MULTI-MODALITY APPROPRIATE USE CRITERIA FOR THE DETECTION AND RISK ASSESSMENT OF ISCHEMIC HEART DISEASE

GUIDELINE MAPPING AND REFERENCES

GENERAL REFERENCES

Relevant Prior AUC Documents

1. Douglas PS, Garcia MJ, Haines DE, et al. ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/SCCT/SCMR 2011 Appropriate Use Criteria for Echocardiography. A Report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, American Society of Echocardiography, American Heart Association, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Critical Care Medicine, Society of Cardiovascular Computed Tomography, and Society for Cardiovascular Magnetic Resonance Endorsed by the American College of Chest Physicians. J Am Coll Cardiol. 2011 Mar 1;57(9):1126-66.
2. Taylor AJ, Cerqueira M, Hodgson JM, et al. ACCF/SCCT/ACR/AHA/ASE/ASNC/NASCI/SCAI/SCMR 2010 appropriate use criteria for cardiac computed tomography. A report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, the Society of Cardiovascular Computed Tomography, the American College of Radiology, the American Heart Association, the American Society of Echocardiography, the American Society of Nuclear Cardiology, the North American Society for Cardiovascular Imaging, the Society for Cardiovascular Angiography and Interventions, and the Society for Cardiovascular Magnetic Resonance. J Am Coll Cardiol. 2010 Nov 23;56(22):1864-94.
3. Patel MR, Dehmer GJ, Hirshfeld JW, Smith PK, Spertus JA. ACCF/SCAI/STS/AATS/AHA/ASNC 2009 appropriateness criteria for coronary revascularization: a report by the American College of Cardiology Foundation Appropriateness Criteria Task Force, Society for Cardiovascular Angiography and Interventions, Society of Thoracic Surgeons, American Association for Thoracic Surgery, American Heart Association, and the American Society of Nuclear Cardiology. J Am Coll Cardiol 2009;53:530–53.
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Other Relevant AUC/Outcome Studies

1. Druz RS, Phillips LM, Sharifova G. Clinical evaluation of the appropriateness use criteria for single-photon emission-computed tomography: differences by patient population, physician specialty, and patient outcomes. ISRN Cardiol. 2011;2011:798318. Epub 2011 Jun 2.
2. Cortigiani L, Bigi R, Bovenzi F, et al. Prognostic implication of appropriateness criteria for pharmacologic stress echocardiography performed in an outpatient clinic. Circ Cardiovasc Imaging. 2012 May 1;5(3):298-305.
3. Koh AS, Flores JL, Keng FY, et al. Correlation between clinical outcomes and appropriateness grading for referral to myocardial perfusion imaging for preoperative evaluation prior to non-cardiac surgery. J Nucl Cardiol. 2012 Apr;19(2):277-84.
4. Choosing Wisely. An initiative of the ABIM Foundation. Five Things Physicians and Patients Should Question. http://choosingwisely.org/wp-content/uploads/2012/04/5things_12_factsheet_Amer_Coll_Cardio.pdf

SECTION 1. DETECTION OF CAD/RISK ASSESSMENT

Table 1.1 Symptomatic orIschemic Equivalent

Refer to pages 10 - 11 for relevant definitions, in particular Table A and text for age, gender, symptom presentation, and risk factors relevant to each pre-test probability category		
Indication text		**Guideline Recommendations**
1.	• Low pretest probability of CAD • ECG interpretable AND able to exercise	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **2.1.6. Developing the Probability Estimate** • "When the probability of disease is ‹5%, further testing is usually not warranted because the likelihood of a false-positive test (i.e., positive test in the absence of obstructive CAD) is actually higher than that of a true positive" **2.2.2. Stress Testing and Advanced Imaging for Initial Diagnosis in Patients With Suspected SIHD Who Require Noninvasive Testing: Recommendations** **2.2.2.1. ABLE TO EXERCISE** CLASS IIa • For patients with a low pretest probability of obstructive IHD who do require testing, **standard exercise ECG testing** can be useful, provided the patient has an interpretable ECG and at least moderate physical functioning or no disabling comorbidity. (Level of Evidence: C) CLASS IIb • For patients with a low [includes low intermediate*] pretest probability of obstructive IHD who do require testing, **standard exercise stress echocardiography** might be reasonable, provided the patient has an interpretable ECG and at least moderate physical functioning or no disabling comorbidity. (Level of Evidence: C) - *Note: Guideline includes a vague definition of low pre-test probability that includes low intermediate pre-test probability (10%-20% or 10%-30%). Guideline definition for intermediate: "The precise definition of intermediate probability (i.e., between … 20% and 80%, or 30% and 70%) is somewhat arbitrary." CLASS III: No Benefit • **Pharmacological stress with nuclear MPI, echocardiography, or CMR** is not recommended for patients who have an interpretable ECG and at least moderate physical functioning or no disabling comorbidity (155,167,168). (Level of Evidence: C) • **Exercise stress with nuclear MPI** is not recommended as an initial test in low-risk patients who have an interpretable ECG and at least moderate physical functioning or no disabling comorbidity. (Level of Evidence: C) . **2.2.2.3. OTHER** CLASS IIb • For patients with a low to intermediate pretest probability of obstructive IHD, **noncontrast cardiac CT** to determine the CAC score may be considered (174). (Level of Evidence: C)

Refer to pages 10 - 11 for relevant definitions, in particular Table A and text for age, gender, symptom presentation, and risk factors relevant to each pre-test probability category		
Indication text		**Guideline Recommendations**
		3.3.1. Coronary Angiography as an Initial Testing Strategy to Assess Risk: Recommendations CLASS III • **Coronary angiography** is not recommended to assess risk in patients who are at low risk according to clinical criteria and who have not undergone noninvasive risk testing. (Level of Evidence: C)
2.	• Low pretest probability of CAD • ECG uninterpretable OR unable to exercise	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **2.2.2. Stress Testing and Advanced Imaging for Initial Diagnosis in Patients With Suspected SIHD Who Require Noninvasive Testing: Recommendations** **2.2.2.2. UNABLE TO EXERCISE** CLASS IIa • **Pharmacological stress echocardiography** is reasonable for patients with a low pretest probability of IHD who require testing and are incapable of at least moderate physical functioning or have disabling comorbidity. (Level of Evidence: C) • **CCTA** is reasonable for patients with a low to intermediate pretest probability of IHD who are incapable of at least moderate physical functioning or have disabling comorbidity (158–166). (Level of Evidence: B) CLASS III: No Benefit • **Standard exercise ECG testing** is not recommended for patients who have an uninterpretable ECG or are incapable of at least moderate physical functioning or have disabling comorbidity (91,132,148–156,161). (Level of Evidence: C) **2.2.2.3. OTHER** CLASS IIb • For patients with a low to intermediate pretest probability of obstructive IHD, noncontrast cardiac CT to determine the CAC score may be considered (174). (Level of Evidence: C) **3.3.1. Coronary Angiography as an Initial Testing Strategy to Assess Risk: Recommendations** CLASS III • **Coronary angiography** is not recommended to assess risk in patients who are at low risk according to clinical criteria and who have not undergone noninvasive risk testing. (Level of Evidence: C)

Refer to pages 10 - 11 for relevant definitions, in particular Table A and text for age, gender, symptom presentation, and risk factors relevant to each pre-test probability category		
Indication text		**Guideline Recommendations**
3.	• Intermediate pretest probability of CAD • ECG interpretable AND able to exercise	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **2.2.2. Stress Testing and Advanced Imaging for Initial Diagnosis in Patients With Suspected SIHD Who Require Noninvasive Testing: Recommendations** **2.2.2.1. ABLE TO EXERCISE** CLASS I • **Standard exercise ECG testing** is recommended for patients with an intermediate pretest probability of IHD who have an interpretable ECG and at least moderate physical functioning or no disabling comorbidity (114,145–147). (Level of Evidence: A) • **Exercise stress with nuclear MPI or echocardiography** is recommended for patients with an intermediate to high pretest probability of IHD who have an uninterpretable ECG and at least moderate physical functioning or no disabling comorbidity (91,132,148–156). (Level of Evidence: B) CLASS IIa • **Exercise stress with nuclear MPI or echocardiography** is reasonable for patients with an intermediate to high pretest probability of obstructive IHD who have an interpretable ECG and at least moderate physical functioning or no disabling comorbidity (91,132,148–156). (Level of Evidence: B) • Pharmacological stress with CMR can be useful for patients with an intermediate to high pretest probability of obstructive IHD who have an uninterpretable ECG and at least moderate physical functioning or no disabling comorbidity (153,157,158). (Level of Evidence: B) CLASS IIb • For patients with a low [includes low intermediate*] pretest probability of obstructive IHD who do require testing, **standard exercise stress echocardiography** might be reasonable, provided the patient has an interpretable ECG and at least moderate physical functioning or no disabling comorbidity. (Level of Evidence: C) - *Note: Guideline includes a vague definition of low pre-test probability that includes low intermediate pre-test probability (10%-20% or 10%-30%). Guideline definition for intermediate: "The precise definition of intermediate probability (i.e., between … 20% and 80%, or 30% and 70%) is somewhat arbitrary." CLASS IIb • **CCTA** might be reasonable for patients with an intermediate pretest probability of IHD who have at least moderate physical functioning or no disabling comorbidity (158–166). (Level of Evidence: B) **2.2.2.3. OTHER** CLASS IIb • For patients with a low to intermediate pretest probability of obstructive IHD, **noncontrast cardiac CT** to determine the CAC score may be considered (174). (Level of Evidence: C)

Refer to pages 10 - 11 for relevant definitions, in particular Table A and text for age, gender, symptom presentation, and risk factors relevant to each pre-test probability category		
Indication text		**Guideline Recommendations**
4.	• Intermediate pretest probability of CAD • ECG uninterpretable OR unable to exercise	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **2.2.2. Stress Testing and Advanced Imaging for Initial Diagnosis in Patients With Suspected SIHD Who Require Noninvasive Testing: Recommendations** **2.2.2.2. UNABLE TO EXERCISE** CLASS I • **Pharmacological stress with nuclear MPI or echocardiography** is recommended for patients with an intermediate to high pretest probability of IHD who are incapable of at least moderate physical functioning or have disabling comorbidity (148–150,152–156). (Level of Evidence: B) CLASS IIa • **Pharmacological stress CMR** is reasonable for patients with an intermediate to high pretest probability of IHD who are incapable of at least moderate physical functioning or have disabling comorbidity (153,157,158,169–172). (Level of Evidence: B) CLASS III: No Benefit • **Standard exercise ECG testing** is not recommended for patients who have an uninterpretable ECG or are incapable of at least moderate physical functioning or have disabling comorbidity (91,132,148–156,161). (Level of Evidence: C) **2.2.2.3. OTHER** CLASS IIa • **CCTA** is reasonable for patients with an intermediate pretest probability of IHD who a) have continued symptoms with prior normal test findings, or b) have inconclusive results from prior exercise or pharmacological stress testing, or c) are unable to undergo stress with nuclear MPI or echocardiography (173). (Level of Evidence: C) CLASS IIb • For patients with a low to intermediate pretest probability of obstructive IHD, **noncontrast cardiac CT** to determine the CAC score may be considered (174). (Level of Evidence: C)

Refer to pages 10 - 11 for relevant definitions, in particular Table A and text for age, gender, symptom presentation, and risk factors relevant to each pre-test probability category		
Indication text		**Guideline Recommendations**
5.	• High pretest probability of CAD • ECG Interpretable AND able to exercise	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **2.2.2. Stress Testing and Advanced Imaging for Initial Diagnosis in Patients With Suspected SIHD Who Require Noninvasive Testing: Recommendations** **2.2.2.1. ABLE TO EXERCISE** CLASS I • **Exercise stress with nuclear MPI or echocardiography** is recommended for patients with an intermediate to high pretest probability of IHD who have an uninterpretable ECG and at least moderate physical functioning or no disabling comorbidity (91,132,148–156). (Level of Evidence: B) CLASS IIa • **Exercise stress with nuclear MPI or echocardiography** is reasonable for patients with an intermediate to high pretest probability of obstructive IHD who have an interpretable ECG and at least moderate physical functioning or no disabling comorbidity (91,132,148–156). (Level of Evidence: B) • **Pharmacological stress with CMR** can be useful for patients with an intermediate to high pretest probability of obstructive IHD who have an uninterpretable ECG and at least moderate physical functioning or no disabling comorbidity (153,157,158). (Level of Evidence: B) **2.2.2.2. UNABLE TO EXERCISE** CLASS I • **Pharmacological stress with nuclear MPI or echocardiography** is recommended for patients with an intermediate to high pretest probability of IHD who are incapable of at least moderate physical functioning or have disabling comorbidity (148–150,152–156). (Level of Evidence: B) CLASS IIa • **Pharmacological stress CMR** is reasonable for patients with an intermediate to high pretest probability of IHD who are incapable of at least moderate physical functioning or have disabling comorbidity (153,157,158,169–172). (Level of Evidence: B)

Refer to pages 10 - 11 for relevant definitions, in particular Table A and text for age, gender, symptom presentation, and risk factors relevant to each pre-test probability category		
Indication text		**Guideline Recommendations**
6.	• High pretest probability of CAD • ECG uninterpretable OR unable to exercise	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **2.2.2. Stress Testing and Advanced Imaging for Initial Diagnosis in Patients With Suspected SIHD Who Require Noninvasive Testing: Recommendations** **2.2.2.1. ABLE TO EXERCISE** CLASS I • **Exercise stress with nuclear MPI or echocardiography** is recommended for patients with an intermediate to high pretest probability of IHD who have an uninterpretable ECG and at least moderate physical functioning or no disabling comorbidity (91,132,148–156). (Level of Evidence: B) CLASS IIa • **Exercise stress with nuclear MPI or echocardiography** is reasonable for patients with an intermediate to high pretest probability of obstructive IHD who have an interpretable ECG and at least moderate physical functioning or no disabling comorbidity (91,132,148–156). (Level of Evidence: B) • **Pharmacological stress with CMR** can be useful for patients with an intermediate to high pretest probability of obstructive IHD who have an uninterpretable ECG and at least moderate physical functioning or no disabling comorbidity (153,157,158). (Level of Evidence: B) **2.2.2.2. UNABLE TO EXERCISE** CLASS I • **Pharmacological stress with nuclear MPI or echocardiography** is recommended for patients with an intermediate to high pretest probability of IHD who are incapable of at least moderate physical functioning or have disabling comorbidity (148–150,152–156). (Level of Evidence: B) CLASS IIa • **Pharmacological stress CMR** is reasonable for patients with an intermediate to high pretest probability of IHD who are incapable of at least moderate physical functioning or have disabling comorbidity (153,157,158,169–172). (Level of Evidence: B)

2012 Guideline for the Diagnosis and Management of Patients with Stable Ischemic Heart Disease References:

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Table 1.2 Asymptomatic (Without Symptoms or Ischemic Equivalent)

Refer to pages 11 for relevant definitions		
Indication text		**Guideline Recommendations**
7.	• Low global CHD risk • Regardless of ECG interpretability and ability to exercise	**2010 Guidelines for Assessment of Cardiovascular Risk Among Asymptomatic Adults** Class III • Persons at low risk (<6% 10-year risk) should not undergo **CAC** measurement for cardiovascular risk assessment. (Level of Evidence: B) • **Stress echocardiography** is not indicated for cardiovascular risk assessment in low- or intermediate-risk asymptomatic adults. (Exercise or pharmacologic stress echocardiography is primarily used for its role in advanced cardiac evaluation of symptoms suspected of representing CHD and/or estimation of prognosis in patients with known coronary artery disease or the assessment of patients with known or suspected valvular heart disease.) *(Level of Evidence C)* • **Stress MPI** is not indicated for cardiovascular risk assessment in low- or intermediate-risk asymptomatic adults (Exercise or pharmacologic stress MPI is primarily used and studied for its role in advanced cardiac evaluation of symptoms suspected of representing CHD and/or estimation of prognosis in patients with known coronary artery disease.) *(Level of Evidence: C)* • **Magnetic resonance imaging** for detection of vascular plaque is not recommended for cardiovascular risk assessment in asymptomatic adults. *(Level of Evidence: C)* • **Coronary computed tomography angiography** is not recommended for cardiovascular risk assessment in asymptomatic adults. *(Level of Evidence: C)* **2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **3.3.1. Coronary Angiography as an Initial Testing Strategy to Assess Risk: Recommendations** CLASS III • **Coronary angiography** is not recommended to assess risk in patients who are at low risk according to clinical criteria and who have not undergone noninvasive risk testing. (Level of Evidence: C)
8.	• Intermediate global CHD risk • ECG interpretable and able to exercise	**2010 Guidelines for Assessment of Cardiovascular Risk Among Asymptomatic Adults** Class IIA • Measurement of **CAC** is reasonable for cardiovascular risk assessment in asymptomatic adults at intermediate risk (10% to 20% 10-year risk). (Level of Evidence: B) Class IIB • An **exercise ECG** may be considered for cardiovascular risk assessment in intermediate-risk asymptomatic adults (including sedentary adults considering starting a vigorous exercise program), particularly when attention is paid to non-ECG markers such as exercise capacity. (Level of Evidence: B)

Refer to pages 11 for relevant definitions		
Indication text		**Guideline Recommendations**
9.	• Intermediate global CHD risk • ECG uninterpretable OR unable to exercise	**2010 Guidelines for Assessment of Cardiovascular Risk Among Asymptomatic Adults** Class IIA • Measurement of **CAC** is reasonable for cardiovascular risk assessment in asymptomatic adults at intermediate risk (10% to 20% 10-year risk). (Level of Evidence: B) Class IIB • An **exercise ECG** may be considered for cardiovascular risk assessment in intermediate-risk asymptomatic adults (including sedentary adults considering starting a vigorous exercise program), particularly when attention is paid to non-ECG markers such as exercise capacity. (Level of Evidence: B)
10.	• High global CAD Risk • ECG interpretable and able to exercise	**2010 Guidelines for Assessment of Cardiovascular Risk Among Asymptomatic Adults** Class IIB • **Stress MPI** may be considered for advanced cardiovascular risk assessment in asymptomatic adults with diabetes or asymptomatic adults with a strong family history of CHD or when previous risk assessment testing suggests high risk of CHD, such as a coronary artery calcium (CAC) score of 400 or greater. (Level of Evidence: C)
11.	• High global CAD Risk • ECG uninterpretable OR unable to exercise	**2010 Guidelines for Assessment of Cardiovascular Risk Among Asymptomatic Adults** Class IIB **Stress MPI** may be considered for advanced cardiovascular risk assessment in asymptomatic adults with diabetes or asymptomatic adults with a strong family history of CHD or when previous risk assessment testing suggests high risk of CHD, such as a coronary artery calcium (CAC) score of 400 or greater. (Level of Evidence: C)

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Table 1.3 Other Cardiovascular Conditions

Refer to pages 11 for relevant definitions		
Indication text		**Guideline Recommendations**
New Onset Heart Failure No Prior CAD Evaluation		
12.	• Newly diagnosed systolic heart failure	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease 3.3.1. Coronary Angiography as an Initial Testing Strategy to Assess Risk: Recommendations** Class I • Patients with SIHD who develop symptoms and signs of heart failure should be evaluated to determine whether **coronary angiography** should be performed for risk assessment (352–355). (Level of Evidence: B) **2009 Focused Update: Guidelines for the Diagnosis and Management of Heart Failure in Adults Section 3: Initial and Serial Clinical Assessment of Patients Presenting with Heart Failure** 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: B)
13.	• Newly diagnosed diastolic heart failure	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease 3.3.1. Coronary Angiography as an Initial Testing Strategy to Assess Risk: Recommendations** Class I • Patients with SIHD who develop symptoms and signs of heart failure should be evaluated to determine whether **coronary angiography** should be performed for risk assessment (352–355). (Level of Evidence: B) **2009 Focused Update: Guidelines for the Diagnosis and Management of Heart Failure in Adults Section 3: Initial and Serial Clinical Assessment of Patients Presenting with Heart Failure** 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)

Refer to pages 11 for relevant definitions		
Indication text		**Guideline Recommendations**
Evaluation of Arrhythmias (incidentally detected by monitoring) without Ischemic Equivalent		
14.	• Sustained VT	**2006 Guideline for the Management of Patients with Ventricular Arrhythmias** **Recommendations for Exercise Testing** Class I • **Exercise testing** is recommended in adult patients with ventricular arrhythmias who have an intermediate or greater probability of having CHD by age, gender, and symptoms* to provoke ischemic changes or ventricular arrhythmias. (Level of Evidence: B) • **Exercise testing**, regardless of age, is useful in patients with known or suspected exercise-induced ventricular arrhythmias, including catecholaminergic VT, to provoke the arrhythmia, achieve a diagnosis, and determine the patient's response to tachycardia. (Level of Evidence: B) • **Exercise testing** may be useful in patients with ventricular arrhythmias and a low probability of CHD by age, gender, and symptoms.* (Level of Evidence: C **Recommendations for Left Ventricular Function and Imaging** Class I • **Exercise testing with an imaging modality (echocardiography or nuclear perfusion [single-photon emission computed tomography (SPECT)])** is recommended to detect silent ischemia in patients with ventricular arrhythmias 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, LVH, greater than 1-mm ST-segment depression at rest, WPW syndrome, or LBBB. (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 ventricular arrhythmias 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). **2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **3.3.1. Coronary Angiography as an Initial Testing Strategy to Assess Risk: Recommendations** Class I • Patients with SIHD who have survived sudden cardiac death or potentially life-threatening ventricular arrhythmia should undergo **coronary angiography** to assess cardiac risk (349–351). (Level of Evidence: B)

Refer to pages 11 for relevant definitions		
Indication text		**Guideline Recommendations**
15.	• Ventricular Fibrillation	**2006 Guideline for the Management of Patients with Ventricular Arrhythmias** Recommendations for Left Ventricular Function and Imaging Class I • **Exercise testing with an imaging modality (echocardiography or nuclear perfusion [single-photon emission computed tomography (SPECT)])** is recommended to detect silent ischemia in patients with ventricular arrhythmias 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, LVH, greater than 1-mm ST-segment depression at rest, WPW syndrome, or LBBB. (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 ventricular arrhythmias 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).
16.	• Exercise induced VT or nonsustained VT	**2006 Guideline for the Management of Patients with Ventricular Arrhythmias** Recommendations for Left Ventricular Function and Imaging Class I • **Exercise testing with an imaging modality (echocardiography or nuclear perfusion [single-photon emission computed tomography (SPECT)])** is recommended to detect silent ischemia in patients with ventricular arrhythmias 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, LVH, greater than 1-mm ST-segment depression at rest, WPW syndrome, or LBBB. (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 ventricular arrhythmias 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).
17.	• Frequent PVCs	
18.	• Infrequent PVCs	**2006 Guideline for the Management of Patients with Ventricular Arrhythmias** **Recommendations for management of Ventricular Arrhythmias** Class IIB • **Exercise testing** may be useful in the investigation of isolated premature ventricular complexes (PVCs) in middle-aged or older patients without other evidence of CHD. (Level of Evidence: C)
19.	• New-onset atrial fibrillation	None
20.	• Prior to initiation of anti-arrhythmia therapy in high global CAD risk patients	None
Syncope without Ischemic Equivalent		
21.	• Low global CAD Risk	None
22.	• Intermediate or High Global CAD Risk	None

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Section 2: Prior Testing or Procedure

Section 2.1 Prior Testing without Intervening Revascularization - (If Intervening Revascularization Since Most Recent Test, Refer to Section 2.2)

Table 2.1 Sequential Testing (≤ 90 days): Abnormal Prior Test/Study

Indication text		Guideline Recommendations
23.	• Abnormal rest EKG findings (potentially ischemic in nature such as LBBB, T wave inversions) • Low global CAD risk	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **3.2.2.3 Risk Assessment Regardless of Patients' Ability to Exercise** Class I • Pharmacological stress with either nuclear MPI or echocardiography is recommended for risk assessment in patients with SIHD who have LBBB on ECG, regardless of ability to exercise to an adequate workload. (Level of Evidence: B)
24.	• Abnormal rest EKG findings (potentially ischemic in nature such as LBBB, T wave inversions) • Intermediate to high global CAD risk	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **3.2.2.3 Risk Assessment Regardless of Patients' Ability to Exercise** Class I Class I • Pharmacological stress with either nuclear MPI or echocardiography is recommended for risk assessment in patients with SIHD who have LBBB on ECG, regardless of ability to exercise to an adequate workload. (Level of Evidence: B)
25.	• Abnormal prior exercise ECG test	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **3.2.2.3 Risk Assessment Regardless of Patients' Ability to Exercise** Class I • Either exercise or pharmacological stress with imaging (nuclear MPI, echocardiography, or CMR) is recommended for risk assessment in patients with SIHD who are being considered for revascularization of known coronary stenosis of unclear physiological significance (Level of Evidence: B) Class IIb • CCTA might be considered for risk assessment in patients with SIHD unable to undergo stress imaging or as an alternative to invasive coronary angiography when functional testing indicates a moderate- to high-risk result and knowledge of angiographic coronary anatomy is unknown. (Level of Evidence: C) **3.3.2 Coronary Angiography to Assess Risk After Initial Workup With Noninvasive Testing: Recommendations** Class I • Coronary arteriography is recommended for patients with SIHD whose clinical characteristics and results of noninvasive testing indicate a high likelihood of severe IHD and when the benefits are deemed to exceed risk. (Level of Evidence: C)

Indication text		Guideline Recommendations
26.	• Abnormal prior stress imaging study (assumes not repeat same type of stress imaging study)	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **3.2.2.3 Risk Assessment Regardless of Patients' Ability to Exercise** Class IIa • CCTA can be useful for risk assessment in patients with SIHD who have an indeterminate result from functional testing (286). (Level of Evidence: C) Class IIb • CCTA might be considered for risk assessment in patients with SIHD unable to undergo stress imaging or as an alternative to invasive coronary angiography when functional testing indicates a moderate- to high-risk result and knowledge of angiographic coronary anatomy is unknown. (Level of Evidence: C) **3.3.2 Coronary Angiography to Assess Risk After Initial Workup With Noninvasive Testing: Recommendations** Class I • Coronary arteriography is recommended for patients with SIHD whose clinical characteristics and results of noninvasive testing indicate a high likelihood of severe IHD and when the benefits are deemed to exceed risk. (Level of Evidence: C)
27.	• Obstructive CAD on prior CCTA study	None
28.	• Obstructive CAD on prior invasive coronary angiography	None
29.	• Abnormal prior CCT calcium (Agatston Score >100)	**2010 Guidelines for Assessment of Cardiovascular Risk Among Asymptomatic Adults** Class IIb • **Stress MPI** may be considered for advanced cardiovascular risk assessment in asymptomatic adults with diabetes or asymptomatic adults with a stong family history of CHD or when previous risk assessment testing suggests high risk of CHD, such as a coronary artery calcium (CAC) score of 400 or greater. (Level of Evidence: C)

Table 2.2 Sequential or Follow-up Testing (<1 year): Uncertain Prior Results

Indication text		Guideline Recommendations
Equivocal, Borderline, or Discordant Prior Noninvasive Evaluation Where Obstructive CAD Remains a Concern		
30.	Prior exercise ECG test	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **3.2.2.3 Risk Assessment Regardless of Patients' Ability to Exercise** Class IIa • CCTA can be useful for risk assessment in patients with SIHD who have an indeterminate result from functional testing. (Level of Evidence: C) **3.3.2 Coronary Angiography to Assess Risk After Initial Workup With Noninvasive Testing: Recommendations** • Coronary angiography is reasonable to further assess risk in patients with SIHD and inconclusive prognostic information after noninvasive testing or in patients for whom noninvasive testing is contraindicated or inadequate. (Level of Evidence: C)
31.	Prior stress imaging study (assumes not repeat same type of	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **3.2.2.3 Risk Assessment Regardless of Patients' Ability to Exercise**

Indication text		Guideline Recommendations
	study)	Class IIa • CCTA can be useful for risk assessment in patients with SIHD who have an indeterminate result from functional testing. (Level of Evidence: C) **3.3.2 Coronary Angiography to Assess Risk After Initial Workup With Noninvasive Testing: Recommendations** • Coronary angiography is reasonable to further assess risk in patients with SIHD and inconclusive prognostic information after noninvasive testing or in patients for whom noninvasive testing is contraindicated or inadequate. (Level of Evidence: C)
32.	Prior CTA	None
Prior Coronary Angiography (Invasive or Noninvasive)		
33.	Coronary stenosis or abnormality of unclear significance found on cardiac CTA	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **3.3.2. Coronary Angiography to Assess Risk After Initial Workup With Noninvasive Testing:Recommendations** Class IIa • **Coronary angiography** is reasonable to further assess risk in patients with SIHD and inconclusive prognostic information after noninvasive testing or in patients for whom noninvasive testing is contraindicated or inadequate. (Level of Evidence: C) **3.3.2.3. Risk Assessment Regardless of Patients' Ability to Exercise: Recommendations** Class I • **Either exercise or pharmacological stress with imaging (radionuclide MPI, echocardiography, or CMR)** is recommended for risk assessment in patients with SIHD who are being considered for revascularization of known coronary stenosis of unclear physiologic significance (Level of Evidence: B)
34.	Coronary stenosis or anatomic abnormality of unclear significance on previous coronary angiography	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **3.3.2.3. Risk Assessment Regardless of Patients' Ability to Exercise: Recommendations** Class I • **Either exercise or pharmacological stress with imaging (radionuclide MPI, echocardiography, or CMR)** is recommended for risk assessment in patients with SIHD who are being considered for revascularization of known coronary stenosis of unclear physiologic significance (Level of Evidence: B)

Table 2.3 Follow-up testing (>1 month) Asymptomatic or Stable Symptoms

Indication text	Guideline Recommendations
Abnormal Prior Exercise ECG Study Asymptomatic (Without Ischemic Equivalent) or Stable Symptoms	

Indication text		Guideline Recommendations
35.	• Last test < 2 years ago	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **6.3.2. Noninvasive Testing in Known SIHD: Asymptomatic (or Stable Symptoms): Recommendations** Class IIB • **Standard exercise ECG testing** performed at 1 year or longer intervals might be considered for follow-up assessment in patients with SIHD who have had prior evidence of silent ischemia or at high-risk for a recurrent cardiac event and are able to exercise to an adequate workload and have an interpretable ECG. (Level of Evidence: C) • In patients who have no new or worsening symptoms, or no prior evidence of silent ischemia and are not at high risk for a recurrent cardiac event, the usefulness of annual surveillance **exercising ECG testing** is not well established. (Level of Evidence: C)
36.	• Last test≥ 2 years ago	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **6.3.2. Noninvasive Testing in Known SIHD: Asymptomatic (or Stable Symptoms): Recommendations** Class IIa • **Radionuclide MPI, echocardiography, or CMR with either exercise or pharmacological stress** can be useful for follow-up assessment at 2-year or longer intervals in patients with SIHD with prior evidence of silent ischemia or at high risk for a recurrent cardiac event, and who are a) unable to exercise to an adequate workload, b) have an uninterpretable ECG, or c) have a history of incomplete coronary revascularization. (Level of Evidence: C)
Abnormal Prior Stress Imaging Study Asymptomatic (Without Ischemic Equivalent) or Stable Symptoms		
37.	• Last test < 2 years ago	None
38.	• Last test≥ 2 years ago	None
Obstructive CAD on Prior Coronary Angiography (Invasive or Noninvasive) Asymptomatic (Without Ischemic Equivalent) or Stable Symptoms		
39.	• Last test< 2 years ago	None
40.	• Last test ≥ 2 years ago	None
Prior Coronary Calcium Agatston Score Asymptomatic (Without Ischemic Equivalent) or Stable Symptoms		
41.	• Agatston score < 100	None
42.	• Low to intermediate global CAD risk Agatston score between 100 and 400	None
43.	• High global CAD risk Agatston score between 100 and 400	None
44.	• Agatston score > 400	None
Normal Prior Exercise ECG test Asymptomatic (Without Ischemic Equivalent)		
45.	• Low global CAD Risk	None
46.	• Intermediate to high global CAD Risk • Test < 2 years ago	None

Indication text		Guideline Recommendations
47.	• Intermediate to high global CAD Risk • Test ≥ 2 years ago	None
Normal Prior Stress Imaging Study OR Non-obstructive CAD on Angiogram (Invasive or Noninvasive) Asymptomatic (Without Ischemic Equivalent)		
48.	• Low global CAD Risk	None
49.	• Intermediate to high global CAD Risk • Test < 2 years ago	None
50.	• Intermediate to high global CAD Risk • Test ≥ 2 years ago	None
Normal Prior Non-imaging Exercise ECG Test Stable Symptoms		
51.	• Low global CAD Risk	None
52.	• Intermediate to high global CAD Risk • Study < 2 years ago	None
53.	• Intermediate to high global CAD Risk • Study ≥ 2 years ago	None
Normal Prior Stress Imaging Study OR Non-Obstructive CAD on Angiogram (Invasive or Noninvasive) Stable Symptoms		
54.	• Low global CAD Risk	None
55.	• Intermediate to high global CAD Risk • Study < 2 years ago	None
56.	• Intermediate to high global CAD Risk • Study ≥ 2 years ago	None

Table 2.4 Follow-up Testing (> 1 month) New or Worsening Symptoms

Indication text		Guideline Recommendations
57.	• Normal exercise ECG test	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **6.3.1.1. Patients Able to Exercise** Class I • **Standard exercise ECG testing** is recommended in patients with known SIHD who have new or worsening symptoms not consistent with UA, and who have a) at least moderate physical functioning and no disabling comorbidity and b) an interpretable ECG (Level of Evidence: B) • **Exercise with radionuclide MPI or echocardiography** is recommended in patients with known SIHD who have new or worsening symptoms not consistent with UA, and who have a) at least moderate
58.	• Non-obstructive CAD on coronary angiography (invasive or non-invasive) OR normal prior stress imaging study	
59.	• Abnormal exercise ECG test	
60.	• Abnormal prior stress imaging study hy	
61.	• Obstructive CAD on CCTA study	
62.	• Obstructive CAD on invasive coronary angiography	

Indication text		Guideline Recommendations
		physical functioning or no disabling comorbidity but b) an uninterpretable ECG. (Level of Evidence: B) Class IIA • **Exercise with nuclear MPI or echocardiography** is reasonable in patients with known SIHD who have new or worsening symptoms not consistent with UA and who have a)at least moderate physical function and no disabling comorbidity, b)previously required imaging with exercise stress, or c)known multivessel disease or high risk for multivessel diesease Class III • **Pharmacological stress imaging with nuclear MPI, echocardiography, or CMR** is not recommended in patients with known SIHD who have new or worsening symptoms not consistent with UA and who are capable of at least moderate physical functioning or have no disabling comorbidity (Level of Evidence C). **6.3.1.2 Patients Unable to Exercise** Class I • **Pharmacological stress imaging with nuclear MPI or echocardiography** is recommended in patients with known SIHD who have new or worsening symptoms not consistent with UA and who are incapable of at least moderate physical functioning or have disabling comorbidity (Level of Evidence B). Class IIA • **Pharmacological stress imaging with CMR** is reasonable in patients with known SIHD who have new or worsening symptoms not consistent with UA and who are incapable of at least moderate physical functioning or have disabling comorbidity (Level of Evidence B) Class III: No Benefit • **Standard exercise ECG testing** should not be performed in patients with known SIHD who have new or worsening symptoms not consistent with UA and who a)are incapable of at least moderate physical functioning or have disabling comorbidity or b)have an uninterpretable ECG (Level of Evidence C) **6.3.1.3 Irrespective of Ability to Exercise** Class IIB • **CCTA** might be reasonable in patients with known SIHD who have new or worsening symptoms not consistent with UA, irrespective of ability to exercise, in the absence of known moderate or severe calcification or if the CCTA is intended to assess coronary stents less than 3 mm in diameter (Level of Evidence B). **3.2.2.2. Risk Assessment in Patients Not Able to Exercise** Class IIA • **Exercise with radionuclide MPI or echocardiography** is reasonable in patients with known SIHD who have new or worsening symptoms not consistent with UA, and who have either a) at least moderate physical functioning and no disabling comorbidity, b) previously required imaging with exercise stress or c)

Indication text		Guideline Recommendations
		known or at high risk for multivessel disease. (Level of Evidence: B) Class IIB • **CCTA** might be reasonable in patients with known SIHD who have new or worsening symptoms not consistent with UA, irrespective of ability to exercise in the absence of known moderate or severe calcification or if the CCTA is intended to assess coronary stents less than 3 mm in diameter. (Level of Evidence: A)
63.	• Abnormal CCT calcium (Agatston Score >100)	

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SECTION 2.2: POST REVASCULARIZATION (PCI OR CABG)

Table 2.4 Symptomatic (Ischemic Equivalent)

Indication text		Guideline Recommendations
64.	• Evaluation of ischemic equivalent	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **6.3.2. Noninvasive Testing in Known SIHD—Asymptomatic (or Stable Symptoms): Recommendations** Class III • **Nuclear MPI, echocardiography, or CMR, with either exercise or pharmacological stress or CCTA**, is not recommended for follow-up assessment in patients with SIHD, if performed more frequently than at a) 5-year intervals after CABG or b) 2-year intervals after PCI. (Level of Evidence: C) **2011 Guideline for Percutaneous Coronary Intervention** Class III: NO BENEFIT • **Routine periodic stress testing of asymptomatic patients** after PCI without specific clinical indications should not be performed. (Level of Evidence: C)

Table 2.5 Asymptomatic (without Ischemic Equivalent)

Indication text		Guideline Recommendations
65.	• Incomplete revascularization • Additional revascularization feasible	None
66.	• Prior left main coronary stent	None
67.	• < 5 years after CABG	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **6.3.2. Noninvasive Testing in Known SIHD—Asymptomatic (or Stable Symptoms): Recommendations** Class III • **Nuclear MPI, echocardiography, or CMR, with either exercise or pharmacological stress or CCTA**, is not recommended for follow-up assessment in patients with SIHD, if performed more frequently than at a) 5-year intervals after CABG or b) 2-year intervals after PCI. (Level of Evidence: C)
68.	• ≥ 5 years after CABG	**None**
69.	• < 2 years after PCI	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **6.3.2. Noninvasive Testing in Known SIHD—Asymptomatic (or Stable Symptoms): Recommendations** Class III • **Nuclear MPI, echocardiography, or CMR, with either exercise or pharmacological stress or CCTA**, is not recommended for follow-up assessment in patients with SIHD, if performed more frequently than at a) 5-year intervals after CABG or b) 2-year intervals after PCI. (Level of Evidence: C) **2011 Guideline for Percutaneous Coronary Intervention** Class III: NO BENEFIT • **Routine periodic stress testing of asymptomatic patients** after PCI without specific clinical indications should not be performed. (Level of Evidence: C)
70.	• ≥ 2 years after PCI	**2012 Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease** **6.3.2. Noninvasive Testing in Known SIHD—Asymptomatic (or Stable Symptoms): Recommendations**

Indication text		Guideline Recommendations
		Class IIa • **Nuclear MPI, echocardiography, or CMR with either exercise or pharmacological stress** can be useful for follow-up assessment at 2 year or longer intervals in patients with SIHD with prior evidence of silent ischemia or who are at high risk for recurrent cardiac event and a)are unable to exercise to an adequate workload, b)a have an uninterpretable ECG, or c)have a history of incomplete coronary revascularization. *(Level of Evidence: C)* **2011 Guideline for Percutaneous Coronary Intervention** Class III: NO BENEFIT • **Routine periodic stress testing of asymptomatic** patients after PCI without specific clinical indications should not be performed. (Level of Evidence: C)

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SECTION 3: PREOPERATIVE EVALUATION FOR NONCARDIAC SURGERY

Table 3.1 Moderate to good functional capacity (≥ 4 METs) OR no clinical risk factors

Refer to page 13 -15 for relevant definitions		
Indication text		**Guideline Recommendations**
71.	• Any surgery	**2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for 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)

Table 3.2 Asymptomatic AND < 1 year post any of the following Normal CT or invasive angiogram, normal stress test for CAD, or revascularization

Refer to page 13 -15 for relevant definitions		
Indication text		**Guideline Recommendations**
72.	• Any surgery	None

Table 3.3 Poor or unknown functional capacity (< 4 METs)

Refer to page 13 -15 for relevant definitions		
Indication text		**Guideline Recommendations**
73.	• Low-risk surgery • ≥ 1 clinical risk factor	**2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery** Class III • **Noninvasive testing** is not useful for patients undergoing low-risk noncardiac surgery. (Level of Evidence: C)
74.	• Intermediate-risk surgery • ≥ 1 clinical risk factor	**2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for 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 or vascular surgery if it will change management. (Level of Evidence: B)
75.	• Vascular surgery • 1 clinical risk factor	**2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for 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 or vascular surgery if it will change management. (Level of Evidence: B)
76.	• Kidney transplant	None
77.	• Liver transplant*	

* Renal transplant is assumed to be similar to other intermediate risk surgery, and therefore, it is not presented separately.

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Section 4: Determine Exercise LEVEL Prior to Initiation of Exercise Prescription or Cardiac Rehabilitation

Table 4.1 Exercise Prescription

		Guideline Recommendations
78	• No prior revascularization	None

Table 4.2 Cardiac Rehabilitation (Able to Exercise)

		Guideline Recommendations
79.	• Post revascularization (PCI or CABG)	**2011 Guideline for Percutaneous Coronary Intervention** CLASS IIa In patients entering a formal cardiac rehabilitation program after PCI, treadmill exercise testing is reasonable. (Level of Evidence: C)
80.	• Heart failure	None

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