National Imaging Associates, Inc.	
Clinical Guidelines **STRESS ECHOCARDIOGRAPHY**	**Original Date: February 2010**
CPT Codes: 93350, 93351, +93320, +93321, +93325, +93352, +93356	**Last Revised Date: July 2019**
Guideline Number: NIA_CG_026	**Implementation Date: January 2020**

INDICATIONS for STRESS ECHO

SUSPECTED CORONARY ARTERY DISEASE (CAD)

Symptomatic patients without known CAD (use Diamond Forrester table)

- Low pretest probability, if electrocardiogram (ECG) is uninterpretable and patient can exercise
- Intermediate pretest probability, if ECG is uninterpretable (Wolk 2014)
- High pretest probability
  - Repeat testing in patient with new or worse symptoms and negative result at least one year ago

Asymptomatic patients without known CAD

- Previously unevaluated ECG evidence of possible myocardial ischemia such as substantial ischemic ST segment or T wave abnormalities
- Previously unevaluated pathologic Q waves
- Unevaluated complete left bundle branch block

INCONCLUSIVE CAD EVALUATION WITHIN THE PAST 2 YEARS AND OBSTRUCTIVE CAD REMAINS A CONCERN

- Exercise stress ECG with low risk Duke treadmill score ≥5), but patient's current symptoms indicate an intermediate or high pretest probability
- Exercise stress ECG with an intermediate Duke treadmill score
- Intermediate coronary computed tomography angiography (CCTA) (e.g. 30 - 70% lesions
- An indeterminate (equivocal, borderline, or discordant) evaluation by prior stress imaging (SE or CMR) within the past 2 years

FOLLOW-UP OF PATENTS POST CORONARY REVASCULARIZATION (PCI or CABG)
(Doherty 2019)

- **Asymptomatic follow-up stress imaging (MPI or SE),** at a minimum of 2 years post coronary artery bypass grafting (CABG), or percutaneous coronary intervention (PCI), whichever is later, is appropriate only for patients with a history of silent ischemia or a history of a prior left main stent **OR**
- For patients with high occupational risk (e.g. associated with public safety, airline and boat pilots, bus and train drivers, bridge and tunnel workers/toll collectors, police officers and firefighters)

NIA Magellan℠

- **New, recurrent or worsening symptoms post coronary revascularization,** is an indication for stress imaging (MPI or SE), if it will alter management

FOLLOW-UP OF KNOWN CAD

- **Routine follow-up of asymptomatic or stable symptoms** when last invasive or non-invasive assessment of coronary disease showed hemodynamically significant CAD (ischemia on stress test or FFR less than or equal to 0.80 or stenosis greater than or equal to 70% of a major vessel) over two years ago without intervening coronary revascularization is an appropriate indication for stress imaging (MPI or SE) in patients if it will alter management

SPECIAL DIAGNOSTIC CONDITIONS REQUIRING CORONARY EVALUATION

- Prior acute coronary syndrome (as documented in MD notes), without invasive or non-invasive coronary evaluation
- Newly diagnosed systolic heart failure (EF > 50%), especially when symptoms or signs of ischemia are present or suspected, unless invasive coronary angiography is immediately planned (Fihn 2012, Patel 2013, Yancy, 2013).
- New wall motion abnormality
- Ventricular arrhythmias:
    - Sustained ventricular tachycardia (VT) > 100 bpm, ventricular fibrillation (VF), or exercise induced VT, when invasive coronary arteriography is not the initially planned test (Al-Khatib 2018)
    - Nonsustained VT, multiple episodes, each ≥ 3 beats at ≥ 100 bpm, frequent VPC's (defined as greater than or equal to 30/hour), without known cause or associated cardiac pathology when an exercise ECG could not be performed (Zimetbaum 2018)
- Prior to Class IC antiarrhythmic drug initiation (Propafenone or Flecanide), in intermediate and high global risk patients (Reiffel 2015)
- Assessment of hemodynamic significance of known
    - Anomalous coronary arteries (Grani 2017);
    - Myocardial bridging of a coronary artery (perform with exercise stress) (Tang 2011);
    - Coronary aneurysms in Kawasaki's disease (McCrindle 2017) or due to atherosclerosis
    - Following radiation therapy to the anterior or left chest, at 5 years post initiation and every 5 years thereafter (Lancellotti 2013)

CHRONIC VALVULAR DISEASE

Evaluation with Inclusion of Doppler

(Baumgartner 2017, Nishimura 2014, Steiner 2017)

- Low dose dobutamine SE for the evaluation of aortic stenosis and flow (contractile) reserve in symptomatic patients with severe aortic stenosis by calculated valve area, low flow / low gradient, and ejection fraction < 50%
- Exercise echo Doppler evaluation for mitral stenosis when there is a discrepancy between resting Doppler and clinical signs or symptoms.
- Exercise echo Doppler evaluation for mitral regurgitation (MR) if there is:
    - Discrepancy between exertional symptoms and severity of MR at rest; **OR**
    - Need to distinguish moderate from severe MR in the asymptomatic patient

PRIOR TO ELECTIVE NONCARDIAC SURGERY
(Fleischer 2014, Patel 2015)

- Patients who have no other indication for a non-invasive coronary evaluation, but are referred for preoperative cardiac evaluation, are eligible for SE, based upon cardiac risk ≥ 1%, if **ALL 4** criteria are met:
    - Surgery is supra-inguinal vascular, intrathoracic, or intra-abdominal; **AND**
    - The patient has **at least** one of these additional cardiac complication risk factors:
        - Ischemic Heart Disease
        - History of stroke or trans-ischemic attack (TIA)
        - History of congestive heart failure (CHF) or ejection fraction ≤ 35%
        - Insulin-requiring diabetes mellitus
        - Creatinine ≥ 2.0 mg/dl

    AND
    - The patient has limited functional capacity (< 4 metabolic equivalents) **such as one** of the following: (would likely be requested as MPI)
        - Cannot take care of their ADLs or ambulate
        - Cannot walk 2 blocks on level ground
        - Cannot climb 1 flight of stairs

    AND
    - There has been no non-invasive coronary testing within one year, and the result of such a test would be likely to substantially alter therapy and/or preclude proceeding with the intended surgery

- Planning for solid organ transplantation (liver or kidney), is an indication for preoperative dobutamine SE, if there has not been a conclusive stress evaluation within the past year (Lentine, 2012):
    - In a patient with poor or unknown functional capacity (4 metabolic equivalents, as characterized under preoperative evaluation for noncardiac surgery section above) (Wolk 2013); **OR**
    - In a patient **with ≥ 3** of the following (Lentine, 2012):
        - Age > 60
        - Smoking
        - Hypertension
        - Dyslipidemia
        - Left ventricular hypertrophy
        - > 1 year on dialysis (for renal transplant patients)
        - Diabetes mellitus
        - Prior ischemic heart disease

POST CARDIAC TRANSPLANTATION

Annually, for the first five years post cardiac transplantation, in patient who otherwise should not undergo annual invasive coronary arteriography

- After the first five years post cardiac transplantation:
    - Patients with transplant coronary vasculopathy, can be screened annually if the risk of annual invasive coronary arteriography is not acceptable (e.g. high risk of contrast nephropathy) or desired.

BACKGROUND:
Stress echocardiography (SE) refers to ultrasound imaging of the heart during exercise electrocardiography (ECG) testing, during which visualized wall motion abnormalities can provide evidence of significant coronary artery disease (CAD).

While drug-induced stress with dobutamine can be an alternative to exercise stress testing in patients who are unable to exercise, this guideline does not require use of this modality Hence, reference in this document to SE almost always refers to exercise stress echocardiography.

Although SE provides comparable accuracy, without radiation risk, relative to myocardial perfusion imaging (MPI), scenarios which do not permit effective use of SE might be better suited for stress imaging with MPI, cardiovascular magnetic resonance imaging (CMR) or positron emission tomography (PET), or coronary computed tomography angiography (CCTA)

Stable patients without known CAD fall into 2 categories:
(Fihn 2012, Montalescot 2013, Wolk 2013)

- **Asymptomatic patients**, for whom Global Risk of CAD events can be determined from coronary risk factors using calculators available online section)
- **Symptomatic patients,** for whom we estimate the Pretest Probability that their chest-related symptoms are due to clinically significant CAD (see below):

The 3 Types of Chest Pain or Discomfort:

- **Typical Angina (Definite)** is defined as including all **3** of these characteristics:
    - Substernal chest pain or discomfort with characteristic quality and duration
    - Provoked by exertion or emotional stress
    - Relieved by rest and/or nitroglycerine
- **Atypical Angina (Probable)** has only **2** of the above characteristics
- **Nonanginal Chest Pain/Discomfort** has only **0-1** of the above characteristics

Once the type of chest pain has been established from the medical record, the Pretest Probability of obstructive CAD is estimated from the **Diamond Forrester Table** below, recognizing that in some cases multiple additional coronary risk factors could increase pretest probability (Fihn 2012, Wolk 2013):

Diamond Forrester Table

Age (Years)	Gender	Typical/Definite Angina Pectoris	Atypical/Probable Angina Pectoris	Nonanginal Chest Pain
≤ 39	Men	Intermediate	Intermediate	Low
	Women	Intermediate	Very low	Very low
40 – 49	Men	High	Intermediate	Intermediate
	Women	Intermediate	Low	Very low
50 – 59	Men	High	Intermediate	Intermediate
	Women	Intermediate	Intermediate	Low
≥ 60	Men	High	Intermediate	Intermediate
	Women	High	Intermediate	Intermediate

- **Very low:** < 5% pretest probability of CAD, usually not requiring stress evaluation (Fihn, 2012)
- **Low:** 5 - 10% pretest probability of CAD
- **Intermediate:** 10% - 90% pretest probability of CAD
- **High:** > 90% pretest probability of CAD

OVERVIEW

MPI may be performed without diversion to SE in any of the following (Henzlova 2016, Wolk 2013):

- Inability to exercise
  - Physical limitations precluding ability to exercise for at least 3 full minutes of Bruce protocol
  - The patient has limited functional capacity (< 4 metabolic equivalents) **such as one** of the following:
    - Cannot take care of their activities of daily living (ADLs) or ambulate
    - Cannot walk 2 blocks on level ground
    - Cannot climb 1 flight of stairs
    - Cannot vacuum, dust, do dishes, sweep, or carry a small grocery bag
- Other comorbidities
  - Severe chronic obstructive pulmonary disease with pulmonary function test (PFT) documentation, severe shortness of breath on minimal exertion, or requirement of home oxygen during the day
  - Poorly controlled hypertension, with systolic BP > 180 or Diastolic BP > 120 (and clinical urgency not to delay MPI)
- Risk related scenarios
  - High pretest probability in suspected CAD
  - Intermediate or high global risk in patients requiring type IC antiarrhythmic drugs (prior to initiation of therapy)
  - Arrhythmia risk with exercise
- ECG and Echo Related Uninterpretable Wall Motion
  - Prior cardiac surgery
  - Obesity with body mass index (BMI) over 40 or poor acoustic imaging window
  - Left ventricular ejection fraction ≤ 40%
  - Pacemaker or ICD
  - Atrial fibrillation
  - Resting wall motion abnormalities that would make SE interpretation difficult
  - Complete LBBB

ECG Stress Test Alone versus Stress Testing with Imaging

Prominent scenarios suitable for an ECG stress test WITHOUT imaging (i.e. exercise treadmill ECG test) are inferred from the guidelines presented above, often (but not always) requiring that the patient can exercise for at least 3 minutes of Bruce protocol with achievement of near maximal heart rate AND has an interpretable ECG for ischemia during exercise (Wolk 2013):

- The (symptomatic) low or intermediate pretest probability patient who is able to exercise and has an interpretable ECG
- The (asymptomatic) high global risk patient who is able to exercise and has an interpretable ECG
- The patient who is under evaluation for exercise induced arrhythmia (Al-Khatib 2017)
- The patient who requires an entrance stress test ECG for a cardiac rehab program or for an exercise prescription.

Duke Exercise ECG Treadmill Score calculates risk from ECG treadmill alone**:**

- The equation for calculating the Duke treadmill score (DTS) is: DTS = exercise time in minutes - (5 x ST deviation in mm or 0.1 mV increments) - (4 x exercise angina score), with angina score being 0 = none, 1 = non-limiting, and 2 = exercise-limiting.
- The score typically ranges from - 25 to + 15. These values correspond to low-risk (with a score of ≥ + 5), intermediate risk (with scores ranging from - 10 to + 4), and high-risk (with a score of ≤ - 11) categories.

An uninterpretable baseline ECG includes (Fihn 2012):

- ST segment depression 1 mm or more; (Not for non-specific ST- T wave changes)
- Ischemic looking T wave -- at least 2.5 mm inversions (excluding V1 and V2)
- LVH, pre excitation pattern such as WPW, a ventricular paced rhythm, or left bundle branch block
- Digitalis use with associated ST segment
- Resting HR under 50 bpm on a medication that is required for patient's treatment and cannot be stopped with an anticipated suboptimal workload

Global Risk of Cardiovascular Disease

Global risk of CAD is defined as the probability of manifesting cardiovascular disease over the next 10 years and refers to **asymptomatic** patients without known cardiovascular disease. It should be determined using one of the risk calculators below. A high risk is considered greater than a 20% risk of a cardiovascular event over the ensuing 10 years. High global risk by itself generally lacks scientific support as an indication for stress imaging. (There are rare exemptions, such as patients requiring an I-C antiarrhythmic drug, who might require coronary risk stratification prior to initiation of the drug, when global risk is moderate or high.

- **CAD Risk—Low**
  10-year absolute coronary or cardiovascular risk less than 10%.
- **CAD Risk—Moderate**
  10-year absolute coronary or cardiovascular risk between 10% and 20%.
- **CAD Risk—High**
  10-year absolute coronary or cardiovascular risk of greater than 20%.

Websites for Global Cardiovascular Risk Calculators*

*Patients who have already manifested cardiovascular disease are already at high global risk and are not applicable to the calculators (D'Agostino 2008, Goff 2014, McClelland 2015, Ridker 2007).

Risk Calculator	Link to Online Calculator
Framingham Cardiovascular Risk	https://reference.medscape.com/calculator/framingham-cardiovascular-disease-risk
Reynolds Risk Score Can use if no diabetes Unique for use of family history	http://www.reynoldsriskscore.org/
Pooled Cohort Equation	http://clincalc.com/Cardiology/ASCVD/PooledCohort.aspx?example
ACC/AHA Risk Calculator	http://tools.acc.org/ASCVD-Risk-Estimator/
MESA Risk Calculator With addition of Coronary Artery Calcium Score, for CAD-only risk	https://www.mesa-nhlbi.org/MESACHDRisk/MesaRiskScore/RiskScore.aspx

Definitions of Coronary Artery Disease

(Fihn 2012, Mintz 2016, Montalescot 2013, Patel 2017, Tobis 2007)

- Percentage stenosis refers to the reduction in diameter stenosis when angiography is the method and refers to cross sectional narrowing when IVUS (intravascular ultrasound) is the method of determination
- Coronary artery calcification is a marker of risk, as measured by Agatston score on coronary artery calcium imaging. It is not a diagnostic tool so much as it is a **risk stratification** tool. Its incorporation into Global Risk can be achieved by using the MESA risk calculator.
- Ischemia-producing disease (also called hemodynamically or functionally significant disease, for which revascularization might be appropriate) generally implies at least one of the following:
  - Suggested by percentage diameter stenosis ≥ 70% by angiography; borderline lesions are 40 - 70% (Fihn 2012, Tobis 2007)
  - For a left main artery, suggested by a percentage stenosis ≥ 50% or minimum lumen cross sectional area on IVUS ≤ 6 square mm (Fihn 2012, Mintz 2016)
  - FFR (fractional flow reserve) ≤ 0.80 for a major vessel (Mintz 2016)
  - iFR (instantaneous wave-free ratio) ≤ 0.89 for a major vessel (Davies 2017, Gotberg 2017)
- A major vessel is a coronary vessel that would typically be substantial enough for revascularization, if indicated. A major vessel is a coronary vessel that would typically be substantial enough for revascularization, if indicated. This assessment is made based on the diameter of the vessel and/or the extent of myocardial territory served by the vessel.
- FFR (fractional flow reserve) is the distal to proximal pressure ratio across a coronary lesion during maximal hyperemia induced by either intravenous or intracoronary adenosine. Less than or equal to 0.80 is considered a significant reduction in coronary flow.
- iFR (instantaneous wave-free ratio) ≤ 0.89 for a major vessel (Davies 2017, Gotberg 2017)
- New technology is evolving that estimates FFR from CCTA images. This is covered under the separate NIA Guideline for FFR-CT.

Anginal Equivalent
(Fihn 2012, Moya 2009, Shen 2017)

Development of an anginal equivalent (e.g. shortness of breath, fatigue, or weakness) either with or without prior coronary revascularization should be based upon the documentation of reasons to suspect that symptoms other than chest discomfort are not due to other organ systems (e.g. dyspnea due to lung disease, fatigue due to anemia. This may include respiratory rate, oximetry, lung exam, etc. (as well as d-dimer, chest CT(A), and/or PFTs, when appropriate), and then incorporated into the evaluation of coronary artery disease as would chest discomfort. Syncope per se is not an anginal equivalent.

Abbreviations

AAD	Antiarrhythmic drug
ADLs	Activities of daily living
BSA	Body surface area in square meters
CAD	Coronary artery disease
ECG	Electrocardiogram
FFR	Fractional flow reserve
LBBB	Left bundle-branch block
LVEF	Left ventricular ejection fraction
LVH	Left ventricular hypertrophy
MI	Myocardial infarction
MET	Estimated metabolic equivalent of exercise
MPI	Myocardial perfusion imaging
PFT	Pulmonary function test
PVCs	Premature ventricular contractions
SE	Stress echocardiography
VT	Ventricular tachycardia
VF	Ventricular fibrillation
WPW	Wolf Parkinson White

POLICY HISTORY:
Review Date: July 23, 2019
Review Summary:

- Stress echo for suspected CAD deleted the following indication: Repeat testing in patient with recurrent symptomatic presentation and negative result over 2 years ago
- Added indications: 'For assessment of hemodynamic significance due to atherosclerosis or following radiation therapy to the anterior or left chest, at 5 years post initiation inception of radiation and every 5 years thereafter'; and 'Following radiation therapy to the anterior or left chest, at 5 years post initiation inception of radiation and every 5 years thereafter'
- Removed secondary mitral regurgitation indication under doppler evaluation section
- Clarified indication as follows: Routine follow-up of asymptomatic or stable symptoms when last invasive or non-invasive assessment of coronary disease showed hemodynamically significant CAD (ischemia on stress test or FFR less than or equal to 0.80 or stenosis greater than or equal to 70% of a major vessel) over two years ago without intervening coronary revascularization is an appropriate indication for stress imaging (MPI or SE) in patients if it will alter management

November 2019

- Addded CPT code +93356

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