AmeriHealth Caritas Louisiana

National Imaging Associates, Inc.*	
Clinical guidelines **HEART (Cardiac) PET**	**Original Date: July 1999**
CPT Codes: 78459, 78491, 78492, +78434	**Last Revised Date: March 2021**
Guideline Number: NIA_CG_072	**Implementation Date: January 2022**

GENERAL INFORMATION

It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. All prior relevant imaging results, and the reason that alternative imaging cannot be performed must be included in the documentation submitted.

INDICATIONS FOR HEART PET

SUSPECTED CAD (When neither SE nor MPI have provided or are expected to provide optimal imaging)

Symptomatic patients without known CAD (use Diamond Forrester Table)

- Low or intermediate pretest probability and unable to exercise
- High pretest probability
- Repeat testing in a patient with new or worsening symptoms and negative result at least one year ago **AND** meets one of the criteria above

Asymptomatic patients without known CAD

- Previously unevaluated ECG evidence of possible myocardial ischemia including substantial ischemic ST segment or T wave abnormalities
- Previously unevaluated pathologic Q waves
- Unevaluated complete left bundle branch block
- **History of diabetes mellitus, > 40 years old, with calcium score >400**
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INCONCLUSIVE CAD EVALUATION WITHIN THE PAST 2 YEARS AND OBSTRUCTIVE CAD REMAINS A CONCERN (When neither SE nor MPI have provided or are expected to provide optimal imaging)

- 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
- Inconclusive/borderline coronary computed tomography angiography (CCTA) (e.g., 40 - 70% lesions)
- Non-diagnostic exercise stress test with physical inability to achieve target heart rate (THR)
- An intermediate evaluation by prior stress imaging (within the past 2 years)

FOLLOW-UP OF PATIENT'S POST CORONARY REVASCULARIZATION (PCI or CABG) wWhen LVEF is ≤ 40% and revascularization is under consideration

- **Asymptomatic, follow-up stress imaging** 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)
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- **New, recurrent, or worsening symptoms post coronary revascularization,** is an indication for stress imaging, if it will alter management

FOLLOW-UP OF KNOWN CAD (When neither SE nor MPI have provided or are expected to provide optimal imaging)

- **For assessment of suspected significant hibernating myocardium in the presence of known severe major vessel CAD, when EF is below 40%, in order to determine a patient's potential benefit from coronary revascularization (Patel, 2013; Tsai, 2014; Yancy, 2013)**
- **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 ≤ 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 in patients if it will alter management

SPECIAL DIAGNOSTIC CONDITIONS REQUIRING CORONARY EVALUATION (When neither SE nor MPI have provided or are expected to provide optimal imaging)

- Prior acute coronary syndrome (as documented in MD notes), without subsequent invasive or non-invasive coronary evaluation
- Newly diagnosed systolic heart failure (EF < 50%), especially with symptoms or signs of ischemia unless invasive coronary angiography is immediately planned (Fihn, 2012; Patel, 2013; Yancy, 2013)
- Reduced LVEF ≤ 50% requiring myocardial viability assessment to assist with decisions regarding coronary **revascularization**. (Diversion from PET not required when LVEF less than or equal to 40%) (Patel, 2013; Tsai, 2014; Yancy, 2013)
- Ventricular arrhythmias
    - Sustained ventricular tachycardia (VT) > 100 bpm, ventricular fibrillation (VF), or exercise--induced VT, when invasive coronary arteriography is not the immediately planned test (Al-Khatib, 2018)
    - Nonsustained VT, multiple episodes, each ≥ 3 beats at ≥ 100 bpm, frequent PVC's (defined as greater than or equal to 30/hour on remote monitoring) without known cause or associated cardiac pathology, when an exercise ECG cannot be performed
- Prior to Class IC antiarrhythmic drug initiation (Propafenone or Flecanide), **as well as annually** in intermediate and high global risk patients (SE diversion not required) (Reiffel, 2015)
- Assessment of hemodynamic significance of one of the following documented conditions (Anagnostopoulos, 2004):
    - Anomalous coronary arteries (Grani, 2017)
    - Muscle bridging of coronary artery (perform with exercise stress) (Sorajja, 2021~~18~~)
- 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)

- **Cardiac Sarcoidosis** (Birnie, 2016; Blankstein, 2016; Vita, 2018)
    - Evaluation and therapy monitoring in patients with sarcoidosis, after documentation of suspected cardiac involvement by echo or ECG, when CMR has not been performed
    - Evaluation of suspected cardiac sarcoid, after CMR has shown equivocal or negative findings in the setting of a high clinical suspicion (Vita, 2018)
    - Evaluation of CMR findings showing highly probable cardiac sarcoidosis, when PET could serve to identify inflammation and the consequent potential role for immunosuppressive therapy (Vita, 2018)
    - Initial and follow--up PET in monitoring therapy for cardiac sarcoid with immunosuppressive therapy, typically about 4 times over 2 years

- **Infective Endocarditis**

- In suspected infective endocarditis with moderate to high probability (i.e., staph bacteremia, fungemia, prosthetic heart valve, or intracardiac device), when TTE and TEE have been inconclusive with respect to diagnosis of infective endocarditis or characterization of paravalvular invasive complications (Doherty, 2017; Habib, 2016; Wang, 2018)

- **Aortitis**
  - For diagnosis and surveillance of Aortitis, PET/CT or PET/MRI‡ hybrid imaging (Bhave, 2018)
    ‡NOTE: If PET/MR study is requested, there is no specific CPT Code for this imaging study and a Health Plan review will be required.

PRIOR TO ELECTIVE NON-CARDIAC SURGERY (When neither SE nor MPI have provided or are expected to provide optimal imaging)

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

    AND
  - The patient has limited functional capacity (< 4 METS), such as one of the following:
    - Unable to take care of their activities of daily living (ADLs) or ambulate
    - Unable to walk 2 blocks on level ground
    - Unable to climb 1 flight of stairs

    AND
  - There has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year, and the results of such a test would be likely to substantially alter therapy and/or preclude proceeding with the intended surgery.

- Planning for solid organ transplantation is an indication for preoperative MPI, if there has not been a conclusive stress evaluation, CTA, or heart catheterization within the past year with ≥ 3 of the following risk factors (SE diversion not required) (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 TRANSPLANT (SE diversion not required)
(McArdle, 2012)

- ~~-~~Annually, for the first five years post cardiac transplantation, in a patient not undergoing invasive coronary arteriography
- After the first five years post cardiac transplantation, patients with documented transplant coronary vasculopathy can be screened annually if invasive coronary arteriography is not planned

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BACKGROUND
(Bateman, 2016; Fazel, 2011)

PET Scan

- ~~I~~PET is indicated when all the criteria for MPI are met
- **AND** t~~T~~here is likely to be equivocal imaging results because of BMI or large breasts or implants or prior thoracic surgery or results of a prior MPI
- ~~For assessment of suspected significant hibernating myocardium in the presence of known severe major vessel CAD, when EF is below 40%, in order to determine a patient's potential benefit from coronary revascularization (Patel, 2013; Tsai, 2014; Yancy, 2013)~~
- ~~When strong suspicion of balanced ischemia is noted, and further non-invasive coronary evaluation required, PET can be used, without diversion from PET (Bengel, 2009)~~
- ~~Prior alternative **perfusion** (MPI or CMR) imaging resulted in an indeterminate evaluation for CAD~~
- ~~Cardiac positron emission tomography (PET) can characterize myocardial blood flow by perfusion scanning with either rubidium-82 (Rb-82) or nitrogen-13 (N-13) ammonia~~
- C~~PET c~~an identify regions of myocardial viability with hibernating myocardium (viable, with poor flow and contractility) by imaging with fluorine18 (F-18) fluorodeoxyglucose (FDG or 18-FDG) for this purpose.
- U~~PET can be use u~~seful in the evaluation of inflammation: e.g., evaluation and therapy monitoring in patients with sarcoidosis, after documentation of cardiac involvement by echo or electrocardiography (ECG), in place of, or subsequent to CMR if needed to help with an uncertain diagnosis

Coronary application of PET includes evaluation of **stable patients without known CAD**, who fall into two categories (Fihn, 2012; Montalescot, 2013; Wolk, 2014~~3~~)

- **Asymptomatic**, for whom global risk of CAD events can be determined from coronary risk factors, using calculators available online (see Websites for **Global Cardiovascular Risk Calculators** section).
- **Symptomatic,** for whom we estimate the pretest probability that their chest-related symptoms are due to clinically significant (≧ 50%) CAD (below):

The 3 Types of Chest Pain or Discomfort

- **Typical Angina (Definite)** is defined as including all **3** 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 CAD (meaning obstructive CAD defined as coronary arterial narrowing ≥ 50%) 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, 2014~~3~~):

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, usually not requiring stress evaluation
- **Low:** 5 - 10% pretest probability of CAD
- **Intermediate:** 10% - 90% pretest probability of CAD
- **High:** > 90% pretest probability of CAD

OVERVIEW

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) require 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, 2014~~3~~):

- The (symptomatic) low or intermediate pretest probability patient who is able to exercise and has an interpretable ECG (Wolk, 2014)
- The patient who is under evaluation for exercise-induced arrhythmia
- The patient who requires an entrance stress test ECG for a cardiac rehab program or for an exercise prescription.
- For the evaluation of syncope or presyncope during exertion (Shen, 2017)

Duke Exercise ECG Treadmill Score (Mark, 1987)
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 waves; at least 2.5 mm inversions (excluding V1 and V2)
- LVH with repolarization abnormalities, pre-excitation pattern such as WPW, ventricular paced rhythm, or left bundle branch block
- Digitalis use with associated ST segment abnormalities

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 exceptions, such as patients requiring IC antiarrhythmic drugs who might require coronary risk stratification prior to initiation of the drug or patients with a CAC score > 400 Agatston units, 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*
(Arnett, 2019; D'Agostino, 2008; Goff, 2014; McClelland, 2015; Ridker, 2007)

*Patients who have already manifested cardiovascular disease are already at high global risk and are not applicable to the calculators.

Risk Calculator	Websites for 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; Montalescot, 2013; Patel, 2017)

Percentage stenosis refers to the reduction in diameter stenosis when angiography is the method and can be estimated or measured using angiography or more accurately measured with intravascular ultrasound (IVUS).

- 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)
    - For a left main artery, suggested by a percentage stenosis ≥ 50% or minimum lumen cross--sectional area on IVUS ≤ 6 square mm (Fihn, 2012; Lofti, 2018)
    - FFR (fractional flow reserve) ≤ 0.80 for a major vessel (Lofti, 2018)
    - iFR (instantaneous wave-free ratio) ≤ 0.89 for a major vessel (Davies, 2017; Gotberg, 2017; Lofti, 2018)
    - Demonstrable ischemic findings on stress testing (ECG or stress imaging), that are at least mild in degree
- A major vessel would be a coronary vessel that would be amenable to 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) measures the ratio of distal coronary to aortic pressure during the wave free period of diastole, with a value ≤ 0.89 considered hemodynamically significant (Davies, 2017; Gotberg, 2017).
- Newer technology that estimates FFR from CCTA image is covered under the separate NIA Guideline for FFR-CT.

Anginal Equivalent
(Fihn, 2012; 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), by presentation of clinical data, such as 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. Most syncope per se is not an anginal equivalent.

Abbreviations

ADLs	Activities of daily living
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

Date	Summary
March 2021	• Added annual indication for IC antiarrhythmics • Added History of diabetes mellitus, > 40 years old, with calcium score >400
March 2020	• Added general information section as Introduction which outlines requirements for documentation of pertinent office notes by a licensed clinician, and inclusion of laboratory testing and relevant imaging results for case review • Added clarification of repeat testing in a patient with new or worsening symptoms and negative result at least one year prior to include the statement "AND meets one of the criteria above" • Added clarification of frequent PVCs under ventricular arrhythmias which states defined as greater than or equal to 30/hour to include "on remote monitoring" • Edited indication of planning for solid organ transplantation to remove the requirement of limited functional capacity but maintaining requirement of ≥ 3 listed risk factors • Edits to the Background section include the following: ○ Indication changed to read as follows: PET is indicated when all the criteria for MPI are met AND There is likely to be equivocal imaging results because of BMI or large breasts or implants or prior thoracic surgery or results of a prior MPI • Removed the statement regarding radiation burden • Added edits to the Coronary Artery disease definition section • Updated and added new references
November 2019	• Removed CPT code +0482T and replaced with code +78434
August 2019	• Changes in CAD indications in line with MPI/SE • Added infective endocarditis and aortitis indications • Removed cardiac neoplasms and masses indication section • Added myocardial viability indications

	• **Expanded indications for cardiac sarcoidosis as the initial and follow-up study**

~~August 2019~~

- ~~Changes in CAD indications in line with MPI/SE~~
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~~March 2021.~~
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~~History of diabetes mellitus, > 40 years old, with calcium score >40~~

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