of Uncertain Indications	9
# of Inappropriate Indications	25
	67
# of Indications with Agreement	41
# of Indications with Disgreement	2
# of Indications with Neither Agreement nor Disagreement	33

RELEVANT LITERATURE FOR CARDIAC RADIONUCLIDE IMAGING

Table 1. Detection of CAD: Symptomatic

	Indication	Appropriate Use Criteria (Median Score)
	Evaluation of Ischemic Equivalent (Non-Acute)	
1	• Low pre-test probability of CAD • ECG interpretable AND able to exercise	
2	• Low pre-test probability of CAD • ECG uninterpretable OR unable to exercise	
3	• Intermediate pre-test probability of CAD • ECG interpretable AND able to exercise	
4	• Intermediate pre-test probability of CAD • ECG uninterpretable OR unable to exercise	
5	• High pre-test probability of CAD • Regardless of ECG interpretability and ability to exercise	
	Acute Chest Pain	
6	• Possible ACS • ECG—no ischemic changes or with LBBB or electronically ventricular paced rhythm • Low-risk TIMI score • Peak Troponin: borderline, equivocal, minimally elevated	
7	• Possible ACS • ECG—no ischemic changes or with LBBB or electronically ventricular paced rhythm • High-risk TIMI score • Peak Troponin: borderline, equivocal, minimally elevated	
8	• Possible ACS • ECG – no ischemic changes or with LBBB or electronically ventricular paced rhythm • Low-risk TIMI score • Negative peak troponin levels	
9	• Possible ACS • ECG – no ischemic changes or with LBBB or electronically ventricular paced rhythm • High-risk TIMI score • Negative peak troponin levels	
10	• Definite ACS*	

	Acute Chest Pain (Rest Imaging Only)	
11	• Possible ACS • ECG—no ischemic changes or with LBBB or electronically ventricular paced rhythm • Initial troponin negative • Recent or on-going chest pain	

I. New Lit Search:

Berman DS, Shaw LJ, Hachamovitch R, Friedman JD, Polk DM, Hayes SW, Thomson LE, Germano G, Wong ND, Kang X, Rozanski A. "Comparative use of radionuclide stress testing, coronary artery calcium scanning, and noninvasive coronary angiography for diagnostic and prognostic cardiac assessment." *Semin Nucl Med*. 2007 Jan;37(1):2-16. Review.

Berman DS, Hachamovitch R, Shaw LJ, Friedman JD, Hayes SW, Thomson LE, Fieno DS, Germano G, Wong ND, Kang X, Rozanski A.. "Roles of nuclear cardiology, cardiac computed tomography, and cardiac magnetic resonance: Noninvasive risk stratification and a conceptual framework for the selection of noninvasive imaging tests in patients with known or suspected coronary artery disease." *J Nucl Med*. 2006 Jul;47(7):1107-18. Review.

Bax JJ, van der Wall EE. "Assessment of coronary artery disease in patients with (a)symptomatic diabetes." *Eur Heart J*. 2006 Mar;27(6):631-2. Epub 2006 Feb 23. No abstract available.

Mieres JH, Shaw LJ, Arai A, Budoff MJ, Flamm SD, Hundley WG, Marwick TH, Mosca L, Patel AR, Quinones MA, Redberg RF, Taubert KA, Taylor AJ, Thomas GS, Wenger NK; Cardiac Imaging Committee, Council on Clinical Cardiology, and the Cardiovascular Imaging and Intervention Committee, Council on Cardiovascular Radiology and Intervention, American Heart Association. "Role of noninvasive testing in the clinical evaluation of women with suspected coronary artery disease: Consensus statement from the Cardiac Imaging Committee, Council on Clinical Cardiology, and the Cardiovascular Imaging and Intervention Committee, Council on Cardiovascular Radiology and Intervention, American Heart Association." *Circulation*. 2005 Feb 8;111(5):682-96. Epub 2005 Feb 1.

Utsunomiya D, Tomiguchi S, Yamashita Y. "Role of cardiac computed tomography in patients with suspected coronary artery disease: interaction with nuclear cardiology. " *Radiat Med.* 2007 Dec;25(10):493-501. Epub 2007 Dec 25.

Miller TD, DiCarli MF. "Nuclear cardiac imaging for the assessment of coronary artery disease in the elderly." *Am J Geriatr Cardiol.* 2007 Nov-Dec;16(6):355-62. Review.

Hacker M, Jakobs T, Matthiesen F, Nikolaou K, Becker C, Knez A, Tiling R. “Combined functional and morphological imaging consisting of gated myocardial perfusion SPECT and 16-detector multislice spiral CT angiography in the noninvasive evaluation of coronary artery disease: first experiences.” *Clin Imaging*. 2007 Sep-Oct;31(5):313-20.

Heijenbrok-Kal MH, Fleischmann KE, Hunink MG. “Stress echocardiography, stress single-photon-emission computed tomography and electron beam computed tomography for the assessment of coronary artery disease: a meta-analysis of diagnostic performance.” *Am Heart J.* 2007 Sep;154(3):415-23.

Travin MI. “Is it possible for myocardial perfusion imaging to avoid missing any patients with high-risk coronary disease?” *J Nucl Cardiol.* 2007 Jul;14(4):492-6. No abstract available.

Stanford W. “Radiologic evaluation of acute chest pain--suspected myocardial ischemia*.” Am Fam Physician*. 2007 Aug 15;76(4):533-7.

Shaw LJ. “Myocardial perfusion imaging in the evaluation of chest pain in the acute care setting: Clinical and economic outcomes.” *J Nucl Cardiol*. 2007 May-Jun;14(3 Suppl):S133-8. Review. No abstract available.

Candell-Riera J, Oller-Martínez G, de León G, Castell-Conesa J, Aguadé-Bruix S. “Yield of early rest and stress myocardial perfusion single-photon emission computed tomography and electrocardiographic exercise test in patients with atypical chest pain, nondiagnostic electrocardiogram, and negative biochemical markers in the emergency department*.” Am J Cardiol*. 2007 Jun 15;99(12):1662-6. Epub 2007 May 4.

Gani F, Jain D, Lahiri A. “The role of cardiovascular imaging techniques in the assessment of patients with acute chest pain.” *Nucl Med Commun.* 2007 Jun;28(6):441-9. Review.

Sabharwal NK, Stoykova B, Taneja AK, Lahiri A. “A randomized trial of exercise treadmill ECG versus stress SPECT myocardial perfusion imaging as an initial diagnostic strategy in stable patients with chest pain and suspected CAD: cost analysis.” *J Nucl Cardiol.* 2007 Apr;14(2):174-86. Erratum in: J Nucl Cardiol. 2007

Sampson UK, Dorbala S, Limaye A, Kwong R, Di Carli MF. “Diagnostic accuracy of rubidium-82 myocardial perfusion imaging with hybrid positron emission tomography/computed tomography in the detection of coronary artery disease.” *J Am Coll Cardiol.* 2007 Mar 13;49(10):1052-8. Epub 2007 Feb 26.

Graf S, Khorsand A, Gwechenberger M, Novotny C, Kletter K, Sochor H, Pirich C, Maurer G, Porenta G, Zehetgruber M. “Typical chest pain and normal coronary angiogram: cardiac risk factor analysis versus PET for detection of microvascular disease.” *J Nucl Med.* 2007 Feb;48(2):175-81.

Storto G, Sorrentino AR, Pellegrino T, Liuzzi R, Petretta M, Cuocolo A. “Assessment of coronary flow reserve by sestamibi imaging in patients with typical chest pain and normal coronary arteries.” *Eur J Nucl Med Mol Imaging*. 2007 Aug;34(8):1156-61. Epub 2007 Jan 6.

Shaw LJ, Marwick TH, Berman DS, Sawada S, Heller GV, Vasey C, Miller DD. “Incremental cost-effectiveness of exercise echocardiography vs. SPECT imaging for the evaluation of stable chest pain.” *Eur Heart J.* 2006 Oct;27(20):2448-58. Epub 2006 Sep 26.

Graf S, Khorsand A, Gwechenberger M, Schütz M, Kletter K, Sochor H, Dudczak R, Maurer G, Pirich C, Porenta G, Zehetgruber M. “Myocardial perfusion in patients with typical chest pain and normal angiogram.” *Eur J Clin Invest*. 2006 May;36(5):326-32.

Moralidis E, Anagnostopoulos C. “Cardiac radionuclide imaging in clinical decision making.” *Hell J Nucl Med.* 2005 May-Aug;8(2):95-102. Review.

Conti A, Sammicheli L, Gallini C, Costanzo EN, Antoniucci D, Barletta G.” Assessment of patients with low-risk chest pain in the emergency department: Head-to-head comparison of exercise stress echocardiography and exercise myocardial SPECT.” *Am Heart J*. 2005 May;149(5):894-901.

Ramakrishna G, Milavetz JJ, Zinsmeister AR, Farkouh ME, Evans RW, Allison TG, Smars PA, Gibbons RJ. “Effect of exercise treadmill testing and stress imaging on the triage of patients with chest pain: CHEER substudy.” *Mayo Clin Proc*. 2005 Mar;80(3):322-9.

Amsterdam EA, Lewis WR. “Stress imaging in chest pain units: is less more?” *Mayo Clin Proc.* 2005 Mar;80(3):317-9. No abstract available.

Bigi R, De Chiara B. “Prognostic value of noninvasive stressing modalities in patients with chest pain and normal coronary angiogram.” *Herz.* 2005 Feb;30(1):61-6. Review.

Weinsaft JW, Gade CL, Wong FJ, Kim HW, Min JK, Manoushagian SJ, Okin PM, Szulc M. “Diagnostic impact of SPECT image display on assessment of obstructive coronary artery disease.” *J Nucl Cardiol.* 2007 Sep-Oct;14(5):659-68.

Gould KL. “Positron emission tomography in coronary artery disease.” *Curr Opin Cardiol.* 2007 Sep;22(5):422-8. Review.

Toriyama T, Takase H, Goto T, Sugiura T, Nakazawa A, Hayashi K, Ishikawa H, Hikita Y, Ueda R, Dohi Y. “Coronary artery disease investigated using 99mTc-tetrofosmin myocardial SPECT.” *Eur J Clin Invest.* 2007 Jun;37(6):478-82.

Sabharwal NK, Stoykova B, Taneja AK, Lahiri A. “A randomized trial of exercise treadmill ECG versus stress SPECT myocardial perfusion imaging as an initial diagnostic strategy in stable patients with chest pain and suspected CAD: cost analysis.” *J Nucl Cardiol.* 2007 Apr;14(2):174-86. Erratum in: *J Nucl Cardiol.* 2007

Yoshinaga K, Chow BJ, Williams K, Chen L, deKemp RA, Garrard L, Lok-Tin Szeto
A, Aung M, Davies RA, Ruddy TD, Beanlands RS. “What is the prognostic value of myocardial perfusion imaging using rubidium-82 positron emission tomography?” *J Am Coll Cardiol.* 2006 Sep 5;48(5):1029-39. Epub 2006 Aug 17.

Di Carli MF, Dorbala S, Hachamovitch R. “Integrated cardiac PET-CT for the diagnosis and management of CAD.” *J Nucl Cardiol.* 2006 Mar-Apr;13(2):139-44. Review. No abstract available.

Bateman TM, Heller GV, McGhie AI, Friedman JD, Case JA, Bryngelson JR, Hertenstein GK, Moutray KL, Reid K, Cullom SJ. “Diagnostic accuracy of rest/stress ECG-gated Rb-82 myocardial perfusion PET: comparison with ECG-gated Tc-99m sestamibi SPECT.” *J Nucl Cardiol.* 2006 Jan-Feb;13(1):24-33.

Di Carli MF, Hachamovitch R. “Should PET replace SPECT for evaluating CAD? The end of the beginning.” *J Nucl Cardiol.* 2006 Jan-Feb;13(1):2-7. No abstract available.

Sdringola S, Loghin C, Boccalandro F, Gould KL. “Mechanisms of progression and regression of coronary artery disease by PET related to treatment intensity and clinical events at long-term follow-up.” *J Nucl Med.* 2006 Jan;47(1):59-67.

Conti A, Sammicheli L, Gallini C, Costanzo EN, Antoniucci D, Barletta G. “Assessment of patients with low-risk chest pain in the emergency department: Head-to-head comparison of exercise stress echocardiography and exercise myocardial SPECT.” *Am Heart J.* 2005 May;149(5):894-901.

Schinkel AF, Elhendy A, Biagini E, van Domburg RT, Valkema R, Rizello V, Pedone C, Simoons M, Bax JJ, Poldermans D. “Prognostic stratification using dobutamine stress 99mTc-tetrofosmin myocardial perfusion SPECT in elderly patients unable to perform exercise testing.” *J Nucl Med*. 2005 Jan;46(1):12-8.

Kontos MC, Tatum JL. “Imaging in the evaluation of the patient with suspected acute coronary syndrome.” *Cardiol Clin.* 2005 Nov;23(4):517-30, vii. Review.

Rao S, Lele V, Lele RD. “Prognostic value of 99mTc-Sestamibi stress Myocardial Perfusion Single Photon Emission Computed Tomography (SPECT) in ischemic heart disease.” *J Assoc Physicians India*. 2005 Dec;53:1036-42.

Beanlands RS, Chow BJ, Dick A, Friedrich MG, Gulenchyn KY, Kiess M, Leong-Poi H, Miller RM, Nichol G, Freeman M, Bogaty P, Honos G, Hudon G, Wisenberg G, Van Berkom J, Williams K, Yoshinaga K, Graham J; Canadian Cardiovascular Society; Canadian Association of Radiologists; Canadian Association of Nuclear Medicine; Canadian Nuclear Cardiology Society; Canadian Society of Cardiac Magnetic Resonance. “CCS/CAR/CANM/CNCS/CanSCMR joint position statement on advanced noninvasive cardiac imaging using positron emission tomography, magnetic resonance imaging and multidetector computed tomographic angiography in the diagnosis and evaluation of ischemic heart disease--executive summary.” *Can J Cardiol*. 2007 Feb;23(2):107-19.

Schinkel A, Bax J, Elhendy A, van Domburg R, Valkema R, Vourvouri E, et al. Long-term prognostic value of dobutamine stress echocardiography compared with myocardial perfusion scanning in patients unable to perform exercise tests. Am J Med 2004;117:1-9.

Olmos L, Dakik H, Gordon R, Dunn J, Verani M, Quinones M, et al. Long-term prognostic value of exercise echocardiography compared with exercise 201TI, ECG, and clinical variables in patients evaluated for coronary artery disease. Circulation 1998;98:2679-2686.

Gould KL, Goldstein RA, Mullani NA. “Economic analysis of clinical positron emission tomography of the heart with rubidium-82.” *J Nucl Med.* 1989 May;30(5):707-17.

Gould KL. “Clinical cardiac positron emission tomography: state of the art. *Circulation.* 1991 Sep;84(3 Suppl):I22-36. Review.

Mullani NA, Caras D, Ahn C, Lundberg G, Page D, Kleinman D, Bladuell N, Weisman E, Patillo M, Posthauer J, Simone G. “Fewer women than men have positive SPECT and PET cardiac findings among patients with no history of heart disease.” *J Nucl Med*. 2000 Feb;41(2):263-8.

Lucignani G, Landoni C, Paolini G, Messa MC, Gilardi MC, Rossetti C, Fazio F. “Positron emission tomography for the assessment of myocardial viability: a synopsis of methods and indications.” *Rays.* 1999 Jan-Mar;24(1):81-95. English, Italian.

Hör G, Kranert WT, Maul FD, Schröder O, Karimian-Tatriz A, Geb O, Baum RP,Scherer UW. “Gated metabolic positron emission tomography (GAPET) of the myocardium: 18F-FDG-PET to optimize recognition of myocardial hibernation.” *Nucl Med Commun.* 1998 Jun;19(6):535-45.

Yonekura Y, Tamaki N, Senda M, Nohara R, Kambara H, Konishi Y, Koide H, Kureshi SA, Saji H, Ban T, et al. “Detection of coronary artery disease with 13N-ammonia and high-resolution positron-emission computed tomography.” *Am Heart J*. 1987 Mar;113(3):645-54.

MacIntyre WJ, Go RT, King JL, Cook SA, Neumann DR, Saha GB, Antar MA. “Clinical outcome of cardiac patients with negative thallium-201 SPECT and positive rubidium-82 PET myocardial perfusion imaging.” *J Nucl Med.* 1993 Mar;34(3):400-4.

Simone GL, Mullani NA, Page DA, Anderson BA Sr. “Utilization statistics and diagnostic accuracy of a nonhospital-based positron emission tomography center for the detection of coronary artery disease using rubidium-82.” *Am J Physiol Imaging*. 1992 Jul-Dec;7(3-4):203-9.

Jadvar H, Strauss HW, Segall GM. “SPECT and PET in the evaluation of coronary artery disease.” *Radiographics.* 1999 Jul-Aug;19(4):915-26. Review.

Barnett K, Feldman JA. Noninvasive imaging techniques to aid in the triage of patients with suspected acute coronary syndrome: a review. Emerg Med Clin North Am. 2005 Nov;23(4):977-98. Review.

Vashist A, Abbott BG. Noninvasive cardiac imaging in the evaluation of suspected acute coronary syndromes. Expert Rev Cardiovasc Ther. 2005 May;3(3):473-86. Review.

Bülow H, Schwaiger M. Nuclear cardiology in acute coronary syndromes. Q J Nucl Med Mol Imaging. 2005 Mar;49(1):59-71. Review.

Kontos MC, Tatum JL. Imaging in the evaluation of the patient with suspected acute coronary syndrome. Semin Nucl Med. 2003 Oct;33(4):246-58. Review.

Abbott BG, Jain D. Impact of myocardial perfusion imaging on clinical management and the utilization of hospital resources in suspected acute coronary syndromes. Nucl Med Commun. 2003 Oct;24(10):1061-9.

Conti A, Zanobetti M, Grifoni S, Berni G, Costanzo E, Gallini C, Ferri P, Pieroni C. Implementation of myocardial perfusion imaging in the early triage of

patients with suspected acute coronary syndromes. Nucl Med Commun. 2003 Oct;24(10):1055-60.

Anand DV, Lahiri A. Myocardial perfusion imaging versus biochemical markers in acute coronary syndromes. Nucl Med Commun. 2003 Oct;24(10):1049-54.

Abbott BG, Wackers FJ. Use of radionuclide imaging in acute coronary syndromes. Curr Cardiol Rep. 2003 Jan;5(1):25-31. Review.

Abbott BG, Jain D. Nuclear cardiology in the evaluation of acute chest pain in the emergency department. Echocardiography. 2000 Aug;17(6 Pt 1):597-604. Review.

Kobayashi H. Myocardial perfusion imagings in acute coronary syndromes. Nippon Rinsho. 1998 Oct;56(10):2539-43. Review. Japanese.

Kim SC, Adams SL, Hendel RC. Role of nuclear cardiology in the evaluation of acute coronary syndromes. Ann Emerg Med. 1997 Aug;30(2):210-8. Review.

Gibbons RJ, Balady GJ, Beasley JW, et al. ACC/AHA Guidelines for Exercise Testing: a report of the American College of Cardiology/American Heart Association Task Force on practice Guidelines (Committee on Exercise Testing). J Am Coll Cardiol 1997;30:260-311.

DeLorenzo A, Hachamovitch R, Kang X, et al. Prognostic value of myocardial perfusion SPECT versus exercise electrocardiography in patients with ST-segment depression on resting electrocardiography. J Nucl Cardiol 2005;12:655-61.

De Winter O, Velghe A, Van de Veire N, et al. Incremental prognostic value of combined perfusion and function assessment during myocardial gated SPECT in patients aged 75 years or older. J Nucl Cardiol 2005;12:662-70.

Schinkel AF, Elhendy A, Biagini E, et al. Prognostic stratification using dobutamine stress 99mTc-tetrofosmin myocardial perfusion SPECT in elderly patients unable to perform exercise testing. J Nucl Med 2005;46:12-8.

Pedone C, Schinkel AF, Elhendy A, et al. Incremental prognostic value of dobutamine-atropine stress 99mTc-tetrofosmin myocardial perfusion imaging for predicting outcome in diabetic patients with limited exercise capacity. Eur J Nucl Med Mol Imaging 2005;32:1057-63.

Fleischmann KE, Humink MG, Kuntz KM, et al. Exercise echocardiography or exercise SPECT imaging? A meta-analysis of diagnostic test performance. JAMA 1998;280:913-20.

Mowatt G, Brazzelli M, Gemmell H, et al. Aberdeen Technology Assessment Group. Systematic review of the prognostic effectiveness of SPECT myocardial perfusion scintigraphy in patient with suspected or known coronary artery disease and following myocardial infarction. Nucl Med Comm 2005;26:217-29.

Giri S, Shaw LJ, Murthy D, et al. Impact of diabetes on the risk stratification using stress single-photon emission computed tomography myocardial perfusion imaging in patients with symptoms suggestive of coronary artery disease. Circulation 2002;105:32-40.

Shaw LJ, Hachamovitch R, Berman DS, et al. The economic consequences of available diagnostic and prognostic strategies for the evaluation of stable angina patients: an observational assessment of the value of precatheterization ischemia. Economics of Noninvasive Diagnosis (END) Multicenter Study Group. J Am Coll Cardiol 1999;33:661-9.

Des Prez RD, Shaw LJ, Gillespie RL, et al. Cost-effectiveness of myocardial perfusion imaging: a summary of the currently available literature. J Nucl Cardiol 2005;12:750-9.

II. References from 2005 SPECT MPI Appropriateness Criteria:

Morise AP, Haddad WJ, Beckner D. “Development and validation of a clinical score to estimate the probability of coronary artery disease in men and women presenting with suspected coronary disease.” *Am J Med* 1997;102:350–6.

Pryor DB, Harrell FE Jr., Lee KL, Califf RM, Rosati RA. “Estimating the likelihood of significant coronary artery disease.” *Am J Med* 1983;75:771– 80.

Diamond GA, Forrester JS. “Analysis of probability as an aid in the clinical diagnosis of coronary-artery disease.” *N Engl J Med* 1979;300: 1350–8.

Table 2. Detection of CAD/Risk Assessment Without Chest Pain Syndrome

	Indication	**Appropriate Use Criteria (Median Score)**
	Asymptomatic	
12	• Low CHD risk (ATP III risk criteria)	
13	• Moderate CHD risk (ATP III risk criteria) • ECG interpretable	

14	• Moderate CHD risk (ATP III risk criteria) • ECG uninterpretable	
15	• High CHD risk (ATP III risk criteria)	
	New-Onset or Newly Diagnosed Heart Failure with LV Systolic Dysfunction Without Ischemic Equivalent	
16	• No prior CAD evaluation AND no planned coronary angiography	
	New-onset Atrial Fibrillation	
17	• Part of evaluation when etiology unclear	
	Ventricular Tachycardia	
18	• Low CHD risk (ATP III risk criteria)	
19	• Moderate or High CHD risk (ATP III risk criteria)	
	Syncope	
20	• Low CHD risk (ATP III risk criteria)	
21	• Moderate or high CHD risk (ATP III risk criteria)	
	Elevated Troponin	
22	• Troponin elevation without additional evidence of acute coronary syndrome	

I. New Lit Search:

Bax JJ, van der Wall EE. "Assessment of coronary artery disease in patients with (a)symptomatic diabetes." *Eur Heart J*. 2006 Mar;27(6):631-2. Epub 2006 Feb 23. No abstract available.

Askew JW, Miller TD, Hodge DO, Gibbons RJ. "The value of myocardial perfusion single-photon emission computed tomography in screening asymptomatic patients with atrial fibrillation for coronary artery disease. *J Am Coll Cardiol*. 2007 Sep 11;50(11):1080-5. Epub 2007 Aug 24.

Haji SA. "Dyspnea and stress testing." *N Engl J Med*. 2006 Feb 23;354(8):871-3; author reply 871-3. No abstract available.

Abidov A, Rozanski A, Hachamovitch R, Hayes SW, Aboul-Enein F, Cohen I, Friedman JD, Germano G, Berman DS. "Prognostic significance of dyspnea in patients referred for cardiac stress testing." *N Engl J Med.* 2005 Nov 3;353(18):1889-98.

Bax JJ, Bonow RO, Tschöpe D, Inzucchi SE, Barrett E; "Global Dialogue Group for the Evaluation of Cardiovascular Risk in Patients With Diabetes. The potential of myocardial perfusion scintigraphy for risk stratification of asymptomatic patients with type 2 diabetes." *J Am Coll Cardiol.* 2006 Aug 15;48(4):754-60. Epub 2006 Jul 24.

Freeman M. "Myocardial perfusion imaging in diabetes mellitus." *Can J Cardiol.* 2006 Feb;22 Suppl A:22A-25A. Review.

Lacourcière Y, Côté C, Lefebvre J, Dumont M. “Noninvasive detection of silent coronary artery disease in patients with essential hypertension, alone or associated with type 2 diabetes mellitus, using dipyridamole stress 99mtechnetium-sestamibi myocardial perfusion imaging.” *Can J Cardiol*. 2006 Feb;22 Suppl A:16A-21A.

Mieres JH, Shaw LJ, Arai A, Budoff MJ, Flamm SD, Hundley WG, Marwick TH, Mosca L, Patel AR, Quinones MA, Redberg RF, Taubert KA, Taylor AJ, Thomas GS, Wenger NK; Cardiac Imaging Committee, Council on Clinical Cardiology, and the Cardiovascular Imaging and Intervention Committee, Council on Cardiovascular Radiology and Intervention, American Heart Association. “Role of noninvasive testing in the clinical evaluation of women with suspected coronary artery disease: Consensus statement from the Cardiac Imaging Committee, Council on Clinical Cardiology, and the Cardiovascular Imaging and Intervention Committee, Council on Cardiovascular Radiology and Intervention, American Heart Association.” *Circulation.* 2005 Feb 8;111(5):682-96. Epub 2005 Feb 1.

Balaravi B, Miller TD, Hodge DO, Gibbons RJ. “The value of stress single photon emission computed tomography in patients without known coronary artery disease presenting with dyspnea.” *Am Heart J.* 2006 Sep;152(3):551-7.

Naidoo VV. “Review of gated SPECT imaging in women with suspected coronary heart disease*.” J Nucl Cardiol*. 2006 Jul;13(4):474-9. Review. No abstract available.

Freeman M. “Myocardial perfusion imaging in diabetes mellitus.” *Can J Cardiol.* 2006 Feb;22 Suppl A:22A-25A. Review.

Elhendy A, Schinkel AF, van Domburg RT, Bax JJ, Valkema R, Huurman A, Feringa HH, Poldermans D. “Risk stratification of patients with angina pectoris by stress 99mTc-tetrofosmin myocardial perfusion imaging.” *J Nucl Med.* 2005 Dec;46(12):2003-8.

Valeti US, Miller TD, Hodge DO, Gibbons RJ. “Exercise single-photon emission computed tomography provides effective risk stratification of elderly men and elderly women.” *Circulation.* 2005 Apr 12;111(14):1771-6. Epub 2005 Apr 4.

Wackers FJ. “Diabetes and coronary artery disease: the role of stress myocardial perfusion imaging.” *Cleve Clin J Med.* 2005 Jan;72(1):21-5, 29-33. Review.

Sdringola S, Patel D, Gould KL. “High prevalence of myocardial perfusion abnormalities on positron emission tomography in asymptomatic persons with a

parent or sibling with coronary artery disease." *Circulation.* 2001 Jan 30;103(4):496-501.

Dayanikli F, Grambow D, Muzik O, Mosca L, Rubenfire M, Schwaiger M. "Early detection of abnormal coronary flow reserve in asymptomatic men at high risk for coronary artery disease using positron emission tomography." *Circulation.* 1994 Aug;90(2):808-17.

Arrighi JA, Ng CK, Dey HM, Wackers FJ, Soufer R. "Effect of left ventricular function on the assessment of myocardial viability by technectium-99m sestamibi and correlation with positron emission tomography in patients with healed myocardial infarcts or stable angina pectoris, or both." *Am J Cardiol*. 1997 Oct 15;80(8):1007-13.

Schinkel AF, Elhendy A, Biagini E, et al. Prognostic stratification using dobutamine stress 99mTc-tetrofosmin myocardial perfusion SPECT in elderly patients unable to perform exercise testing. J Nucl Med 2005;46:12-8.

Pedone C, Schinkel AF, Elhendy A, et al. Incremental prognostic value of dobutamine-atropine stress 99mTc-tetrofosmin myocardial perfusion imaging for predicting outcome in diabetic patients with limited exercise capacity. Eur J Nucl Med Mol Imaging 2005;32:1057-63.

Fleischmann KE, Humink MG, Kuntz KM, et al. Exercise echocardiography or exercise SPECT imaging? A meta-analysis of diagnostic test performance. JAMA 1998;280:913-20.

Mowatt G, Brazzelli M, Gemmell H, et al. Aberdeen Technology Assessment Group. Systematic review of the prognostic effectiveness of SPECT myocardial perfusion scintigraphy in patient with suspected or known coronary artery disease and following myocardial infarction. Nucl Med Comm 2005;26:217-29.

Fuster V, Ryden LE, Cannom DS, et al. ACC/AHA/ESC 2006 guidelines for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association task force on practice guidelines and the European Society of Cardiology Committee for practice guidelines. (Writing Committee to Revise the 2001 Guidelines for the Management of Patients with Atrial Fibrillation). J Am Coll Cardiol 2006;48:e149-246.

Fleg JL, Gerstenblith G, Zonderman A, et al. Prevalence and prognostic significance of exercise-induced silent myocardial ischemia detected by thallium scintigraphy and electrocardiography in asymptomatic volunteers. Circulation 1990;81:428-36.

Danias PG, Papaioannou GI, Ahlberg AW, et al. Usefulness of electrocardiographic-gated stress technetium-99m sestamibi singlephoton emission computed tomography to differentiate ischemic from nonischemic cardiomyopathy. Am J Cardiol 2004;94:14-9.

Danias PG, Ahlberg AW, Clark BA III, et al. Combined assessment of myocardial perfusion and left ventricular function with exercise technetium-99m sestamibi gated single-photon emission computed tomography can differentiate between ischemic and nonischemic dilated cardiomyopathy. Am J Cardiol 1998;82:1253-8.

I. References from 2005 SPECT Appropriateness Criteria:

Grundy SM, Pasternak R, Greenland P, Smith S Jr., Fuster V. "AHA/ACC scientific statement: assessment of cardiovascular risk by use of multiple-risk-factor assessment equations: a statement for healthcare professionals from the American Heart Association and the American College of Cardiology." *J Am Coll Cardiol* 1999;34:1348–59.

Table 3. Risk Assessment With Prior Test Results and/or Known Chronic Stable CAD

	Indication	**Appropriate Use Criteria (Median Score)**
	Asymptomatic OR Stable Symptoms Normal Prior Stress Imaging Study	
23	• Low CHD risk (ATP III risk criteria) • Last stress imaging study done less than 2 years ago	
24	• Intermediate to High CHD risk (ATP III risk criteria) • Last stress imaging study done less than 2 years ago	
25	• Low CHD risk (ATP III risk criteria) • Last stress imaging study done more than 2 years ago	
26	• Intermediate to High CHD risk (ATP III risk criteria) • Last stress imaging study done more than 2 years ago	
	Asymptomatic OR Stable Symptoms Abnormal Coronary Angiography OR Abnormal Prior Stress Imaging Study, No Prior Revascularization	
27	• Known CAD on coronary angiography OR prior abnormal stress imaging study • Last stress imaging study done less than 2 years ago	
28	• Known CAD on coronary angiography OR prior abnormal stress imaging study • Last stress imaging study done more than or equal to 2 years ago	
	Prior non-invasive evaluation	

29	• Equivocal, borderline, or discordant stress testing where obstructive CAD remains a concern	
	New or Worsening Symptoms	
30	• Abnormal coronary angiography OR abnormal prior stress imaging study	
31	• Normal coronary angiography OR normal prior stress imaging study	
	Coronary Angiography (Invasive or Noninvasive)	
32	• Coronary stenosis or anatomic abnormality of uncertain significance.	
	Asymptomatic **Prior Coronary Calcium Agatston Score**	
33	• Agatston score less than 100	
34	• Low to Intermediate CHD risk • Agatston score between 100-400	
35	• High CHD risk • Agatston score between 100-400	
36	• Agatston score greater than 400	
	Duke Treadmill Score	
37	• Low-Risk Duke treadmill score	
38	• Intermediate-Risk Duke treadmill score	
39	• High-Risk Duke treadmill score	

I. New Lit Search:

Berman DS, Shaw LJ, Hachamovitch R, Friedman JD, Polk DM, Hayes SW, Thomson LE, Germano G, Wong ND, Kang X, Rozanski A. "Comparative use of radionuclide stress testing, coronary artery calcium scanning, and noninvasive coronary angiography for diagnostic and prognostic cardiac assessment." *Semin Nucl Med*. 2007 Jan;37(1):2-16. Review.

Ramakrishna G, Miller TD, Breen JF, Araoz PA, Hodge DO, Gibbons RJ. "Relationship and prognostic value of coronary artery calcification by electron beam computed tomography to stress-induced ischemia by single photon emission computed tomography. *Am Heart J* 2007; 153:807-14.

Koehli M, Monbaron D, Prior JO, Calcagni ML, Fivaz-Arbane M, Stauffer JC, Gaillard RC, Bischof Delaloye A, Ruiz J. "SPECT myocardial perfusion imaging: long-term prognostic value in diabetic patients with and without coronary artery disease." *Nuklearmedizin*. 2006;45(2):74-81.

Baghdasarian SB, Heller GV. “The role of myocardial perfusion imaging in the diagnosis of patients with coronary artery disease: developments over the past year.” *Curr Opin Cardiol*. 2005 Sep;20(5):369-74. Review.

Nagao T, Chikamori T, Hida S, Igarashi Y, Kuwabara Y, Nishimura S, Yamazaki J, Yamashina A; Q-PROVE Study Group. “Quantitative gated single-photon emission computed tomography with (99m)Tc sestamibi predicts major cardiac events in elderly patients with known or suspected coronary artery disease: the QGS-Prognostic Value in the Elderly” *(Q-PROVE) Study. Circ J.* 2007 Jul;71(7):1029-34.

Vashist A, Abbott BG. “Noninvasive cardiac imaging in the evaluation of suspected acute coronary syndromes.” *Expert Rev Cardiovasc Ther*. 2005 May;3(3):473-86. Review.

Bülow H, Schwaiger M. “Nuclear cardiology in acute coronary syndromes.” *Q J Nucl Med Mol Imaging.* 2005 Mar;49(1):59-71. Review.

Becker A, Leber A, Becker C, Knez A. “Predictive value of coronary calcifications for future cardiac events in asymptomatic individuals.” *Am Heart J*. 2008 Jan;155(1):154-60. Epub 2007 Oct 17.

Berman DS, Hachamovitch R, Shaw LJ, Friedman JD, Hayes SW, Thomson LE, Fieno DS, Germano G, Wong ND, Kang X, Rozanski A. “Roles of nuclear cardiology, cardiac computed tomography, and cardiac magnetic resonance: Noninvasive risk stratification and a conceptual framework for the selection of noninvasive imaging tests in patients with known or suspected coronary artery disease.” *J Nucl Med.* 2006 Jul;47(7):1107-18. Review.

Bax JJ, Schuifj JD. “Can Coronary Calcification Define the Warranty Period of a Normal Myocardial Perfusion Study?” *Mayo Clinic Proceedings*. 2008 Jan; 83(1): 10-12. Editorial.

Baghdasarian SB, Heller GV. “The role of myocardial perfusion imaging in the diagnosis of patients with coronary artery disease: developments over the past year.” *Curr Opin Cardiol.* 2005 Sep;20(5):369-74. Review.

Ahlberg AW, Baghdasarian SB, Athar H, Thompsen JP, Katten DM, Noble GL, Mamkin I, Shah AR, Leka IA, Heller GV. “Symptom-limited exercise combined with dipyridamole stress: prognostic value in assessment of known or suspected coronary artery disease by use of gated SPECT imaging.” *J Nucl Cardiol.* 2008 Jan-Feb;15(1):42-56.

Askew JW, Miller TD, Araoz PA, Breen JF, Hodge DO, Gibbons RJ. “Abnormal electron beam computed tomography results: the value of repeating myocardial perfusion single-photon emission computed tomography in the

ongoing assessment of coronary artery disease." *Mayo Clin Proc*. 2008 Jan;83(1):17-22.

Becker A, Leber A, Becker C, Knez A. "Predictive value of coronary calcifications for future cardiac events in asymptomatic individuals." *Am Heart J.* 2008 Jan;155(1):154-60. Epub 2007 Oct 17.

Schepis T, Gaemperli O, Koepfli P, Namdar M, Valenta I, Scheffel H, Leschka S, Husmann L, Eberli FR, Luscher TF, Alkadhi H, Kaufmann PA. "Added value of coronary artery calcium score as an adjunct to gated SPECT for the evaluation of coronary artery disease in an intermediate-risk population." *J Nucl Med*. 2007 Sep;48(9):1424-30.

Rosman J, Shapiro M, Pandey A, VanTosh A, Bergmann SR. "Lack of correlation between coronary artery calcium and myocardial perfusion imaging." *J Nucl Cardiol*. 2006 May-Jun;13(3):333-7.

Yang MF, Dou KF, Liu XJ, Yang YJ, He ZX. "Prognostic value of normal exercise 99mTc-sestamibi myocardial tomography in patients with angiographic coronary artery disease." *Nucl Med Commun*. 2006 Apr;27(4):333-8.

Gudmundsson P, Winter R, Dencker M, Kitlinski M, Thorsson O, Ljunggren L, Willenheimer R. "Real-time perfusion adenosine stress echocardiography versus myocardial perfusion adenosine scintigraphy for the detection of myocardial ischaemia in patients with stable coronary artery disease." *Clin Physiol Funct Imaging.* 2006 Jan;26(1):32-8.

Mowatt G, Brazzelli M, Gemmell H, Hillis GS, Metcalfe M, Vale L; Aberdeen Technology Assessment Review Group. "Systematic review of the prognostic effectiveness of SPECT myocardial perfusion scintigraphy in patients with suspected or known coronary artery disease and following myocardial infarction." *Nucl Med Commun*. 2005 Mar;26(3):217-29.

Ahlberg AW, Baghdasarian SB, Athar H, Thompsen JP, Katten DM, Noble GL, Mamkin I, Shah AR, Leka IA, Heller GV. "Symptom-limited exercise combined with dipyridamole stress: prognostic value in assessment of known or suspected coronary artery disease by use of gated SPECT imaging." *J Nucl Cardiol.* 2008 Jan-Feb;15(1):42-56.

Berman DS, Kang X, Slomka PJ, Gerlach J, de Yang L, Hayes SW, Friedman JD, Thomson LE, Germano G. "Underestimation of extent of ischemia by gated SPECT myocardial perfusion imaging in patients with left main coronary artery disease." *J Nucl Cardiol.* 2007 Jul;14(4):521-8.

Parkash R, deKemp RA, Ruddy TD, Kitsikis A, Hart R, Beauchesne L, Williams K, Davies RA, Labinaz M, Beanlands RS. "Potential utility of rubidium

82 PET quantification in patients with 3-vessel coronary artery disease." *J Nucl Cardiol*. 2004 Jul-Aug;11(4):440-9. Erratum in: *J Nucl Cardiol*. 2004 Nov-Dec;11(6):756. Beauschene, L [corrected to Beauchesne, L].

Muzik O, Duvernoy C, Beanlands RS, Sawada S, Dayanikli F, Wolfe ER Jr, Schwaiger M. "Assessment of diagnostic performance of quantitative flow measurements in normal subjects and patients with angiographically documented coronary artery disease by means of nitrogen-13 ammonia and positron emission tomography." *J Am Coll Cardiol.* 1998 Mar 1;31(3):534-40.

Araujo LI, Lammertsma AA, Rhodes CG, McFalls EO, Iida H, Rechavia E, Galassi A, De Silva R, Jones T, Maseri A. "Noninvasive quantification of regional myocardial blood flow in coronary artery disease with oxygen-15-labeled carbon dioxide inhalation and positron emission tomography." *Circulation.* 1991 Mar;83(3):875-85.

Wijns W, Camici PG. "The value of quantitative myocardial perfusion imaging with positron emission tomography in coronary artery disease." *Herz.* 1997 Apr;22(2):87-95. Review.

Haas F, Augustin N, Holper K, Wottke M, Haehnel C, Nekolla S, Meisner H, Lange R, Schwaiger M. "Time course and extent of improvement of dysfunctioning myocardium in patients with coronary artery disease and severely depressed left ventricular function after revascularization: correlation with positron emission tomographic findings." *J Am Coll Cardiol.* 2000 Nov 15;36(6):1927-34.

Di Carli MF, Davidson M, Little R, Khanna S, Mody FV, Brunken RC, Czernin J, Rokhsar S, Stevenson LW, Laks H, et al. "Value of metabolic imaging with positron emission tomography for evaluating prognosis in patients with coronary artery disease and left ventricular dysfunction." *Am J Cardiol.* 1994 Mar 15;73(8):527-33.

Amanullah AM. Diagnostic and prognostic value of myocardial perfusion imaging in patients with known or suspected stable coronary artery disease. Echocardiography. 2000 Aug;17(6 Pt 1):587-95. Review.

Verani MS. Stress myocardial perfusion imaging versus echocardiography for the diagnosis and risk stratification of patients with known or suspected coronary artery disease. Semin Nucl Med. 1999 Oct;29(4):319-29. Review.

Giri S, Shaw LJ, Murthy D, et al. Impact of diabetes on the risk stratification using stress single-photon emission computed tomography myocardial perfusion imaging in patients with symptoms suggestive of coronary artery disease. Circulation 2002;105:32-40.

Hachamovitch R, Berman DS, Shaw LJ, et al. Incremental prognostic value of myocardial perfusion single photon emission computed tomography for the prediction of cardiac death: differential stratification for risk of cardiac death and myocardial infarction. Circulation 1998;97:535-43.

Metz LD, Beattie M, Hom R, et al. The prognostic value of normal myocardial perfusion imaging and exercise echocardiography. J Am Coll Cardiol 2007;49:227-37.

Iskander S, Iskandrian AE. Risk assessment using single-photon emission computed tomographic technetium-99m sestamibi imaging. J Am Coll Cardiol 1998;32:57-62.

Schinkel AF, Elhendy A, Van Domburg RT, et al. Long-term prognostic value of dobutamine stress 99mTc-sestamibi SPECT: single-center experience with 8-year follow-up. Radiology 2002;225:701-6.

Bax JJ, Inzucchi SE, Bonow RO, et al. Cardiac imaging for risk stratification in diabetes. Diabetes Care 2007;30:1295-304.

Hachamovitch R, Hayes S, Friedman JD, et al. Determinants of risk and its temporal variation in patients with normal stress myocardial perfusion scans: what is the warranty period of a normal scan? J Am Coll Cardiol 2003;41:1329-40.

Hachamovitch R, Berman DS, Kiat H, et al. Exercise myocardial perfusion SPECT in patients without known coronary artery disease: incremental prognostic value and use in risk stratification. Circulation 1996;93:905-14.

Garcia MJ, Lessick J, Hoffmann MH. Accuracy of 16-row multidetector computed tomography for the assessment of coronary artery stenosis. JAMA 2006;296:403-11.

Di Carli MF, Hachamovitch R. New technology for noninvasive evaluation of coronary artery disease. Circulation 2007;115:1464-80.

Schuijf JD, Wijns W, Wouter Jukema J, et al. Relationship between noninvasive coronary angiography with multi-slice computed tomography and myocardial perfusion imaging. J Am Coll Cardiol 2006;48:2508-14.

Hacker M, Jakobs T, Matthiesen F, et al. Comparison of spiral multi-detector CT angiography and myocardial perfusion imaging in the noninvasive detection of functionally relevant coronary artery lesions: first clinical experiences. J Nucl Med 2005;46:1294-300.

Table 4. Risk Assessment: Preoperative Evaluation for Non-Cardiac Surgery

	Indication	Appropriate Use Criteria (Median Score)
	Low-Risk Surgery	
40	• Preoperative evaluation for non-cardiac surgery risk assessment	
	Intermediate-Risk Surgery	
41	• Moderate to Good functional capacity (greater than or equal to 4 METs)	
42	• No clinical risk factors†	
43	• Greater than or equal to 1 clinical risk factor • Poor or unknown functional capacity (less than 4 METs)	
44	• Asymptomatic up to 1 year post normal catheterization, non-invasive test, or previous revascularization	
	Vascular Surgery	
45	• Moderate to Good functional capacity (greater than or equal to 4 METs)	
46	• No clinical risk factors†	
47	• Greater than or equal to 1 clinical risk factor • Poor or unknown functional capacity (less than 4 METs)	
48	• Asymptomatic up to 1 year post normal catheterization, non-invasive test, or previous revascularization	

I. New Lit Search:

Watanabe K, Ohsumi Y, Abe H, Hattori M, Minatoguchi S, Fujiwara H. "Benefits of quantitative gated SPECT in evaluation of perioperative cardiac risk in noncardiac surgery." *Ann Nucl Med*. 2007 Dec;21(10):563-8. Epub 2007 Dec 25.

Haas F, Haehnel CJ, Picker W, Nekolla S, Martinoff S, Meisner H, Schwaiger M. "Preoperative positron emission tomographic viability assessment and perioperative and postoperative risk in patients with advanced ischemic heart disease." *J Am Coll Cardiol.* 1997 Dec;30(7):1693-700.

Lucignani G, Paolini G, Landoni C, Zuccari M, Paganelli G, Galli L, Di Credico G, Vanoli G, Rossetti C, Mariani MA, et al. "Presurgical identification of hibernating myocardium by combined use of technetium-99m hexakis 2-methoxyisobutylisonitrile single photon emission tomography and fluorine-18 fluoro-2-deoxy-D-glucose positron emission tomography in patients with coronary artery disease."
Eur J Nucl Med. 1992;19(10):874-81.

Kertai M, Boersma E, Bax J. A meta-analysis comparing the prognostic accuracy of six diagnostic rests for predicting perioperative cardiac risk in patients undergoing major vascular surgery. Heart 2003;89:1327-34.

Hachamovitch R, Berman DS, Shaw LJ, et al. Incremental prognostic value of myocardial perfusion single photon emission computed tomography for the prediction of cardiac death: differential stratification for risk of cardiac death and myocardial infarction. Circulation 1998;97:535-43.

Iskander S, Iskandrian AE. Risk assessment using single-photon emission computed tomographic technetium-99m sestamibi imaging. J Am Coll Cardiol 1998;32:57-62.

Table 5. Risk Assessment: Within 3 Months of an Acute Coronary Syndrome

	Indication	**Appropriate Use Criteria (Median Score)**
	STEMI	
49	• Primary PCI with complete revascularization • No recurrent symptoms	
50	• Hemodynamically stable no recurrent chest pain symptoms or no signs of HF • To evaluate for inducible ischemia • No prior coronary angiography	
51	• Hemodynamically unstable, signs of cardiogenic shock, or mechanical complications	
	UA/NSTEMI	
52	• Hemodynamically stable, no recurrent chest pain symptoms or no signs of HF • To evaluate for inducible ischemia • No prior coronary angiography	
	ACS - Asymptomatic Post Revascularization (PCI or CABG)	
53	• Evaluation prior to hospital discharge	
	Cardiac Rehabilitation	
54	• Prior to initiation of cardiac rehabilitation (as a stand-alone indication)	

I. New Lit Search:

Kontos MC, Tatum JL. “Imaging in the evaluation of the patient with suspected acute coronary syndrome.” *Cardiol Clin.* 2005 Nov;23(4):517-30, vii. Review.

Marso SP, Miller T, Rutherford BD, Gibbons RJ, Qureshi M, Kalynych A, Turco M,Schultheiss HP, Mehran R, Krucoff MW, Lansky AJ, Stone GW. "Comparison of myocardial reperfusion in patients undergoing percutaneous coronary intervention in ST-segment elevation acute myocardial infarction with versus without diabetes mellitus (from the EMERALD Trial)." *Am J Cardiol*. 2007 Jul 15;100(2):206-10. Epub 2007 Jun 4.

De Lorenzo A, Hachamovitch R, Kang X, Gransar H, Sciammarella MG, Hayes SW, Friedman JD, Cohen I, Germano G, Berman DS. "Prognostic value of myocardial perfusion SPECT versus exercise electrocardiography in patients with ST-segment depression on resting electrocardiography." *J Nucl Cardiol.* 2005 Nov-Dec;12(6):655-61.

Bülow H, Schwaiger M. "Nuclear cardiology in acute coronary syndromes." *Q J Nucl Med Mol Imaging*. 2005 Mar;49(1):59-71. Review.

de Silva R, Yamamoto Y, Rhodes CG, Iida H, Nihoyannopoulos P, Davies GJ, Lammertsma AA, Jones T, Maseri A. "Preoperative prediction of the outcome of coronary revascularization using positron emission tomography." *Circulation.* 1992 Dec;86(6):1738-42.

Lee BC, Chen SY, Hsu HC, Su MY, Wu YW, Chien KL, Tseng WY, Chen MF, Lee YT. Effect of cardiac rehabilitation on myocardial perfusion reserve in postinfarction patients. Am J Cardiol. 2008 May 15;101(10):1395-402. Epub 2008 Mar 26.

Atwood E, Jensen D, Froelicher V, Gerber K, Witztum K, Slutsky R, Ashburn W. Radionuclide perfusion images before and after cardiac rehabilitation. Aviat Space Environ Med. 1980 Sep;51(9 Pt 1):892-8.

Table 6. Risk Assessment: Post-Revascularization (PCI or CABG)
I. New Lit Search:

	Indication	**Appropriate Use Criteria (Median Score)**
	Symptomatic	
55	• Evaluation of ischemic equivalent	
	Asymptomatic	
56	• Incomplete revascularization • Additional revascularization feasible	
57	• Less than 5 years after CABG	
58	• Greater than or equal to 5 years after CABG	
59	• Less than 2 years after PCI	

60	• Greater than or equal to 2 years after PCI	
	Cardiac Rehabilitation	
61	• Prior to initiation of cardiac rehabilitation (as a stand-alone indication)	

Slart RH, Bax JJ, van Veldhuisen DJ, van der Wall EE, Dierckx RA, de Boer J, Jager PL. "Prediction of functional recovery after revascularization in patients with coronary artery disease and left ventricular dysfunction by gated FDG-PET." *J Nucl Cardiol.* 2006 Mar-Apr;13(2):210-9.

Adams GL, Ambati SR, Adams JM, Borges-Neto S. "Role of nuclear imaging after coronary revascularization." *J Nucl Cardiol.* 2006 Mar-Apr;13(2):163-9. Review. No abstract available.

Acampa W, Evangelista L, Petretta M, Liuzzi R, Cuocolo A. "Usefulness of stress cardiac single-photon emission computed tomographic imaging late after percutaneous coronary intervention for assessing cardiac events and time to such events." *Am J Cardiol.* 2007 Aug 1;100(3):436-41. Epub 2007 Jun 13.

Wu YW, Tadamura E, Yamamuro M, Kanao S, Marui A, Tanabara K, Komeda M, Togashi K. "Comparison of contrast-enhanced MRI with (18)F-FDG PET/201Tl SPECT in dysfunctional myocardium: relation to early functional outcome after surgical revascularization in chronic ischemic heart disease." *J Nucl Med*. 2007 Jul;48(7):1096-103. Erratum in: J Nucl Med. 2007 Nov;48(11):1789.

Fenchel M, Franow A, Stauder NI, Kramer U, Helber U, Claussen CD, Miller S. "Myocardial perfusion after angioplasty in patients suspected of having single-vessel coronary artery disease: improvement detected at rest-stress first-pass perfusion MR imaging--initial experience." *Radiology.* 2005 Oct;237(1):67-74. Epub 2005 Aug 26.

Beanlands RS, Ruddy TD, deKemp RA, Iwanochko RM, Coates G, Freeman M, Nahmias C, Hendry P, Burns RJ, Lamy A, Mickleborough L, Kostuk W, Fallen E, Nichol G; PARR Investigators. "Positron emission tomography and recovery following revascularization (PARR-1): the importance of scar and the development of a prediction rule for the degree of recovery of left ventricular function." *J Am Coll Cardiol*. 2002 Nov 20;40(10):1735-43.

Adams GL, Ambati SR, Adams JM, Borges-Neto S. Role of nuclear imaging after coronary revascularization. J Nucl Cardiol 2006;13:163-9.

Zellweger MJ, Lewin HC, Lai S, et al. When to stress patients after coronary artery bypass surgery? Risk stratification in patients early and late post-

CABG using stress myocardial perfusion SPECT: implications of appropriate clinical strategies. J Am Coll Cardiol 2001;37:144-52.

Lauer MS, Lytle B, Pashkow F, Snader CE, Marwick TH. Prediction of death and myocardial infarction by screening with exercise-thallium testing after coronary-artery-bypass grafting. Lancet 1998;351:615-22.

Bergmann SR, Giedd KN. Silent ischemia: unsafe at any time. J Am Coll Cardiol 2003;42:41-4.

Cottin Y, Rezaizadeh K, Touzery C, et al. Long-term prognostic value of 201Tl single-photon emission computed tomographic myocardial perfusion imaging after coronary stenting. Am Heart J 2001;141:999-1006.

Zellweger MJ, Weinbacher M, Zutter AW, et al. Long-term outcome of patients with silent versus symptomatic ischemia six months after percutaneous coronary intervention and stenting. J Am Coll Cardiol 2003;42:33-40.

Pfisterer M, Rickenbacher P, Kiowski W, Müller-Brand J, Burkart F. Silent ischemia after percutaneous coronary angioplasty: incidence and prognostic significance. J Am Coll Cardiol 1993;22:1446-54.

Ruygrok PN, Webster MW, de Valk V, et al. Clinical and angiographic factors associated with asymptomatic restenosis after percutaneous coronary intervention. Circulation 2001;104:2289-94.

Hecht HS, Shaw RE, Chin HL, Ryan C, Stertzer SH, Myler RK. Silent ischemia after coronary angioplasty: evaluation of restenosis and extent of ischemia in asymptomatic patients by tomographic thallium-201 exercise imaging and comparison with symptomatic patients. J Am Coll Cardiol 1991;17:670-7.

Marie PY, Danchin N, Karcher G, et al. Usefulness of exercise SPECT-thallium to detect asymptomatic restenosis in patients who had angina before coronary angioplasty. Am Heart J 1993;126:571-7.

Table 7. Assessment of Viability/Ischemia

	Indication	**Appropriate Use Criteria (Median Score)**
	Ischemic Cardiomyopathy/Assessment of Viability	
62	• Known severe LV dysfunction • Patient eligible for revascularization	

I. New Lit Search:

Di Carli MF, Dorbala S, Curillova Z, Kwong RJ, Goldhaber SZ, Rybicki FJ,

Hachamovitch R.. “Relationship between CT coronary angiography and stress perfusion imaging in patients with suspected ischemic heart disease assessed by integrated PET-CT imaging.” *J Nucl Cardiol.* 2007 Nov-Dec;14(6):799-809. Epub 2007 Oct 22.

Banerjee SK, Haque KM, Sharma AK, Ahmed CM, Iqbal AT, Nisa L. “Role of exercise tolerance test (ETT) and gated single photon emission computed tomography-myocardial perfusion imaging (SPECT-MPI) in predicting severity of ischemia in patients with chest pain.” *Bangladesh Med Res Counc Bull*. 2005 Apr;31(1):27-35.

Berman DS, Kang X, Slomka PJ, Gerlach J, de Yang L, Hayes SW, Friedman JD, Thomson LE, Germano G. “Underestimation of extent of ischemia by gated SPECT myocardial perfusion imaging in patients with left main coronary artery disease.” *J Nucl Cardiol*. 2007 Jul;14(4):521-8.

Tzonevska A, Tzvetkov K, Dimitrova M, Piperkova E. “Assessment of myocardial viability with (99m)Tc-sestamibi -gated SPET images in patients undergoing percutaneous transluminar coronary angioplasty.” *Hell J Nucl Med.* 2005 Jan-Apr;8(1):48-53.

Sharir T. “Role of regional myocardial dysfunction by gated myocardial perfusion SPECT in the prognostic evaluation of patients with coronary artery disease.” *J Nucl Cardiol.* 2005 Jan-Feb;12(1):5-8. No abstract available.

Arrighi JA, Dilsizian V. “Assessment of myocardial viability by radionuclide and echocardiographic techniques: is it simply a sensitivity and specificity issue?” *Curr Opin Cardiol.* 2006 Sep;21(5):450-6. Review.

Ghesani M, Depuey EG, Rozanski A. “Role of F-18 FDG positron emission tomography (PET) in the assessment of myocardial viability.” *Echocardiography.* 2005 Feb;22(2):165-77. Review.

Arrighi JA, Ng CK, Dey HM, Wackers FJ, Soufer R. “Effect of left ventricular function on the assessment of myocardial viability by technectium-99m sestamibi and correlation with positron emission tomography in patients with healed myocardial infarcts or stable angina pectoris, or both.” *Am J Cardiol.* 1997 Oct 15;80(8):1007-13.

Ling LH, Christian TF, Mulvagh SL, Klarich KW, Hauser MF, Nishimura RA,,Pellikka PA. Determining myocardial viability in chronic ischemic left ventricular dysfunction: A prospective comparison of rest-redistribution thallium 201 single-photon emission computed tomography, nitroglycerin-dobutamine echocardiography, and intracoronary myocardial contrast echocardiography. Am Heart J 151:882-9, 2006.

Bisi G, Podio V, Sciagrà R. “Detection of myocardial viability with 99mTc-labelled myocardial perfusion agents.” *Q J Nucl Med.* 1996 Mar;40(1):68-75. Review.

Landoni C, Lucignani G, Paolini G, Zuccari M, Galli L, Di Credico G, Rossetti C, Pelenghi S, Gilardi MC, Fazio F, Grossi A. “Assessment of CABG-related risk in patients with CAD and LVD. Contribution of PET with [18F]FDG to the assessment of myocardial viability.” *J Cardiovasc Surg (Torino).* 1999 Jun;40(3):363-72.

Vom Dahl J, Altehoefer C, Sheehan FH, Buechin P, Schulz G, Schwarz ER, Koch KC, Uebis R, Messmer BJ, Buell U, Hanrath P. “Effect of myocardial viability assessed by technetium-99m-sestamibi SPECT and fluorine-18-FDG PET on clinical outcome in coronary artery disease.” *J Nucl Med.* 1997 May;38(5):742-8.

Yamakawa Y, Takahashi N, Ishikawa T, Uchino K, Mochida Y, Ebina T, Kobayashi T, Matsushita K, Matsumoto K, Kawasaki N, Shimura M, Ohkusu Y, Sumita S, Kimura K, Inoue T, Umemura S. “Clinical usefulness of ECG-gated 18F-FDG PET combined with 99mTC-MIBI gated SPECT for evaluating myocardial viability and function.” *Ann Nucl Med.* 2004 Jul;18(5):375-83.

Grandin C, Wijns W, Melin JA, Bol A, Robert AR, Heyndrickx GR, Michel C, Vanoverschelde JL. “Delineation of myocardial viability with PET.” *J Nucl Med*. 1995 Sep;36(9):1543-52.

Maddahi J, Schelbert H, Brunken R, Di Carli M. “Role of thallium-201 and PET imaging in evaluation of myocardial viability and management of patients with coronary artery disease and left ventricular dysfunction.” *J Nucl Med*. 1994 Apr;35(4):707-15. Review.

Schröter G, Schneider-Eicke J, Schwaiger M. “Assessment of tissue viability with fluorine-18-fluoro-2-deoxyglucose (FDG) and carbon-11-acetate PET imaging.” *Herz.* 1994 Feb;19(1):42-50. Review.

Brunken RC, Mody FV, Hawkins RA, Nienaber C, Phelps ME, Schelbert HR. “Positron emission tomography detects metabolic viability in myocardium with persistent 24-hour single-photon emission computed tomography 201Tl defects.” *Circulation.* 1992 Nov;86(5):1357-69.

Table 8. Evaluation of Ventricular Function

	Indication	**Appropriate Use Criteria (Median Score)**
	Evaluation of Left Ventricular Function	

63	• Assessment of LV function with radionuclide angiography (ERNA or FP (first pass) RNA) • In absence of recent reliable diagnostic information regarding ventricular function obtained with another imaging	
64	• Routine+ use of rest/stress ECG-gating with SPECT or PET myocardial perfusion imaging	
65	• Routine+ use of stress FP RNA in conjunction with rest/stress gated SPECT MPI	
66	• Selective use of stress FP RNA in conjunction with rest/stress gated SPECT MPI • Borderline, mild, or moderate stenoses in three vessels OR moderate or equivocal left main stenosis in left dominant system	
	Use of Potentially Cardiotoxic Therapy (e.g., Doxorubicin)	
67	• Serial assessment of LV function with radionuclide angiography (ERNA or FP RNA) • Baseline and serial measures after key therapeutic milestones or evidence of toxicity	

I. New Lit Search:

Kim IJ, Choo KS, Lee JS, Kim SJ, Kim JH, Kim YK, Kim DS, Cho HJ. "Comparison of gated blood pool SPECT and multi-detector row computed tomography for measurements of left ventricular volumes and ejection fraction in patients with atypical chest pain: validation with radionuclide ventriculography." *Cardiology.* 2007;107(1):8-16. Epub 2006 May 24.

Chareonthaitawee P, Sorajja P, Rajagopalan N, Miller TD, Hodge DO, Frye RL, Gibbons RJ. "Prevalence and prognosis of left ventricular systolic dysfunction in asymptomatic diabetic patients without known coronary artery disease referred for stress single-photon emission computed tomography and assessment of left ventricular function." *Am Heart J.* 2007 Sep;154(3):567-74.

Demir H, Tan YZ, Kozdag G, Isgoren S, Anik Y, Ural D, Demirci A, Berk F. "Comparison of gated SPECT, echocardiography and cardiac magnetic resonance imaging for the assessment of left ventricular ejection fraction and volumes*." Ann Saudi Med.* 2007 Nov-Dec;27(6):415-20.

Khorsand A, Graf S, Eidherr H, Wadsak W, Kletter K, Sochor H, Schuster E, Porenta G. "Gated cardiac 13N-NH3 PET for assessment of left ventricular volumes, mass, and ejection fraction: comparison with electrocardiography-gated 18F-FDG PET." *J Nucl Med.* 2005 Dec;46(12):2009-13.

Bigi R, Bestetti A, Strinchini A, Conte A, Gregori D, Brusoni B, Fiorentini C. "Combined assessment of left ventricular perfusion and function by gated

single-photon emission computed tomography for the risk stratification of high-risk hypertensive patients." *J Hypertens.* 2006 Apr;24(4):767-73.

Kanayama S, Matsunari I, Kajinami K. "Comparison of gated N-13 ammonia PET and gated Tc-99m sestamibi SPECT for quantitative analysis of global and regional left ventricular function." *J Nucl Cardiol.* 2007 Sep-Oct;14(5):680-7.

Sharir T. "Gated myocardial perfusion imaging for the assessment of left ventricular function and volume: from SPECT to PET." *J Nucl Cardiol.* 2007 Sep-Oct;14(5):631-3. No abstract available.

Sciagrà R. "The expanding role of left ventricular functional assessment using gated myocardial perfusion SPECT: the supporting actor is stealing the scene." *Eur J Nucl Med Mol Imaging.* 2007 Jul;34(7):1107-22. Review.

Hida S, Chikamori T, Tanaka H, Usui Y, Igarashi Y, Nagao T, Yamashina A. "Diagnostic value of left ventricular function after stress and at rest in the detection of multivessel coronary artery disease as assessed by electrocardiogram-gated SPECT." *J Nucl Cardiol.* 2007 Jan;14(1):68-74.

Lim TK, Senior R. "Noninvasive modalities for the assessment of left ventricular function: all are equal but some are more equal than others." *J Nucl Cardiol.* 2006 Jul;13(4):445-9. No abstract available.

Schepis T, Gaemperli O, Koepfli P, Valenta I, Strobel K, Brunner A, Leschka S, Desbiolles L, Husmann L, Alkadhi H, Kaufmann PA. "Comparison of 64-slice CT with gated SPECT for evaluation of left ventricular function." *J Nucl Med*. 2006 Aug;47(8):1288-94.

Iskandrian AE, Heo J, Mehta D, Tauxe EL, Yester M, Hall MB, MacGregor JM. "Gated SPECT perfusion imaging for the simultaneous assessment of myocardial perfusion and ventricular function in the BARI 2D trial: an initial report from the Nuclear Core Laboratory." *J Nucl Cardiol.* 2006 Jan-Feb;13(1):83-90.

Djaballah W, Muller MA, Bertrand AC, Marie PY, Chalon B, Djaballah K, Olivier P, Codreanu A, Karcher G, Bertrand A. "Gated SPECT assessment of left ventricular function is sensitive to small patient motions and to low rates of triggering errors: a comparison with equilibrium radionuclide angiography." *J Nucl Cardiol.* 2005 Jan-Feb;12(1):78-85.

Kanayama S, Matsunari I, Hirayama A, Kitayama M, Matsudaira M, Yoneyama T, Nekolla SG, Hisada K, Kajinami K, Takekoshi N. "Assessment of global and regional left ventricular function by electrocardiographic gated N-13 ammonia positron emission tomography in patients with coronary artery disease." *Circ J.* 2005 Feb;69(2):177-82.

Tout DA, Rogers A, Van Aswegen A, Underwood SR. “Left ventricular function parameters obtained from gated myocardial perfusion SPECT imaging: a comparison of two data processing systems.” *Nucl Med Commun*. 2005 Feb;26(2):103-7.

McFalls EO, Baldwin D, Kuskowski M, Liow J, Chesler E, Ward HB. “Utility of positron emission tomography in predicting improved left ventricular ejection fraction after coronary artery bypass grafting among patients with ischemic cardiomyopathy.” *Cardiology.* 2000;93(1-2):105-12.

Santana CA, Shaw LJ, Garcia EV, Soler-Peter M, Candell-Riera J, Grossman GB, Krawczynska EG, Faber TL, Ribera A, Vaccarino V, Halkar R, Di Carli MF. “Incremental prognostic value of left ventricular function by myocardial ECG-gated FDG PET imaging in patients with ischemic cardiomyopathy.” *J Nucl Cardiol.* 2004 Sep-Oct;11(5):542-50.

Slart RH, Bax JJ, de Jong RM, de Boer J, Lamb HJ, Mook PH, Willemsen AT, Vaalburg W, van Veldhuisen DJ, Jager PL. “Comparison of gated PET with MRI for evaluation of left ventricular function in patients with coronary artery disease.” *J Nucl Med.* 2004 Feb;45(2):176-82.

Soufer R, Dey HM, Ng CK, Zaret BL. “Comparison of sestamibi single-photon emission computed tomography with positron emission tomography for estimating left ventricular myocardial viability.” *Am J Cardiol*. 1995 Jun 15;75(17):1214-9.

Appropriate Use Criteria for Cardiac Radionuclide Imaging

Cardiac Radionuclide Imaging
(SPECT or PET Myocardial Perfusion Imaging)

RELEVANT GUIDELINE RECOMMENDATIONS

Assumptions:

1. Panel members were to assume that all radionuclide techniques with specifically different radiopharmaceuticals and imaging protocols were available for each indication, and that each was performed in a manner similar to that found in the published literature.

2. Radionuclide imaging is performed in accordance with best practice standards as delineated in the imaging guidelines for nuclear cardiology procedures (*J Nucl Cardiol* 2006;13:e21-171) It is also assumed that procedures are performed in an accredited facility, with appropriately credentialed physicians.

3. Unless otherwise noted, all indications referred to gated SPECT MPI and PET MPI. All radionuclide perfusion imaging indications also assume gated SPECT MPI and PET MPI determination of global ventricular function (i.e., left ventricular ejection fraction) and regional wall motion as part of the evaluation.

4. For all stress imaging, the mode of stress testing was assumed to be exercise for patients able to exercise. For patients unable to exercise, pharmacologic stress testing was assumed to be used. Further background on the rationale for the assumption of exercise testing is available in the ACC/AHA 2002 Guideline Update for Exercise Testing (8).
5. In the setting of a known ACS, the use of stress testing should be performed in conjunction with pharmacologic stress testing not exercise.

6. The use of testing in the perioperative setting is assumed to have the potential to impact clinical decision making and to direct therapeutic interventions.

7. The category of uncertain should be used when insufficient clinical data
is available for a definitive categorization or there is substantial disagreement regarding the appropriateness of that indication. The designation of “uncertain” is assumed to not provide grounds for denial of reimbursement.

Table 1. Detection of CAD: Symptomatic

Indication	Guideline Recommendations
Evaluation of Ischemic Equivalent (Non-Acute)	
1. **Evaluation of Ischemic Equivalent (Non-Acute)** ▪ Pre-test Probability of CAD: **Low** ▪ Test Results: **ECG: Interpretable** **AND** ▪ Exercise Ability: **Able to exercise**	***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Able to Exercise** **Class IIb** Exercise myocardial perfusion imaging, exercise echocardiography, adenosine or dipyridamole myocardial perfusion imaging, or dobutamine echocardiography as the initial stress test in a patient with a normal rest ECG who is not taking digoxin. *(Level of Evidence: B)* Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with a low or high probability of CAD in the absence of electronically paced ventricular rhythm or left bundle-branch block. *(Level of Evidence: B)*
2. **Evaluation of Ischemic Equivalent (Non-Acute)** ▪ Pre-test Probability of CAD: **Low** ▪ Test Results: **ECG: Uninterpretable** **OR** ▪ Exercise Ability: **Unable to exercise**	***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Unable to Exercise** **Class IIb** Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with a low or high probability of CAD in the absence of electronically paced ventricular rhythm or left bundle-branch block. *(Level of Evidence: B)* Exercise myocardial perfusion imaging or exercise echocardiography in patients with a low or high probability of CAD who have one of the following baseline ECG abnormalities: a. Pre-excitation (Wolff-Parkinson-White) syndrome. (Level of Evidence: B) b. More than 1 mm of ST depression. (Level of Evidence: B)

3. **Evaluation of Ischemic Equivalent (Non-Acute)** ▪ Pre-test Probability of CAD: **Intermediate** ▪ Test Results: **ECG: Interpretable** **AND** ▪ Exercise Ability: **Able to exercise**	***RNI (p. 24 - 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class I** Adenosine or dipyridamole myocardial perfusion SPECT in patients with LBBB or electronically-paced ventricular rhythm. *(Level of Evidence: B)* Exercise myocardial perfusion SPECT to identify the extent, severity, and location of ischemia in patients who do not have LBBB or an electronically-paced ventricular rhythm but do have a baseline ECG abnormality which interferes with the interpretation of exercise-induced ST segment changes (ventricular pre-excitation, LVH, digoxin therapy, or more than 1 mm ST depression). *(Level of Evidence: B)* ***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Able to Exercise** **Class IIb** Exercise myocardial perfusion imaging, exercise echocardiography, adenosine or dipyridamole myocardial perfusion imaging, or dobutamine echocardiography as the initial stress test in a patient with a normal rest ECG who is not taking digoxin. *(Level of Evidence: B)*

4. **Evaluation of Ischemic Equivalent (Non-Acute)** ▪ Pre-test Probability of CAD: **Intermediate** ▪ Test Results: **ECG: Uninterpretable** **OR** ▪ Exercise Ability: **Unable to exercise**	***RNI (p. 24 - 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Unable to Exercise.** **Class I** Adenosine or dipyridamole myocardial perfusion SPECT to identify the extent, severity, and location of ischemia. *(Level of Evidence: B)* **Class IIa** Adenosine or dipyridamole myocardial perfusion SPECT as the initial test in patients who are considered to be at high risk (patients with diabetes or patients otherwise defined as having a more than 20% 10-year risk of a coronary heart disease event). *(Level of Evidence: B)* ***RNI PET (p. e27)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk** **Stratification of Patients With an Intermediate or High Likelihood of CAD** **Class IIa** Adenosine or dipyridamole myocardial perfusion PET to identify the extent, severity, and location of ischemia as the initial diagnostic test in patients who are unable to exercise. (Level of Evidence: B) ***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Unable to Exercise** **Class I** 1. Adenosine or dipyridamole myocardial perfusion imaging or dobutamine echocardiography in patients with an intermediate pretest probability of CAD. *(Level of Evidence: B)*

5. **Evaluation of Ischemic Equivalent (Non-Acute)** ▪ Pre-test Probability of CAD: **High** ▪ Test Results: **ECG: Regardless** ▪ Exercise Ability: **Regardless**	***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Able to Exercise** **Class IIb** Exercise myocardial perfusion imaging, exercise echocardiography, adenosine or dipyridamole myocardial perfusion imaging, or dobutamine echocardiography as the initial stress test in a patient with a normal rest ECG who is not taking digoxin. *(Level of Evidence: B)* Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with a low or high probability of CAD in the absence of electronically paced ventricular rhythm or left bundle-branch block. *(Level of Evidence: B)* Exercise myocardial perfusion imaging or exercise echocardiography in patients with a low or high probability of CAD who have one of the following baseline ECG abnormalities: a. Pre-excitation (Wolff-Parkinson-White) syndrome. (Level of Evidence: B) b. More than 1 mm of ST depression. (Level of Evidence: B) **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Unable to Exercise** **Class IIb** Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with a low or high probability of CAD in the absence of electronically paced ventricular rhythm or left bundle-branch block. (Level of Evidence: B) ***RNI (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class IIa** Exercise myocardial perfusion SPECT as the initial test in patients who are considered to be at high risk (patients with diabetes or patients otherwise defined as having a more than 20% 10-year risk of a coronary heart disease event). *(Level of Evidence: B)* **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Unable to Exercise.** **Class IIa** Adenosine or dipyridamole myocardial perfusion SPECT as the initial test in patients who are considered to be at high risk (patients with diabetes or patients otherwise defined as having a more than 20% 10-year risk of a coronary heart disease event). *(Level of Evidence: B)* ***RNI PET (p. e27)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD** **Class IIa** Adenosine or dipyridamole myocardial perfusion PET to identify the extent, severity, and location of ischemia as the initial diagnostic test in patients who are unable to exercise. (Level of Evidence: B) Adenosine or dipyridamole myocardial perfusion PET to identify the extent, severity, and location of ischemia as the initial diagnostic test in patients who are able to exercise but have LBBB or an electronically-paced rhythm. (Level of Evidence: B)

Acute Chest Pain	
6. Acute Chest Pain ▪ **Possible ACS** ▪ Test Results: **ECG: no ischemic changes or with LBBB or electronically ventricular paced rhythm** **Low-risk TIMI score** **Peak Troponin: borderline, equivocal, minimally elevated**	***UA/NSTEMI (p. e11)*** **Immediate Management** **Class I** In patients with suspected ACS in whom ischemic heart disease is present or suspected, if the follow up 12-lead ECG and biomarker measurements are normal, a stress test (exercise or pharmacological) to provoke ischemia should be performed in the ED, in a chest pain unit, or on an outpatient basis in a timely fashion (within 72 h) as an alternative to inpatient admission. Low-risk patients with a negative stress diagnostic test can be managed as outpatients. (Level of Evidence: C) Patients with possible ACS and negative cardiac biomarkers who are unable to exercise or who have an abnormal resting ECG should undergo a pharmacological stress test. *(Level of Evidence: B* **Immediate Management (p. e31)** **Class IIa** In patients with suspected ACS with a low or intermediate probability of CAD, in whom the follow-up 12-lead ECG and cardiac biomarkers measurements are normal, performance of a noninvasive coronary imaging test (i.e., CCTA) is reasonable as an alternative to stress testing. (Level of Evidence: B) ***RNI (p. 7, Table 2)*** **Recommendations for Emergency Department Imaging for Suspected Acute Coronary Syndromes** **Class III** Routine imaging of patients with myocardial ischemia necrosis already documented clinically, by ECG and/or serum markers or enzymes. *(Level of Evidence: C)*

7. **Acute Chest Pain** ▪ **Possible ACS** ▪ Test Results: **ECG: no ischemic changes or with LBBB or electronically ventricular paced rhythm** **High-risk TIMI score** **Peak Troponin: borderline, equivocal, minimally elevated**	***UA/NSTEMI (p. e11)*** **Immediate Management** **Class I** In patients with suspected ACS in whom ischemic heart disease is present or suspected, if the follow up 12-lead ECG and biomarker measurements are normal, a stress test (exercise or pharmacological) to provoke ischemia should be performed in the ED, in a chest pain unit, or on an outpatient basis in a timely fashion (within 72 h) as an alternative to inpatient admission. Low-risk patients with a negative stress diagnostic test can be managed as outpatients. (Level of Evidence: C) Patients with possible ACS and negative cardiac biomarkers who are unable to exercise or who have an abnormal resting ECG should undergo a pharmacological stress test. *(Level of Evidence: B* **Immediate Management (p. e31)** **Class IIa** In patients with suspected ACS with a low or intermediate probability of CAD, in whom the follow-up 12-lead ECG and cardiac biomarkers measurements are normal, performance of a noninvasive coronary imaging test (i.e., CCTA) is reasonable as an alternative to stress testing. (Level of Evidence: B) ***RNI (p. 7, Table 2)*** **Recommendations for Emergency Department Imaging for Suspected Acute Coronary Syndromes** **Class III** Routine imaging of patients with myocardial ischemia necrosis already documented clinically, by ECG and/or serum markers or enzymes. *(Level of Evidence: C)*

8. **Acute Chest Pain** ▪ **Possible ACS** ▪ Test Results: **ECG: no ischemic changes or with LBBB or electronically ventricular paced rhythm** **Low-risk TIMI score** ▪ **Negative peak troponin levels**	***UA/NSTEMI (p. e11)*** **Immediate Management** **Class I** In patients with suspected ACS in whom ischemic heart disease is present or suspected, if the follow up 12-lead ECG and biomarker measurements are normal, a stress test (exercise or pharmacological) to provoke ischemia should be performed in the ED, in a chest pain unit, or on an outpatient basis in a timely fashion (within 72 h) as an alternative to inpatient admission. Low-risk patients with a negative stress diagnostic test can be managed as outpatients. (Level of Evidence: C) Patients with possible ACS and negative cardiac biomarkers who are unable to exercise or who have an abnormal resting ECG should undergo a pharmacological stress test. *(Level of Evidence: B* **Immediate Management (p. e31)** **Class IIa** In patients with suspected ACS with a low or intermediate probability of CAD, in whom the follow-up 12-lead ECG and cardiac biomarkers measurements are normal, performance of a noninvasive coronary imaging test (i.e., CCTA) is reasonable as an alternative to stress testing. (Level of Evidence: B) ***RNI (p. 7, Table 2)*** **Recommendations for Emergency Department Imaging for Suspected Acute Coronary Syndromes** **Class III** Routine imaging of patients with myocardial ischemia necrosis already documented clinically, by ECG and/or serum markers or enzymes. *(Level of Evidence: C)*

9. **Acute Chest Pain** ▪ **Possible ACS** ▪ Test Results: **ECG: no ischemic changes or with LBBB or electronically ventricular paced rhythm** **High-risk TIMI score** ▪ **Negative peak troponin levels**	***UA/NSTEMI (p. e11)*** **Immediate Management** **Class I** In patients with suspected ACS in whom ischemic heart disease is present or suspected, if the follow up 12-lead ECG and biomarker measurements are normal, a stress test (exercise or pharmacological) to provoke ischemia should be performed in the ED, in a chest pain unit, or on an outpatient basis in a timely fashion (within 72 h) as an alternative to inpatient admission. Low-risk patients with a negative stress diagnostic test can be managed as outpatients. (Level of Evidence: C) Patients with possible ACS and negative cardiac biomarkers who are unable to exercise or who have an abnormal resting ECG should undergo a pharmacological stress test. *(Level of Evidence: B* **Immediate Management (p. e31)** **Class IIa** In patients with suspected ACS with a low or intermediate probability of CAD, in whom the follow-up 12-lead ECG and cardiac biomarkers measurements are normal, performance of a noninvasive coronary imaging test (i.e., CCTA) is reasonable as an alternative to stress testing. (Level of Evidence: B) ***RNI (p. 7, Table 2)*** **Recommendations for Emergency Department Imaging for Suspected Acute Coronary Syndromes** **Class III** Routine imaging of patients with myocardial ischemia necrosis already documented clinically, by ECG and/or serum markers or enzymes. *(Level of Evidence: C)*

10. **Acute Chest Pain** ▪ **Definite ACS**	***UA/NSTEMI (p. e11)*** **Immediate Management** **Class I** In patients with suspected ACS in whom ischemic heart disease is present or suspected, if the follow up 12-lead ECG and biomarker measurements are normal, a stress test (exercise or pharmacological) to provoke ischemia should be performed in the ED, in a chest pain unit, or on an outpatient basis in a timely fashion (within 72 h) as an alternative to inpatient admission. Low-risk patients with a negative stress diagnostic test can be managed as outpatients. (Level of Evidence: C) Patients with possible ACS and negative cardiac biomarkers who are unable to exercise or who have an abnormal resting ECG should undergo a pharmacological stress test. *(Level of Evidence: B* **Immediate Management (p. e31)** **Class IIa** In patients with suspected ACS with a low or intermediate probability of CAD, in whom the follow-up 12-lead ECG and cardiac biomarkers measurements are normal, performance of a noninvasive coronary imaging test (i.e., CCTA) is reasonable as an alternative to stress testing. (Level of Evidence: B) ***RNI (p. 7, Table 2)*** **Recommendations for Emergency Department Imaging for Suspected Acute Coronary Syndromes** **Class III** Routine imaging of patients with myocardial ischemia necrosis already documented clinically, by ECG and/or serum markers or enzymes. *(Level of Evidence: C)*
Acute Chest Pain (Rest Imaging Only)	

11. **Acute Chest Pain (Rest Imaging Only)** ▪ **Possible ACS** ▪ Test Results: **ECG: no ischemic changes or with LBBB or electronically ventricular paced rhythm** ▪ **Initial troponin negative** ▪ **Recent or on-going chest pain**	***UA/NSTEMI (p. e11)*** **Immediate Management** **Class I** In patients with suspected ACS in whom ischemic heart disease is present or suspected, if the follow up 12-lead ECG and biomarker measurements are normal, a stress test (exercise or pharmacological) to provoke ischemia should be performed in the ED, in a chest pain unit, or on an outpatient basis in a timely fashion (within 72 h) as an alternative to inpatient admission. Low-risk patients with a negative stress diagnostic test can be managed as outpatients. (Level of Evidence: C) Patients with possible ACS and negative cardiac biomarkers who are unable to exercise or who have an abnormal resting ECG should undergo a pharmacological stress test. *(Level of Evidence: B* **Immediate Management (p. e31)** **Class IIa** In patients with suspected ACS with a low or intermediate probability of CAD, in whom the follow-up 12-lead ECG and cardiac biomarkers measurements are normal, performance of a noninvasive coronary imaging test (i.e., CCTA) is reasonable as an alternative to stress testing. (Level of Evidence: B) ***RNI (p. 7, Table 2)*** **Recommendations for Emergency Department Imaging for Suspected Acute Coronary Syndromes** **Class III** Routine imaging of patients with myocardial ischemia necrosis already documented clinically, by ECG and/or serum markers or enzymes. *(Level of Evidence: C)*

Table 2. Detection of CAD/Risk Assessment Without Ischemic Equivalent

Indication	Guideline Recommendations
Asymptomatic	
12. **Asymptomatic** ▪ CHD Risk (ATP III risk criteria): **Low**	***Stable Angina (p. 27)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Asymptomatic Patients** **Class III** Exercise myocardial perfusion imaging, exercise echocardiography, adenosine or dipyridamole myocardial perfusion imaging, or dobutamine echocardiography as the initial stress test in an asymptomatic patient with a normal rest ECG who is not taking digoxin. *(Level of Evidence: C)* Adenosine or dipyridamole myocardial perfusion imaging or dobutamine echocardiography in asymptomatic patients who are able to exercise and do not have left bundle-branch block or electronically paced ventricular rhythm. *(Level of Evidence: C)*

13. **Asymptomatic** ▪ CHD Risk (ATP III risk criteria): **Moderate** **ECG Interpretable**	***Stable Angina (p. 27)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Asymptomatic Patients** **Class III** Exercise myocardial perfusion imaging, exercise echocardiography, adenosine or dipyridamole myocardial perfusion imaging, or dobutamine echocardiography as the initial stress test in an asymptomatic patient with a normal rest ECG who is not taking digoxin. *(Level of Evidence: C)* Adenosine or dipyridamole myocardial perfusion imaging or dobutamine echocardiography in asymptomatic patients who are able to exercise and do not have left bundle-branch block or electronically paced ventricular rhythm. *(Level of Evidence: C)* ***RNI PET (p. e27)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk** **Stratification of Patients With an Intermediate or High Likelihood of CAD** **Class IIa** Adenosine or dipyridamole myocardial perfusion PET to identify the extent, severity, and location of ischemia as the initial diagnostic test in patients who are unable to exercise. (Level of Evidence: B) Adenosine or dipyridamole myocardial perfusion PET to identify the extent, severity, and location of ischemia as the initial diagnostic test in patients who are able to exercise but have LBBB or an electronically- paced rhythm. (Level of Evidence: B)

14. **Asymptomatic** ▪ CHD Risk (ATP III risk criteria): **Moderate** **ECG Uninterpretable**	***RNI PET (p. e27)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk** **Stratification of Patients With an Intermediate or High Likelihood of CAD** **Class IIa** Adenosine or dipyridamole myocardial perfusion PET to identify the extent, severity, and location of ischemia as the initial diagnostic test in patients who are unable to exercise. (Level of Evidence: B) Adenosine or dipyridamole myocardial perfusion PET to identify the extent, severity, and location of ischemia as the initial diagnostic test in patients who are able to exercise but have LBBB or an electronically- paced rhythm. (Level of Evidence: B)

15. **Asymptomatic** ▪ CHD Risk (ATP III risk criteria): **High**	***RNI (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class IIa** Exercise myocardial perfusion SPECT as the initial test in patients who are considered to be at high risk (patients with diabetes or patients otherwise defined as having a more than 20% 10-year risk of a coronary heart disease event). *(Level of Evidence: B)* **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Unable to Exercise.** **Class IIa** Adenosine or dipyridamole myocardial perfusion SPECT as the initial test in patients who are considered to be at high risk (patients with diabetes or patients otherwise defined as having a more than 20% 10-year risk of a coronary heart disease event). *(Level of Evidence: B)* ***RNI PET (p. e27)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD** **Class IIa** Adenosine or dipyridamole myocardial perfusion PET to identify the extent, severity, and location of ischemia as the initial diagnostic test in patients who are unable to exercise. (Level of Evidence: B) Adenosine or dipyridamole myocardial perfusion PET to identify the extent, severity, and location of ischemia as the initial diagnostic test in patients who are able to exercise but have LBBB or an electronically-paced rhythm. (Level of Evidence: B) ***Stable Angina (p. 27)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Asymptomatic Patients** **Class III** Exercise myocardial perfusion imaging, exercise echocardiography, adenosine or dipyridamole myocardial perfusion imaging, or dobutamine echocardiography as the initial stress test in an asymptomatic patient with a normal rest ECG who is not taking digoxin. *(Level of Evidence: C)* Adenosine or dipyridamole myocardial perfusion imaging or dobutamine echocardiography in asymptomatic patients who are able to exercise and do not have left bundle-branch block or electronically paced ventricular rhythm. *(Level of Evidence: C)*

New-Onset or Diagnosed Heart Failure with LV Systolic Dysfunction Without Ischemic Equivalent	
16. **New Onset or Newly Diagnosed Heart Failure with LV Systolic Dysfunction without Ischemic Equivalent** ▪ Test Results: **No prior CAD evaluation** ▪ Context: **No planned coronary angiography**	***RNI (p. 27)*** **Recommendations for the Use of Radionuclide Imaging in Patients With Heart Failure: Fundamental Assessment** **Class IIa** Assessment of the copresence of CAD in patients without angina. *(Level of Evidence: B)* ***Heart Failure (p. 9)*** **Recommendations for the Initial Clinical Assessment of Patients Presenting with HF** **Class IIb** Noninvasive imaging may be considered to define the likelihood of coronary artery disease in patients with HF and LV dysfunction. *(Level of Evidence: C)*
New Onset Atrial Fibrillation	
17. **New Onset Atrial Fibrillation** ▪ Context: **Part of the evaluation when etiology unclear**	**None**
Ventricular Tachycardia	

18. **Ventricular Tachycardia** ▪ CHD Risk (ATP III risk criteria): **Low**	***Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death*** **Left Ventricular Function and Imaging (p. e15)** **Class I** ET with an imaging modality (echocardiography or nuclear perfusion [single-photon emission computed tomography (SPECT)]) is recommended to detect silent ischemia in patients with VA who have an intermediate probability of having CHD by age, symptoms, and gender, and in whom ECG assessment is less reliable because of digoxin use, left ventricular (LV) hypertrophy, greater than 1 mm ST-segment depression at rest, Wolff-Parkinson-White Syndrome or left bundle-branch block. (Level of Evidence: B) Pharmacological stress testing with an imaging modality (echocardiography or myocardial perfusion SPECT) is recommended to detect silent ischemia in patients with VA who have an intermediate probability of having CHD by age, symptoms, and gender and are physically unable to perform a symptom-limited exercise test. (Level of Evidence: B) **Polymorphic Ventricular Tachycardia (p. e23)** **Class I** Urgent angiography with a view to revascularization should be considered for patients with polymorphic VT when myocardial ischemia cannot be excluded. (Level of Evidence: C)

19.	**Ventricular Tachycardia** ▪ CHD Risk (ATP III risk criteria): **Moderate or High**	***Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death*** **Left Ventricular Function and Imaging (p. e15)** **Class I** ET with an imaging modality (echocardiography or nuclear perfusion [single-photon emission computed tomography (SPECT)]) is recommended to detect silent ischemia in patients with VA who have an intermediate probability of having CHD by age, symptoms, and gender, and in whom ECG assessment is less reliable because of digoxin use, left ventricular (LV) hypertrophy, greater than 1 mm ST-segment depression at rest, Wolff-Parkinson-White Syndrome or left bundle-branch block. (Level of Evidence: B) Pharmacological stress testing with an imaging modality (echocardiography or myocardial perfusion SPECT) is recommended to detect silent ischemia in patients with VA who have an intermediate probability of having CHD by age, symptoms, and gender and are physically unable to perform a symptom-limited exercise test. (Level of Evidence: B) **Polymorphic Ventricular Tachycardia (p. e23)** **Class I** Urgent angiography with a view to revascularization should be considered for patients with polymorphic VT when myocardial ischemia cannot be excluded. (Level of Evidence: C)
Syncope		
20.	**Syncope** ▪ CHD Risk (ATP III risk criteria): **Low**	***None***
21.	**Syncope** ▪ CHD Risk (ATP III risk criteria): **Moderate or High**	***None***
Elevated Troponin		

22.	**Elevated Troponin** ▪ Troponin elevation without additional evidence of acute coronary syndrome	***RNI (p. 7, Table 2)*** **Recommendations for Emergency Department Imaging for Suspected Acute Coronary Syndromes** **Class III** Routine imaging of patients with myocardial ischemia necrosis already documented clinically, by ECG and/or serum markers or enzymes. *(Level of Evidence: C)*

Table 3. Detection of CAD and Risk Assessment With Prior Test Results and/or Known Chronic Stable CAD

Indication	Guideline Recommendations
Asymptomatic OR Stable Symptoms Normal Prior Stress Imaging Study	
23. **Asymptomatic OR Stable Symptoms Normal Prior Stress Imaging Study** ▪ CHD Risk (ATP III risk criteria): **Low** ▪ Context: **Last stress imaging study done less than 2 years ago**	**None**

24.	**Asymptomatic OR Stable Symptoms Normal Prior Stress Imaging Study (** ▪ CHD Risk (ATP III risk criteria): **Intermediate to High** ▪ Context: **Last stress imaging study done more than 2 years ago**	***RNI (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class IIb** Exercise myocardial perfusion SPECT in asymptomatic patients who have a high-risk occupation. (*Level of Evidence: B*) **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Unable to Exercise.** **Class IIb** Adenosine or dipyridamole myocardial perfusion SPECT in asymptomatic patients who have a high risk occupation. *(Level of Evidence: C)*
25	**Asymptomatic OR Stable Symptoms Normal Prior Stress Imaging Study** ▪ CHD Risk (ATP III risk criteria): **Low** ▪ Context: **Last stress imaging study done more than 2 years ago**	**None**

26. **Asymptomatic OR Stable Symptoms** **Normal Prior Stress Imaging Study (** ▪ CHD Risk (ATP III risk criteria): **Intermediate to High** ▪ Context: **Last stress imaging study done more than 2 years ago**	***RNI (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class IIb** Exercise myocardial perfusion SPECT in asymptomatic patients who have a high-risk occupation. (*Level of Evidence: B*) **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Unable to Exercise.** **Class IIb** Adenosine or dipyridamole myocardial perfusion SPECT in asymptomatic patients who have a high risk occupation. *(Level of Evidence: C)*
Asymptomatic OR Stable Symptoms **Abnormal Coronary Angiography OR Abnormal Prior Stress Imaging Study, No Prior Revascularization**	

27.	**Asymptomatic OR Stable Symptoms Abnormal Coronary Angiography OR Abnormal Prior Stress Imaging Study, No Prior Revascularization** ▪ Test Results **Known CAD on coronary angiography OR prior abnormal stress imaging study** ▪ Timeframe: **Last stress imaging study done less than 2 years ago**	***RNI (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class IIb** Repeat exercise myocardial perfusion SPECT 1 to 3 years after initial perfusion imaging in patients with known or a high likelihood of CAD, stable symptoms, and a predicted annual mortality of more than 1%, to redefine the risk of a cardiac event. *(Level of Evidence: C)* Repeat exercise myocardial perfusion SPECT on cardiac active medications after initial abnormal perfusion imaging to assess the efficacy of medical therapy. *(Level of Evidence: C)* **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who are Unable to Exercise** **Class IIb** Repeat adenosine or dipyridamole MPI 1 to 3 years after initial perfusion imaging in patients with known or a high likelihood of CAD, stable symptoms, and a predicted annual mortality of more than 1%, to redefine the risk of a cardiac event. *(Level of Evidence: C)* Repeat adenosine or dipyridamole myocardial perfusion SPECT on cardiac active medications after initial abnormal perfusion imaging to assess the efficacy of medical therapy. *(Level of Evidence: C)* ***RNI PET (p. e26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk** **Stratification of Patients With an Intermediate or High Likelihood of CAD** **Class I** Adenosine or dipyridamole myocardial perfusion PET in patients in whom an appropriately indicated myocardial perfusion SPECT study has been found to be equivocal for diagnostic or risk stratification purposes. (Level of Evidence: B)

28.	**Asymptomatic OR Stable Symptoms Abnormal Coronary Angiography OR Abnormal Prior Stress Imaging Study, No Prior Revascularization** ▪ Test Results **Known CAD on coronary angiography OR prior abnormal stress imaging** ▪ Timeframe: **Last stress imaging study done more than or equal to 2 years ago**	***RNI (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class IIb** Repeat exercise myocardial perfusion SPECT 1 to 3 years after initial perfusion imaging in patients with known or a high likelihood of CAD, stable symptoms, and a predicted annual mortality of more than 1%, to redefine the risk of a cardiac event. *(Level of Evidence: C)* Repeat exercise myocardial perfusion SPECT on cardiac active medications after initial abnormal perfusion imaging to assess the efficacy of medical therapy. *(Level of Evidence: C)* **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who are Unable to Exercise** **Class IIb** Repeat adenosine or dipyridamole MPI 1 to 3 years after initial perfusion imaging in patients with known or a high likelihood of CAD, stable symptoms, and a predicted annual mortality of more than 1%, to redefine the risk of a cardiac event. *(Level of Evidence: C)* Repeat adenosine or dipyridamole myocardial perfusion SPECT on cardiac active medications after initial abnormal perfusion imaging to assess the efficacy of medical therapy. *(Level of Evidence: C)* ***RNI PET (p. e26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk** **Stratification of Patients With an Intermediate or High Likelihood of CAD** **Class I** Adenosine or dipyridamole myocardial perfusion PET in patients in whom an appropriately indicated myocardial perfusion SPECT study has been found to be equivocal for diagnostic or risk stratification purposes. (Level of Evidence: B)
	Prior Non-Invasive Evaluation	

29. **Prior Non-Invasive Evaluation** ▪ Test Results **Equivocal, borderline, or discordant stress testing where obstructive CAD remains a concern.**	***RNI PET (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk** **Stratification of Patients With an Intermediate or High Likelihood of CAD** **Class I** Adenosine or dipyridamole myocardial perfusion PET in patients in whom an appropriately indicated myocardial perfusion SPECT study has been found to be equivocal for diagnostic or risk stratification purposes. (Level of Evidence: B)
New or Worsening Symptoms	

30.	**New or Worsening Symptoms** ▪ Test Results **Abnormal Coronary Angiography OR Abnormal Prior Stress Imaging Study**	***RNI (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class I** Repeat exercise MPI after initial perfusion imaging in patients whose symptoms have changed to redefine the risk for cardiac event. *(Level of Evidence: C)* **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who are Unable to Exercise** **Class I** Adenosine or dipyridamole myocardial perfusion SPECT after initial perfusion imaging in patients whose symptoms have changed to redefine the risk for cardiac event. (*Level of Evidence: C)* ***RNI PET (p. e26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD** **Class I** Adenosine or dipyridamole myocardial perfusion PET in patients in whom an appropriately indicated myocardial perfusion SPECT study has been found to be equivocal for diagnostic or risk stratification purposes. (Level of Evidence: B) ***Stable Angina (p. 91)*** **Recommendations for Echocardiography, Treadmill Exercise Testing, Stress Imaging Studies, and Coronary Angiography During Patient Follow-up** **Class I** Stress radionuclide imaging or stress echocardiography procedures for patients without prior revascularization who have a significant change in clinical status and are unable to exercise or have one of the following ECG abnormalities: a. Pre-excitation (Wolff-Parkinson-White) syndrome. (Level of Evidence: C) b. Electronically paced ventricular rhythm. (Level of Evidence: C) c. More than 1 mm of rest ST depression. (Level of Evidence: C) d. Complete left bundle-branch block. (Level of Evidence: C) ***Stable Angina (p. 91)*** **Recommendations for Echocardiography, Treadmill Exercise Testing, Stress Radionuclide Imaging, Stress Echocardiography Studies, and Coronary Angiography During Patient Follow-up** **Class I** Stress radionuclide imaging or stress echocardiography procedures for patients who have a significant change in clinical status and required a stress imaging procedure on their initial evaluation because of equivocal or intermediate-risk treadmill results. (Level of Evidence: C

31.	**New or Worsening Symptoms** ▪ Test Results **Normal Coronary Angiography OR Normal Prior Stress Imaging Study**	***RNI (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class I** Repeat exercise MPI after initial perfusion imaging in patients whose symptoms have changed to redefine the risk for cardiac event. *(Level of Evidence: C)* **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who are Unable to Exercise** **Class I** Adenosine or dipyridamole myocardial perfusion SPECT after initial perfusion imaging in patients whose symptoms have changed to redefine the risk for cardiac event. (*Level of Evidence: C)* ***RNI PET (p. e26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD** **Class I** Adenosine or dipyridamole myocardial perfusion PET in patients in whom an appropriately indicated myocardial perfusion SPECT study has been found to be equivocal for diagnostic or risk stratification purposes. (Level of Evidence: B) ***Stable Angina (p. 91)*** **Recommendations for Echocardiography, Treadmill Exercise Testing, Stress Imaging Studies, and Coronary Angiography During Patient Follow-up** **Class I** Stress radionuclide imaging or stress echocardiography procedures for patients without prior revascularization who have a significant change in clinical status and are unable to exercise or have one of the following ECG abnormalities: a. Pre-excitation (Wolff-Parkinson-White) syndrome. (Level of Evidence: C) b. Electronically paced ventricular rhythm. (Level of Evidence: C) c. More than 1 mm of rest ST depression. (Level of Evidence: C) d. Complete left bundle-branch block. (Level of Evidence: C) ***Stable Angina (p. 91)*** **Recommendations for Echocardiography, Treadmill Exercise Testing, Stress Radionuclide Imaging, Stress Echocardiography Studies, and Coronary Angiography During Patient Follow-up** **Class I** Stress radionuclide imaging or stress echocardiography procedures for patients who have a significant change in clinical status and required a stress imaging procedure on their initial evaluation because of equivocal or intermediate-risk treadmill results. (Level of Evidence: C

Coronary Angiography (Invasive or Noninvasive)		
32.	**Coronary Angiography (Invasive or Noninvasive)** ▪ Test Results: **Coronary stenosis or anatomic abnormality of uncertain significance**	***RNI PET (p. e26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk** **Stratification of Patients With an Intermediate or High Likelihood of CAD** **Class I** Adenosine or dipyridamole myocardial perfusion PET in patients in whom an appropriately indicated myocardial perfusion SPECT study has been found to be equivocal for diagnostic or risk stratification purposes. (Level of Evidence: B)
Asymptomatic Prior Coronary Calcium Agatston Score		
33.	**Asymptomatic Prior Coronary Calcium Agatston Score** ▪ Test Results: **Agatson score less than 100**	**None**
34.	**Asymptomatic Prior Coronary Calcium Agatston Score** ▪ CHD Risk (ATP III risk criteria): **Low to Intermediate** ▪ Test Results: **Agatston score between 100 and 400**	**None**

35.	**Asymptomatic** **Prior Coronary Calcium Agatston Score** ▪ CHD Risk (ATP III risk criteria): **High** ▪ Test Results: **Agatston score between 100-400**	**None**

36.	**Asymptomatic** **Prior Coronary Calcium Agatston Score** ▪ Test Results: **Agatston score greater than 400**	***Stable Angina (p. 43)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Risk Stratification in Asymptomatic Patients** **Class IIb** Exercise perfusion imaging or exercise echocardiography in asymptomatic patients with severe coronary calcification on EBCT who are able to exercise and have one of the following baseline ECG abnormalities: a. Pre-excitation (Wolff-Parkinson-White) syndrome. *(Level of Evidence: C)* b. More than 1 mm of ST depression at rest. *(Level of Evidence: C)* Adenosine or dipyridamole myocardial perfusion imaging or dobutamine echocardiography in patients with possible myocardial ischemia on ambulatory ECG monitoring or with severe coronary calcification on EBCT who are unable to exercise. *(Level of Evidence: C)* ***RNI (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class IIb** Exercise myocardial perfusion SPECT in symptomatic or asymptomatic patients who have severe coronary calcification (CT CCS more than 75th percentile for age and sex) in the presence on the resting ECG of pre-excitation (Wolff-Parkinson-White) syndrome or more than 1 mm ST segment depression.(*Level of Evidence: B*) **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Unable to Exercise** **Class IIb** Adenosine or dipyridamole myocardial perfusion SPECT in symptomatic or asymptomatic patients who have severe coronary calcification (CT CCS more than the 75th percentile for age and sex) in the presence on the resting ECG of LBBB or an electronically-paced ventricular system. (*Level of Evidence: B*)

Duke Treadmill Score		
37.	**Duke Treadmill Score** ▪ Test Results: **Low-Risk Duke treadmill score**	**None**
38.	**Duke Treadmill Score** ▪ Test Results: **Intermediate-Risk Duke treadmill score**	***RNI (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class I** Exercise myocardial perfusion SPECT in patients with intermediate Duke treadmill score. (*Level of Evidence: B*)
39.	**Duke Treadmill Score** ▪ Test Results: **High-Risk Duke treadmill score**	**None**

Table 4. Risk Assessment: Preoperative Evaluation for Non-Cardiac Surgery Without Active Cardiac Conditions*

Indication	**Guideline Recommendations**
Low-Risk Surgery	

40. **Low Risk Surgery** ▪ Context: **Preoperative evaluation for non-cardiac surgery risk assessment**	***Peri-op (pg. e169)*** Peri-op guideline flow chart (figure 1) ***Peri-op (pg. e180)*** **Recommendations for Noninvasive Stress Testing Before Noncardiac Surgery** **Class III** Noninvasive testing is not useful for patients undergoing low-risk noncardiac surgery (*Level of Evidence: C)* ***Peri-op Errata*** **Recommendations for Perioperative Cardiac Assessment** **Class I** Patients who are at low risk for surgery are recommended to proceed to planned surgery (*Level of Evidence: B)* ***RNI (p. 27)*** **Recommendations: Cardiac Stress Perfusion Imaging Before Noncardiac Surgery** **Class III** Routine screening of asymptomatic men or women with low pretest likelihood of CAD. (*Level of Evidence: C)* Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with a low or high probability of CAD in the absence of electronically paced ventricular rhythm or left bundle-branch block. *(Level of Evidence: B)* Exercise myocardial perfusion imaging or exercise echocardiography in patients with a low or high probability of CAD who have one of the following baseline ECG abnormalities: a. Pre-excitation (Wolff-Parkinson-White) syndrome. (Level of Evidence: B) b. More than 1 mm of ST depression. (Level of Evidence: B)
Intermediate Risk Surgery	

41. **Intermediate Risk Surgery** ▪ Perioperative Risk Predictor: **Moderate to Good Functional Capacity (greater than or equal to 4 METs)**	***Peri-op (pg. e169)*** Peri-op guideline flow chart ***Peri-op (pg. e180)*** **Recommendations for Noninvasive Stress Testing Before Noncardiac Surgery** **Class III** Noninvasive testing is not useful for patients with no clinical risk factors undergoing intermediate-risk noncardiac surgery (*Level of Evidence: C)* ***Peri-op Errata*** **Recommendations for Perioperative Cardiac Assessment** **Class I** Patients with good functional capacity (MET level greater than or equal to 7) without symptoms should proceed to planned surgery. (*Level of Evidence: B)* ***RNI (p. 27)*** **Recommendations: Cardiac Stress Perfusion Imaging Before Noncardiac Surgery** **Class III** Routine screening of asymptomatic men or women with low pretest likelihood of CAD. (*Level of Evidence: C)* Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with a low or high probability of CAD in the absence of electronically paced ventricular rhythm or left bundle-branch block. *(Level of Evidence: B)* Exercise myocardial perfusion imaging or exercise echocardiography in patients with a low or high probability of CAD who have one of the following baseline ECG abnormalities: a. Pre-excitation (Wolff-Parkinson-White) syndrome. (Level of Evidence: B) b. More than 1 mm of ST depression. (Level of Evidence: B)

42. **Intermediate Risk Surgery** ▪ Perioperative Risk Predictor: **No clinical risk factors**	***Peri-op (pg. e169)*** Peri-op guideline flow chart ***Peri-op (pg. e180)*** **Recommendations for Noninvasive Stress Testing Before Noncardiac Surgery** **Class III** Noninvasive testing is not useful for patients with no clinical risk factors undergoing intermediate-risk noncardiac surgery (*Level of Evidence: C)* ***Peri-op Errata*** **Recommendations for Perioperative Cardiac Assessment** **Class I** Patients with good functional capacity (MET level greater than or equal to 7) without symptoms should proceed to planned surgery. (*Level of Evidence: B)*

43. **Intermediate Risk Surgery** ▪ Perioperative Risk Predictor: **Greater than or equal to 1 clinical risk factor** ▪ Exercise Tolerance: **Poor or unknown functional capacity (less than 4 METs)**	***Peri-op (pg. e169)*** Peri-op guideline flow chart ***Peri-op Errata*** **Recommendations for Perioperative Cardiac Assessment** **Class IIa** Patients with poor (less than 4 METs) or unknown functional capacity and 3 or more clinical risk factors‖ who are scheduled for intermediate risk surgery are probably recommended to proceed with planned surgery with heart rate control¶. (Level of Evidence: B) Patients with poor (less than 4 METs) or unknown functional capacity and 1 or 2 clinical risk factors‖ who are scheduled for vascular or intermediate risk surgery are probably recommended to proceed with planned surgery with heart rate control¶. *(Level of Evidence: B*) **Class IIb** Noninvasive testing might be considered if it will change management for patients with poor (less than 4 METs) or unknown functional capacity and 3 or more clinical risk factors‖ who are scheduled for intermediate risk surgery. (*Level of Evidence: B*) Noninvasive testing might be considered if it will change management for patients with poor (less than 4 METs) or unknown functional capacity and 1 or 2 clinical risk factors‖ who are scheduled for vascular or intermediate risk surgery. (Level of Evidence: B) ***Peri-op (pg. e180)*** **Recommendations for Noninvasive Stress Testing Before Noncardiac Surgery** **Class IIb** Noninvasive stress testing may be considered for patients with at least 1 to 2 clinical risk factors and poor functional capacity (less than 4 METs) who require intermediate-risk noncardiac surgery if it will change management. (*Level of Evidence: B)* *See Table 2 for active clinical conditions. †See Class III recommendations in section 5.2.3. Noninvasive Stress Testing in full text guideline. ‡See Table 3 for estimated MET level equivalent. §Noninvasive testing may be considered before surgery in specific patient populations with risk factors if it will change management. ‖Clinical risk factors include: ischemic heart disease, compensated or prior heart failure, diabetes mellitus, renal insufficiency, and cerebrovascular disease. ¶Consider perioperative beta-blockade (see Table 12) for populations in which this has been shown to reduce cardiac morbidity/mortality.

44. **Intermediate Risk Surgery** ▪ Context: **Asymptomatic up to 1 year post normal catheterization, non-invasive test, or previous revascularization**	***Peri-op (pg. e169)*** Peri-op guideline flow chart ***Peri-op Errata*** **Recommendations for Perioperative Cardiac Assessment** **Class IIa** Patients with poor (less than 4 METs) or unknown functional capacity and 3 or more clinical risk factors‖ who are scheduled for intermediate risk surgery are probably recommended to proceed with planned surgery with heart rate control¶. (Level of Evidence: B) Patients with poor (less than 4 METs) or unknown functional capacity and 1 or 2 clinical risk factors‖ who are scheduled for vascular or intermediate risk surgery are probably recommended to proceed with planned surgery with heart rate control¶. *(Level of Evidence: B*) **Class IIb** Noninvasive testing might be considered if it will change management for patients with poor (less than 4 METs) or unknown functional capacity and 3 or more clinical risk factors‖ who are scheduled for intermediate risk surgery. (*Level of Evidence: B*) Noninvasive testing might be considered if it will change management for patients with poor (less than 4 METs) or unknown functional capacity and 1 or 2 clinical risk factors‖ who are scheduled for vascular or intermediate risk surgery. (Level of Evidence: B)
Vascular Surgery	
45. **Vascular Surgery** ▪ Exercise Tolerance: **Moderate to Good Functional Capacity (greater than or equal to 4 METs)**	***RNI (p. 27)*** **Recommendations: Cardiac Stress Perfusion Imaging Before Noncardiac Surgery** **Class III** Routine screening of asymptomatic men or women with low pretest likelihood of CAD. (*Level of Evidence: C)* Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with a low or high probability of CAD in the absence of electronically paced ventricular rhythm or left bundle-branch block. *(Level of Evidence: B)* Exercise myocardial perfusion imaging or exercise echocardiography in patients with a low or high probability of CAD who have one of the following baseline ECG abnormalities: a. Pre-excitation (Wolff-Parkinson-White) syndrome. (Level of Evidence: B) b. More than 1 mm of ST depression. (Level of Evidence: B)

46. **Vascular Surgery** ▪ Perioperative Risk Predictor: **No clinical risk factors**	***Peri-op (pg. e169)*** Peri-op guideline flow chart ***Peri-op Errata*** **Recommendations for Perioperative Cardiac Assessment** **Class IIa** Patients with poor (less than 4 METs) or unknown functional capacity and 1 or 2 clinical risk factors‖ who are scheduled for vascular or intermediate risk surgery are probably recommended to proceed with planned surgery with heart rate control¶. *(Level of Evidence: B*) **Class IIb** Noninvasive testing might be considered if it will change management for patients with poor (less than 4 METs) or unknown functional capacity and 1 or 2 clinical risk factors‖ who are scheduled for vascular or intermediate risk surgery. (Level of Evidence: B) ***RNI (p. 27)*** **Recommendations: Cardiac Stress Perfusion Imaging Before Noncardiac Surgery** **Class III** Routine screening of asymptomatic men or women with low pretest likelihood of CAD. (*Level of Evidence: C)* Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with a low or high probability of CAD in the absence of electronically paced ventricular rhythm or left bundle-branch block. *(Level of Evidence: B)* Exercise myocardial perfusion imaging or exercise echocardiography in patients with a low or high probability of CAD who have one of the following baseline ECG abnormalities: a. Pre-excitation (Wolff-Parkinson-White) syndrome. (Level of Evidence: B) b. More than 1 mm of ST depression. (Level of Evidence: B)

47. **Vascular Surgery** ▪ Perioperative Risk Predictor: **Greater than or equal to 1 clinical risk factor** ▪ Exercise Tolerance: **Poor or unknown functional capacity (less than 4 METs)**	***Peri-op (pg. e169)*** Peri-op guideline flow chart ***Peri-op (pg. e180)*** **Recommendations for Noninvasive Stress Testing Before Noncardiac Surgery** **Class IIB** Noninvasive stress testing may be considered for patients with at least 1 to 2 clinical risk factors and good functional capacity (greater than or equal to 7 METs) who are undergoing vascular surgery (Level of Evidence: B) ***RNI (p. 27)*** **Recommendations: Cardiac Stress Perfusion Imaging Before Noncardiac Surgery** **Class III** Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with a low or high probability of CAD in the absence of electronically paced ventricular rhythm or left bundle-branch block. *(Level of Evidence: B)* Exercise myocardial perfusion imaging or exercise echocardiography in patients with a low or high probability of CAD who have one of the following baseline ECG abnormalities: a. Pre-excitation (Wolff-Parkinson-White) syndrome. (Level of Evidence: B) b. More than 1 mm of ST depression. (Level of Evidence: B)

48. **Vascular Surgery** ▪ Timeframe: **Asymptomatic up to 1 year post normal catheterization, non-invasive test, or previous revascularization**	***RNI (p. 27)*** **Recommendations: Cardiac Stress perfusion Imaging Before Noncardiac Surgery** **Class IIb** Routine assessment of active, asymptomatic patients who have remained stable for up to 5 years after CABG surgery. (*Level of Evidence: C*) Routine evaluation of active, asymptomatic patients who have remained stable for up to 2 years after previous abnormal coronary angiography or noninvasive assessment of myocardial perfusion. *(Level of Evidence: C)* Diagnosis of restenosis and regional ischemia in active, asymptomatic patients within weeks to months after PCI. *(Level of Evidence: C)* **Class III** Routine screening of asymptomatic men or women with low pretest likelihood of CAD. (*Level of Evidence: C)* Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with a low or high probability of CAD in the absence of electronically paced ventricular rhythm or left bundle-branch block. *(Level of Evidence: B)* Exercise myocardial perfusion imaging or exercise echocardiography in patients with a low or high probability of CAD who have one of the following baseline ECG abnormalities: a. Pre-excitation (Wolff-Parkinson-White) syndrome. (Level of Evidence: B) b. More than 1 mm of ST depression. (Level of Evidence: B)

Table 5. Risk Assessment: Within 3 Months of an Acute Coronary Syndrome

Indication	**Guideline Recommendations**
STEMI	
49. **STEMI** ▪ **Primary PCI with complete revascularization** ▪ **No recurrent symptoms**	***RNI (p. 8, Table 3)*** **Recommendations for Use of Radionuclide Testing in Diagnosis, Risk Assessment, Prognosis, and Assessment of Therapy After Acute ST-Segment Elevation Myocardial Infarction (Patient Subgroup: Thrombolytic therapy without catheterization)** **Class I** Detection of inducible ischemia and myocardium at risk *(Level of Evidence: B)*

		STEMI (p. e136) **Exercise Myocardial Perfusion Imaging** **Class I** Dipyridamole or adenosine stress perfusion nuclear scintigraphy or dobutamine echocardiography before or early after discharge should be used in patients with STEMI who are not undergoing cardiac catheterization to look for inducible ischemia in patients judged to be unable to exercise. *(Level of Evidence: B)*
50.	**STEMI** ▪ **Hemodynamically stable, no recurrent chest pain symptoms or no signs of HF** ▪ **To evaluate for inducible ischemia** ▪ **No prior coronary angiography**	***RNI (p. 8, Table 3)*** **Recommendations for Use of Radionuclide Testing in Diagnosis, Risk Assessment, Prognosis, and Assessment of Therapy After Acute ST-Segment Elevation Myocardial Infarction (Patient Subgroup: Thrombolytic therapy without catheterization)** **Class I** Detection of inducible ischemia and myocardium at risk *(Level of Evidence: B)* ***STEMI (p. e136)*** **Exercise Myocardial Perfusion Imaging** **Class I** Dipyridamole or adenosine stress perfusion nuclear scintigraphy or dobutamine echocardiography before or early after discharge should be used in patients with STEMI who are not undergoing cardiac catheterization to look for inducible ischemia in patients judged to be unable to exercise. *(Level of Evidence: B)*
51.	**STEMI** ▪ **Hemodynamically unstable, signs of cardiogenic shock, or mechanical complications**	**None**
	UA/NSTEMI	
52.	**UA/NSTEMI** ▪ **Hemodynamically Stable, No Recurrent Chest Pain Symptoms, or No Signs of HF** ▪ **To evaluate for inducible ischemia**	***UA/NSTEMI (p. e28)*** **Risk Stratification Recommendations** **Class I** ▪ Noninvasive stress testing is recommended in low and intermediate-risk patients who have been free of ischemia at rest or with low-level activity and of heart failure for a minimum of 12 to 24 h. *(Level of Evidence: C)* ▪ An imaging modality should be added in patients with resting ST-segment depression (greater

	▪ **No prior coronary angiography**	than or equal to 0.10 mV), LV hypertrophy, bundle-branch block, intraventricular conduction defect, pre-excitation, or digoxin who are able to exercise. In patients undergoing a low-level exercise test, an imaging modality can add sensitivity. *(Level of Evidence: B)* ▪ Pharmacological stress testing with imaging is recommended when physical limitations (e.g., arthritis, amputation, severe peripheral vascular disease, severe chronic obstructive pulmonary disease, general debility) preclude adequate exercise stress. *(Level of Evidence: B)* ▪ A noninvasive test (echocardiogram or radionuclide angiogram) is recommended to evaluate LV function in patients with definite ACS who are not scheduled for coronary angiography and left ventriculography.*(Level of Evidence: B)* **Immediate Management (p. e11)** **Class I** In patients with suspected ACS in whom ischemic heart disease is present or suspected, if the follow up 12-lead ECG and biomarker measurements are normal, a stress test (exercise or pharmacological) to provoke ischemia should be performed in the ED, in a chest pain unit, or on an outpatient basis in a timely fashion (within 72 h) as an alternative to inpatient admission. Low-risk patients with a negative stress diagnostic test can be managed as outpatients. (Level of Evidence: C) Patients with possible ACS and negative cardiac biomarkers who are unable to exercise or who have an abnormal resting ECG should undergo a pharmacological stress test. *(Level of Evidence:B)*
ACS—Asymptomatic Post Revascularization (PCI or CABG)		
53.	**ACS – Asymptomatic Post Revascularization (PCI or CABG)** ▪ Timeframe: **Evaluation prior to hospital discharge**	***UA/NSTEMI (p. e11)*** **Immediate Management** **Class I** In patients with suspected ACS in whom ischemic heart disease is present or suspected, if the follow up 12-lead ECG and biomarker measurements are normal, a stress test (exercise or pharmacological) to provoke ischemia should be performed in the ED, in a chest pain unit, or on an outpatient basis in a timely fashion (within 72 h) as an alternative to inpatient admission. Low-risk patients with a negative stress diagnostic test can be managed as outpatients. (Level of Evidence: C) Patients with possible ACS and negative cardiac biomarkers who are unable to exercise or who have an abnormal resting ECG should undergo a pharmacological stress test. *(Level of Evidence: B)*

Cardiac Rehabilitation	
54. **ACS – Asymptomatic Post Revascularization (PCI or CABG)** ▪ Timeframe: **Prior to initiation of cardiac rehabilitation (as a stand-alone indication)**	**None**

Table 6. Risk Assessment: Post-Revascularization (PCI or CABG)

Indication	**Guideline Recommendations**
Symptomatic	

55. **Symptomatic** ▪ **Evaluation of Ischemic Equivalent**	***RNI (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class I** Repeat exercise MPI after initial perfusion imaging in patients whose symptoms have changed to redefine the risk for cardiac event. *(Level of Evidence: C)* **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Unable to Exercise** **Class I** Adenosine or dipyridamole myocardial perfusion SPECT after initial perfusion imaging in patients whose symptoms have changed to redefine the risk for cardiac event. (*Level of Evidence: C)* ***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Able to Exercise** **Class I** Exercise myocardial perfusion imaging or exercise echocardiography in patients with prior revascularization (either PCI or CABG). *(Level of Evidence: B)* ***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Unable to Exercise** **Class I** Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with prior revascularization (either PCI or CABG). *(Level of Evidence: B)*
Asymptomatic	

56. **Asymptomatic** ▪ Context: **Incomplete Revascularization** **Additional revascularization feasible**	***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Able to Exercise** **Class I** Exercise myocardial perfusion imaging or exercise echocardiography in patients with prior revascularization (either PCI or CABG). *(Level of Evidence: B)* ***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Unable to Exercise** **Class I** Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with prior revascularization (either PCI or CABG). *(Level of Evidence: B)*

57. **Asymptomatic** ▪ Timeframe: **Less than 5 years after CABG**	***RNI (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class IIa** Exercise myocardial perfusion SPECT at 3 to 5 years after revascularization (either PCI or CABG) in selected, high-risk asymptomatic patients. (*Level of Evidence: B*) **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Unable to Exercise** **Class IIa** Adenosine or dipyridamole SPECT at 3 to 5 years after revascularization (either PCI or CABG) in selected, high-risk asymptomatic patients. (*Level of Evidence: B*) ***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Able to Exercise** **Class I** Exercise myocardial perfusion imaging or exercise echocardiography in patients with prior revascularization (either PCI or CABG). *(Level of Evidence: B)* ***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Unable to Exercise** **Class I** Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with prior revascularization (either PCI or CABG). *(Level of Evidence: B)*

58. **Asymptomatic** ▪ Timeframe: **Greater than or equal to 5 years after CABG**	***RNI (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class IIa** Exercise myocardial perfusion SPECT at 3 to 5 years after revascularization (either PCI or CABG) in selected, high-risk asymptomatic patients. (*Level of Evidence: B*) **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Unable to Exercise** **Class IIa** Adenosine or dipyridamole SPECT at 3 to 5 years after revascularization (either PCI or CABG) in selected, high-risk asymptomatic patients. (*Level of Evidence: B*) ***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Able to Exercise** **Class I** Exercise myocardial perfusion imaging or exercise echocardiography in patients with prior revascularization (either PCI or CABG). *(Level of Evidence: B)* ***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Unable to Exercise** **Class I** Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with prior revascularization (either PCI or CABG). *(Level of Evidence: B)*

59. **Asymptomatic** ▪ Timeframe: **Less than 2 years after PCI**	***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Able to Exercise** **Class I** Exercise myocardial perfusion imaging or exercise echocardiography in patients with prior revascularization (either PCI or CABG). *(Level of Evidence: B)* ***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Unable to Exercise** **Class I** Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with prior revascularization (either PCI or CABG). *(Level of Evidence: B)*

60. **Asymptomatic** ▪ Timeframe: **Greater than or equal to 2 years after PCI**	***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Able to Exercise** **Class I** Exercise myocardial perfusion imaging or exercise echocardiography in patients with prior revascularization (either PCI or CABG). *(Level of Evidence: B)* ***Stable Angina (p. 22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Diagnosis in Patients With Chronic Stable Angina Who Are Unable to Exercise** **Class I** Adenosine or dipyridamole stress myocardial perfusion imaging or dobutamine echocardiography in patients with prior revascularization (either PCI or CABG). *(Level of Evidence: B)* ***RNI (p. 26)*** **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of MPHR)** **Class IIa** Exercise myocardial perfusion SPECT at 3 to 5 years after revascularization (either PCI or CABG) in selected, high-risk asymptomatic patients. (*Level of Evidence: B*) **Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Unable to Exercise** **Class IIa** Adenosine or dipyridamole SPECT at 3 to 5 years after revascularization (either PCI or CABG) in selected, high-risk asymptomatic patients. (*Level of Evidence: B*)
Cardiac Rehabilitation	
61. **Cardiac Rehabilitation** ▪ Timeframe: **Prior to initiation of cardiac rehabilitation (as a stand-alone indication)**	**None**

Table 7. Assessment of Viability/Ischemia

Indication	Guideline Recommendations
Ischemic Cardiomyopathy/Assessment of Viability	

62.	**Ischemic Cardiomyopathy/Assessment of Viability** ▪ Test Results: **Known severe LV dysfunction** ▪ Context: **Patient eligible for revascularization**	***RNI (p. 27)*** **Recommendations for the Use of Radionuclide Imaging in Patients With Heart Failure: Fundamental Assessment** **Class I** Assessment of myocardial viability for consideration of revascularization in patients with CAD and LV systolic dysfunction who do not have angina (Level of Evidence: B) ***Heart Failure (p. 9)*** **Recommendations for the Initial Clinical Assessment of Patients Presenting with HF** **Class IIa** Noninvasive imaging to detect myocardial ischemia and viability is reasonable in patients presenting with HF who have known coronary artery disease and no angina, unless the patient is not eligible for revascularization of any kind. (Level of Evidence: C) ***Stable Angina (p.22)*** **Recommendations for Cardiac Stress Imaging as the Initial Test for Risk Stratification of Patients With Chronic Stable Angina Who Are Unable to Exercise** **Class I** Dipyridamole or adenosine myocardial perfusion imaging or dobutamine echocardiography to assess the functional significance of coronary lesions (if not already known) in planning PCI. (Level of Evidence: B) ***Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death*** **Left Ventricular Function and Imaging (p. e15)** **Class I** ET with an imaging modality (echocardiography or nuclear perfusion [single-photon emission computed tomography (SPECT)]) is recommended to detect silent ischemia in patients with VA who have an intermediate probability of having CHD by age, symptoms, and gender, and in whom ECG assessment is less reliable because of digoxin use, left ventricular (LV) hypertrophy, greater than 1 mm ST-segment depression at rest, Wolff-Parkinson-White Syndrome or left bundle-branch block. (Level of Evidence: B) Pharmacological stress testing with an imaging modality (echocardiography or myocardial perfusion SPECT) is recommended to detect silent ischemia in patients with VA who have an intermediate probability of having CHD by age, symptoms, and gender and are physically unable to perform a symptom-limited exercise test. (Level of Evidence: B)

Table 8. Evaluation of Ventricular Function

Indication	Guideline Recommendations
Evaluation of Left Ventricular Function	

63. **Evaluation of Left Ventricular Function** ▪ Test Results: **Assessment of LV function with radionuclide angiography (ERNA or FP (first pass) RNA)** ▪ **In absence of recent reliable diagnostic information regarding ventricular function obtained with another imaging modality**	***RNI (p. 27)*** **Recommendations for the Use of Radionuclide Imaging in Patients With Heart Failure: Fundamental Assessment** **Class I** Initial assessment of LV and RV function at rest* *(Level of Evidence: A)* *National consensus treatment guidelines are directed by quantitative assessment of LVEF and identification of LVEF less than or equal to 40% (356). ***Heart Failure (p. 9)*** **Recommendations for the Initial Clinical Assessment of Patients Presenting with HF** **Class II** Two-dimensional echocardiography with Doppler should be performed during initial evaluation of patients presenting with HF to assess LVEF, LV size, wall thickness, and valve function. Radionuclide ventriculography can be performed to assess LVEF and volume. (Level of Evidence: C) **Recommendations for Diagnosis and Initial Evaluation (pg. e32)** **Class I** Radionuclide angiography or magnetic resonance imaging is indicated for the initial and serial assessment of LV volume and function at rest in patients with AR and suboptimal echocardiograms. *(Level of Evidence: B)* **Class IIb** Exercise stress testing in patients with radionuclide angiography may be considered for assessment of LV function in asymptomatic or symptomatic patients with chronic AR. *(Level of Evidence: B)* ***UA/NSTEMI (p. e28)*** **Risk Stratification** **Class I** A noninvasive test (echocardiogram or radionuclide angiogram) is recommended to evaluate LV function in patients with definite ACS who are not scheduled for coronary angiography and left ventriculography.*(Level of Evidence: B)* ***Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death*** **Left Ventricular Function and Imaging (p. e15)** **Class IIa** Magnetic resonance imaging, cardiac computed tomography, or radionuclide angiography can be useful in patients with VA when echocardiography does not provide accurate assessment of LV and RV function, and/or evaluation of structural changes. (Level of Evidence: B)

64. **Evaluation of Left Ventricular Function** ▪ Context: **Routine+ use of rest/stress ECG-gating with SPECT or PET myocardial perfusion imaging**	***Heart Failure (p. 9)*** **Recommendations for Diagnosis and Initial Evaluation (pg. e32)** **Class I** Radionuclide angiography or magnetic resonance imaging is indicated for the initial and serial assessment of LV volume and function at rest in patients with AR and suboptimal echocardiograms. *(Level of Evidence: B)* **Class IIb** Exercise stress testing in patients with radionuclide angiography may be considered for assessment of LV function in asymptomatic or symptomatic patients with chronic AR. *(Level of Evidence: B)* ***UA/NSTEMI (p. e28)*** **Risk Stratification** **Class I** A noninvasive test (echocardiogram or radionuclide angiogram) is recommended to evaluate LV function in patients with definite ACS who are not scheduled for coronary angiography and left ventriculography.*(Level of Evidence: B)* ***Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death*** **Left Ventricular Function and Imaging (p. e15)** **Class IIa** Magnetic resonance imaging, cardiac computed tomography, or radionuclide angiography can be useful in patients with VA when echocardiography does not provide accurate assessment of LV and RV function, and/or evaluation of structural changes. (Level of Evidence: B)

65. **Evaluation of Left Ventricular Function** Context: **Routine use of FP RNA in conjunction with rest/stress gated SPECT MPI** **Detection of multi-vessel CAD**	***Heart Failure (p. 9)*** **Recommendations for Diagnosis and Initial Evaluation (pg. e32)** **Class I** Radionuclide angiography or magnetic resonance imaging is indicated for the initial and serial assessment of LV volume and function at rest in patients with AR and suboptimal echocardiograms. *(Level of Evidence: B)* **Class IIb** Exercise stress testing in patients with radionuclide angiography may be considered for assessment of LV function in asymptomatic or symptomatic patients with chronic AR. *(Level of Evidence: B)* ***UA/NSTEMI (p. e28)*** **Risk Stratification** **Class I** A noninvasive test (echocardiogram or radionuclide angiogram) is recommended to evaluate LV function in patients with definite ACS who are not scheduled for coronary angiography and left ventriculography.*(Level of Evidence: B)* ***Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death*** **Left Ventricular Function and Imaging (p. e15)** **Class IIa** Magnetic resonance imaging, cardiac computed tomography, or radionuclide angiography can be useful in patients with VA when echocardiography does not provide accurate assessment of LV and RV function, and/or evaluation of structural changes. (Level of Evidence: B)

66. **Evaluation of Left Ventricular Function** Context: **Selective use of FP RNA in conjunction with rest/stress gated SPECT MPI** **Borderline, mild, or moderate stenoses in three vessels OR moderate or equivocal left main stenosis in left dominant system**	***Heart Failure (p. 9)*** **Recommendations for Diagnosis and Initial Evaluation (pg. e32)** **Class I** Radionuclide angiography or magnetic resonance imaging is indicated for the initial and serial assessment of LV volume and function at rest in patients with AR and suboptimal echocardiograms. *(Level of Evidence: B)* **Class IIb** Exercise stress testing in patients with radionuclide angiography may be considered for assessment of LV function in asymptomatic or symptomatic patients with chronic AR. *(Level of Evidence: B)* ***UA/NSTEMI (p. e28)*** **Risk Stratification** **Class I** A noninvasive test (echocardiogram or radionuclide angiogram) is recommended to evaluate LV function in patients with definite ACS who are not scheduled for coronary angiography and left ventriculography.*(Level of Evidence: B)* ***Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death*** **Left Ventricular Function and Imaging (p. e15)** **Class IIa** Magnetic resonance imaging, cardiac computed tomography, or radionuclide angiography can be useful in patients with VA when echocardiography does not provide accurate assessment of LV and RV function, and/or evaluation of structural changes. (Level of Evidence: B)
Use of Potentially Cardiotoxic Therapy (e.g. Doxorubicin)	

67.	**Use of Potentially Cardiotoxic Therapy (e.g., doxorubicin)** ▪ Context: **Serial assessment of LV function with radionuclide angiography (ERNA or FP RNA)** **Baseline and serial measures after key therapeutic milestones or evidence of toxicity**	***Heart Failure (p. 16)*** **Recommendations for Patients at High Risk for Developing Heart Failure (Stage A)** **Class I** Healthcare providers should perform a noninvasive evaluation of LV function (i.e., LVEF) in patients with a strong family history of cardiomyopathy or in those receiving cardiotoxic intervention. (*Level of Evidence: C)* ***RNI (p. 34)*** **Recommendations for the Use of Radionuclide Imaging to Diagnose Specific Causes of Dilated Cardiomyopathy** **Class I** Rest RNA – Baseline and serial monitoring of LV function during therapy with cardiotoxic drugs (e.g., doxorubicin). (Level of Evidence: A) ***Chronic Heart Failure in the Adult (pg. e16)*** **Recommendations for Patients At High Risk for Developing HF** **Class I** Healthcare providers should perform a noninvasive evaluation of LV function (i.e., LVEF) in patients with a strong family history of cardiomyopathy or in those receiving cardiotoxic interventions. (Level of Evidence: C)