Clinical Appropriateness Guidelines: Advanced Imaging

Appropriate Use Criteria: Imaging of the Heart
Effective Date: November 3, 2014

Proprietary
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AIM Specialty Health (AIM) has developed proprietary clinical appropriateness guidelines (together with any updates, referred to collectively as the “Guidelines”). The Guidelines are designed to evaluate and direct the appropriate utilization of high technology diagnostic imaging services. They are based on data from the peer-reviewed scientific literature, from criteria developed by specialty societies and from guidelines adopted by other health care organizations. Access to these Guidelines is being provided for informational purposes only. AIM is under no obligation to update its Guidelines. Therefore, these Guidelines may be out of date.

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Use of AIM’s Diagnostic Imaging Guidelines:
AIM’s proprietary clinical appropriateness guidelines are designed to evaluate and direct the appropriate utilization of elective, high technology advanced imaging services. In the process, multiple functions are accomplished:

- To promote the most efficient and cost-effective use of evidence-based advanced imaging services
- To assist the practitioner as an educational tool
- To encourage standardization of medical practice patterns and reduce variation in clinical evaluation
- To curtail the performance of inappropriate, elective advanced imaging studies
- To reduce the performance of duplicate advanced imaging studies
- To advocate biosafety issues, including unnecessary radiation exposure (for CT and plain film radiography) and MRI safety concerns
- To enhance quality of healthcare for elective advanced imaging studies, using evidence-based medicine and outcomes research from numerous resources

AIM Guideline Development Process and Resources:
AIM reviews its proprietary clinical appropriateness guidelines on an ongoing basis, throughout the year based on the results of the research and development process and feedback from physicians and other providers. New Guidelines are also developed as needed.

Development of appropriate use criteria within AIM guidelines is based on objective medical evidence including assessment of potential benefits and harms. The resources considered during AIM guideline development can include but are not limited to:

- Professional Society Guidelines
- Professional Society Appropriate Use Criteria
- Agency for Healthcare Research and Quality (AHRQ) Comparative Effectiveness Guidelines
- Recommendations from the United States Preventive Services Task Force
- National Guideline Clearinghouse
- Centers for Medicare and Medicaid Services (CMS) * When variances occur, Medicare NCD and LCD determinations will be used instead of AIM guidelines for Medicare Advantage patients
- Initiatives sponsored by Specialty Licensing Boards, including but not limited to Choosing Wisely recommendations
- National Guideline Clearinghouse
- The latest scientific and clinical peer-reviewed literature

Guideline Review:
AIM’s proprietary guidelines for appropriate use of advanced imaging are reviewed routinely by:

- An External Expert Panel, consisting of physicians from multiple specialties and practice settings across the United States
- Health Plan Medical Directors
- Other clinical reviewers, under the governance of our clients’ state regulatory agencies
- Subject matter specialty physician experts and primary care physicians
Standard Anatomic Coverage for Multiple Simultaneous Imaging Requests

The major area of concern is contiguous body parts where clinical signs and symptoms may be coming from abnormalities involving either region or different modalities can be considered to evaluate the same anatomy for the same clinical problem. These are areas where ordering multiple tests before the results of any of the tests are known lead to inappropriate imaging.

General Considerations for Multiple Simultaneous Imaging Requests

Rapid breakthroughs in technology, with attendant rise of new imaging tests available to improve patient management, have created a dilemma for clinicians. Many factors in choosing the right test now come into play. One must consider basic data in the decision-making process. Considerations include the possible effect on patient management, the pretest probability that the patient is affected by a particular disease, the prevalence of the disease in the population, and the accuracy (sensitivity/specificity) of the test. When a screening approach is adopted, rather than targeting the particular test or anatomic site with the highest pretest probability of success, the possibility of one or more of the tests being superfluous and not contributing meaningfully to patient management increases to an unacceptable level.

For this reason, simultaneous ordering of multiple examinations may subject these examinations to more intensive levels of review than would be the case if these same tests were ordered sequentially. Depending on the clinical situation, one or more of the requested studies might not meet medical necessity criteria until the results of the lead study are known.

Common Indications for Multiple Simultaneous Imaging Requests

- The initial diagnosis/staging or follow-up of oncology patients
- Follow-up of patients who have had operative procedures on multiple anatomic sites
- Patients in whom the suspected anatomic abnormality might extend into multiple regions, such as diverticulitis or suspected syringomyelia

Common Inappropriate Multiple Simultaneous Imaging Requests

- Brain MRA ordered routinely with brain MRI without vascular indications
- Brain CT ordered simultaneously with sinus CT for headache
- Multiple levels of spine MRI’s or CT’s for diffuse back pain or radicular symptoms
- Cervical spine and shoulder MRI’s ordered simultaneously for shoulder pain
- Pelvic or hip MRI’s ordered simultaneously with lumbar spine MRI for hip pain
- Pelvic CT ordered routinely with abdominal CT for suspected upper quadrant disease processes
- CT Angiography (CTA) utilizes the data obtained from standard CT imaging. Request for a CT exam, in addition to CT Angiography of the same anatomic area AND during the same imaging session, is inappropriate
Imaging Considerations for all Exams

- Duplicative testing or repeat imaging of the same anatomic area with same or similar technology may be subject to high-level review and may not be medically necessary unless there is a persistent diagnostic problem or there has been a change in clinical status (e.g., deterioration) or there is a medical intervention which warrants interval reassessment.

- Request for re-imaging due to technically limited exams is the responsibility of the imaging providers.

- In general, follow-up exams should be performed only when there is a clinical change, with new signs or symptoms.

- AIM's clinical guidelines do not supersede the enrollee’s health plan medical policy specific to a given exam for a given anatomic structure.

Imaging Considerations Specific to CT and CTA

- Advantages of CTA over MRA include higher sensitivity for detection of mural calcification; usually shorter scan time, which results in less motion, pulsation and turbulent flow artifact; avoidance of MRA in-plane flow as a cause of apparent exaggerated stenosis; more facile detection of surgical clips and stents.

- Disadvantages of CTA include radiation exposure and use of intravascular iodinated contrast material.

- Multi-detector row CT is preferred but not required in the performance of CTA, when compared with single detector CT.

- CTA studies are typically performed through acquisition of thin CT sections, during intravenous bolus infusion of iodinated contrast material.

- Contrast-enhancement for CT/CTA may be contraindicated in certain circumstances, such as a documented allergy to intravenous contrast material and renal insufficiency. Special consideration should also be given to patients with multiple myeloma.

- CT Angiography (CTA) utilizes imaging data from standard CT acquisitions. Request for a CT exam in addition to CT Angiography of the same anatomic area during the same imaging session is inappropriate.

Imaging Considerations Specific to MRI and MRA

Patient Compatibility Issues:

- Artifact due to patient motion may have a particularly significant impact on exam quality.

- Metallic implants present in spine and brain.

- Eye and brain for metallic foreign bodies.

- Breath hold requirements:
  - Some imaging sequences require breath holding and this may be difficult or impossible for some patients.

- Claustrophobic patients:
  - Patients with claustrophobia may need to be premedicated in order to tolerate the imaging procedure. Rarely patients with severe claustrophobia will not be suitable candidates for imaging.

Biosafety Issues:

- Ordering and imaging providers are responsible for considering biosafety issues prior to MRI/MRA examination, to ensure patient safety. Among the generally recognized contraindications to MRI/MRA exam performance are permanent pacemakers (some newer models are MRI/MRA compatible and others may be safe depending on sequences used; contact imaging facility for substantiation), implantable cardioverter-defibrillators (ICD), intracranial aneurysm surgical clips that are not compatible with MR imaging, as well as other devices considered unsafe in MRI scanners (including certain implanted materials in the patient as well as external equipment, such as portable oxygen tanks).

- Contrast utilization is at the discretion of the ordering and imaging providers.
Ordering Issues:

- The CPT code assignment for an MRI procedure is based on the anatomic area imaged. Requests for multiple MRI exams of the same anatomic area to address patient positional changes, additional sequences or equipment are not allowed. These variations or extra sequences are included within the original imaging request.

- There are rare circumstances when both CT and MRI exams should be ordered for the same clinical presentation. The specific rationale for each study must be delineated at the time of request.

- There are uncommon circumstances when both MRA and CTA should be ordered for the same clinical presentation. The specific rationale must be delineated at the time of request.

- Advantages of MRA, compared with CTA include avoidance of radiation exposure as well as intravascular administration of iodinated contrast material.

- Disadvantages of MRA, compared with CTA, include lower sensitivity for detection of mural calcification; usually longer scanning time, with potential for greater motion, pulsation and turbulent flow artifact; in-plane flow causing apparent exaggerated stenosis; greater difficulty in identifying surgical clips and stents.

Reference/Literature Review


CPT Codes

78451.................. Myocardial perfusion imaging, tomographic (SPECT) (including attenuation correction, qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); single study, at rest or stress (exercise or pharmacologic)

78452.................. Myocardial perfusion imaging, tomographic (SPECT) (including attenuation correction, qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); multiple studies, at rest and/or stress (exercise or pharmacologic) and/or redistribution and/or rest reinjection

78453.................. Myocardial perfusion imaging, planar (including qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); single study, at rest or stress (exercise or pharmacologic)

78454.................. Myocardial perfusion imaging, planar (including qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); multiple studies, at rest and/or stress (exercise or pharmacologic) and/or redistribution and/or rest reinjection

Commonly Used Radiopharmaceuticals

- Thallium-201 Chloride
- Technetium-99m Sestamibi
- Technetium-99m Tetrofosmin

Uses of Myocardial Perfusion Imaging (MPI)

- The primary use of MPI is in the diagnosis, exclusion or evaluation of obstructive coronary artery disease (CAD)
- MPI is also used for management of established coronary artery disease
- MPI may be used for assessment of myocardial viability in patients who have had myocardial infarction

Imaging Considerations

- A recent EKG is strongly recommended, preferably within 30 days of request for a Myocardial Perfusion Imaging Exam. The findings on the resting EKG may be important in determining the need for imaging, the selection of the appropriate imaging protocol and may also show evidence of ischemia at rest or interval myocardial infarction
- Age, gender and the character of the chest pain provide useful predictors of CAD, as stratified in Table 1 below

Table 1*: Pre-Test Probability of Coronary Artery Disease by Age, Gender and Symptoms:

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Gender</th>
<th>Typical/Definite Angina Pectoris</th>
<th>Atypical/Probable Angina Pectoris</th>
<th>Non-Anginal Chest Pain</th>
<th>Asymptomatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-39</td>
<td>Men</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very Low</td>
<td>Very Low</td>
</tr>
<tr>
<td>40-49</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very Low</td>
<td>Very Low</td>
</tr>
<tr>
<td>50-59</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very Low</td>
</tr>
<tr>
<td>60-69</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
</tbody>
</table>

Imaging Considerations

- Myocardial Perfusion Imaging and Stress Echocardiography may provide useful information on Coronary Heart Disease. Comparison data on Sensitivity and Specificity are provided in Table 2 below. Due to regional variation in technical expertise and interpretive proficiency, the clinician should use the diagnostic imaging modality that has been proven most accurate in his/her practices.

Table 2**: Comparison of Non-Invasive Diagnostic Imaging


<table>
<thead>
<tr>
<th></th>
<th>Nuclear Imaging Sensitivity (%)</th>
<th>Stress Echo Sensitivity (%</th>
<th>Nuclear Imaging Specificity (%)</th>
<th>Stress Echo Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise (7 studies)</td>
<td>83%</td>
<td>78%</td>
<td>83%</td>
<td>91%</td>
</tr>
<tr>
<td>Dobutamine (8 studies)</td>
<td>86%</td>
<td>80%</td>
<td>73%</td>
<td>86%</td>
</tr>
<tr>
<td>Adenosine (3 studies)</td>
<td>89%</td>
<td>63%</td>
<td>73%</td>
<td>86%</td>
</tr>
<tr>
<td>Dipyridamole (4 studies)</td>
<td>83%</td>
<td>68%</td>
<td>88%</td>
<td>89%</td>
</tr>
</tbody>
</table>

Several clinical indications listed for Myocardial Perfusion Imaging include standard methods of risk assessment, such as the SCORE (Systematic Coronary Risk Evaluation) or the Framingham risk score calculation. These risk calculation systems include consideration of the following factors:

<table>
<thead>
<tr>
<th>Age</th>
<th>Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal Lipid Profile</td>
<td>Hypertension</td>
</tr>
<tr>
<td>Diabetes Mellitus (always = high risk)</td>
<td>Cigarette Smoking</td>
</tr>
</tbody>
</table>

Other coronary risk factors such as family history of premature CAD, coronary artery calcification, C reactive protein levels, obesity etc. are not included in the standard methods of risk assessment but are thought to contribute to coronary artery disease risk.

- Selection of the optimal diagnostic work-up for evaluation or exclusion of coronary artery disease should be made within the context of available studies (which include treadmill stress test, stress myocardial perfusion imaging, stress echocardiography, cardiac PET imaging and invasive cardiac/coronary angiography), so that the resulting information facilitates patient management decisions and does not merely add a new layer of testing.

- Occasionally it may be appropriate to do a second non-invasive test for diagnosis or exclusion of CAD when the initially selected test is technically suboptimal and the diagnosis of CAD cannot be established or excluded.

- In order to optimize image quality, imaging protocols may need to be modified in specific patient populations. Thus, patients who are obese may benefit from 2 day imaging protocols and/or prolonged image acquisition times. Similarly, imaging in the prone position may improve accuracy in patients who are obese and women with high likelihood of breast attenuation artifact. Patients whose baseline EKG demonstrates left bundle branch block, may be better suited to pharmacologic stress imaging than to exercise stress protocols.

- Rarely, absolute or relative contraindications to MPI will be encountered. MPI should not be used in pregnant or lactating women. Patients who are unable to remain motionless for several minutes or comprehend simple instructions are not suitable candidates for MPI. Image quality in morbidly obese patients (BMI >40) is usually suboptimal such that consideration should be given to other imaging modalities. If imaging studies using other radioactive tracers have been recently performed, adequate time must elapse to allow for clearance of activity from the heart and surrounding regions.

- For patients who are unable to walk on a treadmill for non-cardiac reasons (orthopedic limitations, claudication, neurological conditions, advanced lung disease, etc.) exercise stress testing is not an option. These patients will require pharmacological testing with echo or nuclear imaging.

- It is anticipated that the evaluation of patients with acute chest pain will occur in the emergency room or in an inpatient setting and MPI performed in these locations is not included in the AIM preauthorization program.
Common Diagnostic Indications

The following diagnostic indications for myocardial perfusion imaging may be accompanied by pre-test considerations as well as supporting clinical data and prerequisite information.

Suspected coronary artery disease in asymptomatic patients

- Patients with high-risk of CAD (SCORE) who have not had evaluation of coronary artery disease (MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization) within the preceding three (3) years; OR
- Patients with moderate or high risk of CAD (SCORE) who have a high risk occupation that would endanger others in the event of a myocardial infarction, for example: airline pilot, law-enforcement officer, firefighter, mass transit operator, bus driver) who have not had evaluation of coronary artery disease (MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization) within the preceding three (3) years; OR
- Patients with diseases/conditions with which coronary artery disease commonly coexist and who have not had evaluation of coronary artery disease (MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization) within the preceding three (3) years:
  - Diabetes mellitus; OR
  - Abdominal aortic aneurysm; OR
  - Established and symptomatic peripheral vascular disease; OR
  - Prior history of cerebrovascular accident (CVA), transient ischemic attack (TIA) or carotid endarterectomy (CEA) or high grade carotid stenosis (>70%); OR
  - Chronic renal insufficiency or renal failure; OR
- Patients who have undergone cardiac transplantation and have had no evaluation for coronary artery disease within the preceding one (1) year; OR
- Patients in whom a decision has been made to treat with interleukin 2

Suspected coronary artery disease in symptomatic patients who have not had evaluation of coronary artery disease (MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization) within the preceding sixty (60) days

- Chest pain
  - With intermediate or high pretest probability of CAD (Table 1); OR
  - With low or very low pretest probability of CAD (Table 1) and high risk of CAD (SCORE)
- Atypical symptoms: syncope, shortness of breath (dyspnea), neck, jaw, arm, epigastric or back pain, or sweating (diaphoresis)
  - With moderate or high risk of CAD (SCORE)
- Other symptoms: palpitation, dizziness, lightheadedness, near syncope, nausea, vomiting, anxiety, weakness, fatigue, etc.
  - With high risk of CAD (SCORE)
- Patients with any cardiac symptom who have diseases/conditions with which coronary artery disease commonly coexists such as:
  - Diabetes mellitus; OR
  - Abdominal aortic aneurysm; OR
  - Established and symptomatic peripheral vascular disease; OR
  - Prior history of cerebrovascular accident (CVA), transient ischemic attack (TIA) or carotid endarterectomy (CEA) or high grade carotid stenosis (>70%); OR
  - Chronic renal insufficiency or renal failure; OR
- Patients who have undergone cardiac transplantation; OR
- Patients in whom a decision has been made to treat with Interleukin 2
Common Diagnostic Indications

Established coronary artery disease (diagnosed by previous cardiac catheterization, MPI, cardiac PET, or stress echo in patients who have new or worsening symptoms)

Note: If symptoms are typical of myocardial ischemia cardiac catheterization may be more appropriate than MPI

Established coronary artery disease (diagnosed by previous cardiac catheterization, MPI, cardiac PET, or stress echo) in patients who have not undergone revascularization and have no symptoms or stable symptoms

- No evaluation of CAD (MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization) within the preceding three (3) years
- No evaluation of CAD (MPI, cardiac PET, stress echo, coronary CTA or cardiac catheterization) within the preceding one (1) year in a patient who has undergone cardiac transplantation and has been found to have CAD since transplantation

Established coronary artery disease in patients who have undergone revascularization

- For evaluation of new or worsening cardiac symptoms
  - If symptoms are typical of myocardial ischemia cardiac catheterization may be more appropriate than MPI; OR
  - For evaluation of stable patients who have undergone coronary artery bypass grafting more than five (5) years previously and who have not had an evaluation for coronary artery disease (MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization) within the past two (2) years
    - Stable patients whose revascularization has been incomplete may undergo MPI three (3) years following the procedure and every three (3) years thereafter; OR
  - For evaluation of stable patients who have undergone percutaneous coronary intervention (PCI) more than three (3) years previously and who have not had an evaluation for coronary artery disease (MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization) within the past three (3) years

Established coronary artery disease in patients who have had myocardial infarction (ST elevation or non-ST elevation) or unstable angina within the preceding ninety (90) days provided that:

- The patient did not undergo coronary angiography at the time of the acute event; AND
- The patient is currently clinically stable

Patients with new onset arrhythmias (patient can be symptomatic or asymptomatic)

This guideline applies to patients with suspected or established CAD

- Patients with sustained (lasting more than 30 seconds) or non-sustained (more than 3 beats but terminating within 30 seconds) ventricular tachycardia; OR
- Patients with atrial fibrillation or flutter and high or moderate risk of CAD (SCORE); OR
- Patients with atrial fibrillation or flutter and established CAD; OR
- Patients who have frequent premature ventricular contractions (PVC) defined as more than ten (10) PVCs per hour on ambulatory EKG (Holter) monitoring
  - It is not clinically indicated to perform MPI for evaluation of infrequent premature atrial or ventricular depolarizations
Common Diagnostic Indications

**Patients with new onset congestive heart failure or recently recognized left ventricular systolic dysfunction (patient can be symptomatic or asymptomatic)**

This guideline applies to patients with suspected or established CAD

For patients in this category whose CAD risk (SCORE) is high, cardiac catheterization may be more appropriate than non-invasive evaluation

- Provided that new or worsening CAD has not been excluded as the cause of LV dysfunction/CHF by any of the following tests: MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization

**Patients with abnormal exercise treadmill test (performed without imaging)**

This guideline applies to patients with suspected or established CAD

- Abnormal findings on an exercise treadmill test include (chest pain, ST segment change, abnormal BP response or complex ventricular arrhythmias)

**Patients who have undergone recent (within the past 60 days) stress echocardiography**

- When the stress echocardiogram is technically suboptimal, technically limited, inconclusive, indeterminate, or equivocal, such that myocardial ischemia cannot be adequately excluded
  - It is not appropriate to perform MPI on patients who have had a recent normal or abnormal stress echocardiogram
  - A stress echocardiogram is deemed to be abnormal when there are echocardiographic abnormalities. Electrocardiographic abnormalities without echocardiographic evidence of ischemia are considered to be normal studies

**Patients with abnormal findings on cardiac CT / coronary CTA**

**Symptomatic Patients:**

- With coronary artery calcium score > 400 Agatston units; OR
- Intermediate severity coronary stenosis on coronary CTA

*Note: If symptoms are typical of myocardial ischemia cardiac catheterization may be more appropriate than MPI*

**Asymptomatic patients who have not had MPI, stress echo, cardiac PET or cardiac catheterization within the preceding three (3) years:**

- With coronary artery calcium score > 400 Agatston units; OR
- Intermediate severity coronary stenosis coronary CTA

**Patients with abnormal findings on cardiac catheterization**

- To determine flow limiting significance of intermediate coronary stenosis

**Myocardial viability evaluation**

MPI may be used to evaluate myocardial viability in patients who

- Have established coronary artery disease; **AND**
- Have left ventricular systolic dysfunction (Left Ventricular Ejection Fraction <55%); **AND**
- Are candidates for revascularization; **AND**
- Do not have evidence of viability using other imaging modalities (for example: Stress Echo, MRI, PET)
Pre-operative cardiac evaluation of patients undergoing non-cardiac surgery

This guideline applies to patients undergoing non-emergency surgery

It is assumed that those who require emergency surgery will undergo inpatient pre-operative evaluation

- Patients with active cardiac conditions such as unstable coronary syndromes (unstable angina), decompensated heart failure (NYHA function of class IV, worsening or new onset heart failure), significant arrhythmias (third degree AV block Mobitz II AV block, uncontrolled supraventricular arrhythmia, symptomatic ventricular arrhythmias, ventricular tachycardia), symptomatic bradycardia or severe stenotic valvular lesions. It is recommended that these conditions be evaluated and managed per ACC/AHA guidelines prior to considering elective surgery. That evaluation may include MPI.

**Low-risk surgery** (endoscopic procedures, superficial procedures, cataract surgery, breast surgery, ambulatory surgery)

- Provided that there are no active cardiac conditions (as outlined above), MPI prior to low-risk surgery is considered not medically necessary.

**Intermediate risk surgery** (including but not limited to intraperitoneal and intrathoracic surgery, carotid endarterectomy, head and neck surgery, orthopedic surgery, prostate surgery, gastric bypass surgery) or **High-risk surgery** (including but not limited to aortic and other major vascular surgery, peripheral vascular surgery) when

- The patient has not had a normal coronary angiogram, SE, MPI, CCTA, Cardiac PET perfusion study or revascularization procedure within the previous one (1) year; **AND**

- At least one of the following applies:
  - Patient has established CAD (prior MI, prior PTCA, stent, or CABG) or presumed CAD (Q waves on EKG, abnormal MPI, SE or cardiac PET); OR
  - Patient has compensated heart failure or prior history of heart failure (CHF); OR
  - Patient has diabetes mellitus; OR
  - Patient has chronic renal insufficiency or renal failure; OR
  - Patient has a history of cerebrovascular disease (TIA, CVA or documented carotid stenosis requiring carotid endarterectomy); OR
  - Patient is unable to walk on a treadmill for reasons other than obesity

**Abnormal EKG findings**

Some patients have resting EKG findings which would render the interpretation of an exercise EKG test difficult or impossible. In these situations patients who, in the absence of the EKG abnormality, would not meet approval criteria for MPI, may be approved for MPI because exercise EKG testing without imaging would provide little clinically useful data. Patients with the following resting EKG abnormalities are included this category:

- Left bundle branch block; OR
- Ventricular paced rhythm; OR
- Left ventricular hypertrophy with repolarization abnormality; OR
- Digoxin effect; OR
- 1 mm ST depression or more on a recent EKG (within the past 30 days); OR
- Pre-excitation syndromes (E.G. WPW syndrome)

**Unable to walk on a treadmill for reasons other than obesity**
CPT Codes

- 78472.................. Gated equilibrium; planar, single study, wall motion plus ejection fraction
- 78473.................. Gated equilibrium; planar, multiple studies, wall motion study plus ejection fraction
- 78481.................. First pass technique; single study, wall motion study plus ejection fraction
- 78483.................. First pass technique; multiple studies, wall motion study plus ejection fraction
- 78494.................. Gated equilibrium: SPECT, at rest, wall motion study plus ejection fraction
- 78496.................. This code is an add-on code to be used in conjunction with 78472. As such, this code does not require separate review

Commonly Used Radiopharmaceuticals

- Technetium-99m

Imaging Considerations

- Primarily used to evaluate global and regional ventricular function and to determine ejection fraction(s)
- May be used in the evaluation of intracardiac shunting or diastolic function
- First-pass studies display initial transit of the radiotracer bolus passing through the cardiopulmonary and central systemic circulations. Right and/or left ventricular function may be evaluated
- Equilibrium studies display gated data (MUGA) which is acquired over many cardiac cycles, using a blood pool radiotracer. Both right and left ventricles may be evaluated
- First pass studies should be acquired on a high count-rate camera in order that images have sufficient temporal resolution. High count-rate cameras are not required for MUGA
- Studies may be performed at rest and/or during exercise
- MUGA studies are technically more difficult in patients with irregular heart rhythms. Imaging times may have to be prolonged to acquire adequate data
- Selection of the optimal diagnostic imaging for cardiac evaluation should be made within the context of other available studies (which include transthoracic echocardiography, transesophageal echocardiography, stress myocardial perfusion imaging, stress echocardiography, cardiac MRI, cardiac CT, cardiac PET imaging and invasive cardiac/coronary angiography), so that the resulting information facilitates patient management decisions and does not merely add a new layer of testing
- Some disease states and medications interfere with red blood cell labeling. These should be taken into account when selecting the optimal imaging modality
- In interpretation of this document, the term "clinically stable" is taken to mean that the patient has no new or worsening cardiac symptoms and there are no changes on cardiovascular examination
Common Diagnostic Indications

The following diagnostic indications for cardiac blood pool imaging are accompanied by pre-test considerations as well as supporting clinical data and prerequisite information.

Evaluation of left ventricular function

Note: It is assumed that left ventricular function will be evaluated using a single imaging modality. Thus, if left ventricular function has been evaluated recently by echocardiography reevaluation using blood pool imaging is not necessary.

- Initial evaluation of known or suspected heart failure; OR
- Reevaluation of patients with known LV dysfunction (systolic or diastolic) in a patient with a change in clinical status; OR
- Reevaluation of clinically stable patients with left ventricular systolic dysfunction (Left Ventricular ejection fraction <55%) at yearly intervals; OR
- Evaluation of patients with resting EKG abnormalities (LBBB, RBBB with left anterior or posterior hemiblock, LVH, RVH, Q waves suggestive of prior infarction); OR
- Reevaluation of patients with known heart failure (systolic or diastolic) in a patient with a change in clinical status; OR
- Reevaluation of asymptomatic, clinically stable patients with left ventricular systolic dysfunction (Left Ventricular ejection fraction <55%) at yearly intervals; OR
- Baseline and serial reevaluation in patients undergoing, planning to undergo or who have undergone therapy with cardiotoxic agents (examples including but not limited to some chemotherapeutic agents for cancer, Novantrone [mitoxantrone] for multiple sclerosis); OR
- Screening study for left ventricular dysfunction every two (2) years in clinically stable and first-degree relatives of patients with inherited cardiomyopathy; OR
- Evaluation of suspected restrictive, infiltrative or genetic cardiomyopathy; OR
- Evaluation of patients with diagnosed or suspected myocarditis; OR
- Evaluation of LV function in a patient with known cardiomyopathy being considered for cardiac resynchronization therapy (CRT), implantable defibrillator (AICD) or ventricular assist device (VAD); OR
- Initial evaluation for cardiac resynchronization therapy (CRT) device optimization following implantation; OR
- Evaluation of a patient being treated with cardiac resynchronization therapy (CRT) with new or persistent signs or symptoms of heart failure for device optimization; OR
- Blood pool imaging is indicated for optimization of device settings in patients with ventricular assist device (VAD); OR
- When left ventricular dysfunction is suggested by other testing (chest x-ray, elevated BNP) and LV function has not been evaluated by another modality since that testing was performed; OR
- Where a significant discrepancy (more than would be expected for the range of error of the methods) exists in the evaluation of left ventricular dysfunction by two other imaging modalities, MUGA/First Pass can be used as an arbiter; OR
- Pre and post cardiac transplantation

Evaluation of right ventricular function

- In patients suspected of having right ventricular dysfunction based on history and/or physical examination; OR
- Reevaluation of patients with established right ventricular dysfunction in patients with a change in clinical status; OR
- Evaluation of right ventricular function in patients with pulmonary hypertension; OR
- Evaluation of right ventricular function in patients with diagnoses known to cause right ventricular dysfunction including but not limited to coronary artery disease, valvular heart disease, left ventricular dysfunction, congenital heart disease, morbid obesity, sleep apnea syndrome, advanced lung disease, pulmonary thromboembolic disease, and right ventricular dysplasia; OR
- Evaluation of right ventricular function in patients with myocardial infarction where right ventricular involvement is suspected; OR
- Evaluation of right ventricular function in patients who are being evaluated for or have undergone cardiac or lung transplantation.
Common Diagnostic Indications

**Coronary artery disease (CAD) (applies to patients with established coronary artery disease)**
- Recent (< 3 weeks) acute coronary syndrome (myocardial infarction or unstable angina) for initial assessment of LV function
  - This study is usually done prior to discharge
  - Not required if left ventricular function has been assessed using another imaging modality; OR
- Prior acute coronary syndrome (myocardial infarction or unstable angina) for reevaluation of ventricular function during recovery phase (up to six [6] months following acute coronary syndrome); OR
- Prior acute coronary syndrome (myocardial infarction or unstable angina) for reevaluation of ventricular function after the recovery phase (more than six [6] months) in patients who develop new signs or symptoms suggestive of heart failure; OR
- Prior myocardial infarction for reevaluation of LV function in patients being considered for AICD or cardiac resynchronization therapy (CRT)

**Congenital heart disease**
- For detection and localization of shunts (ventricular septal defect [VSD], atrial septal defect [ASD], patent ductus arteriosus [PDA], anomalous pulmonary venous drainage)
  - Echocardiography is generally considered to be a preferable imaging modality in this clinical situation
- For evaluation of RV and/or LV function in a patient with established complex congenital heart disease

**Valvular heart disease**
- Established valvular heart disease in patients with new or worsening signs or symptoms
  - In patients with suspected valvular heart disease echocardiography is the appropriate initial imaging modality; OR
- Patients with severe asymptomatic aortic regurgitation to assist in optimal timing of aortic valve replacement
  - Rest and stress studies are appropriate in this clinical situation
Nuclear Cardiology
Infarct Imaging

CPT Codes

78466.................. Planar, infarct avid; qualitative or quantitative
78468.................. Planar, infarct avid; with ejection fraction by first pass technique
78469.................. SPECT, infarct avid; with or without quantification

Radiopharmaceuticals

● Technetium-99m Pyrophosphate

Imaging Considerations

● Infarct imaging is typically optimal at 48-72 hours post-event
● False positive findings have been attributed to the following conditions:
  ○ Amyloidosis
  ○ Cardiac valvular and pericardial calcification
  ○ Cardiomyopathy
  ○ Doxorubicin (Adriamycin) Treatment
  ○ Myocarditis and Pericarditis
  ○ Prior myocardial infarction, that remains persistently positive
  ○ Radiation Therapy
  ○ Ventricular aneurysm
● Selection of the optimal diagnostic imaging for cardiac evaluation should be made within the context of other available studies (which include treadmill stress test, stress myocardial perfusion imaging, stress echocardiography, cardiac MRI, cardiac PET imaging and invasive cardiac/coronary angiography), so that the resulting information facilitates patient management decisions and does not merely add a new layer of testing

Common Diagnostic Indications

The following diagnostic indications for Infarct Imaging are accompanied by pre-test considerations as well as supporting clinical data and prerequisite information

Suspected acute myocardial infarction, which likely occurred within the last 7 days
● Including interrogation of the following:
  ○ Negative (past expected peak) cardiac enzymes
  ○ Abnormal baseline ECG, due to prior myocardial infarction
  ○ Left bundle branch block

Differentiation of subendocardial (non-Q-wave) infarction versus ischemia

Post-cardioversion

Following significant chest trauma or major surgical procedure, with chest pain
CPT Codes

93350.............. Echocardiography, transthoracic during rest and cardiovascular stress test using treadmill, bicycle exercise and/or pharmacologically induced stress, with interpretation and report

93351.............. Echocardiography, transthoracic during rest and cardiovascular stress test using treadmill, bicycle exercise and/or pharmacologically induced stress, with interpretation and report; including performance of continuous electrocardiographic monitoring with physician supervision

93320.............. This code is an add-on code to be used in conjunction with 93350, 93351. As such, this code does not require separate review

93321.............. This code is an add-on code to be used in conjunction with 93350, 93351. As such, this code does not require separate review

93325.............. This code is an add-on code to be used in conjunction with 93350, 93351. As such, this code does not require separate review

93352.............. This code is an add-on code to be used in conjunction with 93350, 93351. As such, this code does not require separate review

Uses of Stress Echocardiography (SE)

- The primary use of SE is in the diagnosis or exclusion of obstructive coronary artery disease (CAD)
- SE is also used for management of established coronary artery disease
- SE may be used for assessment of myocardial viability in patients who have had myocardial infarction
- SE is occasionally used in the evaluation of valvular heart disease, and for the detection and management of occult pulmonary hypertension

Imaging Considerations

- A recent EKG is strongly recommended, preferably within 7 days of request for stress echocardiogram. The findings on the resting EKG may help to determine the need for imaging and may also show evidence of ischemia at rest or interval myocardial infarction
- Unlike MPI, stress echocardiography does not expose the patient to ionizing radiation
- Age, gender and the character of the chest pain provide useful predictors of CAD, as stratified in Table 1 below

Table 1*: Pre-Test Probability of Coronary Artery Disease by Age, Gender and Symptoms:

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Gender</th>
<th>Typical/Definite Angina Pectoris</th>
<th>Atypical/Probable Angina Pectoris</th>
<th>Non-Anginal Chest Pain</th>
<th>Asymptomatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-39</td>
<td>Men</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Very Low</td>
<td>Very Low</td>
<td>Very Low</td>
</tr>
<tr>
<td>40-49</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very Low</td>
<td>Very Low</td>
</tr>
<tr>
<td>50-59</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
<td>Very Low</td>
</tr>
<tr>
<td>60-69</td>
<td>Men</td>
<td>High</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>High</td>
<td>Intermediate</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

Imaging Considerations

- Myocardial Perfusion Imaging and Stress Echocardiography may provide useful information on Coronary Heart Disease. Comparison data on Sensitivity and Specificity are provided in Table 2 below. Due to regional variation in technical expertise and interpretive proficiency, the clinician should use the diagnostic imaging modality that has been proven most accurate in his/her practices.

Table 2**: Comparison of Non-Invasive Diagnostic Imaging


<table>
<thead>
<tr>
<th></th>
<th>Nuclear Imaging Sensitivity (%)</th>
<th>Stress Echo Sensitivity (%)</th>
<th>Nuclear Imaging Specificity (%)</th>
<th>Stress Echo Specificity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise (7 studies)</td>
<td>83%</td>
<td>78%</td>
<td>83%</td>
<td>91%</td>
</tr>
<tr>
<td>Dobutamine (8 studies)</td>
<td>86%</td>
<td>80%</td>
<td>73%</td>
<td>86%</td>
</tr>
<tr>
<td>Adenosine (3 studies)</td>
<td>89%</td>
<td>63%</td>
<td>73%</td>
<td>86%</td>
</tr>
<tr>
<td>Dipyridamole (4 studies)</td>
<td>83%</td>
<td>68%</td>
<td>88%</td>
<td>89%</td>
</tr>
</tbody>
</table>

Several clinical indications listed for Stress Echo include standard methods of risk assessment, such as the SCORE (Systematic Coronary Risk Evaluation) or the Framingham risk score calculation. These risk calculation systems include consideration of the following factors:

<table>
<thead>
<tr>
<th>Age</th>
<th>Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal Lipid Profile</td>
<td>Hypertension</td>
</tr>
<tr>
<td>Diabetes Mellitus (always = high risk)</td>
<td>Cigarette Smoking</td>
</tr>
</tbody>
</table>

Other coronary risk factors such as family history of premature CAD, coronary artery calcification, C reactive protein levels, obesity etc. are not included in the standard methods of risk assessment but are thought to contribute to coronary artery disease risk.

- Selection of the optimal diagnostic work-up for evaluation or exclusion of coronary artery disease should be made within the context of available studies (which include treadmill stress test, stress myocardial perfusion imaging, stress echocardiography, cardiac PET imaging and invasive cardiac/coronary angiography), so that the resulting information facilitates patient management decisions and does not merely add a new layer of testing.

- Occasionally it may be appropriate to do a second non-invasive test for diagnosis or exclusion of CAD when the initially selected test is technically suboptimal and the diagnosis of CAD cannot be established or excluded.

- SE may be performed using either physical or pharmacologic stress. If physical stress is used, the choice rests between treadmill exercise test and bicycle exercise test. While it is possible to acquire images during exercise in patients undergoing bicycle exercise testing, image quality during treadmill exercise is suboptimal. In this situation, the “stress” images are actually acquired immediately following peak exercise. Thus, the laboratory must be set up in a manner that allows imaging to be completed within 45 to 60 seconds after peak exercise.

- Some patients may not be suitable candidates for SE. Image quality is frequently suboptimal in morbidly obese patients and in those with advanced lung disease. If image quality at rest is inadequate, the test should be canceled and consideration given to an alternative imaging modality.

- For patients who are unable to walk on a treadmill for non-cardiac reasons (orthopedic limitations, claudication, neurological conditions, advanced lung disease, etc. exercise stress testing is not an option. These patients will require pharmacological testing with echo or nuclear imaging.

- It is anticipated that the evaluation of patients with acute chest pain will occur in the emergency room or in an inpatient setting and stress echo performed in these locations is not included in the AIM preauthorization program.
Common Diagnostic Indications

The following diagnostic indications for stress echocardiography may be accompanied by pre-test considerations as well as supporting clinical data and prerequisite information.

Suspected coronary artery disease in asymptomatic patients

- Patients with high-risk of CAD (SCORE) who have not had evaluation of coronary artery disease (MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization) within the preceding three (3) years; OR
- Patients with moderate or high risk of CAD (SCORE) who have a high risk occupation that would endanger others in the event of a myocardial infarction (for example: airline pilot, law-enforcement officer, firefighter, mass transit operator, bus driver) who have not had evaluation of coronary artery disease (MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization) within the preceding three (3) years; OR
- Patients with diseases/conditions with which coronary artery disease commonly coexists and who have not had evaluation of coronary artery disease (MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization) within the preceding three (3) years:
  - Diabetes mellitus; OR
  - Abdominal aortic aneurysm; OR
  - Established and symptomatic peripheral vascular disease; OR
  - Prior history of cerebrovascular accident (CVA), transient ischemic attack (TIA) or carotid endarterectomy (CEA) or high grade carotid stenosis (>70%); OR
  - Chronic renal insufficiency; OR
- Patients who have undergone cardiac transplantation and have had no evaluation for coronary artery disease within the preceding one (1) year; OR
- Patients in whom a decision has been made to treat with Interleukin 2

Suspected coronary artery disease in symptomatic patients who have not had evaluation of coronary artery disease (MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization) within the preceding sixty (60) days

- Chest pain
  - With intermediate or high pretest probability of CAD (Table 1); OR
  - With low or very low pretest probability of CAD (Table 1) and high risk of CAD (SCORE)
- Atypical symptoms: syncope, shortness of breath (dyspnea), neck, jaw, arm, epigastric or back pain, sweating (diaphoresis)
  - With moderate or high risk of CAD (SCORE)
- Other symptoms: palpitation, dizziness, lightheadedness, near syncope, nausea, vomiting, anxiety, weakness, fatigue, etc.
  - With high risk of CAD (SCORE)
- Patients with any cardiac symptom who have diseases/conditions with which coronary artery disease commonly coexists such as:
  - Diabetes mellitus; OR
  - Abdominal aortic aneurysm; OR
  - Established and symptomatic peripheral vascular disease; OR
  - Prior history of cerebrovascular accident (CVA), transient ischemic attack (TIA) or carotid endarterectomy (CEA) or high grade carotid stenosis (>70%); OR
  - Chronic renal insufficiency or renal failure; OR
- Patients who have undergone cardiac transplantation; OR
- Patients in whom a decision has been made to treat with Interleukin 2
Common Diagnostic Indications

Established coronary artery disease (diagnosed by previous cardiac catheterization, MPI, cardiac PET, or stress echo) in patients who have new or worsening symptoms

Note: If symptoms are typical of myocardial ischemia cardiac catheterization may be more appropriate than MPI

Established coronary artery disease (diagnosed by previous cardiac catheterization, MPI, cardiac PET, or stress echo) in patients who have not undergone revascularization and have no symptoms or stable symptoms

- No evaluation of CAD (MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization) within the preceding three (3) years
- No evaluation of CAD (MPI, cardiac PET, stress echo, coronary CTA or cardiac catheterization) within the preceding one (1) year in a patient who has undergone cardiac transplantation and has been found to have CAD since transplantation

Established coronary artery disease in patients who have undergone revascularization

- For evaluation of new or worsening cardiac symptoms
  - If symptoms are typical of myocardial ischemia cardiac catheterization may be more appropriate than MPI; OR
  - For evaluation of stable patients who have undergone coronary artery bypass grafting more than five (5) years previously and who have not had an evaluation for coronary artery disease (MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization) within the past two (2) years
    - Stable patients whose revascularization has been incomplete may undergo MPI three (3) years following the procedure and every three (3) years thereafter; OR
  - For evaluation of stable patients who have undergone percutaneous coronary intervention (PCI) more than three (3) years previously and who have not had an evaluation for coronary artery disease (MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization) within the past three (3) years

Established coronary artery disease in patients who have had myocardial infarction (ST elevation or non-ST elevation) or unstable angina within the preceding ninety (90) days provided that

- The patient did not undergo coronary angiography at the time of the acute event; AND
- The patient is currently clinically stable

Patients with new onset arrhythmias (patient can be symptomatic or asymptomatic)

This guideline applies to patients with suspected or established CAD

- Patients with sustained (lasting more than 30 seconds) or non-sustained (more than 3 beats but terminating within 30 seconds) ventricular tachycardia; OR
- Patients with atrial fibrillation or flutter and high or moderate risk of CAD (SCORE); OR
- Patients with atrial fibrillation or flutter and established CAD; OR
- Patients who have frequent premature ventricular contractions (PVC) defined as more than ten (10) PVCs per hour on ambulatory EKG (Holter) monitoring
  - It is not appropriate to perform stress echocardiography for evaluation of infrequent premature atrial or ventricular depolarizations
Common Diagnostic Indications

Patients with new onset congestive heart failure or recently recognized left ventricular systolic dysfunction (patient can be symptomatic or asymptomatic)
This guideline applies to patients with suspected or established CAD
For patients in this category whose CAD risk (SCORE) is high, cardiac catheterization may be more appropriate than non-invasive evaluation

- Provided that new or worsening CAD has not been excluded as the cause of LV dysfunction/CHF by any of the following tests: MPI, stress echo, cardiac PET, coronary CTA or cardiac catheterization

Patients with abnormal exercise treadmill test (performed without imaging)
This guideline applies to patients with suspected or established CAD
- Abnormal findings on an exercise treadmill test include (chest pain, ST segment change, abnormal BP response or complex ventricular arrhythmias)

Patients who have undergone recent (within the past 60 days) myocardial perfusion imaging (MPI)
- When the MPI is technically suboptimal, technically limited, inconclusive, indeterminate, or equivocal, such that myocardial ischemia cannot be adequately excluded
  - It is not appropriate to perform SE on patients who have had a recent normal or abnormal MPI
  - An MPI is deemed to be abnormal when there are abnormalities on the nuclear imaging portion of the test. Electrocardiographic abnormalities without evidence of ischemia on the nuclear imaging portion of the test are considered to be normal studies

Patients with abnormal findings on cardiac CT/coronary CTA
Symptomatic Patients:
- With coronary artery calcium score > 400 Agatston units; OR
- Intermediate severity coronary stenosis on coronary CTA

Note: If symptoms are typical of myocardial ischemia, cardiac catheterization may be more appropriate than stress echo

Asymptomatic patients who have not had MPI, stress echo, cardiac PET or cardiac catheterization within the preceding three (3) years:
- With coronary artery calcium score > 400 Agatston units; OR
- Intermediate severity coronary stenosis on coronary CTA

Patients with abnormal findings on cardiac catheterization
- To determine flow limiting significance of intermediate coronary stenosis

Myocardial viability evaluation
Stress Echo may be used to evaluate myocardial viability in patients who
- Have established coronary artery disease; AND
- Have left ventricular systolic dysfunction (Left Ventricular Ejection Fraction <55%); AND
- Are candidates for revascularization; AND
- Do not have evidence of viability using other imaging modalities (for example: MPI, MRI, PET)

Note: Pharmacologic stress echocardiography with a drug such as dobutamine that increases myocardial contractility is the preferred protocol
Common Diagnostic Indications

Pre-operative cardiac evaluation of patients undergoing non-cardiac surgery

This guideline applies to patients undergoing non-emergency surgery

It is assumed that those who require emergency surgery will undergo in-patient pre-operative evaluation

- Patients with active cardiac conditions such as unstable coronary syndromes (unstable angina), decompensated heart failure (NYHA function of class IV, worsening or new onset heart failure), significant arrhythmias (third degree AV block, Mobitz II AV block, uncontrolled supraventricular arrhythmia, symptomatic ventricular arrhythmias, ventricular tachycardia), symptomatic bradycardia or severe stenotic valvular lesions. It is recommended that these conditions be evaluated and managed per ACC/AHA guidelines prior to considering elective surgery. That evaluation may include Stress Echo

Low-risk surgery (endoscopic procedures, superficial procedures, cataract surgery, breast surgery, ambulatory surgery)

- Provided that there are no active cardiac conditions (as outlined above) MPI prior to low-risk surgery is considered not medically necessary

Intermediate risk surgery (including but not limited to intraperitoneal and intrathoracic surgery, carotid endarterectomy, head and neck surgery, orthopedic surgery, prostate surgery, gastric bypass surgery) or High-risk surgery (including but not limited to aortic and other major vascular surgery, peripheral vascular surgery) when

- The patient has not had a normal coronary angiogram, SE, MPI, CCTA, Cardiac PET perfusion study or revascularization procedure within the previous one (1) year; AND

- At least one of the following applies:
  - Patient has established CAD (prior MI, prior PTCA, stent, or CABG) or presumed CAD (Q waves on EKG, abnormal MPI, SE or cardiac PET); OR
  - Patient has compensated heart failure or prior history of heart failure (CHF); OR
  - Patient has diabetes mellitus; OR
  - Patient has chronic renal insufficiency or renal failure; OR
  - Patient has a history of cerebrovascular disease (TIA, CVA or documented carotid stenosis requiring carotid endarterectomy); OR
  - Patient is unable to walk on a treadmill for reasons other than obesity

Valvular heart disease

- Stress echocardiography may be used in evaluation of asymptomatic patients with any of the following valvular lesions
  - Severe aortic stenosis
  - Severe aortic regurgitation with normal left ventricular size and function
  - Severe mitral stenosis
  - Severe mitral regurgitation with normal left ventricular size and function; OR

- Stress echocardiography may be used in evaluation of symptomatic patients with any of the following valvular lesions
  - Aortic stenosis of uncertain degree (due to the presence of co-existent severe left ventricular systolic dysfunction). Pharmacologic stress echocardiography with a drug such as dobutamine that increases myocardial contractility is the preferred protocol
  - Moderate mitral stenosis
  - Moderate mitral regurgitation

Pulmonary hypertension

- For evaluation or exclusion of exercise induced pulmonary hypertension; OR

- For evaluation of right and/or left ventricular function during exercise in patients with established exercised induced pulmonary hypertension
Common Diagnostic Indications

Hypertrophic obstructive cardiomyopathy
- For the evaluation of dynamic changes during exercise in patients with an established diagnosis of hypertrophic obstructive cardiomyopathy who do not have a resting outflow tract gradient of 50 mm Hg or more.

Abnormal EKG findings
Some patients have resting EKG findings which would render the interpretation of an exercise EKG test difficult or impossible. In these situations patients who, in the absence of the EKG abnormality, would not meet approval criteria for MPI, may be approved for MPI because exercise EKG testing without imaging would provide little clinically useful data. Patients with the following resting EKG abnormalities are included in this category:

- Left bundle branch block; OR
- Ventricular paced rhythm; OR
- Left ventricular hypertrophy with repolarization abnormality; OR
- Digoxin effect; OR
- 1 mm ST depression or more on a recent EKG (within the past 30 days); OR
- Pre-excitation syndromes (e.g. WPW syndrome)

Unable to walk on a treadmill for reasons other than obesity
Transesophageal Echocardiography (TEE)

CPT Codes

93312.................. TEE real-time with image documentation (2-D) (with or without M-mode recording)
93313.................. Placement of transesophageal probe only
93314.................. Image acquisition, interpretation and report only
93315.................. TEE for congenital cardiac anomalies
93316.................. Placement of transesophageal probe only (congenital cardiac anomalies)
93317.................. Image acquisition, interpretation and report only (congenital cardiac anomalies)
93320.................. This code is an add-on code to be used in conjunction with 93312, 93314, 93315, 93317. As such, this code does not require separate review
93321.................. This code is an add-on code to be used in conjunction with 93312, 93314, 93315, 93317. As such, this code does not require separate review
93325.................. This code is an add-on code to be used in conjunction with 93312, 93314, 93315, 93317. As such, this code does not require separate review

Standard Anatomic Coverage

- Heart, proximal great vessels, pericardium

Imaging Considerations

- In general, it is assumed that TEE is appropriately used as an adjunct or subsequent test to transthoracic echocardiography (TTE) when suboptimal TTE images preclude obtaining a diagnostic study
- There are some clinical situations for which TEE is a more appropriate initial imaging test than TTE. These situations are outlined below under Common Diagnostic Indications for TEE
- Since TEE requires conscious sedation, it should only be performed at locations where cardiac monitoring and appropriate equipment for cardiopulmonary resuscitation are readily available
- Patients with oropharyngeal or esophageal pathology which contraindicates intubation of the esophagus are not suitable candidates for TEE
- Intraoperative TEE (93318) is beyond the scope of AIMs diagnostic imaging management program and will not be addressed in this document
Common Diagnostic Indications

The following diagnostic indications for TEE are accompanied by pre-test considerations as well as supporting clinical data and prerequisite information.

In patients who have had, or are likely to have suboptimal transthoracic imaging
- When image quality is suboptimal such that the clinical question(s) prompting the TEE has/have not been adequately answered; OR
- When it is likely that transthoracic imaging will be suboptimal in the following situations:
  - Previous transthoracic echocardiograms were of suboptimal quality
  - In patients with severe abnormalities of thoracic contour (pectus deformities, severe kyphoscoliosis)
  - In patients who have recently had thoracic surgery where post-operative tenderness or the location of dressings or incisions would preclude imaging from the usual transthoracic locations
  - Following severe chest trauma
  - Following extensive burns to the thorax
  - In patients with a cardiac diagnosis made by TEE who require reevaluation, the results of which would lead to a change in therapy (e.g. resolution of an intracardiac thrombus following anticoagulation)

In patients whose clinical situation suggests that TEE may be preferable to transthoracic echocardiography as an initial imaging test
- In evaluation of suspected acute aortic pathology; OR
- In evaluation of valvular structure and function to assess suitability for and assist in planning of surgical or catheter based valvular intervention; OR
- To diagnose/manage endocarditis with a moderate or high pretest probability (e.g. bacteremia, especially staph bacteremia or fungemia); OR
- To diagnose/manage endocarditis involving prosthetic heart valves; OR
- In evaluation of persistent fever in a patient with an intracardiac device to exclude endocarditis; OR
- In evaluation of a patient with atrial fibrillation/flutter to facilitate clinical decision-making with regards to anticoagulation and/or cardioversion and/or radiofrequency ablation
  - TEE is not required when the decision has been made to anticoagulate the patient and not perform cardioversion; OR
- In evaluation of a patient who has undergone surgical correction of complex congenital heart disease for the exclusion of intracardiac thrombus

In patients who have undergone technically adequate transthoracic echocardiography (TTE)
- In evaluation for cardiovascular source of embolic event when no non-cardiac source has been identified
Resting Transthoracic Echocardiography (TTE)

**CPT Codes**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>93303</td>
<td>Transthoracic echocardiography or congenital cardiac anomalies; complete</td>
</tr>
<tr>
<td>93304</td>
<td>Transthoracic echocardiography or congenital cardiac anomalies; follow-up or limited study</td>
</tr>
<tr>
<td>93306</td>
<td>Transthoracic echocardiography, real-time with image documentation (2D), includes M-mode recording, when performed, complete, with spectral Doppler echocardiography, and with color flow Doppler echocardiography</td>
</tr>
<tr>
<td>93307</td>
<td>Transthoracic echocardiography; complete, without spectral Doppler echocardiography, or color flow Doppler echocardiography</td>
</tr>
<tr>
<td>93308</td>
<td>Transthoracic echocardiography; complete, without spectral Doppler echocardiography, or color flow Doppler echocardiography follow-up or limited study</td>
</tr>
<tr>
<td>93320</td>
<td>This code is an add-on code to be used in conjunction with 93303, 93304 93308. As such, this code does not require separate review</td>
</tr>
<tr>
<td>93321</td>
<td>This code is an add-on code to be used in conjunction with 93303, 93304 93308. As such, this code does not require separate review</td>
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<td>93325</td>
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</tr>
</tbody>
</table>

**Standard Anatomic Coverage**

- Heart, proximal great vessels, pericardium

**Imaging Considerations**

**Advantages of transthoracic echocardiography:**

- No risk to the patient
- Minimal patient discomfort
- Widely available
- Extremely portable
- No exposure to ionizing radiation

**Disadvantages of transthoracic echocardiography:**

- Image quality suboptimal in some patients
- Less sensitive than transesophageal echocardiography in some clinical situations

**Ordering Issues:**

- Transthoracic echocardiography should only be acquired on equipment which has the capability to perform Doppler echocardiography (pulsed-wave and continuous wave with spectral display) and color flow velocity mapping
- In interpretation of this document, the term “clinically stable” is taken to mean that the patient has no new or worsening cardiac symptoms and there are no changes on cardiovascular examination
Common Diagnostic Indications

The following diagnostic indications for resting thoracic echocardiography are accompanied by pre-test considerations as well as supporting clinical data and prerequisite information

**Suspected valvular heart disease**
- Evaluation of cardiac murmurs when the diagnosis of valvular heart disease has not been established
  - After the diagnosis of valvular heart disease has been established, follow the guidelines for the specific valvular lesion (e.g., established aortic stenosis)
- Initial evaluation for mitral valve prolapse when signs or symptoms of mitral valve prolapse are present
- Initial evaluation for bicuspid aortic valve when there is a family history (established diagnosis in a first-degree relative)

**Established native valvular stenosis**
- Changing signs or symptoms; OR
- Reevaluation of clinically stable patients with moderate or severe stenosis annually; OR
- Reevaluation of clinically stable patients with mild stenosis every three (3) years; OR
- Assessment of changes in hemodynamic severity and left ventricular function in patients with known aortic stenosis during pregnancy; OR
- Annual assessment of children age six (6) years or younger with pulmonic stenosis of any degree

**Established native valvular regurgitation**
- Changing signs or symptoms; OR
- Reevaluation of clinically stable patients with moderate or severe regurgitation annually; OR
- Reevaluation of clinically stable patients with mild regurgitation every three (3) years

**Established bicuspid aortic valve**
- Changing signs or symptoms suggesting the development of aortic valve dysfunction; OR
- Bicuspid aortic valve and dilated aortic root on prior echo (annual echocardiography is indicated); OR
- Bicuspid aortic valve and normal aortic root on prior echo [echo at three (3) yearly intervals is indicated]

**Established mitral valve prolapse**
- Changing signs or symptoms

**Prosthetic cardiac valves (mechanical or bioprosthetic) and patients who have undergone valve repair**
- Initial post-operative evaluation of valve function (baseline study); OR
- Signs and/or symptoms suggesting dysfunction of a repaired or replaced valve; OR
- Annual reevaluation of a patient with a prosthetic or repaired heart valve noted on prior imaging study to have moderate or severe dysfunction (stenosis or regurgitation); OR
- Evaluation at three (3) yearly intervals of a patient with a prosthetic or repaired heart valve noted on prior imaging study to have mild dysfunction (stenosis or regurgitation); OR
- Reevaluation of clinically stable adults (age 19 years or older) following valve repair or implantation of a bioprosthetic valve every three (3) years
  - This guideline does not apply to patients with a mechanical valve prosthesis; OR
- Annual reevaluation of clinically stable non adult patients (less than or equal to 18 years old)
Common Diagnostic Indications

Evaluation of patients with congenital heart disease

- Evaluation of patients in whom congenital heart disease is suspected based on signs and symptoms (including murmur, cyanosis, unexplained arterial desaturation, abnormal arterial pulses) abnormal EKG, abnormal chest x-ray; OR
- Patients with chromosomal abnormalities or major extra cardiac abnormality associated with a high incidence of coexisting cardiac abnormality; OR
- Patients with established congenital heart disease (repaired or un repaired) in whom there is a change in clinical status; OR
- Adult patients with a childhood history of congenital heart disease (with or without prior surgical repair) in whom the original diagnosis is uncertain or when the precise nature of the structural abnormalities or hemodynamics is unclear; OR
- Biennial (every 2 years) echocardiography is appropriate in clinically stable patients age six (6) years or older with established complex congenital heart disease (with or without prior surgical repair) in whom surveillance for ventricular function, AV valvular regurgitation or pulmonary artery pressure is important in clinical decision-making
  - This does not include patients with successfully repaired patent ductus arteriosus, small atrial or ventricular septal defects, bicuspid aortic valve or mitral valve prolapse; OR
- Semiannual (every six months) echocardiography is appropriate in clinically stable patients age five (5) years or younger with established congenital heart disease (with or without prior surgical repair) in whom surveillance for ventricular function, AV valvular regurgitation or pulmonary artery pressure is important in clinical decision-making; OR
- Initial outpatient post-operative evaluation of patients who have undergone surgical or catheter-based procedures to correct congenital heart disease (within 60 days of the procedure); OR
- TTE is appropriate every three (3) years in the follow up of patients who have undergone catheter-based closure of atrial or ventricular septal defects; OR
- Non adult patients (less than or equal to 18 years old) who are undergoing staged surgical correction of congenital heart disease; OR
- Patients in whom a decision to perform surgical or catheter based repair of congenital heart disease has been made and in whom echocardiography will be used to assist with procedural planning

Evaluation of ventricular function

Note: It is assumed that left ventricular function will be evaluated using a single imaging modality. Thus, if left ventricular function has been evaluated recently by blood pool imaging reevaluation using echocardiography is not necessary

Hypertension

- Initial evaluation of patients with an established diagnosis of hypertension; OR
- Annual evaluation of non-adult patients (less than or equal to 18 years old) with an established diagnosis of hypertension

Heart Failure / Cardiomyopathy / Left Ventricular Dysfunction

- Initial evaluation of known or suspected heart failure; OR
- Reevaluation of patients with known heart failure (systolic or diastolic) in a patient with a change in clinical status; OR
- Reevaluation of patients with known LV dysfunction (systolic or diastolic) in a patient with a change in clinical status; OR
- Reevaluation of clinically stable adult (age 19 years or older) patients with left ventricular systolic dysfunction (Left Ventricular ejection fraction <55%) at yearly intervals; OR
- Reevaluation of clinically stable non-adult (age 18 years or younger) patients with left ventricular systolic dysfunction (Left Ventricular ejection fraction <60%) at six (6) monthly intervals; OR
- Screening study every two (2) years in clinically stable first-degree relatives of patients with inherited cardiomyopathy (see specific indications for hypertrophic obstructive cardiomyopathy (HOCM) below); OR
- Evaluation of suspected restrictive, infiltrative or genetic cardiomyopathy; OR
- Initial evaluation of suspected hypertrophic obstructive cardiomyopathy (HOCM); OR
Common Diagnostic Indications

- Reevaluation of known hypertrophic obstructive cardiomyopathy (HOCM) in a patient with a change in clinical status to guide or evaluate therapy; **OR**
- Annual reevaluation non-adult (age 18 years or younger) first-degree relatives of patients with established hypertrophic obstructive cardiomyopathy (HOCM); **OR**
- Evaluation every five (5) years of adult (age 19 years or older) first-degree relatives of patients with established hypertrophic obstructive cardiomyopathy (HOCM); **OR**
- Annual reevaluation of asymptomatic adult (age 19 years or older) patients with known hypertrophic obstructive cardiomyopathy (HOCM); **OR**
- Reevaluation of asymptomatic non-adult (age 18 years or younger) patients with known hypertrophic obstructive cardiomyopathy (HOCM) at six (6) monthly intervals

Implantable devices

- Evaluation of LV function in a patient with known cardiomyopathy being considered for cardiac resynchronization therapy (CRT), implantable defibrillator (AICD) or ventricular assist device (VAD); **OR**
- Initial evaluation for cardiac resynchronization therapy (CRT) device optimization following implantation; **OR**
- Evaluation of a patient being treated with cardiac resynchronization therapy (CRT) with new or persistent signs or symptoms of heart failure for device optimization; **OR**
- Echocardiography is indicated for optimization of device settings in patients with ventricular assist device (VAD); **OR**
- Echocardiography is indicated for evaluation of signs and/or symptoms suggestive of device related complications in patients with ventricular assist device (VAD)

Abnormalities on other testing

- Evaluation of patients with resting EKG abnormalities (LBBB, RBBB with left anterior or posterior hemiblock, LVH, RVH, Q waves suggestive of prior infarction); **OR**
- When left ventricular dysfunction is suggested by other testing (chest x-ray, elevated BNP) and LV function has not been evaluated by another modality since that testing was performed; **OR**
- Where a significant discrepancy (more than would be expected for the range of error of the methods) exists in the evaluation of left ventricular dysfunction by two other imaging modalities, echocardiography can be used as an arbiter

Other

- Pre and post cardiac transplant evaluation; **OR**
- Evaluation of known or suspected myocarditis; **OR**
- Echocardiography to evaluate right ventricular function in patients with disease likely to affect right ventricular function including but not limited to chronic lung diseases and sleep apnea syndrome; **OR**
- Baseline and serial reevaluation in patients undergoing, planning to undergo or who have undergone therapy with cardiotoxic agents (examples including but not limited to some chemotherapeutic agents for cancer, Novantrone® (mitoxantrone) for multiple sclerosis

Evaluation of patients with cardiac arrhythmias

- In patients who have sustained (lasting more than 30 seconds) or nonsustained (more than 3 beats but terminating within 30 seconds) ventricular tachycardia
- In patients who have sustained (lasting more than 30 seconds) or non-sustained (more than 3 beats but terminating within 30 seconds) supraventricular tachycardia (including but not limited to atrial fibrillation, atrial flutter, atrial tachycardia, AV node reentrant tachycardia, etc.
- In patients who have frequent premature ventricular contractions (PVC) defined as more than ten (10) PVCs per hour on ambulatory EKG (Holter) monitoring
  - It is not clinically indicated to perform echocardiography for evaluation of infrequent premature atrial or ventricular depolarizations
Common Diagnostic Indications

Evaluation of infective endocarditis (native or prosthetic valves)
- Patients with suspected endocarditis (positive blood cultures and/or a new murmur on physical examination)
- Reevaluation of patients with established endocarditis who have any of the following
  - Virulent organism; OR
  - Severe hemodynamic lesion; OR
  - Aortic involvement; OR
  - Persistent bacteremia; OR
  - Clinical deterioration

Evaluation of patients with suspected coronary artery disease
- Chest pain
  - Resting echocardiography may suggest a cause for the chest pain other than myocardial ischemia (mitral valve prolapse) and is therefore a reasonable imaging procedure in patients with chest pain
  - If coronary artery disease is a likely diagnosis and if a resting echocardiogram cannot be performed while the patient is experiencing the pain, a provocative test (exercise or pharmacological stress test with or without imaging as appropriate) is preferable
  - Resting echocardiography has no role in screening for coronary artery disease in asymptomatic patients; OR
- Echocardiography is appropriate in the evaluation of patients with suspected aberrant or anomalous coronary origins or coronary artery fistula; OR
- Echocardiography is appropriate in the evaluation of patients with suspected Kawasaki disease

Evaluation of patients with known coronary artery disease
- Recent (<3 weeks) acute coronary syndrome (myocardial infarction or unstable angina) and hemodynamic instability or signs or symptoms suggesting a complication of myocardial infarction including but not limited to acute mitral regurgitation, hypoxemia, abnormal chest x-ray, acute ventricular septal rupture, free wall rupture / tamponade, shock, right ventricular involvement, heart failure, or thrombus
  - This study is usually requested on an inpatient; OR
- Recent (< 3 weeks) acute coronary syndrome (myocardial infarction or unstable angina) for initial assessment of LV function
  - This study is usually done prior to discharge
  - Not required if left ventricular function has been assessed using a different imaging modality; OR
- Prior acute coronary syndrome (myocardial infarction or unstable angina) for reevaluation of ventricular function during recovery phase (up to six (6) months following acute coronary syndrome); OR
- Prior acute coronary syndrome (myocardial infarction or unstable angina) for reevaluation of ventricular function after the recovery phase (more than six (6) months) in patients who develop new symptoms or signs suggestive of heart failure; OR
- Prior myocardial infarction for reevaluation of LV function in patients being considered for AICD or cardiac resynchronization therapy (CRT); OR
- Annual echocardiography is appropriate in non adult patients (less than or equal to 18 years old) with an established diagnosis of aberrant or anomalous coronary origins or coronary artery fistula if the findings on echocardiography will impact clinical decision making; OR
- Echocardiography is appropriate in patients with an established diagnosis of Kawasaki disease at 6-8 weeks following diagnosis whether or not there was coronary artery involvement at the time of diagnosis. If this study shows no coronary artery abnormalities, no subsequent echocardiograms are necessary; OR
- Annual echocardiography is appropriate in patients with an established diagnosis of Kawasaki disease who have small or medium sized coronary artery aneurysms; OR
- Semiannual (every six months) echocardiography is appropriate in patients with an established diagnosis of Kawasaki disease who have large or giant coronary artery aneurysms or coronary artery obstruction
**Common Diagnostic Indications**

**Evaluation of signs, symptoms or abnormal testing**

- Echocardiography is appropriate in the evaluation of the following newly recognized symptoms (chest pain, dyspnea, lightheadedness, syncope, palpitations, reduced functional capacity, orthopnea, paroxysmal nocturnal dyspnea, transient ischemic attack (TIA) or cerebrovascular attack (CVA)).

- Echocardiography is appropriate in the evaluation of the following newly recognized signs suggesting structural heart disease (murmur, cyanosis, ankle edema, ascites, elevation of jugular venous pressure, unexplained weight gain, tachycardia, tachypnea, audible third heart sound, lung crackles suggestive of pulmonary edema); **OR**

- Echocardiography is appropriate in the evaluation of patients who are hemodynamically unstable or hypotensive for unknown reasons; **OR**

- Echocardiography is appropriate in further evaluation of abnormal results from other testing which suggests underlying cardiac disease (abnormal chest X ray suggesting cardiac chamber enlargement, valvular or congenital heart disease or congestive heart failure, abnormal EKG suggesting chamber hypertrophy, valvular or congenital heart disease (LBBB, RBBB with anterior or posterior hemiblock, left or right ventricular hypertrophy or Q waves suggestive of prior infarction) or abnormal laboratory results suggesting congestive heart failure such as elevated B-type natriuretic peptide (BNP).
  - When other cardiac testing raises concerns of underlying coronary artery disease, provocative testing is recommended over resting echocardiography; **OR**

- Echocardiography is appropriate in the evaluation of respiratory failure of unknown cause; **OR**

- Echocardiography is appropriate annually in the evaluation of patients with syndromes which place them at increased risk for the development of acquired myocardial or aortic diseases (for example, Marfan Syndrome, Ehlers-Danlos Syndrome, Turner Syndrome, etc.); **OR**

- Echocardiography is appropriate in the evaluation of suspected acute rheumatic fever.

**Evaluation of patients with pulmonary embolus**

- In patients with known acute pulmonary embolus, echocardiography may be performed as it is useful in guiding initial decision making (thrombectomy, thrombolysis).
  - Echocardiography is not indicated in the initial evaluation of a patient with suspected pulmonary embolism in order to establish the diagnosis; **OR**

- In patients who have had a pulmonary embolus, echocardiography may be performed to evaluate right ventricular function and pulmonary artery pressure. If right ventricular function and pulmonary artery pressure are normal, repeated studies are not necessary.

**Evaluation of patients with pulmonary hypertension**

- Echocardiography is indicated for evaluation of suspected pulmonary hypertension; **OR**

- Echocardiography is indicated in follow-up of pulmonary arterial pressures in patients with pulmonary hypertension to evaluate response to treatment; **OR**

- Echocardiography may be performed annually in clinically stable patients with an established diagnosis of pulmonary hypertension; **OR**

- Echocardiography may be performed to evaluate signs or symptoms which may be attributable to worsened pulmonary hypertension.
Common Diagnostic Indications

Evaluation of aortic disease

- Echocardiography is appropriate when ascending aortic aneurysm / dilation or dissection is suspected based on symptoms of chest pain or shortness of breath or abnormal physical findings suggesting these diagnoses
  - Although some providers will use transthoracic echocardiography in evaluation of diseases of the thoracic aorta, transesophageal echocardiography (TEE) is often preferable in this situation
- Echocardiography is indicated annually when pathology of the ascending aorta (aneurysm / dilation or dissection) is suspected because the patient has an established diagnosis of a connective tissue disease or genetic condition which predisposes to ascending aortic pathology including but not limited to Marfan syndrome, Ehlers-Danlos syndrome and familial aortic dilation (this guideline does not apply to surveillance of patients with bicuspid aortic valve – see separate guideline for this condition above)
- Echocardiography is appropriate for evaluation of the ascending aorta in patients with a suspected connective tissue disease or genetic condition which predisposes to ascending aortic pathology including but not limited to Marfan syndrome, Ehlers-Danlos syndrome and familial aortic dilation
  - Annual echocardiography is appropriate in patients with an established diagnosis of ascending aortic aneurysm or dissection
  - Annual echocardiographic evaluation is usually sufficient in clinically stable patients but more frequent testing may be appropriate in some situations (e.g. in longitudinal follow-up of large or enlarging thoracic aneurysms, in follow-up of recently diagnosed thoracic aneurysms until stability is established)

Evaluation of pericardial diseases

- Echocardiography is indicated in the evaluation of suspected pericardial conditions including but not limited to pericardial effusion, pericardial mass, constrictive pericarditis, effusive-constrictive conditions, patients post cardiac surgery or suspected pericardial tamponade
- Echocardiography is indicated in the evaluation of established pericardial conditions including but not limited to moderate and large pericardial effusion, pericardial mass, constrictive pericarditis, effusive-constrictive conditions, patients post cardiac surgery or suspected pericardial tamponade
  - Routine surveillance of known small pericardial effusions with no change in clinical status is not appropriate

Evaluation of cardiac masses or cardiac source of embolus

- Echocardiography is indicated in the diagnosis or exclusion of a cardiac source of embolus in a patient who has had or appears to have had a systemic embolic event (although transesophageal echocardiography (TEE) is often preferable in this situation)
- Echocardiography is indicated in the pre- and post-treatment evaluation of cardiac masses (tumor or thrombus)
  - Annual echocardiographic evaluation is usually sufficient in clinically stable patients with cardiac masses (tumors or thrombus) but more frequent testing may be appropriate in some situations (e.g. in longitudinal follow-up of enlarging masses or in follow-up of recently diagnosed masses until stability is established)
CPT Codes

75572. Computed tomography, heart, with contrast material, for evaluation of cardiac structure and morphology (including 3-D image post-processing, assessment of cardiac function, and evaluation of venous structures if performed)

75573. Computed tomography, heart, with contrast material, for evaluation of cardiac structure and morphology in the setting of congenital heart disease (including 3-D post-processing, assessment of left ventricular cardiac function, right ventricular structure and function and evaluation of venous structures, if performed)

Standard Anatomic Coverage

- Heart and great vessels within the thorax

Imaging Considerations

Advantages of Cardiac CT:
- Rapidly acquired exams, with excellent anatomic detail afforded by most multi-detector CT scanners with 16 or more active detector rows

Disadvantages of Cardiac CT include:
- Potential complications from use of intravascular iodinated contrast administration (see biosafety issues, below)
- Exposure to ionizing radiation
- Potential factors that may limit the image quality during acquisition of Cardiac CT such as:
  - Uncontrolled atrial or ventricular arrhythmias
  - Inability to image at a desired heart rate, which may occur despite beta blocker administration
  - Inability of the patient to comply with the requirements of scanning (patient motion during image acquisition, inability to comply with breath hold requirements, inability to lie supine, claustrophobia)
  - Not a suitable imaging modality for morbidly obese patients (BMI > 40)
  - Because of the radiation exposure issues careful consideration should be given to other imaging modalities in pregnant women and children

Biosafety Issues:
- Ordering and imaging providers are responsible for considering safety issues prior to the cardiac CT exam. One of the most significant considerations is the requirement for intravascular iodinated contrast material, which may have an adverse effect on patients with a history of documented allergic contrast reactions or atopy, as well as on individuals with renal impairment, who are at greater risk for contrast-induced nephropathy. In addition, radiation safety issues including cumulative exposure to ionizing radiation should be considered

Ordering Issues:
- This guideline does not apply to coronary CT angiography (CPT 75574)
- This guideline does not apply to Cardiac CT for quantitation of coronary artery calcification (CPT 75571)
- Selection of the optimal diagnostic work-up for cardiac evaluation should be made within the context of other available studies (which include transthoracic and transesophageal echocardiography and cardiac MRI), so that the resulting information facilitates patient management decisions and does not merely add a new layer of testing
- There are uncommon circumstances when both Cardiac CT and Cardiac MRI should be ordered for the same clinical presentation. The specific rationale must be delineated at the time of request
- In general, follow-up Cardiac CT exams should be performed only when there is a clinical change, with new signs or symptoms, or specific finding(s) requiring imaging surveillance
### Common Diagnostic Indications

The following diagnostic indications for cardiac CT are accompanied by pre-test considerations as well as supporting clinical data and prerequisite information.

#### Congenital heart disease
- For evaluation of suspected or established congenital heart disease in patients whose echocardiogram is technically limited or non-diagnostic; OR
- For further evaluation of patients whose echocardiogram suggests a new diagnosis of complex congenital heart disease; OR
- For evaluation of complex congenital heart disease in patients who are less than one year post surgical correction; OR
- For evaluation of complex congenital heart disease in patients who have new or worsening symptoms and/or a change in physical examination; OR
- To assist in surgical planning for patients with complex congenital heart disease; OR
- For evaluation of complex congenital heart disease in patients who have not had cardiac MRI or cardiac CT within the preceding year
  - Cardiac MRI or transesophageal echocardiography may be preferable to cardiac CT in order to avoid radiation exposure

#### Cardiomyopathy
- Evaluation of patients with suspected arrhythmogenic right ventricular dysplasia; OR
- To assess LV function in patients with suspected or established cardiomyopathy when all other non-invasive imaging is not feasible or technically suboptimal
  - Other modalities providing non-invasive evaluation of LV function include transthoracic and transesophageal echocardiography, blood pool imaging (MUGA or First pass) and cardiac MRI; OR
- To assess RV function in patients with suspected RV dysfunction when all other non-invasive imaging is not feasible or technically suboptimal
  - Other modalities providing non-invasive evaluation of RV function include transthoracic and transesophageal echocardiography, blood pool imaging (MUGA or First pass) and cardiac MRI

#### Valvular heart disease
- Evaluation of suspected dysfunction of native or prosthetic cardiac valves when all other cardiac imaging options are not feasible or technically suboptimal
  - Other modalities providing non-invasive evaluation of native or prosthetic valves include transthoracic and transesophageal echocardiography, and cardiac MRI
- Evaluation of established dysfunction of native or prosthetic cardiac valves when all other cardiac imaging options are not feasible or technically suboptimal
  - Other modalities providing non-invasive evaluation of native or prosthetic valves include transthoracic and transesophageal echocardiography, and cardiac MRI

#### Evaluation of patients with established coronary artery disease
- Non-invasive localization of coronary bypass grafts or potential grafts (including internal mammary artery) and/or evaluation of retrosternal anatomy in patients undergoing repeat surgical revascularization
Common Diagnostic Indications

Intra-cardiac and para-cardiac masses and tumors
- In patients with a suspected cardiac or para-cardiac mass (thrombus, tumor, etc.) suggested by transthoracic echocardiography, transesophageal echocardiography, blood pool imaging or contrast ventriculography who have not undergone cardiac CT or cardiac MRI within the preceding 60 days; OR
- In patients with established cardiac or para-cardiac mass (thrombus, tumor, etc.) who are clinically unstable; OR
- In patients with established cardiac or para-cardiac mass (thrombus, tumor, etc.) who are clinically stable and have not undergone cardiac CT or cardiac MRI within the preceding year; OR
- In patients with established cardiac or para-cardiac mass (thrombus, tumor, etc.) who have undergone treatment (chemotherapy, radiation therapy, thrombolysis, antiocoagulation or surgery) within the preceding year and have not had cardiac CT or cardiac MRI within the preceding 60 days

Cardiac aneurysm and pseudoaneurysm

Evaluation of pericardial conditions (pericardial effusion, constrictive pericarditis, or congenital pericardial diseases)
- In patients with suspected pericardial constriction; OR
- In patients with suspected congenital pericardial disease; OR
- In patients with suspected pericardial effusion who have undergone echocardiography deemed to be technically suboptimal in evaluation of the effusion; OR
- In patients whose echocardiogram shows a complex pericardial effusion (loculated, containing solid material)

Evaluation of cardiac venous anatomy
- For localization of the pulmonary veins in patients with chronic or paroxysmal atrial fibrillation/flutter who are being considered for radiofrequency ablation; OR
- Coronary venous localization prior to implantation of a biventricular pacemaker

Evaluation of the thoracic aorta
- In patients with suspected thoracic aortic aneurysm / dilation who have not undergone imaging of the thoracic aorta within the preceding 60 days; OR
- In patients with confirmed thoracic aortic aneurysm / dilation with new or worsening signs/symptoms; OR
- For ongoing surveillance of stable patients with confirmed thoracic aortic aneurysm / dilation who have not undergone imaging of the thoracic aorta within the preceding six months; OR
- In patients with suspected aortic dissection; OR
- In patients with confirmed aortic dissection who have new or worsening symptoms; OR
- In patients with confirmed aortic dissection in whom surgical repair is anticipated (to assist in pre-operative planning); OR
- For ongoing surveillance of stable patients with confirmed aortic dissection who have not undergone imaging of the thoracic aorta within the preceding year; OR
- In patients with confirmed aortic dissection or thoracic aortic aneurysm / dilation who have undergone surgical repair within the preceding year and have not undergone imaging of the thoracic aorta within the preceding six months; OR
- In patients who have sustained blunt chest trauma, penetrating aortic trauma or iatrogenic trauma as a result of aortic instrumentation; OR
- In patients being evaluated for potential transcatheter aortic valve implantation/replacement (TAVI or TAVR) provided that the patient has not undergone cardiac CT or cardiac MRI within the preceding 60 days
## CPT Codes

75574............ Computed tomographic angiography, heart, coronary arteries and bypass grafts (where present), with contrast material, including 3-D image post-processing (including evaluation of cardiac structure and morphology, assessment of cardiac function, and evaluation of venous structures, if performed)

## Standard Anatomic Coverage

- Cardiac and Coronary Artery Imaging: Coverage may vary, depending on the specific clinical indication as well as prior history of coronary artery bypass graft placement

## Imaging Considerations

### Advantages of CTA:

- Advantages of Coronary Artery CTA
  - Rapidly acquired exams, with excellent anatomic detail afforded by most multi-detector CT scanners with 16 or more active detector rows
  - CTA has a very high negative predictive value (93 to 100%)

### Disadvantages of CTA:

- Disadvantages of Coronary Artery CTA include:
  - Exposure to ionizing radiation (2-3 times higher than the average radiation dose administered to patients undergoing cardiac catheterization)
  - Potential complications from use of intravascular iodinated contrast administration (see biosafety issues, below)
  - Potential factors that may limit the image quality during a Cardiac CT/Coronary Artery CTA exam, such as:
    - Uncontrolled atrial or ventricular arrhythmias
    - Extensive coronary artery calcification which may produce artifact
    - Coronary stent evaluation for possible restenosis, as the stent material itself as well as the quality of the scan and scanner may produce artifacts, limiting the exam
    - Inability to image at a desired heart rate, which may occur despite beta blocker administration
    - Inability of the patient to comply with the requirements of scanning (patient motion during image acquisition, inability to comply with breath hold requirements, inability to lie supine, claustrophobia)
    - Not a suitable imaging modality for morbidly obese patients (BMI > 40)
    - Because of the radiation exposure issues careful consideration should be given to other imaging modalities in pregnant women and children
    - CCTA images the coronary arteries directly. Therefore the information provided is anatomical. The presence of coronary stenosis on CCTA (particularly if deemed to be of intermediate severity) does not establish that the lesion has flow limiting significance. Thus, following abnormal CCTA, functional testing may be required to assist in clinical decision-making

### Biosafety Issues:

- Ordering and imaging providers are responsible for considering safety issues prior to the CTA exam. One of the most significant considerations is the requirement for intravascular iodinated contrast material, which may have an adverse effect on patients with a history of documented allergic contrast reactions or atopy, as well as on individuals with renal impairment, who are at greater risk for contrast-induced nephropathy. In addition, radiation safety issues including cumulative exposure to ionizing radiation should be considered
Ordering Issues:

- CCTA exams are not covered by most healthcare insurers as a screening study, in the absence of signs, symptoms or known disease.
- Selection of the optimal diagnostic work-up for cardiac evaluation should be made within the context of other available studies (which include treadmill stress test, stress myocardial perfusion imaging, stress echocardiography, cardiac MRI, cardiac PET imaging and invasive cardiac/coronary angiography), so that the resulting information facilitates patient management decisions and does not merely add a new layer of testing.
- This guideline does not apply to Cardiac CT for quantitation of coronary artery calcification (CPT 75571).
- This guideline does not apply to Cardiac CT for evaluation of cardiac structure (CPT 75572-75573).

Several clinical indications listed for CCTA include standard methods of risk assessment, such as the SCORE (Systematic Coronary Risk Evaluation) or the Framingham risk score calculation. These risk calculation systems include consideration of the following factors:

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<td>Abnormal Lipid Profile</td>
<td>Hypertension</td>
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<td>Diabetes Mellitus</td>
<td>Cigarette Smoking</td>
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Common Diagnostic Indications

The following diagnostic indications for CCTA are accompanied by pre-test considerations as well as supporting clinical data and prerequisite information.

Congenital coronary artery anomalies

- For evaluation of suspected congenital anomalies of the coronary arteries.

Congestive heart failure / cardiomyopathy / left ventricular dysfunction

- For exclusion of coronary artery disease in patients with left ventricular ejection fraction <55% and low or moderate Coronary Heart Disease Risk (using standard methods of risk assessment, such as the SCORE risk calculation) in whom coronary artery disease has not been excluded as the etiology of the cardiomyopathy.
  - Patients with high Coronary Heart Disease Risk should undergo cardiac catheterization.

Evaluation of patients with suspected coronary artery disease including those with prior abnormal cardiac testing (MPI or stress echo)

- Patients with abnormal MPI or stress echo within the preceding 60 days suspected to be false positive on the basis of low Coronary Heart Disease Risk (using standard methods of risk assessment such as the SCORE risk calculation).
  - In the absence of a contraindication (excluding renal impairment and iodinated contrast agent hypersensitivity) patients with moderate or high Coronary Heart Disease Risk should be referred for coronary arteriography; OR
- Patients with equivocal MPI or stress echo within the preceding 60 days who have low or moderate Coronary Heart Disease Risk (using standard methods of risk assessment such as the SCORE risk calculation).
  - In the absence of a contraindication (excluding renal impairment and iodinated contrast agent hypersensitivity) patients with high Coronary Heart Disease Risk should be referred for coronary arteriography.
  - The resulting information from the CCTA should facilitate management decisions and not merely add a new layer of testing.
- Patients at moderate coronary heart disease risk (using standard methods of risk assessment, such as the SCORE risk calculation) being evaluated for non-coronary artery cardiac surgery (including valvular and ascending aortic surgery) to avoid an invasive angiogram, where all the necessary pre-operative information can be obtained using cardiac CT.
- For evaluation of suspected congenital anomalies of the coronary arteries.
CPT Codes

75571.................... Computed tomography, heart, without contrast material, with quantitative evaluation of coronary artery calcium

Standard Anatomic Coverage

- Coronary Artery Imaging

Imaging Considerations

Advantages of cardiac CT for quantitative evaluation of coronary artery calcification:
- Rapidly acquired exams
- Coronary artery calcification has been shown to correlate with the presence of atheromatous coronary artery disease

Disadvantages of cardiac CT for quantitative evaluation of coronary artery calcification:
- Exposure to ionizing radiation
- No role in the evaluation of patients with symptoms potentially due to coronary artery disease
- Not clear that risk stratification data provided by quantitative evaluation of coronary artery calcification impacts patient outcomes

Biosafety issues:
- Ordering and imaging providers are responsible for considering safety issues prior to performing quantitative evaluation of coronary artery calcification

Ordering issues:
- Cardiac CT for quantitative evaluation of coronary artery calcification is not covered by most healthcare insurers as a screening study
- Selection of the optimal diagnostic work-up for cardiac evaluation should be made within the context of other available studies (which include treadmill stress test, stress myocardial perfusion imaging, stress echocardiography, cardiac MRI, cardiac PET imaging and invasive cardiac/coronary angiography), so that the resulting information facilitates patient management decisions and does not merely add a new layer of testing
- This guideline pertains to cardiac CT for quantitative evaluation of coronary artery calcification using either Electron Beam CT (EBCT) or Multi-Detector CT (MDCT)
- This guideline does not apply to coronary CT angiography (CPT 75574)
- This guideline does not apply to cardiac CT for evaluation of cardiac structure and function (CPT 75572-75573)

Quantitative Evaluation of Coronary Artery Calcification

The use of cardiac CT for quantitative evaluation of coronary artery calcification has not been conclusively shown to impact patient outcomes and is therefore considered to be not medically necessary in all clinical situations
CPT Codes

75557 .................. Cardiac MRI for morphology and function, without contrast material
75559 .................. Cardiac MRI for morphology and function, without contrast material, with stress imaging
75561 .................. Cardiac MRI for morphology and function, without contrast material, followed by contrast material
75563 .................. Cardiac MRI for morphology and function, without contrast material, followed by contrast material with stress imaging
75565 .................. This code is an add-on code to be used in conjunction with 75557, 75559, 75561 and 75563. As such, this code does not require separate review

Coding Considerations

Only one procedure in the series 75557-75563 is appropriately reported per session. This code series is not to be used to report cardiac MRA (see unlisted code 76598).

Imaging Considerations

Patient Compatibility Issues:
- Gating Issues:
  - As with other cardiac imaging modalities, the acquisition of images is frequently gated to the electrocardiogram
  - Thus, in patients with irregular heart rhythms, image quality may be suboptimal

Biosafety Issues:
- Ordering and imaging providers are responsible for considering biosafety issues prior to MRI examination, to ensure patient safety. Among the generally recognized contraindications to MRI exam performance are permanent pacemakers (some newer models are MRI compatible) or implantable cardioverter-defibrillators (ICD), intracranial aneurysm surgical clips that are not compatible with MR imaging, as well as other devices considered unsafe in MRI scanners (including certain implanted materials in the patient as well as external equipment, such as portable oxygen tanks)
- Contrast utilization is at the discretion of the ordering and imaging providers

Ordering Issues:
- Selection of the optimal diagnostic work-up for cardiac evaluation should be made within the context of other available studies (which include treadmill stress test, stress myocardial perfusion imaging, stress echocardiography, cardiac MRI, cardiac PET imaging and invasive cardiac/coronary angiography), so that the resulting information facilitates patient management decisions and does not merely add a new layer of testing

Common Diagnostic Indications

The following diagnostic indications for cardiac MRI are accompanied by pre-test considerations as well as supporting clinical data and prerequisite information

Coronary artery disease

Patients who have had a myocardial infarction
- To assess viability of the infarcted myocardium utilizing delayed hyperenhancement (contrast studies) when other studies (myocardial perfusion imaging or stress echocardiography) have yielded equivocal or indeterminate results; OR
- To assess LV function post myocardial infarction when there is discordant information from other studies or when other studies are technically suboptimal; OR
- To assess mitral valve regurgitation post-myocardial infarction when echocardiography is technically suboptimal; OR
- To assess ventricular septal defects post-myocardial infarction when echocardiography is technically suboptimal; OR
- To delineate pericardial effusions associated with acute myocardial infarction when echocardiography is technically suboptimal

Patients with suspected coronary artery disease
- For evaluation of patients with suspected congenital coronary anomalies
Common Diagnostic Indications

**Myocarditis**
- For the evaluation of patients with suspected myocarditis; OR
- For follow-up evaluation LV function of patients with an established diagnosis of myocarditis whose transthoracic echocardiogram is technically suboptimal

**Cardiomyopathy**
- To assess LV function in patients with cardiomyopathy when there is discordant information from other studies or when other studies are technically suboptimal; OR
- Annual evaluation for suspected cardiomyopathy in clinically stable patients with an established diagnosis of a chronic and progressive disease (excluding CAD) which may result in cardiomyopathy when echocardiography fails to exclude cardiomyopathy. This guideline applies to infiltrative cardiomyopathies (e.g. sarcoidosis; amyloidosis; hemochromatosis), hypertrophic obstructive cardiomyopathy (HOCM) and non-compaction cardiomyopathy; OR
- Reevaluation of clinically stable patients with cardiomyopathy at yearly intervals when echocardiography is technically suboptimal; OR
- Evaluation of patients with suspected arrhythmogenic right ventricular dysplasia; OR
- For coronary vein mapping in patients with cardiomyopathy for whom cardiac resynchronization therapy (CRT) is planned

**Cardiac aneurysm or pseudoaneurysm**

**Congenital heart disease**
- For evaluation of suspected congenital anomalies of the coronary arteries; OR
- For evaluation of suspected or established congenital heart disease in patients whose echocardiogram is technically limited or nondiagnostic; OR
- For further evaluation of patients whose echocardiogram suggests a new diagnosis of complex congenital heart disease; OR
- For evaluation of complex congenital heart disease in patients who are less than one year post surgical correction; OR
- For evaluation of complex congenital heart disease in patients who have new or worsening symptoms and/or a change in physical examination; OR
- To assist in surgical planning for patients with complex congenital heart disease; OR
- For surveillance in asymptomatic patients with complex congenital heart disease in patients who have not had cardiac MRI or cardiac CT within the preceding year

**Valvular heart disease**
- Following inconclusive echocardiography or when echocardiography is not feasible; OR
- When moderate or severe valvular disease diagnosed using other imaging modalities requires further definition and that information is likely to affect subsequent management of the patient
  - To assess valvular lesions and measure regurgitant volume, regurgitant fraction, ejection fraction and ventricular volumes
  - To help determine the timing for valvular surgery
Common Diagnostic Indications

Intra-cardiac and para-cardiac masses and tumors

- In patients with a suspected cardiac or para-cardiac mass (thrombus, tumor, etc.) suggested by transthoracic echocardiography, transesophageal echocardiography, blood pool imaging or contrast ventriculography who have not undergone cardiac MRI or cardiac CT within the preceding 60 days; OR
- In patients with established cardiac or para-cardiac mass (thrombus, tumor, etc.) who are clinically unstable; OR
- In patients with established cardiac or para-cardiac mass (thrombus, tumor, etc.) who are clinically stable and have not undergone cardiac MRI or cardiac CT within the preceding year; OR
- In patients with established cardiac or para-cardiac mass (thrombus, tumor, etc.) who have undergone treatment (chemotherapy, radiation therapy, thrombolysis, anticoagulation or surgery) within the preceding year and have not had cardiac MRI or cardiac CT within the preceding 60 days

Evaluation of cardiac venous anatomy

- For localization of the pulmonary veins in patients with chronic or paroxysmal atrial fibrillation/flutter who are being considered for radiofrequency ablation; OR
- Coronary venous localization prior to implantation of a biventricular pacemaker

Evaluation of pericardial conditions (pericardial effusion, constrictive pericarditis, or congenital pericardial diseases)

- In patients with suspected pericardial constriction; OR
- In patients with suspected congenital pericardial disease; OR
- In patients with suspected pericardial effusion (including hemopericardium) who have undergone echocardiography deemed to be technically suboptimal in evaluation of the effusion; OR
- In patients whose echocardiogram shows a complex pericardial effusion (loculated, containing solid material)

Evaluation of the thoracic aorta

- In patients with suspected thoracic aortic aneurysm / dilation who have not undergone imaging of the thoracic aorta within the preceding 60 days; OR
- In patients with confirmed thoracic aortic aneurysm / dilation with new or worsening signs/symptoms; OR
- For ongoing surveillance of stable patients with confirmed thoracic aortic aneurysm / dilation who have not undergone imaging of the thoracic aorta within the preceding six months; OR
- In patients with suspected aortic dissection; OR
- In patients with confirmed aortic dissection who have new or worsening symptoms; OR
- In patients with confirmed aortic dissection in whom surgical repair is anticipated (to assist in pre-operative planning); OR
- For ongoing surveillance of stable patients with confirmed aortic dissection who have not undergone imaging of the thoracic aorta within the preceding year; OR
- In patients with confirmed aortic dissection or thoracic aortic aneurysm / dilation who have undergone surgical repair within the preceding year and have not undergone imaging of the thoracic aorta within the preceding six months; OR
- In patients who have sustained blunt chest trauma, penetrating aortic trauma or iatrogenic trauma as a result of aortic instrumentation; OR
- In patients being evaluated for potential transcatheter aortic valve implantation/replacement (TAVI or TAVR) provided that the patient has not undergone cardiac CT or cardiac MRI within the preceding 60 days

References

Positron Emission Tomography (PET) Myocardial Imaging

CPT Codes

- 78491 .................. PET myocardial perfusion, single study
- 78492 .................. PET myocardial perfusion, multiple studies
- 78459 .................. PET myocardial, metabolic evaluation

Commonly Used Radiopharmaceuticals

- Ammonia (13NH3)
- Rubidium Chloride (82 RbCl)
- 2-(18F) FLURO-2DEOXY-D-GLUCOSE (FDG)

Imaging Considerations

- Perfusion PET imaging, using ammonia or rubidium isotopes, is used to differentiate areas of myocardium with normal coronary blood flow from those with abnormal coronary blood flow
- Rest and or stress perfusion PET imaging can be performed
- Metabolic evaluation (to determine myocardial viability) is performed using PET flurodeoxyglucose (FDG) imaging. Metabolic PET imaging has been shown to be useful in selection of patients who are likely to benefit from revascularization
- Perfusion PET imaging and metabolic PET imaging may occasionally be appropriate in the evaluation of myocardial pathologic processes other than coronary artery disease
- Isotopes used in PET imaging require special handling arrangements because of their short half-lives
- While rubidium may be produced in a commercially available on-site generator, ammonia requires cyclotron production
- Selection of the optimal diagnostic imaging for cardiac evaluation should be made within the context of other available modalities (which include treadmill stress test, stress myocardial perfusion imaging, stress echocardiography, cardiac CT, cardiac MRI and invasive cardiac/coronary angiography), so that the resulting information facilitates patient management decisions and does not merely add a new layer of testing

Requirements for Myocardial PET Imaging

- Perfusion PET imaging is generally (exceptions noted below) to be considered only when a patient has undergone recent nuclear stress testing or stress echocardiography with equivocal results
- When non-invasive imaging is required in morbidly obese patients (BMI > 40), with suspected or established CAD, perfusion PET imaging may be considered as the initial test (because of a higher likelihood of technically suboptimal image quality on nuclear stress testing and stress echocardiography in this patient subgroup)
- Perfusion PET myocardial imaging is not appropriate for screening for coronary artery disease in asymptomatic low risk patients regardless of age or body habitus
- PET metabolic imaging is used in patients with established coronary artery disease and left ventricular systolic dysfunction when determination of myocardial viability will influence the decision regarding revascularization
- PET metabolic imaging of the myocardium provides clinically useful information only when the myocardium is deemed to be nonviable using other imaging modalities (perfusion imaging using thallium / technetium isotopes or echocardiography) or when such imaging modalities are inconclusive regarding the viability status of the myocardium
Common Diagnostic Indications
The following diagnostic indications for cardiac PET are accompanied by pre-test considerations as well as supporting clinical data and prerequisite information.

Perfusion PET imaging – for patients who have BMI greater than 40
- Evaluation of symptoms consistent with myocardial ischemia to diagnose or exclude coronary artery disease; OR
- Established coronary artery disease with recurrent atypical symptoms
  - Coronary arteriography should be considered in patients with established CAD and typical symptoms; OR
- Evaluation of regional myocardial blood flow in patients with multiple vessel coronary artery disease with a view to identifying a culprit lesion for revascularization; OR
- Evaluation of asymptomatic patients who by virtue of risk factor status are at high risk of coronary artery disease (SCORE) and who have not undergone cardiac PET or cardiac catheterization within the past three (3) years; OR
- Evaluation of asymptomatic patients with established CAD who have not undergone cardiac PET or cardiac catheterization within the past three (3) years

Perfusion PET imaging – for patients who have BMI less than 40
- Further evaluation of patients who have had an equivocal nuclear stress test (MPI) or stress echo within the past 60 days

Metabolic PET imaging for evaluation of myocardial viability – when all four of the following conditions are met:
- The patient has established coronary artery disease; AND
- Left ventricular systolic dysfunction; AND
- Viability status is not defined by other testing; AND
- Revascularization is being considered

Metabolic PET imaging for evaluation of non-coronary cardiac diseases
- Metabolic PET imaging may be used in the diagnosis or management of cardiac sarcoidosis


