Instructions for use

The following coverage policy applies to health benefit plans administered by Cigna. Coverage policies are intended to provide guidance in interpreting certain standard Cigna benefit plans and are used by medical directors and other health care professionals in making medical necessity and other coverage determinations. Please note the terms of a customer’s particular benefit plan document may differ significantly from the standard benefit plans upon which these coverage policies are based. For example, a customer’s benefit plan document may contain a specific exclusion related to a topic addressed in a coverage policy.

In the event of a conflict, a customer’s benefit plan document always supersedes the information in the coverage policy. In the absence of federal or state coverage mandates, benefits are ultimately determined by the terms of the applicable benefit plan document. Coverage determinations in each specific instance require consideration of:

1. The terms of the applicable benefit plan document in effect on the date of service
2. Any applicable laws and regulations
3. Any relevant collateral source materials including coverage policies
4. The specific facts of the particular situation

Coverage policies relate exclusively to the administration of health benefit plans. Coverage policies are not recommendations for treatment and should never be used as treatment guidelines.

This evidence-based medical coverage policy has been developed by eviCore, Inc. Some information in this coverage policy may not apply to all benefit plans administered by Cigna.

These guidelines include procedures eviCore does not review for Cigna. Please refer to the Cigna CPT code list for the current list of high-tech imaging procedures that eviCore reviews for Cigna.

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Cardiac Imaging Guidelines

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<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>ACC</td>
<td>American College of Cardiology</td>
</tr>
<tr>
<td>ACS</td>
<td>acute coronary syndrome</td>
</tr>
<tr>
<td>AHA</td>
<td>American Heart Association</td>
</tr>
<tr>
<td>ASCOT</td>
<td>Anglo-Scandinavian Cardiac Outcomes Trial</td>
</tr>
<tr>
<td>ASD</td>
<td>atrial septal defect</td>
</tr>
<tr>
<td>BMI</td>
<td>body mass index</td>
</tr>
<tr>
<td>CABG</td>
<td>coronary artery bypass grafting</td>
</tr>
<tr>
<td>CAD</td>
<td>coronary artery disease</td>
</tr>
<tr>
<td>CHF</td>
<td>congestive heart failure</td>
</tr>
<tr>
<td>COPD</td>
<td>chronic obstructive pulmonary disease</td>
</tr>
<tr>
<td>CT</td>
<td>computed tomography</td>
</tr>
<tr>
<td>CCTA</td>
<td>coronary computed tomography angiography</td>
</tr>
<tr>
<td>CTA</td>
<td>computed tomography angiography</td>
</tr>
<tr>
<td>EBCT</td>
<td>electron beam computed tomography</td>
</tr>
<tr>
<td>ECP</td>
<td>external counterpulsation (also known as EECP)</td>
</tr>
<tr>
<td>ECG</td>
<td>electrocardiogram</td>
</tr>
<tr>
<td>ECP</td>
<td>external counterpulsation</td>
</tr>
<tr>
<td>ETT</td>
<td>exercise treadmill stress test</td>
</tr>
<tr>
<td>FDG</td>
<td>Fluorodeoxyglucose, a radiopharmaceutical used to measure myocardial metabolism</td>
</tr>
<tr>
<td>HCM</td>
<td>hypertrophic cardiomyopathy</td>
</tr>
<tr>
<td>IV</td>
<td>intravenous</td>
</tr>
<tr>
<td>LAD</td>
<td>left anterior descending coronary artery</td>
</tr>
<tr>
<td>LDL-C</td>
<td>low density lipoprotein cholesterol</td>
</tr>
<tr>
<td>LHC</td>
<td>left heart catheterization</td>
</tr>
<tr>
<td>LV</td>
<td>left ventricle</td>
</tr>
<tr>
<td>LVEF</td>
<td>left ventricular ejection fraction</td>
</tr>
<tr>
<td>MI</td>
<td>myocardial infarction</td>
</tr>
<tr>
<td>MPI</td>
<td>myocardial perfusion imaging (SPECT study, nuclear cardiac study)</td>
</tr>
<tr>
<td>MRA</td>
<td>magnetic resonance angiography</td>
</tr>
<tr>
<td>MRI</td>
<td>magnetic resonance imaging</td>
</tr>
<tr>
<td>mSv</td>
<td>millisievert (a unit of radiation exposure) equal to an effective dose of a joule of energy per kilogram of recipient mass</td>
</tr>
<tr>
<td>MUGA</td>
<td>multi gated acquisition scan of the cardiac blood pool</td>
</tr>
<tr>
<td>PCI</td>
<td>percutaneous coronary intervention (includes percutaneous coronary angioplasty (PTCA) and coronary artery stenting)</td>
</tr>
<tr>
<td>PET</td>
<td>positron emission tomography</td>
</tr>
<tr>
<td>PTCA</td>
<td>percutaneous coronary angioplasty</td>
</tr>
<tr>
<td>RHC</td>
<td>right heart catheterization</td>
</tr>
<tr>
<td>SPECT</td>
<td>single photon emission computed tomography</td>
</tr>
<tr>
<td>TEE</td>
<td>transesophageal echocardiogram</td>
</tr>
<tr>
<td>TIA</td>
<td>Transient Ischemic Attack</td>
</tr>
<tr>
<td>VSD</td>
<td>ventricular septal defect</td>
</tr>
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</table>
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agatston Score:</strong></td>
<td>a nationally recognized calcium score for the coronary arteries based on Hounsfield units and size (area) of the coronary calcium</td>
</tr>
<tr>
<td><strong>Angina:</strong></td>
<td>principally chest discomfort, exertional (or with emotional stress) and relieved by rest or nitroglycerine</td>
</tr>
<tr>
<td><strong>Anginal variants or equivalents:</strong></td>
<td>a manifestation of myocardial ischemia which is perceived by individuals to be (otherwise unexplained) dyspnea, unusual fatigue, more often seen in women and may be unassociated with chest pain</td>
</tr>
<tr>
<td><strong>ARVD/ARVC – Arrhythmogenic Right Ventricular Dysplasia/Cardiomyopathy:</strong></td>
<td>a potentially lethal inherited disease with syncope and rhythm disturbances, including sudden death, as presenting manifestations</td>
</tr>
<tr>
<td><strong>BNP:</strong></td>
<td>B-type natriuretic peptide, blood test used to diagnose and track heart failure (n-T-pro-BNP is a variant of this test)</td>
</tr>
<tr>
<td><strong>Brugada Syndrome:</strong></td>
<td>an electrocardiographic pattern that is unique and might be a marker for significant life threatening dysrhythmias</td>
</tr>
<tr>
<td><strong>Double Product</strong> (Rate Pressure Product):</td>
<td>an index of cardiac oxygen consumption, is the systolic blood pressure times heart rate, generally calculated at peak exercise; over 25000 means an adequate stress load was performed</td>
</tr>
<tr>
<td><strong>Fabry’s Disease:</strong></td>
<td>an infiltrative cardiomyopathy, can cause heart failure and arrhythmias</td>
</tr>
<tr>
<td><strong>Hibernating myocardium:</strong></td>
<td>viable but poorly functioning or non-functioning myocardium which likely could benefit from intervention to improve myocardial blood supply</td>
</tr>
<tr>
<td><strong>Optimized Medical Therapy</strong></td>
<td>should include (where tolerated): antiplatelet agents, calcium channel antagonists, partial fatty acid oxidase inhibitors (e.g. ranolazine), statins, short-acting nitrates as needed, long-acting nitrates up to 6 months after an acute coronary syndrome episode, beta blocker drugs (optional), angiotensin-converting enzyme (ACE) inhibitors/angiotensin receptor blocking (ARB) agents (optional)</td>
</tr>
<tr>
<td><strong>Platypnea:</strong></td>
<td>shortness of breath when upright or seated (the opposite of orthopnea) and can indicate cardiac malformations, shunt or tumor</td>
</tr>
<tr>
<td><strong>Silent ischemia:</strong></td>
<td>cardiac ischemia discovered by testing only and not presenting as a syndrome or symptoms</td>
</tr>
<tr>
<td><strong>Syncope:</strong></td>
<td>loss of consciousness; near-syncope is not syncope</td>
</tr>
<tr>
<td><strong>Takotsubo cardiomyopathy:</strong></td>
<td>apical dyskinesis oftentimes associated with extreme stress and usually thought to be reversible</td>
</tr>
<tr>
<td><strong>Troponin:</strong></td>
<td>a marker for ischemic injury, primarily cardiac</td>
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### CD-1: General Guidelines

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<th>Title</th>
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<td>CD-1.8</td>
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<td>CD-1.9</td>
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Practice Estimate of Effective Radiation Dose chart for Selected Imaging Studies

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<th>IMAGING STUDY</th>
<th>Estimate of Effective Radiation Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sestamibi myocardial perfusion study (MPI)</td>
<td>9-12 mSv</td>
</tr>
<tr>
<td>PET myocardial perfusion study:</td>
<td>3 mSv</td>
</tr>
<tr>
<td>Rubidium-82 NH3</td>
<td>2 mSv</td>
</tr>
<tr>
<td>Thallium myocardial perfusion study (MPI)</td>
<td>22-31 mSv</td>
</tr>
<tr>
<td>Diagnostic conventional coronary angiogram (cath)</td>
<td>5-10 mSv</td>
</tr>
<tr>
<td>Computed tomography coronary angiography (CTCA)</td>
<td>5-15 mSv</td>
</tr>
<tr>
<td>(with prospective gating)</td>
<td>Less than 5 mSv</td>
</tr>
<tr>
<td>CT Abdomen and Pelvis</td>
<td>8-14 mSv</td>
</tr>
<tr>
<td>Chest x-ray</td>
<td>&lt;0.1 mSv</td>
</tr>
</tbody>
</table>

CD-1.1: General Issues – Cardiac

- Cardiac imaging is not indicated if the results will not affect individual management decisions. If a decision to perform cardiac catheterization or other angiography has already been made, there is often no need for imaging stress testing.
- A current clinical evaluation (within 60 days) is required prior to considering advanced imaging, which includes:
  - Relevant history and physical examination and appropriate laboratory studies and non-advanced imaging modalities, such as recent ECG (within 60 days), chest x-ray or ECHO/ultrasound, after symptoms started or worsened.
  - Effort should be made to obtain copies of reported “abnormal” ECG studies in order to determine whether the ECG is uninterpretable for ischemia on ETT.
  - Most recent previous stress testing and its findings should be obtained.
  - Other meaningful contact (telephone call, electronic mail or messaging) by an established individual can substitute for a face-to-face clinical evaluation.
  - Vital signs, height and weight or BMI or description of general habitus is needed.
  - Advanced imaging should answer a clinical question which will affect management of the individual’s clinical condition.
  - Assessment of ischemic symptoms can be determined by the following:
    - Typical angina (definite):
      - Angina pectoris is classified as typical when ALL of the following are present:
        - Substernal chest discomfort (generally described as pressure, heaviness, burning, or tightness)
        - Brought on by exertion or emotional stress
        - Relieved by rest or nitroglycerin
      - May radiate to the left arm or jaw
      - When clinical information is received indicating that an individual is experiencing chest pain that is "exertional" or "due to emotional stress" and relieved with rest, this meets the typical angina definition under the
Pre-Test Probability Grid. No further description of the chest pain is required (location within the chest is not required).
- The Pre-Test Probability Grid (Table 1) is based on age, gender, and symptoms. All factors must be considered in order to approve for stress testing with imaging using the Pre-Test Probability Grid.
- **Atypical angina (probable):** Chest pain or discomfort (arm or jaw pain) that lacks one of the characteristics of definite or typical angina.
- **Non-anginal chest pain:** Chest pain or discomfort that meets one or none of the typical angina characteristics.
- **Anginal equivalents:** Symptoms consistent with individual’s known angina pattern in an individual with a history of CABG or PCI.

### Table 1

<table>
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<tr>
<th>Pre-Test Probability of CAD by Age, Gender, and Symptoms</th>
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<tr>
<td><strong>Age (years)</strong></td>
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<tr>
<td>-----------------</td>
</tr>
<tr>
<td><strong>39 and younger</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>40 - 49</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>50 - 59</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>60 and over</strong></td>
</tr>
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<td></td>
</tr>
</tbody>
</table>

**High**
Greater than 90% pre-test probability

**Intermediate**
Between 10% and 90% pre-test probability

**Low**
Between 5% and 10% pre-test probability

**Very Low**
Less than 5% pre-test probability
CD-1.2: Stress Testing without Imaging – Procedures

The Exercise Treadmill Test (ETT) is without imaging.

- Necessary components of an ETT include:
  - ECG that can be interpreted for ischemia.
  - Individual capable of exercise on a treadmill or similar device (generally at 4 METs or greater; See functional capacity below).

- An abnormal ETT (exercise treadmill test) includes any ONE of the following:
  - ST segment depression (usually described as horizontal or downsloping, greater or equal to 1.0 mm below baseline)
  - Development of chest pain
  - Significant arrhythmia (especially ventricular arrhythmia)
  - Hypotension during exercise

- Functional capacity greater than or equal to 4 METs equates to the following:
  - Can walk four blocks without stopping
  - Can walk up a hill
  - Can climb one flights of stairs without stopping
  - Can perform heavy work around the house

Background and Supporting Information
An observational study found that, compared with the Duke Activity Status Index, subjective assessment by clinicians generally underestimated exercise capacity (See reference 25).

CD-1.3: Stress Testing with Imaging – Procedures

- Imaging Stress Tests include any ONE of the following:
  - Stress Echocardiography See CD-2.6: Stress Echocardiography (Stress Echo) – Coding
  - MPI See CD-3.1: Myocardial Perfusion Imaging (MPI) – Coding
  - Stress perfusion MRI See CD-5.3: Cardiac MRI – Indications for Stress MRI

- Stress testing with imaging can be performed with maximal exercise or chemical stress (adenosine, dipyridamole, dobutamine, or regadenoson) and does not alter the CPT® codes used to report these studies.

CD-1.4: Stress Testing with Imaging – Indications

- Stress echo, MPI or stress MRI if there are new, recurrent, or worsening cardiac symptoms and ANY of the following:
  - High pretest probability (greater than 90% probability of CAD) per Table 1
  - A history of CAD based on:
    - A prior anatomic evaluation of the coronaries OR
    - A history of CABG or PCI
  - Evidence or high suspicion of ventricular tachycardia
  - Age 40 years or greater and known diabetes mellitus
- Coronary calcium score ≥100
- Poorly controlled hypertension defined as systolic BP greater than or equal to 180mmhg, if provider feels strongly that CAD needs evaluation prior to BP being controlled.
- ECG is uninterpretable for ischemia due to any ONE of the following:
  - Complete Left Bundle Branch Block (bifasicular block involving right bundle branch and left anterior hemiblock does not render ECG uninterpretable for ischemia)
  - Ventricular paced rhythm
  - Pre-excitation pattern such as Wolff-Parkinson-White
  - Greater or equal to 1.0 mm ST segment depression (NOT nonspecific ST/T wave changes)
  - LVH with repolarization abnormalities, also called LVH with strain (NOT without repolarization abnormalities or by voltage criteria)
  - T wave inversion in the inferior and/or lateral leads. This includes leads II, AVF, V5 or V6. (T wave inversion isolated in lead III or T wave inversion in lead V1 and V2 are not included).
  - Individual on digitalis preparation
- Continuing symptoms in an individual who had a normal or submaximal exercise treadmill test and there is suspicion of a false negative result.
- Individuals with recent equivocal, borderline, or abnormal stress testing where ischemia remains a concern, regardless of symptoms.
- Heart rate less than 50 bpm in individuals, including those on beta blocker, calcium channel blocker, or amiodarone where it is felt that the individual may not achieve an adequate workload for a diagnostic exercise study.
- Inadequate ETT:
  - Physical inability to achieve target heart rate (85% MHR or 220-age. Target heart rate is calculated as 85% of the maximum age predicted heart rate (MHR). MHR is estimated as 220 minus the individual's age).
  - History of false positive exercise treadmill test: a false positive ETT is one that is abnormal however the abnormality does not appear to be due to macrovascular CAD.
- Stress echo, MPI or stress MRI, can be considered regardless of symptoms for ANY of the following:
  - One MPI can be performed within 3 months of an acute coronary syndrome (e.g. ST segment elevation MI [STEMI], unstable angina, non-ST segment elevation MI [NSTEMI]), to evaluate for inducible ischemia if all of the following related to the most recent acute coronary event apply:
    - Individual is hemodynamically stable
    - No recurrent chest pain symptoms and no signs of heart failure
    - No prior coronary angiography or imaging stress test since the current episode of symptoms
  - Assessing myocardial viability in individuals with significant ischemic ventricular dysfunction (suspected hibernating myocardium) and persistent symptoms or heart failure such that revascularization would be considered.
MRI, cardiac PET, MPI, or Dobutamine stress echo can be used to assess myocardial viability depending on physician preference.

PET and MPI perfusion studies are usually accompanied by PET metabolic examinations (CPT® 78459). TI-201 MPI perfusion studies may assess viability without accompanying PET metabolism information.

Unheralded syncope (not near syncope)

Asymptomatic individual with an uninterpretable ECG that:
- Has never been evaluated or
- Is a new uninterpretable change.

Individual with an elevated cardiac troponin.

One routine study 2 years or more after a stent
- Except with a left main stent where it can be done at 1 year.

One routine study at 5 years or more after CABG, without cardiac symptoms.

Every 2 years if there was documentation of previous “silent ischemia” on the imaging portion of a stress test but not on the ECG portion.

To assess for CAD prior to starting a Class IC antiarrhythmic agent (flecainide or propafenone) and annually while taking the medication.

Prior anatomic imaging study (coronary angiogram or CCTA) demonstrating coronary stenosis in a major coronary branch, which is of uncertain functional significance, can have one stress test with imaging.

Evaluating new, recurrent, or worsening left ventricular dysfunction/CHF See CD-9.1: CHF– Imaging for additional indications.

CD-1.5: Stress Testing with Imaging – Preoperative

There are 2 steps that determine the need for imaging stress testing in (stable) preoperative individuals:

- Would the individual qualify for imaging stress testing independent of planned surgery?
  - If yes, proceed to stress testing guidelines;
  - If no, go to step 2

- Is the surgery considered high, moderate or low risk? (See Table 2) If high or moderate-risk, proceed below. If low-risk, there is no evidence to determine a need for preoperative cardiac testing.

  - **High Risk Surgery**: All individuals in this category should receive an imaging stress test if there has not been an imaging stress test within 1 year*, unless the individual has developed new cardiac symptoms or a new change in the EKG since the last stress test.

  - **Intermediate Surgery**: One or more risk factors and unable to perform an ETT per guidelines if there has not been an imaging stress test within 1 year* unless the individual has developed new cardiac symptoms or a new change in the EKG since the last stress test.

  - **Low Risk**: Preoperative imaging stress testing is not supported.

Clinical Risk Factors (for cardiac death & non-fatal MI at time of non-cardiac surgery)
- Planned high risk surgery (open surgery on the aorta or open peripheral vascular surgery)
- History of ischemic heart disease (previous MI, previous positive stress test, use of nitroglycerin, typical angina, ECG Q waves, previous PCI or CABG)
- History of compensated previous congestive heart failure (history of heart failure, previous pulmonary edema, third heart sound, bilateral rales, chest x-ray showing heart failure)
- History of previous TIA or stroke
- Diabetes Mellitus
- Creatinine level >2 mg/dL

*Time interval is based on consensus of eviCore executive cardiology panel.

### Table 2

<table>
<thead>
<tr>
<th>Cardiac Risk Stratification List</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Risk (&gt;5%)</strong></td>
</tr>
<tr>
<td>Open aortic and other major open vascular surgery</td>
</tr>
<tr>
<td>Open peripheral vascular surgery</td>
</tr>
<tr>
<td><strong>Intermediate Risk (1-5%)</strong></td>
</tr>
<tr>
<td>Open intraperitoneal and/or intrathoracic surgery</td>
</tr>
<tr>
<td>Open carotid endarterectomy</td>
</tr>
<tr>
<td>Head and neck surgery</td>
</tr>
<tr>
<td>Open orthopedic surgery</td>
</tr>
<tr>
<td>Open prostate surgery</td>
</tr>
<tr>
<td><strong>Low Risk (&lt;1%)</strong></td>
</tr>
<tr>
<td>Endoscopic procedures</td>
</tr>
<tr>
<td>Superficial procedures</td>
</tr>
<tr>
<td>Cataract surgery</td>
</tr>
<tr>
<td>Breast surgery</td>
</tr>
<tr>
<td>Ambulatory surgery</td>
</tr>
<tr>
<td>Laparoscopic and endovascular procedures that are unlikely to require further extensive surgical intervention</td>
</tr>
</tbody>
</table>

### CD-1.6: Transplant Individuals

- Stress Testing in individuals for Non-Cardiac Transplant
  - Individuals who are candidates for any type of organ bone marrow or stem cell transplant can undergo imaging stress testing every year (usually stress echo or MPI) prior to transplant.
  - Individuals who have undergone organ transplant are at increased risk for ischemic heart disease secondary to their medication. Risk of vasculopathy is 7% at one year, 32% at five years and 53% at ten years. An imaging stress test can be repeated annually after transplant for at least two years or within one year of a prior cardiac imaging study if there is evidence of progressive vasculopathy.
  - After two consecutive normal imaging stress tests, repeated testing is not supported more often than every other year without evidence for progressive vasculopathy or new symptoms.
  - Stress testing after five years may proceed according to normal patterns of consideration.

- Post-Cardiac transplant assessment of transplant CAD:
  - ONE of the following imaging studies may be performed annually:
    - MPI
    - Stress ECHO
- Stress MRI
- Cardiac PET perfusion (CPT® 78491 or CPT® 78492)

**CD-1.7: Non-imaging Heart Function and Cardiac Shunt Imaging**

- Echocardiogram is the preferred method for cardiac shunt detection.
- Echocardiogram, MPI, MUGA study, cardiac MRI, cardiac CT, or cardiac PET to obtain ejection fraction depending on the clinical situation.

**Background and Supporting Information**

- Procedures reported with CPT® 78414 and CPT® 78428 are essentially obsolete and should not be performed in lieu of other preferred modalities.

**CD-1.8: Section left intentionally blank**

**CD-1.9: Section left intentionally blank**

### References


## CD-2: Echocardiography (ECHO)

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CD-2.1: Transthoracic Echocardiography (TTE) - Coding

<table>
<thead>
<tr>
<th>TTE CODES</th>
<th>CPT®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transthoracic Echocardiography</td>
<td></td>
</tr>
<tr>
<td>TTE for congenital cardiac anomalies, complete</td>
<td>93303</td>
</tr>
<tr>
<td>TTE for congenital cardiac anomalies, follow-up or limited</td>
<td>93304</td>
</tr>
<tr>
<td>TTE with 2-D, M-mode, Doppler and color flow, complete</td>
<td>93306</td>
</tr>
<tr>
<td>TTE with 2-D, M-mode, without Doppler or color flow</td>
<td>93307</td>
</tr>
<tr>
<td>TTE with 2-D, M-mode, follow-up or limited</td>
<td>93308</td>
</tr>
<tr>
<td>Doppler Echocardiography</td>
<td>CPT®</td>
</tr>
<tr>
<td>Doppler echo, pulsed wave and/or spectral display</td>
<td>+93320*</td>
</tr>
<tr>
<td>Doppler echo, pulsed wave and/or spectral display, follow-up or limited study</td>
<td>+93321*</td>
</tr>
<tr>
<td>Doppler echo, color flow velocity mapping</td>
<td>+93325</td>
</tr>
</tbody>
</table>

*CPT® 93320 and CPT® 93321 should not be requested or billed together

<table>
<thead>
<tr>
<th>Transthoracic Echocardiography</th>
<th>CPT®</th>
</tr>
</thead>
<tbody>
<tr>
<td>C8921 TTE for congenital cardiac anomalies, complete</td>
<td>93303</td>
</tr>
<tr>
<td>C8922 TTE for congenital cardiac anomalies, follow-up or limited</td>
<td>93304</td>
</tr>
<tr>
<td>C8929 TTE with 2-D, M-mode, Doppler and color flow, complete</td>
<td>93306</td>
</tr>
<tr>
<td>C8923 TTE with 2-D, M-mode, without Doppler or color flow</td>
<td>93307</td>
</tr>
<tr>
<td>C8924 TTE with 2-D, M-mode, follow-up or limited</td>
<td>93308</td>
</tr>
</tbody>
</table>

C codes are unique temporary codes established by CMS. C codes were established for contrast echocardiography. Each echocardiography C code corresponds to a standard echo code (Class I CPT code) The C code and the matching CPT code should not both be approved.

<table>
<thead>
<tr>
<th>Investigational Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0399T Myocardial strain imaging (quantitative assessment of myocardial mechanics using image-based analysis of local myocardial dynamics) (List separately in addition to code for primary procedure)</td>
</tr>
<tr>
<td>0439T Myocardial contrast perfusion echocardiography, at rest or with stress, for assessment of myocardial ischemia or viability</td>
</tr>
</tbody>
</table>

CD-2.1.1: Transthoracic Echocardiography (TTE) – Coding-General Information

- Complete transthoracic echocardiogram with spectral and color flow Doppler (CPT® 93306).
  - CPT® 93306 includes the Doppler exams, so CPT® codes 93320-93325 should not be assigned together with CPT® 93306.
  - Doppler codes (CPT® 93320, CPT® 93321, and CPT® 93325) are ‘add-on codes’ (as denoted by the + sign) and are assigned in addition to code for the primary procedure.
- For a 2D transthoracic echocardiogram without Doppler, report CPT® 93307.
Limited transthoracic echocardiogram should be billed if the report does not “evaluate or document the attempt to evaluate” all of the required structures.
- A limited transthoracic echocardiogram is reported with CPT® 93308.
- CPT® 93321 (not CPT® 93320) should be reported with CPT® 93308 if Doppler is included in the study. CPT® 93325 can be reported with CPT® 93308 if color flow Doppler is included in the study.
- A limited congenital transthoracic echocardiogram is reported with CPT® 93304.

Doppler echo may be used for evaluation of the following:
- Shortness of breath
- Known or suspected valvular disease
- Known or suspected hypertrophic obstructive cardiomyopathy
- Shunt detection

Providers performing echo on a pediatric individual, may not know what procedure codes they will be reporting until the initial study is completed.
- If a congenital issue is found on the initial echo, a complete echo is reported with codes CPT® 93303, CPT® 93320, and CPT® 93325 because CPT® 93303 does NOT include Doppler and color flow mapping.
- If no congenital issue is discovered, then CPT® 93306 is reported alone and includes 2-D, Doppler and color flow mapping.
- Since providers may not know the appropriate code/s that will be reported at the time of the pre-authorization request, they may request all 4 codes (CPT® 93303, CPT® 93320, CPT® 93325, and CPT® 93306).
- Post-service audits may be completed to ensure proper claims submission.

CPT® 76376 and CPT® 76377 are not unique to 3D Echo. These codes also apply to 3D rendering of MRI and CT studies. (See CD-2.8: 3D Echocardiography – Coding)

CPT® 93325 may also be used with fetal echocardiography.

**CD-2.2: Transthoracic Echocardiography (TTE) – Indications**

- TTE can be performed for the following:
  - New or worsening cardiac signs or symptoms, including, but not limited to:
    - Dyspnea
    - Chest pain
    - Palpitations
    - Syncope
    - Heart failure
    - Mural
  - Hypertension – can be done once with initial evaluation
  - New signs or symptoms of cerebral ischemia or peripheral embolic event
  - Valve function and structure:
    - History and/or physical examination suggesting significant valvular disorder
    - Valve Surgery
      - If valve surgery is being considered can have TTE twice a year
- Post-surgery at 6 weeks to establish baseline, then one routine study (surveillance) 3 years or more after valve surgery (repair or prosthetic valve implantation).
- TAVR follow-up is indicated at, 1 month, and at one year post-procedure and annually thereafter.
  - A baseline post-op TTE is usually performed within one week after surgery. This baseline study may also be approved as an outpatient if not performed in the hospital prior to discharge.
  - See **CD-4.8: Transcatheter Aortic Valve Replacement (TAVR)**
- Mitral valve clip follow-up may be approved at 1 month, at 6 months, and at one year post-procedure

- **Ventricular function assessment including, but not limited to the following:**
  - Chemotherapy induced cardiomyopathy See **CD-12.1: Oncologic Indications for Cancer Therapeutics-Related Cardiac Dysfunction (CTRCD)**
  - Post myocardial infarction can be done once in follow-up. This should not be done less than 6 weeks post MI
  - Evaluation prior to ICD/CRT placement, if baseline has not been established

- **Cardiac structure: when there are new or worsening cardiac signs or symptoms, suggesting disorders such as, but not limited to:**
  - Infiltrative diseases (e.g. sarcoid, amyloid)
  - Ventricular septal defect (VSD)
  - Papillary muscle rupture/dysfunction
  - Hypertrophy including:
    - Asymmetric septal hypertrophy
    - Spade heart
    - Hypertensive concentric hypertrophy
    - Infiltrative hypertrophy
    - Pacemaker insertion complication
    - Pericardial effusion
    - Cardiac injury due to blunt chest trauma

- **Cardiac Defects or Masses**
  - Embolic source in individuals with recent Transient Ischemic Attack (TIA), stroke, or peripheral vascular emboli as an initial study before TEE.
  - ASD repair or VSD repair:
    - Within the first year of surgery
    - Incomplete septal defect repair may be followed yearly
  - Tumor evaluation including myxomas
  - Clot detection
  - Evaluation of adult congenital heart disease See **PEDCD-2.2 Congenital Heart Disease** in the Pediatric Cardiac Imaging Guidelines
    - Routine yearly surveillance of adult congenital heart disease is allowed following incomplete or palliative repair, with residual abnormality and without a change in clinical status.
    - Screening for the presence of bicuspid aortic valve is recommended for first-degree relatives of individuals with bicuspid aortic valve.
- Screening of the ascending aorta in known or suspected connective tissue disease that predisposes to an aortic aneurysm or dissection (e.g., Marfan syndrome, hereditary forms of ascending aortopathy).

- See **PVD 2.2 Screening for vascular related genetic connective tissue Disorders (Familial Aneurysm Syndromes/Spontaneous Coronary Artery Dissection (SCAD)/Ehlers-Danlos/Marfan/Loeys-Dietz)** in the Peripheral Vascular Disease Imaging Guidelines.

- **Inflammatory**
  - Pericardial effusion/pericardial disease including pericardial cysts
  - Congenital heart disease
  - Endocarditis including:
    - Fever or
    - Positive blood cultures indicating bacteremia or
    - A new murmur

- **Pacemaker insertion complication**

- Screening for first-degree relatives of individuals with hypertrophic cardiomyopathy (HCM)
  - First-degree relatives who are 12 to 18 years old should be screened yearly for HCM by 2D-echocardiography and ECG.
  - First-degree relatives who are older than age 18 should have 2D-echo and ECG every five years to screen for delayed adult-onset LVH.
  - Systematic screening is usually not indicated for first-degree relatives who are younger than age 12 unless there is a high-risk family history or the child is involved in particularly intense competitive sports.
  - Affected individuals identified through family screening or otherwise should be evaluated every 12 to 18 months with 2D-echo, Holter monitor, and blood pressure response during maximal upright exercise.

- New abnormality on an EKG that has not been evaluated.

- Thoracic aortic aneurysm/dissection See **PVD-6.2: Thoracic Aortic Aneurysm (TAA) and PVD-6.7: Aortic Dissection and Other Aortic Conditions** in the Peripheral Vascular Disease Imaging Guidelines.

- Individuals with BAVs and no demonstrable aortopathy may be followed every 3 years with TTE for the development of aortic enlargement.

**CD-2.3: Frequency of Echocardiography Testing**

- Repeat routine echocardiograms are not supported (annually or otherwise) for evaluation of clinically stable syndromes.

- Every three years, when there is a history of:
  - Bicuspid aortic valve
  - Mild aortic or mitral stenosis
  - Prosthetic heart valve

- Once a year (when no change in clinical status), when there a history of:
  - Significant valve dysfunction, including moderate or severe regurgitation or stenosis
• Significant valve deformity, such as thickened myxomatous valve or bileaflet prolapse, regardless of extent of regurgitation or stenosis
• Hypertrophic cardiomyopathy See CD-2.2: Transthoracic Echocardiography (TTE) – Indications, CD-2.7: Stress Echocardiography – Indications, other than ruling out CAD
• Chronic pericardial effusions
• Left ventricular contractility/diastolic function prior to planned medical therapy for heart failure or to evaluate the effectiveness of on-going therapy
• Pre-operative aortic root dilatation (See CD-11.2.9: Congenital Valvular Aortic Stenosis)
• Pulmonary hypertension (can be done more frequently with change in therapy)
• Systemic Scleroderma
• Prior TAVR

➤ Anytime, without regard for the number or timing of previous ECHO studies, if there is a change in clinical status or new signs or symptoms such as:
  • Cardiac murmurs
  • Myocardial infarction or acute coronary syndrome
  • Congestive heart failure (new or worsening)
    □ New symptoms of dyspnea
    □ Orthopnea
    □ Paroxysmal nocturnal dyspnea
    □ Edema
    □ Elevated BNP
  • Pericardial disease
  • Stroke/transient ischemic attack
  • Decompression illness
  • Prosthetic valve dysfunction or thrombosis
  • A history of prior cardiac transplant, per transplant center protocol

Background and Supporting Information

➤ Decisions regarding routine echocardiographic follow-up should not be based on the degree of regurgitation alone, but should take into account associated structural valvular and cardiac abnormalities. For example: a structurally normal mitral valve with moderate mitral regurgitation by color flow Doppler and normal left atrial size, does not generally require routine echocardiographic follow-up. However, a thickened, myxomatous appearing mitral valve with bi-leaflet prolapse and only trivial or mild mitral regurgitation, should be followed echocardiographically at routine intervals.
## CD-2.4: Transesophageal Echocardiography (TEE) – Coding

<table>
<thead>
<tr>
<th>Transesophageal Echocardiography</th>
<th>CPT®</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEE with 2-D, M-mode, probe placement, image acquisition, interpretation and report</td>
<td>93312</td>
</tr>
<tr>
<td>TEE probe placement only</td>
<td>93313</td>
</tr>
<tr>
<td>TEE image acquisition, interpretation, and report only</td>
<td>93314</td>
</tr>
<tr>
<td>TEE for congenital anomalies with 2-D, M-mode, probe placement, image acquisition, interpretation and report</td>
<td>93315</td>
</tr>
<tr>
<td>TEE for congenital anomalies, probe placement only</td>
<td>93316</td>
</tr>
<tr>
<td>TEE for congenital anomalies, image acquisition, interpretation and report only</td>
<td>93317</td>
</tr>
<tr>
<td>TEE for monitoring purposes, ongoing assessment of cardiac pumping function on an immediate time basis</td>
<td>93318</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Doppler Echocardiography*:</th>
<th>CPT®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doppler echo, pulsed wave and/or spectral display</td>
<td>+93320</td>
</tr>
<tr>
<td>Doppler echo, pulsed wave and/or spectral display, follow-up or limited study</td>
<td>+93321</td>
</tr>
<tr>
<td>Doppler echo, color flow velocity mapping</td>
<td>+93325</td>
</tr>
</tbody>
</table>

*Doppler echo, if performed, may be reported separately in addition to the primary TEE codes: CPT® 93312, CPT® 93314, CPT® 93315, and CPT® 93317.

<table>
<thead>
<tr>
<th>CPT®</th>
<th>Transesophageal Echocardiography</th>
<th>CPT®</th>
</tr>
</thead>
<tbody>
<tr>
<td>93312</td>
<td>TEE with 2-D, M-mode, probe placement, image acquisition, interpretation and report</td>
<td>C8925</td>
</tr>
<tr>
<td>93315</td>
<td>TEE for congenital anomalies with 2-D, M-mode, probe placement, image acquisition, interpretation and report</td>
<td>C8926</td>
</tr>
<tr>
<td>93318</td>
<td>TEE for monitoring purposes, ongoing assessment of cardiac pumping function on an immediate time basis</td>
<td>C8927</td>
</tr>
</tbody>
</table>

- **The complete transesophageal echocardiogram service**, including both (1) probe (transducer) placement and (2) image acquisition/interpretation, is reported with CPT® 93312.
  - Probe placement only is reported with CPT® 93313.
  - The image acquisition/interpretation only is reported with CPT® 93314.

- Physicians assign codes CPT® 93312, CPT® 93313, and/or CPT® 93314 to report professional services if the test is performed in a hospital or other facility where the physician cannot bill globally.
  - Modifier-26 (professional component) is appended to the appropriate code
  - CPT® 93313 and CPT® 93314 should never be used together. If both services are provided, CPT® 93312 is reported.

- Hospitals should report TEE procedures using CPT® 93312 (the complete service). CPT® 93313 and CPT® 93314 are not used for hospital billing.

- Monitoring of individuals undergoing cardiac surgery is CPT® 93318.
CD-2.5: Transesophageal Echocardiography (TEE) – Indications

- Limited transthoracic echo window
- Assessing valvular dysfunction, especially mitral regurgitation, when TTE is inadequate.
- Pre-operative planning for cardiac surgery
- Embolic source or intracardiac shunting when TTE is inconclusive
  - **Examples:** Atrial septal defect, ventricular septal defect, patent foramen ovale, aortic cholesterol plaques, thrombus in cardiac chambers, valve vegetation, tumor
- Embolic events when there is an abnormal TTE or a history of atrial fibrillation
  - Clarify atria/atrial appendage, aorta, mitral/aortic valve beyond the information that other imaging studies have provided
  - Cardiac valve dysfunction
    - Differentiation of tricuspid from bicuspid aortic valve
    - Congenital abnormalities
- Assessing for left atrial thrombus prior to cardioversion of atrial fibrillation.
- Prior to planned atrial fibrillation ablation/pulmonary vein isolation procedure.
- Repeat TEE studies are based upon findings in the original study and documentation of the way in which repeat studies will affect individual management, See **CD-13.5: Percutaneous Mitral Valve Repair (mitral valve clip)**
CD-2.6: Stress Echocardiography (Stress Echo) - Coding

<table>
<thead>
<tr>
<th>Stress Echocardiography</th>
<th>CPT®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Echo, transthoracic, with (2D), includes M-mode, during rest and exercise stress test and/or pharmacologically induced stress, with report;*</td>
<td>93350</td>
</tr>
<tr>
<td>Echo, transthoracic, with (2D), includes M-mode, during rest and exercise stress test and/or pharmacologically induced stress, with report: including performance of continuous electrocardiographic monitoring, with physician supervision*</td>
<td>93351</td>
</tr>
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</table>

Doppler Echocardiography:

<table>
<thead>
<tr>
<th>Doppler Echocardiography</th>
<th>CPT®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doppler echo, pulsed wave and/or spectral display**</td>
<td>+93320</td>
</tr>
<tr>
<td>Doppler echo, pulsed wave and/or spectral display, follow-up/limited study</td>
<td>+93321</td>
</tr>
<tr>
<td>Doppler echo, color flow velocity mapping**</td>
<td>+93325</td>
</tr>
</tbody>
</table>

*CPT® 93350 and CPT® 93351 do not include Doppler studies

*Doppler echo (CPT® +93320 and CPT® +93325), if performed, may be reported separately in addition to the primary SE codes: CPT® 93350 or CPT® 93351.

CD-2.7: Stress Echocardiography–Indications, other than ruling out CAD

See CD-1.4: Stress Testing with Imaging – Indications

- In addition to the evaluation of CAD, stress echo can be used to evaluate the following conditions:
  - Dyspnea on exertion (specifically to evaluate pulmonary hypertension)
  - Right heart dysfunction
  - Valvular heart disease, especially when the outcome would affect a therapeutic or interventional decision
  - Pulmonary hypertension, when the outcome will measure response to therapy and/or prognostic information
  - Hypertrophic cardiomyopathy
    - In an individual with a history of hypertrophic cardiomyopathy who has been previously evaluated with a stress echo, another stress echo may be appropriate if there are worsening symptoms or if there has been a therapeutic change (for example: change in medication, surgical procedure performed).

- In general spectral Doppler (CPT® 93320 or 93321) and color-flow Doppler (CPT® 93325) are necessary in the evaluation of the above conditions and can be added to the stress echo code.
CD-2.8: 3D Echocardiography – Coding

- The procedure codes used to report 3D rendering for echocardiography are not unique to echocardiography and are the same codes used to report the 3D post processing work for CT, MRI, ultrasound and other tomographic modalities.
  - CPT® 76376, not requiring image post-processing on an independent workstation, is the most common code used for 3D rendering done with echocardiography
  - CPT® 76377 requires the use of an independent workstation

CD-2.9: 3D Echocardiography – Indications

- Echocardiography with 3-dimensional (3D) rendering is becoming universally available, yet its utility remains limited based on the current literature.
- 3D Echo may be indicated when a primary echocardiogram is approved and ONE of the following is needed:
  - Left ventricular volume and ejection fraction assessment when measurements are needed for treatment decision (e.g. implantation of ICD, alteration in cardiotoxic chemotherapy)
  - Mitral valve anatomy specifically related to mitral valve stenosis
  - Guidance of transcatheter procedures

CD-2.10: Myocardial strain imaging (CPT® 0399T)

- Investigational See CD-2.1: Transthoracic Echocardiography (TTE) – Coding

CD-2.11: Myocardial contrast perfusion echocardiography (CPT® 0439T)

- Investigational See CD-2.1: Transthoracic Echocardiography (TTE) – Coding
References


## CD-3: Nuclear Cardiac Imaging

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<td>CD-3.2: MPI – Indications</td>
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<tr>
<td>CD-3.3: MUGA - Coding</td>
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<td>CD-3.4: MUGA Study – Cardiac Indications</td>
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<tr>
<td>CD-3.5: MUGA Study - Oncologic Indications for Cancer Therapeutics-Related Cardiac Dysfunction (CTRCD)</td>
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<td>CD-3.6: Myocardial Sympathetic Innervation Imaging in Heart Failure</td>
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<td>CD-3.7: Myocardial Tc-99m Pyrophosphate Imaging</td>
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<tr>
<td>CD-3.8: Cardiac Amyloidosis</td>
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</table>
## CD-3.1: Myocardial Perfusion Imaging (MPI) – Coding

<table>
<thead>
<tr>
<th>Nuclear Cardiac Imaging Procedure Codes</th>
<th>CPT®</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Myocardial Perfusion Imaging (MPI)</strong></td>
<td></td>
</tr>
<tr>
<td>MPI, 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)</td>
<td>78451</td>
</tr>
<tr>
<td>MPI, 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</td>
<td>78452</td>
</tr>
</tbody>
</table>

The most commonly performed myocardial perfusion imaging are single (at rest or stress, CPT® 78451) and multiple (at rest and stress, CPT® 78452) SPECT studies.
- Evaluation of the individual’s left ventricular wall motion and ejection fraction are routinely performed during MPI and are included in the code’s definition.
- First pass studies, (CPT® 78481 and CPT® 78483), MUGA, (CPT® 78472 and CPT® 78473) and SPECT MUGA (CPT® 78494) should not be reported in conjunction with MPI codes.
- Attenuation correction, when performed, is included in the MPI service by code definition. No additional code should be assigned for the billing of attenuation correction.

**Multi-day Studies:** It is not appropriate to bill separately for the rest and stress segments of MPI even if performed on separate calendar dates. A single code is assigned to define the entire procedure on the date all portions of the study are completed.
- 3D rendering, (CPT® 76377), should not be billed in conjunction with MPI.
- Separate codes for such related services as treadmill testing (CPT® 93015 - CPT® 93018) and radiopharmaceuticals should be assigned in addition to MPI.

## CD-3.2: MPI – Indications

- See [CD-1.4: Stress Testing with Imaging - Indications](#)

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### CD-3.3: MUGA - Coding

#### Nuclear Cardiac Imaging Procedure Codes

<table>
<thead>
<tr>
<th>MUGA (Multi Gated Acquisition) – Blood Pool Imaging</th>
<th>CPT®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac blood pool imaging, gated equilibrium; planar, single study at rest or stress, wall motion study plus ejection fraction, with or without quantitative processing</td>
<td>78472</td>
</tr>
<tr>
<td>Cardiac blood pool imaging, gated equilibrium; planar, multiple studies, wall motion study plus ejection fraction, at rest and stress, with or without additional quantification</td>
<td>78473</td>
</tr>
<tr>
<td>Cardiac blood pool imaging, gated equilibrium, SPECT, at rest, wall motion study plus ejection fraction, with or without quantitative processing</td>
<td>78494</td>
</tr>
<tr>
<td>Cardiac blood pool imaging, gated equilibrium, single study, at rest, with right ventricular ejection fraction by first pass technique (List separately in addition to code for primary procedure) [Use in conjunction with CPT® 78472]</td>
<td>+78496</td>
</tr>
</tbody>
</table>

- The technique employed for a MUGA service guides the code assignment. CPT® 78472 is used for a planar MUGA scan at rest or stress, and CPT® 78473 for planar MUGA scans, multiple studies at rest and stress.
- The two most commonly performed MUGA scans are the studies defined by CPT® 78472 and SPECT MUGA, CPT® 78494.
- Planar MUGA studies (CPT® 78472 and CPT® 78473) should not be reported in conjunction with:
  - MPI (CPT® 78451 - CPT® 78454)
  - First pass studies (CPT® 78481- CPT® 78483), and/or
  - SPECT MUGA (CPT® 78494).
- CPT® +78496 is assigned only in conjunction with CPT® 78472.
  - See **CD-3.4: MUGA Study – Cardiac Indications**
  - This add-on code should not be performed as a routine protocol.

### CD-3.4: MUGA Study – Cardiac Indications

#### MUGA (Multi Gated Acquisition) – Blood Pool Imaging Indications:

- Echocardiography is the preferred method of following left ventricular systolic function. Indications below refer to scenarios in which MUGA may be performed rather than ECHO:
  - Prior ECHO demonstrates impaired systolic function (EF <50%).
  - Pre-existing left ventricular wall motion abnormalities from ischemic heart disease or ischemic or non-ischemic cardiomyopathies.
  - ECHO is technically limited and prevents accurate assessment of LV function.
  - AICD placement:
    - MUGA to assess LV ejection fraction when there are conflicting results between other forms of testing and the issue is clinically relevant, e.g. MPI LVEF is 80% and an echo EF is 30%, the MUGA would be appropriate.
    - However, if the MPI LVEF is 80% and the echo EF is 50%, this would **not** be appropriate even though the difference is significant since the echo EF is still normal.
Congestive heart failure
- MUGA to measure response to cardiac medications for CHF if echocardiogram was performed and was technically difficult
- Previous low LV ejection fraction determination was <50% and receiving potentially cardiotoxic chemotherapy
- Documentation of other need for information given by MUGA that cannot be obtained by ECHO

First pass studies (CPT® 78481 and CPT® 78483) when indications are met for MUGA and/or there is need for information that cannot be obtained by MUGA

MUGA is NOT indicated for the following:
- A prior MUGA is not a reason to approve another MUGA (it is not necessary to compare LVEF by the same modality)
- To resolve differences in ejection fraction measurements between ECHO and MPI unless there is clear documentation as to how quantitative measurement of LVEF will affect individual management (e.g. implantation of an AICD).

Background and Supporting Information
- LV ejection fraction measurement is variable and can vary by +/-5-10% without any accompanying change in clinical status. Normal physiologic changes in intravascular volume, catecholamine levels, fever, and medications are among the many factors which cause variation in LVEF in the absence of myocardial pathology.
- Right ventricular first pass study, (CPT® +78496), may be indicated if there is clear documentation of a concern regarding right ventricular dysfunction or overload.

CD-3.5: MUGA Study - Oncologic Indications for Cancer Therapeutics-Related Cardiac Dysfunction (CTRCD)
- See CD-12.1: Oncologic Indications for Cancer Therapeutics-Related Cardiac Dysfunction (CTRCD)

CD-3.6: Myocardial Sympathetic Innervation Imaging in Heart Failure
- Markers have been developed, using radioactive iodine, in an attempt to image this increased myocardial sympathetic activity. Currently, AdreView™ (Iodine-123 meta-iodobenzylguanidine), is the only FDA-approved imaging agent available for this purpose. eviCore currently considers AdreView to be experimental and investigational.
- The AMA has established the following set of Category III codes to report these studies:
  - 0331T - Myocardial sympathetic innervation imaging, planar qualitative and quantitative assessment
  - 0332T - Myocardial sympathetic innervation imaging, planar qualitative and quantitative assessment; with tomographic SPECT.
Background and Supporting Information

In heart failure, the sympathetic nervous system is activated in order to compensate for the decreased myocardial function. Initially this is beneficial however, long term this compensatory mechanism is detrimental and causes further damage.

CD-3.7: Myocardial Tc-99m Pyrophosphate Imaging

<table>
<thead>
<tr>
<th>Myocardial Tc-99m Pyrophosphate Imaging</th>
<th>CPT®</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUGA (Multi Gated Acquisition) – Blood Pool Imaging</td>
<td></td>
</tr>
<tr>
<td>Myocardial Imaging, infarct avid, planar, qualitative or quantitative</td>
<td>78466</td>
</tr>
<tr>
<td>Myocardial Imaging, infarct avid, planar, qualitative or quantitative with ejection fraction by first pass technique</td>
<td>78468</td>
</tr>
<tr>
<td>Myocardial Imaging, infarct avid, planar, qualitative or quantitative tomographic SPECT with or without quantification</td>
<td>78469</td>
</tr>
<tr>
<td>For a single planar imaging session alone (without a SPECT study), Radiopharmaceutical localization of tumor or distribution of radiopharmaceutical agent(s); limited area</td>
<td>78800</td>
</tr>
<tr>
<td>For planar with SPECT, Radiopharmaceutical localization of tumor or distribution of radiopharmaceutical agent(s) tomographic (SPECT). Note: When reporting CPT® 78803, planar imaging of a limited area or multiple areas should be included with the SPECT</td>
<td>78803</td>
</tr>
</tbody>
</table>

CD-3.8: Cardiac Amyloidosis

- Tc-99m pyrophosphate imaging may be used to identify cardiac amyloidosis (CPT® 78803). Chest SPECT and planar imaging may be used, as well as whole body imaging for identification of systemic ATTR (transthyretin) amyloidosis.
- For a single planar imaging session alone (without a SPECT study), report CPT® 78800 Radiopharmaceutical localization of tumor or distribution of radiopharmaceutical agent(s); limited area
- Tc-99m pyrophosphate imaging may be indicated to identify cardiac amyloidosis for ANY of the following:
  - Individuals with heart failure and unexplained increase in left ventricular wall thickness.
  - African-Americans over the age of 60 years with heart failure, unexplained or with increased left ventricular wall thickness (>12 mm).
  - Individuals over the age of 60 years with unexplained heart failure with preserved ejection fraction.
  - Individuals, especially elderly males, with unexplained neuropathy, bilateral carpal tunnel syndrome or atrial arrhythmias in the absence of usual risk factors, and signs/symptoms of heart failure.
  - Evaluation of cardiac involvement in individuals with known or suspected familial amyloidosis.
  - Diagnosis of cardiac ATTR in individuals with CMR or echocardiography consistent with cardiac amyloidosis.
  - Individuals with suspected cardiac ATTR amyloidosis and contraindications to CMR such as renal insufficiency or an implantable cardiac device.14
References


## CD-4: Cardiac CT, Coronary CTA, and CT for Coronary Calcium (CAC)

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<td>CD-4.3</td>
<td>CCTA – Indications for CCTA</td>
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<td>CD-4.7</td>
<td>CT Heart for Congenital Heart Disease</td>
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<td>Transcatheter Aortic Valve Replacement (TAVR)</td>
<td>38</td>
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</tbody>
</table>
# CD-4.1: Cardiac CT and CTA – General Information and Coding

## Cardiac Imaging Procedure Codes

<table>
<thead>
<tr>
<th>Cardiac CT</th>
<th>CPT®</th>
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</thead>
<tbody>
<tr>
<td>CT Heart, without contrast, with quantitative evaluation of coronary calcium</td>
<td>75571</td>
</tr>
<tr>
<td>The code set for Cardiac CT and CCTA (CPT® 75572 - CPT® 75574), include quantitative and functional assessment (for example, calcium scoring), if performed</td>
<td></td>
</tr>
<tr>
<td>CPT® 75571 describes a non-contrast CT Heart with calcium scoring and should be reported only when calcium scoring is performed as a stand-alone procedure.</td>
<td></td>
</tr>
<tr>
<td>Can be used to report a preliminary non-contrast scan which indicates an excessive amount of calcium such that the original scheduled study must be discontinued.</td>
<td></td>
</tr>
<tr>
<td>CPT® 75571 should not be reported in conjunction with any of the contrast CT/CTA codes (CPT® 75572 - CPT® 75574).</td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Cardiac CT and CCTA</th>
<th>CPT®</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT, Heart, with contrast, for evaluation of cardiac structure and morphology (including 3D image post-processing, assessment of cardiac function, and evaluation of venous structures, if performed).</td>
<td>75572</td>
</tr>
<tr>
<td>CT, Heart, with contrast, for evaluation of cardiac structure and morphology in the setting of congenital heart disease (including 3D image post-processing, assessment of cardiac function, and evaluation of venous structures, if performed).</td>
<td>75573</td>
</tr>
<tr>
<td>CTA, Heart, coronary arteries and bypass grafts (when present), with contrast, including 3D image post-processing (including 3D image post-processing, assessment of cardiac function, and evaluation of venous structures, if performed).</td>
<td>75574</td>
</tr>
<tr>
<td>Noninvasive estimated coronary fractional flow reserve (FFR) derived from coronary computed tomography angiography data using computation fluid dynamics physiologic simulation software analysis of functional data to assess the severity of coronary artery disease; data preparation and transmission, analysis of fluid dynamics and simulated maximal coronary hyperemia, generation of estimated FFR model, with anatomical data review in comparison with estimated FFR model to reconcile discordant data, interpretation and report</td>
<td>0501T</td>
</tr>
<tr>
<td>Noninvasive estimated coronary fractional flow reserve (FFR) derived from coronary computed tomography angiography data using computation fluid dynamics physiologic simulation software analysis of functional data to assess the severity of coronary artery disease; data preparation and transmission</td>
<td>0502T</td>
</tr>
<tr>
<td>Noninvasive estimated coronary fractional flow reserve (FFR) derived from coronary computed tomography angiography data using computation fluid dynamics physiologic simulation software analysis of functional data to assess the severity of coronary artery disease; analysis of fluid dynamics and simulated maximal coronary hyperemia, and generation of estimated FFR model</td>
<td>0503T</td>
</tr>
<tr>
<td>Noninvasive estimated coronary fractional flow reserve (FFR) derived from coronary computed tomography angiography data using computation fluid dynamics physiologic simulation software analysis of functional data to assess the severity of coronary artery disease; anatomical data review in comparison with estimated FFR model to reconcile discordant data, interpretation and report</td>
<td>0504T</td>
</tr>
</tbody>
</table>
3D rendering, (CPT® 76377), should not be billed in conjunction with Cardiac CT and CCTA.

Only one code from the set: CPT® 75572 - CPT® 75574 can be reported per encounter.

CPT® 75574 includes evaluation of cardiac structure and morphology, when performed; therefore, additional code/s should not be assigned.

**Background and Supporting Information**

The high negative predictive value (98%-99%) of CCTA in ruling out significant coronary artery disease has been confirmed on multiple studies.

**CD-4.2: CT for Coronary Calcium Scoring (CPT® 75571)**

**CD-4.2.1: CT Calcium Scoring for CAD Screening**

Coronary calcium scoring as a standalone test is considered investigational in asymptomatic individuals with any degree of CAD risk.

Texas Heart Attack Preventive Screening Law (HR 1290) mandates that insurers in Texas cover either a calcium scoring study (CPT® 75571 or HCPCS S8092) or a carotid intima-media thickness study (ultrasound—Category III code 0126T) every five years for certain populations. To qualify, the following must apply:

- Must be a Texas resident.
- Must be a member of a fully-insured Texas health plan.
- Must be a man age 45 to 75 or a woman age 55 to 75.
- Must have either diabetes or a Framingham cardiac risk score of intermediate or higher.
- Must not have had a calcium scoring study or a carotid intima-media thickness study within the past 5 years.

**CD-4.2.2: CT Calcium Scoring Indications**

Symptomatic individuals with a ‘very low’, or ‘low’ pretest probability of CAD*, See Table 1 in CD-1.1: General Issues – Cardiac

**CD-4.3: CCTA – Indications for CCTA**

Symptomatic individuals who have a ‘low’ or ‘intermediate’ pretest probability of CAD*, (See Table 1 in CD-1.1: General Issues – Cardiac):

- ‘Low’ or ‘intermediate’ pre-test probability of coronary disease with persistent symptoms after a stress test.
- Replace performance of invasive coronary angiogram in individuals with low risk of CAD (i.e. Pre-op non-coronary surgery).
- For symptomatic individuals, evaluate post-CABG graft patency when only graft patency is a concern and imaging of the native coronary artery anatomy is not needed, such as in early graft failure.
CD-4.4: CCTA – Additional Indications

- Re-do CABG
  - To identify whether bypass grafts are located directly beneath the sternum, so that alternative ways to enter the chest can be planned.

- Evaluate coronary artery anomalies and other complex congenital heart disease of cardiac chambers or great vessels.
  - Report CPT® 75574 for evaluating coronary artery anomalies.
  - Report CPT® 75573 for congenital heart disease.
    - To evaluate the great vessels, CTA Chest (CPT® 71275) can be performed instead of CCTA or in addition to CCTA. For anomalous pulmonary venous return, can add CT Abdomen and Pelvis with contrast (CPT® 74177).

- Anomalous coronary artery(ies) suspected for diagnosis or to plan treatment and less than age 40 with a history that includes one or more of the following:
  - Persistent exertional chest pain and normal stress test,
  - Full sibling(s) with history of sudden death syndrome before age 30 or with documented anomalous coronary artery,
  - Resuscitated sudden death and contraindications for conventional coronary angiography.
  - Prior nondiagnostic coronary angiography in determining the course of the anomalous coronary artery in relation to the great vessels, origin of a coronary artery or bypass graft location.

- Unexplained new onset of heart failure.

- Evaluation of newly diagnosed congestive heart failure or cardiomyopathy.
  - No prior history of coronary artery disease, the ejection fraction is less than 50 percent, and low or intermediate risk on the pre-test probability assessment, and
  - No exclusions to cardiac CT angiography.
  - No cardiac catheterization, SPECT, cardiac PET, or stress echocardiogram has been performed since the diagnosis of congestive heart failure or cardiomyopathy.

- Ventricular tachycardia (6 beat runs or greater) if CCTA will replace conventional invasive coronary angiography.

- Equivocal coronary artery anatomy on conventional cardiac catheterization.

- Newly diagnosed dilated cardiomyopathy.

- Preoperative assessment of the coronary arteries in individuals who are going to undergo surgery for aortic dissection, aortic aneurysm, or valvular surgery if CCTA will replace conventional invasive coronary angiography.

- Vasculitis/Takayasu’s/Kawasaki’s disease

- **Cardiac Trauma**: CTA Chest (CPT® 71275) and CCTA (CPT® 75574) are useful in detecting aortic and coronary injury and can help in the evaluation of myocardial and pericardial injury (See [CD-10.1: Cardiac Trauma – Imaging](#)).
**CD-4.5: Fractional Flow Reserve by Computed Tomography**

- Fractional flow reserve (FFR) is typically measured using invasive techniques. FFR can be obtained noninvasively from coronary computed tomography angiography data (FFR-CT).
- Indications for FFR-CT
  - To further assess CAD seen on a recent CCTA that is of uncertain physiologic significance

**CD-4.6: CT Heart – Indications**

- Cardiac vein identification for lead placement in individuals needing left ventricular pacing.
- Pulmonary vein isolation procedure (ablation) for atrial fibrillation
  - Cardiac MRI (CPT® 75557 or CPT® 75561), MRV Chest (CPT® 71555), CTV Chest (CPT® 71275), or Cardiac CT (CPT® 75572) can be performed to evaluate anatomy of the pulmonary veins prior to an ablation procedure performed for atrial fibrillation.
  - Study may be repeated post-procedure between 3-6 months after ablation because of a 1%-2% incidence of asymptomatic pulmonary vein stenosis.
  - See **CD-8.2: Pulmonary Vein Imaging - Indications**
- If echocardiogram is inconclusive for:
  - Cardiac or pericardial tumor or mass
  - Cardiac thrombus
  - Pericarditis/constrictive pericarditis
  - Complications of cardiac surgery
- Clinical suspicion of arrhythmogenic right ventricular dysplasia or arrhythmogenic cardiomyopathy (ARVD/ARVC), especially if an individual has presyncope or syncope if the clinical suspicion is supported by established criteria for ARVD.
- Recurrent laryngeal nerve palsy due to cardiac chamber enlargement.
- Coronary imaging is not included in the code definition for CPT® 71275.
  - The AMA definition for CPT® 71275 reads: “CTA Chest (non-coronary), with contrast material(s), including non-contrast images, if performed, and image post-processing.”

**CD-4.7: CT Heart for Congenital Heart Disease**

- Coronary artery anomaly evaluation
  - Cardiac catheterization was performed, and not all coronary arteries were identified.
- Thoracic arteriovenous anomaly evaluation
  - Cardiac MRI or CT angiogram chest was performed and suggested congenital heart disease.
- Complex adult congenital heart disease evaluation
No Cardiac CT or Cardiac MRI has been performed, and there is a contraindication to Cardiac MRI.
Cardiac CT or Cardiac MRI was performed one year ago or more.

**CD-4.8: Transcatheter Aortic Valve Replacement (TAVR)**

- Once the decision has been made for aortic valve replacement, the following may be used to determine if an individual is a candidate for TAVR:
  - CTA Chest (CPT® 71275), Abdomen and Pelvis (CPT® 74174), and ONE of the following
    - Cardiac CT (CPT® 75572) to measure the aortic annulus 2 or
    - Coronary CTA (CCTA CPT® 75574) to both measure the aortic annulus and assess the coronary arteries in lieu of heart catheterization.

- Post TAVR:
  - TTE follow-up is indicated at:
    - Baseline post-op TTE within one week after surgery if not performed in the hospital prior to discharge
    - 1 month post-procedure
    - One year post-procedure
    - Then annually thereafter.
References


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| CD-5.2: Cardiac MRI – Indications (excluding Stress MRI) | 42 |
| CD-5.3: Cardiac MRI – Indications for Stress MRI    | 44 |
| CD-5.4: Cardiac MRI – Aortic Root and Proximal Ascending Aorta | 44 |
| CD-5.5: Cardiac MRI – Evaluation of Pericardial Effusion or Diagnosis of Pericardial Tamponade | 44 |
CD-5.1: Cardiac MRI – Coding

<table>
<thead>
<tr>
<th>Cardiac Imaging Procedure Codes</th>
<th>CPT®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac magnetic resonance imaging for morphology and function without contrast</td>
<td>75557</td>
</tr>
<tr>
<td>Cardiac magnetic resonance imaging for morphology and function without contrast; with stress imaging</td>
<td>75559</td>
</tr>
<tr>
<td>Cardiac magnetic resonance imaging for morphology and function without and with contrast and further sequences</td>
<td>75561</td>
</tr>
<tr>
<td>Cardiac magnetic resonance imaging for morphology and function without and with contrast and further sequences; with stress imaging</td>
<td>75563</td>
</tr>
<tr>
<td>Cardiac magnetic resonance imaging for velocity flow mapping (List separately in addition to code for primary procedure)</td>
<td>+75565</td>
</tr>
</tbody>
</table>

- Only one procedure code from the set (CPT® 75557 - CPT® 75563) should be reported per session.
- Only one flow velocity measurement (CPT® +75565) should be reported per session when indicated.
  - Requests for Cardiac MRI that contain more than one Cardiac/Chest MRI CPT® Code must be forwarded for Medical Director Review.

CD-5.2: Cardiac MRI – Indications (excluding Stress MRI)

- Assess myocardial viability (to differentiate hibernating myocardium from scar) when necessary to determine if revascularization should be performed (CPT® 75561)
- Assessment of global ventricular function and mass if a specific clinical question is left unanswered by a recent echocardiogram and results will affect individual management (CPT® 75557 or CPT® 75561). Particularly useful in evaluating:
  - Cardiomyopathy (ischemic, diabetic, hypertrophic, or muscular dystrophy)
  - Noncompaction
  - Amyloid heart disease
  - Post cardiac transplant
  - Hemochromatosis
  - Post transfusion hemosiderosis
  - Hypertrophic heart disease
  - Myocarditis, cardiac aneurysm, trauma and contusions
  - Monitoring cancer chemotherapy effect on the heart (especially if accurate assessment of right ventricular function is documented as necessary).
Pre and postoperative congenital heart disease assessment (e.g. Tetralogy of Fallot, patent ductus arteriosus, platypnea, atrial septal defects, restrictive VSD, anomalous pulmonary arteries or veins or anomalous coronary arteries) (CPT® 75557 or CPT® 75561).

- MRA Chest (CPT® 71555) may be added if the aorta or pulmonary artery need to be visualized beyond the root.
- Report CPT® +75565 in conjunction with CPT® 75557 or CPT® 75561, only if there is a need to clarify findings on a recent echocardiogram and cardiac Doppler study.

MRA Chest alone (CPT® 71555) can be performed in certain situations (e.g. suspected dissection, coarctation, known or suspected aortic aneurysm).

Coarctation of the aorta
- Follow-up (surveillance) imaging after repair of coarctation:
  - Adults: MRA Chest (CPT® 71555) every 2 to 3 years and before and after any intervention for re-coarctation
  - Infants and children: ECHO every month for several months, then ECHO every 6 months to one year thereafter

Arrhythmogenic right ventricular dysplasia or arrhythmogenic cardiomyopathy (ARVD/ARVC) suspicion (including presyncope or syncope, established criteria for ARVD (CPT® 75557 or CPT® 75561).

Differentiate constrictive pericarditis from restrictive cardiomyopathy (CPT® 75561).

Evaluate cardiac tumor or mass when echocardiogram is inconclusive.

Initial evaluation for cardiac sarcoidosis.

Anomalous coronary arteries: Cardiac MRI (CPT® 75561) or CCTA (CPT® 75574) is much better at detecting this than conventional angiography.

Assess coronary arteries in Kawasaki’s disease.

Fabry disease
- Late enhancement MRI may predict the effect of enzyme replacement therapy on myocardial changes that occur with this disease (CPT® 75561).

Evaluate valvular heart disease when echocardiogram is inconclusive:
- CPT® 75557 or CPT® 75561 and
- CPT® 75565

Cardiac MRI (CPT® 75557 or CPT® 75561) or MRV Chest (CPT® 71555), but not both (See CD-8: Pulmonary Artery and Vein Imaging for guidelines on follow-up imaging after ablation procedure) for pulmonary vein anatomy for planned ablation procedures in individuals with atrial fibrillation.

Suspected cardiac thrombus when echocardiogram is inconclusive (CPT®75557).

Right ventricular function evaluation (CPT® 75557 in conjunction with CPT® +75565) if a recent ECHO has been done, and there is documented need to perform Cardiac MRI in order to resolve an unanswered question.
Shunting through a VSD (CPT® 75557 in conjunction with CPT® +75565) if a recent ECHO has been done, including a bubble study, and there is documented need to perform Cardiac MRI in order to resolve an unanswered question.

Evaluate for iron overload due to conditions requiring frequent blood transfusions (i.e. sickle cell, thalassemia, hemochromatosis, etc.) (CPT® 75557).

**CD-5.3: Cardiac MRI – Indications for Stress MRI**

- For indications for Stress MRI, See [CD-1.4: Stress Testing with Imaging - Indications](#)
- If a nuclear perfusion (MPI) stress test was performed and was equivocal, a stress MRI is appropriate.

**CD-5.4: Cardiac MRI - Aortic Root and Proximal Ascending Aorta**

- See [PVD-6.2: Thoracic Aortic Aneurysm (TAA)](#) in the Peripheral Vascular Diseases Imaging Guidelines

**CD-5.5: Cardiac MRI - Evaluation of Pericardial Effusion or Diagnosis of Pericardial Tamponade**

- Contrast enhanced Cardiac MRI (CPT® 75561) is useful for evaluating pericarditis, neoplastic and other effusion, tamponade or myocardial infiltration if a specific clinical question is left unanswered by echocardiogram or another recent imaging study.
References

<table>
<thead>
<tr>
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<tbody>
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<td><strong>CD-6.1: Cardiac PET – Coding</strong></td>
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<tr>
<td><strong>CD-6.2: Cardiac PET – Perfusion - Indications</strong></td>
</tr>
<tr>
<td>(CPT® 78491 and CPT® 78492)</td>
</tr>
<tr>
<td><strong>CD-6.3: Cardiac PET – Absolute Quantitation of Myocardial Blood Flow (CPT® 0482T)</strong></td>
</tr>
<tr>
<td><strong>CD-6.4: Cardiac PET – Metabolic – Indications (CPT® 78459)</strong></td>
</tr>
</tbody>
</table>
CD-6.1: Cardiac PET – Coding

<table>
<thead>
<tr>
<th>Cardiac Imaging Procedure Codes</th>
<th>CPT®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myocardial imaging, PET, <em>metabolic</em> evaluation</td>
<td>78459</td>
</tr>
<tr>
<td>Myocardial imaging, PET, <em>perfusion</em>; single study at rest or stress</td>
<td>78491</td>
</tr>
<tr>
<td>Myocardial imaging, PET, <em>perfusion</em>; multiple studies at rest and/or stress</td>
<td>78492</td>
</tr>
<tr>
<td>Absolute quantitation of myocardial blood flow, PET, rest and stress</td>
<td>+0482T</td>
</tr>
</tbody>
</table>

- 3D rendering, (CPT® 76377), should not be billed in conjunction with PET.
- Separate codes for such related services as treadmill testing (CPT® 93015 - CPT® 93018) and radiopharmaceuticals should be assigned in addition to perfusion PET.
- 0482T is an add on code for CPT® 78491 or CPT® 78492 and is considered investigational

CD-6.2: Cardiac PET – Perfusion – Indications (CPT® 78491 and CPT® 78492)

- Meets all of the criteria for an imaging stress test and additionally any one of the following:
  - Individual is obese (for example BMI >40 kg/m²) or
  - Individual has large breasts or implants
- Equivocal nuclear perfusion (MPI) stress test
- Routine use in post heart transplant assessment of transplant CAD

CD-6.3: Cardiac PET – Absolute Quantitation of Myocardial Blood Flow (CPT® 0482T)*

- Performance of quantitation of myocardial blood flow by Cardiac PET is currently non-standardized between different vendor products.
- Absolute quantitation of myocardial blood flow is considered experimental, investigational and/or unproven (EIU).
- *Code reviewed by eviCore for Cigna

CD-6.4: Cardiac PET – Metabolic – Indications (CPT® 78459)

- To determine myocardial viability when a previous study has shown significant left ventricular dysfunction when under consideration for revascularization, or
- To identify and monitor response to therapy for established or strongly suspected cardiac sarcoid. This study may be performed in conjunction with a Cardiac PET perfusion examination, single study, CPT® 78491 or MPI SPECT CPT® 78451
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### CD-7.1: Diagnostic Heart Catheterization – Code Sets

<table>
<thead>
<tr>
<th>Cardiac Cath Procedures</th>
<th>CPT®</th>
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<tbody>
<tr>
<td>Congenital Heart Disease Code “Set”</td>
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</tr>
<tr>
<td>Right Heart Catheterization (CHD)</td>
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<tr>
<td>Right/Left Heart Catheterization (CHD)</td>
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<tr>
<td>Right/Left Heart Catheterization (CHD-TS)</td>
<td>93532</td>
</tr>
<tr>
<td>Right/Left Heart Catheterization (CAD-ASD)</td>
<td>93533</td>
</tr>
<tr>
<td>Anomalous coronary arteries, patent foramen ovale, mitral valve prolapse, and bicuspid aortic valve</td>
<td>93451-93464, 93566-93568</td>
</tr>
<tr>
<td>RHC without LHC or coronaries</td>
<td>93451</td>
</tr>
<tr>
<td>LHC without RHC or coronaries</td>
<td>93452</td>
</tr>
<tr>
<td>RHC and retrograde LHC without coronaries</td>
<td>93453</td>
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<tr>
<td>Native coronary artery catheterization;</td>
<td>93454</td>
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<tr>
<td>with bypass grafts</td>
<td>93455</td>
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<tr>
<td>with RHC</td>
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<tr>
<td>with RHC and bypass grafts</td>
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<td>with LHC</td>
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<td>with RHC and LHC</td>
<td>93460</td>
</tr>
<tr>
<td>with RHC and LHC and bypass grafts</td>
<td>93461</td>
</tr>
<tr>
<td>LHC by transseptal or apical puncture</td>
<td>+93462</td>
</tr>
<tr>
<td>Angiography of noncoronary arteries and veins, performed as a distinct service</td>
<td></td>
</tr>
<tr>
<td>Select appropriate codes from the Radiology and Vascular Injection Procedures sections.</td>
<td></td>
</tr>
</tbody>
</table>

- CPT® 93530 to CPT® 93533 are appropriate for invasive evaluation of congenital heart disease. See specific conditions in **CD-11: Adult Congenital Heart Disease**
**CD-7.2: Diagnostic Heart Catheterization – Coding Notes**

Cardiac catheterization (CPT® 93451-CPT® 93461) includes all “road mapping” angiography necessary to place the catheters, including any injections and imaging supervision, interpretation, and report.

Cardiac catheterization (CPT® 93452-CPT® 93461) (for all conditions other than congenital heart disease) includes contrast injections, imaging supervision, interpretation, and report for imaging typically performed.

Catheter placements in native coronaries or bypass grafts (CPT® 93454-CPT® 93461) include intraprocedural injections for bypass graft angiography, imaging supervision, and interpretation.

Injection codes CPT® 93563-CPT® 93565 should not be used in conjunction with CPT® 93452-CPT® 93461.

Codes CPT® 93451-CPT® 93461 do not include contrast injections and imaging supervision, interpretation, and report for imaging that is separately identified by the following specific procedure codes: CPT® 93566, CPT® 93567 and CPT® 93568.

- Separate diagnostic cardiac catheterization codes should only be assigned in conjunction with interventional procedures in the following circumstances:
  - No prior or recent diagnostic catheterization is available to guide therapy
  - Individual’s condition has significantly changed since the last diagnostic cath
  - The treatment plan may be affected
  - Other vessels may be identified for treatment
  - Further establishment of a diagnosis from a non-invasive study is necessary

**CD-7.3: Diagnostic Left Heart Catheterization (LHC)**

**CD-7.3.1: Diagnostic Left Heart Catheterization (LHC)-general information**

- Individuals in acute settings or with active unstable angina should be handled as medical emergencies.
- These guidelines apply to individuals with stable conditions and who are not in the acute setting (acute coronary syndrome or unstable angina).
- Diagnostic Left Heart Catheterization (LHC) is indicated to identify disease for which invasive procedures have been shown to prolong survival:
  - Left main coronary artery disease plus right coronary artery disease plus left ventricular dysfunction.
  - Triple vessel coronary artery disease plus left ventricular dysfunction.
- Incidental angiography can be performed:
  - Iliac/femoral artery angiography when dissection or obstruction to the passage of the catheter/guidewire is encountered.
  - Renal arteriography if criteria outlined in the PVD Imaging Guidelines are met (See PVD-6.5: Renovascular Hypertension in the Peripheral Vascular Disease (PVD) Imaging Guidelines).
CD-7.3.2: Diagnostic Left Heart Catheterization (LHC)-Indications

LHC may be indicated for ANY of the following when there is new onset, persistent, or worsening of angina symptoms:

- Recent history of unstable angina – symptoms suggestive of acute coronary syndrome (ACS) occurring at rest, or with minimal exertion resolving with rest:
  - New onset, accelerating, or worsening ischemic symptoms that are suggestive of unstable angina
  - New onset, accelerating, or worsening symptoms consistent with individual’s known angina pattern in an individual with a history of CABG or PCI
- Symptomatic individuals with a high pretest probability of CAD.
  - See CD-1.1: General Issues – Cardiac, Pre-Test Probability (Table 1)
- Symptoms concerning for coronary artery ischemia (chest discomfort, shortness of breath, etc.) with evidence of significant ischemia on recent stress testing, such as:
  - At least moderate ischemia (medium to large size defect) on imaging stress test
  - At least moderate size area of hypokinesis on stress echo
- Persistent or worsening symptoms to evaluate progression of known CAD when:
  - Recent noninvasive cardiac testing was equivocal, unsuccessful in delineating the clinical problem, or led to a conclusion that intervention is indicated
  - Angina that is unresponsive to optimized medical therapy (See CD-1: General Issues – Cardiac) and for which invasive procedures are needed to provide pain relief.

LHC is indicated for ANY of the following to identify disease for which intervention may be needed:

- Left ventricular dysfunction (congestive heart failure) in individuals suspected of having coronary artery disease.
- Ventricular fibrillation or ventricular tachycardia where the etiology is unclear.
- Un heralded syncope (not near syncope) where the etiology is unclear.
- Recent noninvasive cardiac testing was equivocal, unsuccessful in delineating the clinical problem, or led to a conclusion that intervention is indicated for the following conditions:
  - Cardiomyopathy
  - Suspicion of endocarditis, or myocarditis
  - Significant/serious ventricular arrhythmia
  - An intermediate or large amount of myocardium (>5%) may be in jeopardy
  - Evaluation of coronary grafts
  - Evaluation of previously placed coronary artery stents
  - Evaluation of structural disease
- Evaluation prior to planned surgery
- Ruling out coronary artery disease prior to planned non-coronary cardiac or great vessel surgery (i.e. cardiac valve surgery, aortic dissection, aortic aneurysm, congenital disease repair such as atrial septal defect, etc.).
- Pre-organ transplant (non-cardiac). Some institutions perform a heart cath as part of their initial evaluation protocol. Others use an imaging stress test for evaluation. Either is appropriate and can be approved but **NOT** both.
  - Valvular heart disease when either:
    - There is a discrepancy between the clinical findings (history, physical exam, and non-invasive test results)
    - Valvular surgery is being considered
  - Suspected pericardial disease.
  - Previous cardiac transplant:
    - Per transplant center protocol
    - To assess for accelerated coronary artery disease associated with cardiac transplantation

**CD-7.4: Right Heart Catheterization (RHC)**

**CD-7.4.1: General information RHC (CPT® 93451)**

- It is performed most commonly from the femoral vein, less often through the subclavian or internal jugular veins and inter-atrial septal puncture approach.
- It includes a full oximetry for detection and quantification of shunts.
- Pressure measurements are made and are done simultaneously with aortic and left ventricular pressures.
- Cardiac outputs are calculated by several techniques including thermodilution.

**CD-7.4.2: Diagnostic Right Heart Catheterization – Indications**

- Diagnostic Right heart cath is indicated when results will impact the diagnosis and management of **ANY** of the following:
  - Atrial septal defect (ASD) including shunt detection and quantification
  - Ventricular septal defect (VSD) including shunt detection and quantification
  - Patent foramen ovale (PFO)
  - Anomalous pulmonary venous return
  - Congenital defects including persistent left vena cava
  - Pulmonary hypertension
  - Pericardial diseases (constrictive or restrictive pericarditis)
  - Valvular disease
  - Right heart failure
  - Left heart failure
  - Preoperative evaluation for valve surgery
  - Newly diagnosed or worsening cardiomyopathy
  - During a left heart cath where the etiology of the symptoms remains unclear
  - Pre-lung transplant to assess pulmonary pressures
  - Uncertain intravascular volume status with an unclear etiology
  - Assessment post-cardiac transplant
    - For routine endomyocardial biopsy
    - Assess for rejection
    - Assess pulmonary artery pressure
Can be done per the institution protocol or anytime organ rejection is suspected and biopsy is needed for assessment
- Evaluation of right ventricular morphology
- Suspected arrhythmogenic right ventricular dysplasia

**CD-7.5: Combined Right and Left Heart Catheterization Indications**

- Preoperative evaluation for valve surgery
- Indications for **CD-7.3: Diagnostic Left Heart Catheterization (LHC)** are met and any of the following are present:
  - The major component of the individual symptoms is dyspnea
  - The indications are met according to **CD-7.4: Right Heart Catheterization (RHC)**
  - Newly diagnosed or worsening cardiomyopathy

**CD-7.6: Planned (Staged) Coronary Interventions**

- The CPT® codes for percutaneous coronary interventions (PCI) include the following imaging services necessary for the procedure(s):
  - Contrast injection, angiography, ‘road-mapping’, and fluoroscopic guidance
  - Vessel measurement
  - Angiography following coronary angioplasty, stent placement, and atherectomy
- Separate codes for these services should not be assigned in addition to the PCI code/s because the services are already included.
- A repeat diagnostic left heart catheterization is not medically necessary when the individual is undergoing a planned staged percutaneous coronary intervention.
References


<table>
<thead>
<tr>
<th>CD-8: Pulmonary Artery and Vein Imaging</th>
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<td>CD-8.1: Pulmonary Artery Hypertension (PAH) - Indications</td>
</tr>
<tr>
<td>CD-8.2: Pulmonary Vein Imaging - Indications</td>
</tr>
</tbody>
</table>
CD-8.1: Pulmonary Artery Hypertension (PAH) - Indications

- CT or CTA or MRA pulmonary arteries (CPT® 71260 or CPT® 71275 or CPT® 71555) is useful in the assessment of PAH, especially if there is suspicion for recurrent pulmonary emboli.
- In the absence of a clinical change, follow-up imaging for PAH is not indicated.
- See
  - PVD-5: Pulmonary Artery Hypertension in the Peripheral Vascular Disease Imaging Guidelines.
  - CH-25: Pulmonary Embolism (PE) in the Chest Imaging Guidelines.

CD-8.2: Pulmonary Vein Imaging – Indications

- MRI Cardiac (CPT® 75557 or CPT® 75561 ), MRV Chest (CPT® 71555), CTV Chest (CPT® 71275), or CT Cardiac (CPT® 75572) to evaluate anatomy of the pulmonary veins:
  - Prior to an ablation procedure performed for atrial fibrillation.
  - Post-procedure between 3-6 months after ablation because of a 1% to 2% incidence of asymptomatic pulmonary vein stenosis.
    - If no pulmonary vein stenosis is present, no further follow-up imaging is required.
    - If pulmonary vein stenosis is present on imaging following ablation and symptoms of pulmonary vein stenosis (usually shortness of breath) are present, can be imaged at 1, 3, 6, and 12 months.

Background and Supporting Information

- The majority (81%) of pulmonary vein stenosis remain stable over 1 year. Progression occurs in 8.8% and regression occurs in a small percentage.
References


| CD-9.1: CHF – Imaging                | 60 |
| CD-9.2: Section left intentionally blank | 60 |
| CD-9.3: Myocardial Sympathetic Innervation Imaging | 60 |
CD-9.1: CHF – Imaging

- Congestive heart failure, including post-cardiac transplant failure:
  - Echocardiogram is the first study to be done after the clinical evaluation of the individual who is suspected of having heart failure.
  - MUGA, cardiac MRI or cardiac CT may be indicated if the ECHO is limited or does not completely answer the question.
  - Stress test to assess for CAD may be indicated. Follow stress testing guideline: CD-1.4: Stress Testing with Imaging - Indications

- Arteriovenous fistula with “high output” heart failure:
  - CT Chest with contrast (CPT® 71260 ) and/or CT Abdomen and/or Pelvis with contrast (CPT® 74160 or CPT® 72193 or CPT® 74177) **OR**
  - CTA Chest (CPT® 71275 ) and/or CTA Abdomen and/or Pelvis (CPT® 74175 or CPT® 72191 or CPT® 74174) **OR**
  - MRI Chest and/or MRI Abdomen and/or MRI Pelvis without and with contrast (CPT® 71552 and/or CPT® 74183 and/or CPT® 72197) **OR**
  - MRA Chest and/or MRA Abdomen and/or MRA Pelvis (CPT® 71555 and/or CPT® 74185 and/or CPT® 72198)

- Right-sided congestive heart failure can be a manifestation of pulmonary hypertension or serious lung disease.
  - CT Chest (CPT® 71260) or CTA Chest (CPT® 71275) to evaluate for recurrent pulmonary embolism

CD-9.2: This section left intentionally blank

CD-9.3: Myocardial Sympathetic Innervation Imaging

- Markers have been developed, using radioactive iodine, in an attempt to image this increased myocardial sympathetic activity. Currently, AdreView™ (Iodine-123 meta-iodobenzylguanidine), is the only FDA-approved imaging agent available for this purpose. eviCore currently considers AdreView™ to be experimental and investigational.

- The AMA has established the following set of Category III codes to report these studies:
  - 0331T - Myocardial sympathetic innervation imaging, planar qualitative and quantitative assessment
  - 0332T - Myocardial sympathetic innervation imaging, planar qualitative and quantitative assessment; with tomographic SPECT.

**Background and Supporting Information**

- In heart failure, the sympathetic nervous system is activated in order to compensate for the decreased myocardial function. Initially this is beneficial however, long term this compensatory mechanism is detrimental and causes further damage.
References
CD-10.1: Cardiac Trauma – Imaging

ANY of the following can be used to evaluate cardiac or aortic trauma:
- Echocardiogram (TTE, TEE)
- MRI Cardiac (CPT® 75557, CPT® 75561, and CPT® 75565)
- CT Cardiac (CPT® 75572)
- CCTA (CPT® 75574)
- CTA Chest (CPT® 71275)

References
## CD-11: Adult Congenital Heart Disease

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<td>82</td>
</tr>
</tbody>
</table>
CD-11.1: Congenital heart disease-general information

- This section covers adult congenital heart disease (CHD), for other associated disorders please see the condition specific sections
  - Marfan Syndrome
  - Hypertrophic cardiomyopathy (HCM)
  - Bicuspid aortic valve (BAV)

CD-11.1.1: Definitions

- Physiological stages (A, B, C, D)
  - Each congenital heart lesion is divided into 4 physiological stages (A, B, C, D)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Physiological stage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>NYHA functional class</td>
<td>I</td>
</tr>
<tr>
<td>Hemodynamic or anatomic sequelae</td>
<td>None</td>
</tr>
<tr>
<td>Valvar</td>
<td>None</td>
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<tr>
<td>Aortic enlargement</td>
<td>None</td>
</tr>
<tr>
<td>Exercise capacity limitation</td>
<td>Normal</td>
</tr>
<tr>
<td>Renal hepatic pulmonary dysfunction</td>
<td>None</td>
</tr>
<tr>
<td>Cyanosis/hypoxemia</td>
<td>None</td>
</tr>
<tr>
<td>Arrhythmias</td>
<td>None</td>
</tr>
<tr>
<td>Pulmonary hypertension</td>
<td>None</td>
</tr>
</tbody>
</table>

- CHD Anatomic classification
  - Class I-Simple
    - Native disease
      - Isolated small ASD
      - Isolated small VSD
      - Mild isolated pulmonic stenosis
    - Repaired conditions
- Previously ligated or occluded ductus arteriosus
- Repaired secundum ASD or sinus venosus defect without significant residual shunt or chamber enlargement
- Repaired VSD without significant residual shunt or chamber enlargement

Class II-Moderate Complexity
- Repaired or unrepaired conditions
  - Aorto-left ventricular fistula
  - Anomalous pulmonary venous connection, partial or total
  - Anomalous coronary artery arising from the pulmonary artery
  - Anomalous aortic origin of a coronary artery from the opposite sinus
  - AVSD (partial or complete, including primum ASD)
  - Congenital aortic valve disease
  - Congenital mitral valve disease
  - Coarctation of the aorta
  - Ebstein anomaly (disease spectrum includes mild, moderate, and severe variations)
  - Infundibular right ventricular outflow obstruction
  - Ostium primum ASD
  - Moderate and large unrepaired secundum ASD
  - Moderate and large persistently patent ductus arteriosus
  - Pulmonary valve regurgitation (moderate or greater)
  - Pulmonary valve stenosis (moderate or greater)
  - Peripheral pulmonary stenosis
  - Sinus of Valsalva fistula/aneurysm
  - Sinus venosus defect
  - Subvalvar aortic stenosis (excluding HCM; HCM not addressed in these guidelines)
  - Supravalvar aortic stenosis
  - Straddling atrioventricular valve
  - Repaired tetralogy of Fallot
  - VSD with associated abnormality and/or moderate or greater shunt

Class III-Great Complexity (or Complex)
- Cyanotic congenital heart defect (unrepaired or palliated, all forms)
- Double-outlet ventricle
- Fontan procedure
- Interrupted aortic arch
- Mitral atresia
- Single ventricle (including double inlet left ventricle, tricuspid atresia, hypoplastic left heart, any other anatomic abnormality with a functionally single ventricle)
- Pulmonary atresia (all forms)
- TGA (classic or d-TGA; CCTGA or I-TGA)
- Truncus arteriosus
- Other abnormalities of atrioventricular and ventriculoarterial connection (i.e., crisscross heart, isomerism, heterotaxy syndromes, ventricular inversion)
CD-11.1.2: Modalities

- Echocardiogram - transthoracic (TTE) or transesophageal (TEE)
  - Transthoracic echocardiography (TTE) is an indispensable tool in the initial and serial follow-up evaluation to identify abnormalities and changes that commonly influence management decisions

- Cardiac MRI (CMR)
  - CMR plays a valuable role in assessment of RV size and function, because it provides data that are reproducible and more reliable than data obtained with alternative imaging techniques
  - For intracardiac congenital heart disease, CMR will typically include flow velocity mapping for shunts and flow assessment.
  - Imaging that only requires aortic arch imaging, does not require intracardiac CMR, only MRA Chest

- Cardiac Computed Tomography (CCT) and Cardiac Computed Tomography Angiography (CCTA)
  - The most important disadvantage of CCT (including CT angiography) as an imaging technique is the associated exposure to ionizing radiation

- Cardiac catheterization
  - (Hemodynamic and/or Angiographic) in individuals with adult CHD AP classification II and III, or interventional cardiac catheterization in individuals with adult CHD AP classification I to III should be performed by, or in collaboration with, cardiologists with expertise in adult CHD

- Exercise Testing
  - Exercise test does not imply stress imaging

- Stress Imaging
  - Includes-MPI, stress echo, stress MRI
  - PET stress may be included as per CD-6: Cardiac PET

- Circumstances where CMR, CCT, TEE, and/or Cardiac Catheterization may be Superior to TTE
  - Assessment of RV size and function in repaired Tetralogy of Fallot (TOF), systemic right ventricles, and other conditions associated with right ventricular (RV) volume and pressure overload
  - Identification of anomalous pulmonary venous connections
  - Serial assessment of thoracic aortic aneurysms, especially when the dilation might extend beyond the echocardiographic windows
  - Accurate assessment of pulmonary artery (PA) pressure and pulmonary vascular resistance
  - Assessment for re-coarctation of the aorta
  - Sinus venosus defects
  - Vascular rings
  - Evaluation of coronary anomalies
  - Quantification of valvular regurgitation
### CD-11.1.3: Coding

<table>
<thead>
<tr>
<th>Modality</th>
<th>CPT®</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Echocardiogram</strong></td>
<td></td>
</tr>
<tr>
<td><em>Transthoracic echocardiogram (TTE)</em></td>
<td></td>
</tr>
<tr>
<td>TTE for congenital cardiac anomalies; complete</td>
<td>93303</td>
</tr>
<tr>
<td>TTE for congenital cardiac anomalies; limited study</td>
<td>93304</td>
</tr>
<tr>
<td>TTE (2D) m-mode recording, complete, with spectral and color flow doppler echocardiography</td>
<td>93306</td>
</tr>
<tr>
<td>TTE (2D) with or without m-mode recording; complete</td>
<td>93307</td>
</tr>
<tr>
<td>TTE (2D) with or without m-mode recording; limited study</td>
<td>93308</td>
</tr>
<tr>
<td><em>Transesophageal echocardiogram (TEE)</em></td>
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<tr>
<td>TEE (2D) including probe placement, imaging, interpretation, and report</td>
<td>93312</td>
</tr>
<tr>
<td>TEE for congenital cardiac anomalies; including probe placement, imaging, interpretation, and report</td>
<td>93315</td>
</tr>
<tr>
<td><strong>MRI</strong></td>
<td></td>
</tr>
<tr>
<td><em>cardiac (CMR)</em></td>
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</tr>
<tr>
<td>Cardiac MRI for morphology and function without contrast</td>
<td>75557</td>
</tr>
<tr>
<td>Cardiac MRI for morphology and function without and with contrast</td>
<td>75561</td>
</tr>
<tr>
<td><strong>MRI Chest</strong></td>
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</tr>
<tr>
<td>MRI Chest without contrast</td>
<td>71550</td>
</tr>
<tr>
<td>MRI Chest with contrast</td>
<td>71551</td>
</tr>
<tr>
<td>MRI Chest with and without contrast</td>
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<tr>
<td><strong>MRI Angiography (MRA) MRA Chest</strong></td>
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<td>MRA Chest (excluding myocardium) with or without contrast</td>
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<td><strong>CT</strong></td>
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<tr>
<td><em>cardiac (CCT)</em></td>
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<td>CT, Heart, with contrast material, for evaluation of cardiac structure and morphology</td>
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<tr>
<td>CT, Heart, with contrast material, for evaluation of cardiac structure and morphology in the setting of congenital heart disease</td>
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<td><strong>CT Angiography-Cardiac (CCTA)</strong></td>
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<td>Modality</td>
<td>CPT®</td>
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<td>CTA Heart, coronary arteries and bypass grafts (when present), with contrast, including 3D image post processing</td>
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<tr>
<td><strong>CT-Chest</strong></td>
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<td>CT Thorax without contrast</td>
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<tr>
<td>CT Thorax with contrast</td>
<td>71260</td>
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<tr>
<td>CT Thorax without and with contrast</td>
<td>71270</td>
</tr>
<tr>
<td><strong>CT Angiography-Chest (CTA Chest)</strong></td>
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<tr>
<td>CTA Chest without and with contrast</td>
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</tr>
<tr>
<td><strong>Stress Imaging (echo, MRI, MPI)</strong></td>
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<tr>
<td>Stress echo</td>
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<tr>
<td>Echocardiography (TTE), (2D), with or without m-mode, during rest and cardiovascular stress, with interpretation and report</td>
<td>93350</td>
</tr>
<tr>
<td>Echocardiography (TTE), (2D), m-mode, during rest and cardiovascular stress test using treadmill, bicycle exercise and/or pharmacologically induced stress, with interpretation</td>
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<tr>
<td>Stress MRI</td>
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<td>Cardiac MRI for morphology and function without contrast, with stress imaging</td>
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<tr>
<td>Cardiac MRI for morphology and function without and with contrast, with stress imaging</td>
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<tr>
<td><strong>Myocardial perfusion imaging (MPI)</strong></td>
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<tr>
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<tr>
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<tr>
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</tr>
<tr>
<td>Pulmonary ventilation (e.g., aerosol or gas) and perfusion imaging</td>
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</tr>
<tr>
<td>Quantitative differential pulmonary perfusion, including imaging when performed</td>
<td>78597</td>
</tr>
</tbody>
</table>
CD-11.2: Congenital Heart Disease Imaging Indications

- The following sections are based on the congenital heart lesion. Requests for imaging based on other cardiac conditions, such as CAD, HCM, acquired valvular lesions, should follow the adult cardiac guidelines for those conditions.

CD-11.2.1: ASD - Atrial septal defects

- This section does not include patent foramen ovale (PFO) or PFO occluders.

- Initial studies—Diagnosis, clinical changes, consideration of surgery
  - Echocardiogram at time of diagnosis
    - CMR, CCT (CPT® 75573), and/or TEE are useful if echo (TTE) is suboptimal and either:
      - ASD is suspected
      - To evaluate pulmonary venous connections in known ASD
    - MRA Chest or CTA Chest may be indicated if echo shows pulmonary venous anomalies
      - If normal then repeat pulmonary vein imaging is not required
  - Transesophageal echocardiogram (TEE) is recommended to guide percutaneous ASD closure
  - Diagnostic cath is indicated when there is either:
    - Evidence of pulmonary hypertension
    - Unanswered questions on CMR/CCT for venous drainage

- TTE is indicated post ASD device placement:
  - 6 months to evaluate for erosion
  - 1 week (if amplazter)
  - 1 month
  - 6 months
  - 12 months
  - Then every 1-2 years

- Due to low risk of erosion in PFO devices - PFO device closure requires follow-up at 6-12 months. No additional evaluation unless PFO not closed

- Stress imaging and coronary artery imaging would be based on CD-1.4: Stress Testing with Imaging – Indications
Follow-up ASD, SD, if surgically closed or if no interventions

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological stage</td>
<td>A</td>
</tr>
<tr>
<td>Echo (TTE)</td>
<td>36-60</td>
</tr>
</tbody>
</table>

CD-11.2.2: Anomalous Pulmonary Venous Connections

- Initial studies-Diagnosis, clinical changes, consideration of surgery
  - Echocardiogram at time of diagnosis
    - CMR and/or MRA Chest, or Cardiac CT and/or CTA Chest at time of diagnosis if any issues with pulmonary veins or RV volume
    - Cardiac Cath at time of diagnosis for hemodynamic data and issues not answered on other imaging
  - Routine stress imaging or coronary artery imaging not required
  - Echo, CMR, CT, per cardiology request for clinical changes
  - Diagnostic heart catheterization if questions unanswered on imaging

Follow-up Anomalous Pulmonary Venous Connections

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modality</td>
<td>A</td>
</tr>
<tr>
<td>Echo (TTE)</td>
<td>36-60</td>
</tr>
</tbody>
</table>

CD-11.2.3: Ventricular Septal Defect (VSD)

- Initial studies-Diagnosis, clinical changes, consideration of surgery
  - Echo (TTE) at time of diagnosis
    - CMR or CCT can be performed if questions are unanswered on echo
    - Catheterization at time of diagnosis for hemodynamics if pulmonary hypertension (PHT) or shunt size is a question

Long term follow-up VSD

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological stage</td>
<td>A</td>
</tr>
<tr>
<td>Echo (TTE)</td>
<td>36</td>
</tr>
</tbody>
</table>
**CD-11.2.4: Atrioventricular Septal Defect (AV Canal, AVSD, endocardial cushion defect)**

- Initial studies-Diagnosis, clinical changes, consideration of surgery
  - Echo (TTE) at time of diagnosis
    - CMR or Cardiac CT at time of diagnosis if there are unanswered questions on echo
    - Cardiac cath at time of diagnosis when CMR and TTE leave questions unanswered that affect individual management
  - Stress imaging per **CD-1.4: Stress Testing with Imaging – Indications**

**Long term follow-up – AVSD**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological stage</td>
<td>A</td>
</tr>
<tr>
<td>Echo (TTE)</td>
<td>24-36</td>
</tr>
</tbody>
</table>

**CD-11.2.5: Patent Ductus Arteriosus (PDA)**

- Initial studies-Diagnosis, clinical changes, consideration of surgery
  - Echo at time of diagnosis
    - MR Chest or CT Chest if there are questions left unanswered by echo
    - Cardiac Cath for hemodynamics (if planned device closure, diagnostic cardiac cath is not indicated as it is included in the procedure code)
  - Stress imaging per **CD-1.4: Stress Testing with Imaging – Indications**

**Long term follow-up PDA**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological stage</td>
<td>A</td>
</tr>
<tr>
<td>Echo (TTE)</td>
<td>36-60</td>
</tr>
</tbody>
</table>

**CD-11.2.6: Cor Triatriatum**

- Initial studies-Diagnosis, clinical changes, consideration of surgery
  - Echocardiogram (TTE) at time of diagnosis
    - CMR and/or MRA Chest or Cardiac CT and/or CTA Chest
    - Diagnostic cath if additional information is required for medical management
  - Long term follow-up
    - Stress imaging per **CD-1.4: Stress Testing with Imaging – Indications**

**CD-11.2.7: Congenital Mitral Stenosis**

- Initial studies-Diagnosis, clinical changes, consideration of surgery
  - Echocardiogram (TTE) at time of diagnosis
Long term follow-up congenital mitral stenosis

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological stage</td>
<td>A</td>
</tr>
<tr>
<td>Echo (TTE)</td>
<td>24</td>
</tr>
</tbody>
</table>

CD-11.2.8: Subaortic Stenosis (SAS)

- Initial studies—Diagnosis, clinical changes, consideration of surgery
  - Echocardiogram (TTE) at time of diagnosis
  - Stress imaging (stress echo or stress MRI) for ANY of the following:
    - Once at the time of diagnosis
    - New or changed signs or symptoms of ischemia
    - Changes in cardiac function
    - If cardiac intervention is being considered
    - Any signs or symptoms allowed in CD-1.4: Stress Testing with Imaging – Indications

Long term follow-up SAS

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological stage</td>
<td>A</td>
</tr>
<tr>
<td>Echo (TTE)</td>
<td>24</td>
</tr>
<tr>
<td>Stress imaging</td>
<td>24</td>
</tr>
</tbody>
</table>

CD-11.2.9: Congenital Valvular Aortic Stenosis

- Initial studies—Diagnosis, clinical changes, consideration of surgery
  - Echocardiogram (TTE) at time of diagnosis
  - TEE may be required if TTE limited or equivocal
  - MRA Chest or CTA Chest if ONE of the following:
    - Suspicion of Coarctation based on exam and echocardiogram
    - Proximal ascending aorta not well visualized on TTE

Routine follow-up Congenital Valvular Aortic Stenosis

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage (valvular AS)</td>
<td>Progressive (stage B) Mild Vmax 2.0-2.9 m/s</td>
</tr>
<tr>
<td>Echo (TTE)</td>
<td>3-5 years</td>
</tr>
<tr>
<td>MRA or CTA Chest</td>
<td>if ascending allowed yearly</td>
</tr>
</tbody>
</table>
CD-11.2.10: Aortic disease in Turner Syndrome

- Dissection more common for a given aortic diameter. Mid-ascending aortic disease more common and may not be reliably seen on echocardiogram.

- Initial studies—Diagnosis, clinical changes, consideration of surgery
  - Echocardiogram (TTE) at time of diagnosis
  - MRA or CTA Chest to rule out mid ascending aortic aneurysm if mid aorta was not seen on echocardiogram.

- Surveillance
  - Echocardiogram (TTE) yearly
    - MRA or CTA Chest if mid ascending aorta not visualized
  - For documented thoracic aortic aneurysm (TAA) ≤4cm
    - Routine MRA or CTA Chest yearly
  - For documented thoracic aortic aneurysm (TAA) >4cm
    - MRA or CTA Chest every 6 months

CD-11.3: Aortopathies with CHD

- Dilated aortic arches are not uncommon with several congenital heart disease and postoperative procedures including- Aortic stenosis, Ross repair, Tetralogy of Fallot, Transposition of the great arteries (TGA), Pulmonary atresia, hypoplastic left heart syndrome (HLHS), Truncus Arteriosus, single ventricle individuals.
**CD-11.3.1: Supravalvular Aortic Stenosis**

- Supravalvular aortic stenosis is a relatively rare condition overall but is seen commonly in individuals with Williams syndrome or homozygous familial hypercholesterolemia.

- Initial studies—Diagnosis, clinical changes, consideration of surgery
  - Echocardiogram (TTE) at time of diagnosis
  - MRA Chest or CTA Chest
  - Cardiac MRI or Cardiac CTA to assess coronary ostia
  - Cardiac cath for any individuals pre cardiac intervention for coronary arteries

- New cardiac symptoms—ANY of the following:
  - Cardiac CT or Cardiac MR
  - CTA Chest or MRA Chest
  - Stress imaging as per **CD-1.4: Stress Testing with Imaging – Indications**

**Routine follow-up supravalvar AS**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTE</td>
<td>A 24, B 24, C 12, D 12</td>
</tr>
<tr>
<td>CMR or CCT</td>
<td>A 36-60, B 36-60, C 36-60, D 36-60</td>
</tr>
</tbody>
</table>

**CD-11.3.2: Coarctation of the Aorta**

- Coarctation is suspected based on clinical findings:
  - BP higher in upper extremities than in the lower extremities
  - Absent femoral pulses
  - Continuous murmur
  - Abdominal bruit
  - Berry aneurysm with hemorrhage
  - Rib notching on x-ray
  - Abnormal thoracic aortic imaging and blood pressures

- Initial studies—Diagnosis, clinical changes, consideration of surgery
  - Echocardiogram (TTE) at time of diagnosis
    - No further imaging is required if echocardiogram (TTE), blood pressure, and exam rule out Coarctation.
    - Echo and exam are equivocal or positive ONE of the following is indicated:
      - CTA Chest
      - MRA Chest
    - Individuals with Coarctation of the aorta do not require intracardiac MR unless issue cannot be resolved on echocardiogram.
    - Screening for intracranial aneurysm by MRA or CTA Head is allowed
    - ETT for diagnosis of exercise induced hypertension does not require imaging
    - Cardiac MR not required unless issues unresolved by echo for intracardiac anatomy
Diagnostic cath can be approved prior to stenting of PDA
Stress imaging, TEE, Cardiac MR or CT, Coronary imaging not routinely

Symptomatic
Individuals with Coarctation are at risk for dissection. When individual has new or worsening symptoms ANY of the following:
- Echocardiogram (TTE)
- MRA or CTA Chest
For exertional symptoms, ONE of the following:
- Stress imaging as per **CD-1.4: Stress Testing with Imaging – Indications**
- Cardiac MRI or Cardiac CT

**Routine follow-up Coarctation of the Aorta**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological stage</td>
<td>A</td>
</tr>
<tr>
<td>TTE</td>
<td>24</td>
</tr>
<tr>
<td>MRA Chest or CTA Chest</td>
<td>36-60</td>
</tr>
</tbody>
</table>

**CD-11.3.3: Valvular Pulmonary Stenosis**

Overview Initial studies-Diagnosis, clinical changes, consideration of surgery
- Echocardiogram (TTE) at time of diagnosis
- For issues affecting management not well visualized on TTE
  - Cardiac MRI or Cardiac CT
  - MRA Chest or CTA Chest

Valvular PS routine follow-up and testing.
- Echocardiogram-stages
  - Mild PS – peak gradient <36 mmHg (peak velocity <3m/s)
  - Moderate PS - peak gradient 36-64 mmHg (peak velocity 3-4 m/s)
  - Severe PS - peak gradient >64 mmHg (peak velocity >4 m/s); or mean gradient >35 mmHg.
- Routine stress imaging is not required
- Routine chest or cardiac or ischemia workup not required.

**Valvular PS routine imaging**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological stage</td>
<td>A</td>
</tr>
<tr>
<td>TTE</td>
<td>36-60</td>
</tr>
</tbody>
</table>
**Isolated Pulmonary regurgitating after PS repair-Echo and CMR at same interval as TOF**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological stage</td>
<td>A</td>
</tr>
<tr>
<td>TTE</td>
<td>24</td>
</tr>
<tr>
<td>CMR</td>
<td>36</td>
</tr>
</tbody>
</table>

**CD-11.3.4: Branch and Peripheral pulmonary stenosis**

- **Overview**
  - Can be seen in newborns as a normal variant in the first 6 months of life
  - Can be seen in surgeries of right ventricular outflow (TOF)
    - Noonan
    - Alagille
    - Williams
    - Maternal rubella exposure
    - Keutel syndrome

- **Initial studies-Diagnosis, clinical changes, consideration of surgery**
  - Echocardiogram (TTE) at time of diagnosis
  - Baseline MRA Chest or CTA Chest
  - Cath may be considered if other advanced imaging is not adequate for management
  - VQ scan or MRA Chest for differential blood flow

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological stage</td>
<td>A</td>
</tr>
<tr>
<td>TTE</td>
<td>24-36</td>
</tr>
<tr>
<td>Cardiac MRI or Cardiac CT</td>
<td>36-60</td>
</tr>
<tr>
<td>MRA Chest or CTA Chest</td>
<td>36-60</td>
</tr>
</tbody>
</table>

**CD-11.3.5: Double chambered RV**

- **Initial studies-Diagnosis, clinical changes, consideration of surgery**
  - Echocardiogram (TTE) at time of diagnosis
**Routine follow-up double chambered right ventricle (RV)**

<table>
<thead>
<tr>
<th>Physiological stage</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Echo (TTE)</td>
<td>24-36</td>
<td>24</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

**CD-11.3.6: Ebstein Anomaly**

- Overview: Initial studies—Diagnosis, clinical changes, consideration of surgery
  - Echocardiogram (TTE) at time of diagnosis
  - TEE if either:
    - TTE is not adequate
    - If surgery/intervention planned
  - Cardiac MRI or Cardiac CT at time of Diagnosis

**Routine follow-up Ebstein Anomaly**

<table>
<thead>
<tr>
<th>Physiological stage</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Echo (TTE)</td>
<td>12-24</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Cardiac MRI or Cardiac CT</td>
<td>60</td>
<td>36</td>
<td>24-36</td>
<td>12-24</td>
</tr>
</tbody>
</table>

**CD-11.3.7: Tetralogy of Fallot (TOF, VSD with PS)**

- Includes TOF with pulmonary atresia, VSD PA
- Initial studies—Diagnosis, clinical changes, consideration of surgery
  - Echocardiogram (TTE) at time of diagnosis
  - Cardiac MR or Cardiac CTA at time of diagnosis
  - MRA Chest or CTA Chest at time of diagnosis
  - Cardiac catheterization if other advanced imaging leaves unanswered questions
- Prior to cardiac intervention or surgery
  - Repeat imaging Echo/MR/CT
  - Cath prior to surgery or intervention
    - If planned Catheter Pulmonary Valve replacement, procedure includes diagnostic cath and hemodynamics and diagnostic cath is not billed separately
- New or worsening symptoms
  - Repeat advanced imaging
  - New or worsening symptoms
  - New EKG changes
Stress imaging (stress echo, stress MRI, or MPI) allowed for typical chest pain, even if intermediate pretest probability at atypical symptoms in individuals with known or undefined coronary artery (CA) anatomy or CA pathology

VQ scan or MRA Chest for left/right perfusion abnormality

**Routine Follow-up Tetralogy of Fallot (TOF)**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological</td>
<td>A</td>
</tr>
<tr>
<td>stage</td>
<td>stage</td>
</tr>
<tr>
<td>TTE</td>
<td>24</td>
</tr>
<tr>
<td>Cardiac MRI or</td>
<td>36</td>
</tr>
<tr>
<td>CCTA</td>
<td></td>
</tr>
<tr>
<td>CTA Chest or</td>
<td>36</td>
</tr>
<tr>
<td>MRA Chest</td>
<td></td>
</tr>
<tr>
<td>CD-11.3.8: Right Ventricle–to-Pulmonary Artery Conduit</td>
<td></td>
</tr>
</tbody>
</table>

Initial studies-Diagnosis, clinical changes, consideration of surgery. Surgical repair for many lesions such as TOF/Truncus/Pulmonary atresia

- Echocardiogram (TTE) at time of diagnosis
- Cardiac MRI or Cardiac CTA
- MRA Chest or CTA Chest
- Prior to interventions or surgery may repeat any of the above imaging
- Cath allowed for new symptoms or with new imaging findings as needed for management
- Stress imaging (stress echo, stress MRI or MPI) as requested for symptoms

**Routine follow-up Right Ventricle–to-Pulmonary Artery Conduit**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological</td>
<td>A</td>
</tr>
<tr>
<td>stage</td>
<td>stage</td>
</tr>
<tr>
<td>TTE</td>
<td>12-24</td>
</tr>
<tr>
<td>CMR or CTA</td>
<td>36-60</td>
</tr>
<tr>
<td>MRA Chest or</td>
<td>36-60</td>
</tr>
<tr>
<td>CTA Chest</td>
<td></td>
</tr>
</tbody>
</table>

**CD-11.3.9: Transposition of the great arteries (TGA)**

Initial studies-Diagnosis, clinical changes, consideration of surgery

- Echocardiogram (TTE) at time of diagnosis
- Baseline Cardiac MRI or CCTA
- Baseline MRA Chest or CTA Chest
- Stress imaging as requested for symptoms or signs of ischemia
- V/Q scan for left to right PA perfusion or MRA Chest
- Symptomatic individuals should be offered stress physiological imaging and repeat anatomic imaging considered if symptoms are suggestive of coronary ischemia (regardless of diamond forester pretest probability category)
- Cath right and left heart when issues not elucidated on advanced imaging

**Routine follow-up TGA**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological stage</td>
<td>A</td>
</tr>
<tr>
<td>TTE</td>
<td>12-24</td>
</tr>
<tr>
<td>CMR or CCT</td>
<td>36-60</td>
</tr>
<tr>
<td>MR Chest or CT Chest</td>
<td>36-60</td>
</tr>
</tbody>
</table>

**CD-11.3.10: Congenitally corrected TGA**

- Initial studies-Diagnosis, clinical changes, consideration of surgery
  - Echocardiogram (TTE) at time of diagnosis
  - Baseline CMR and MRA Chest
  - CMR and/or Echo for changes in clinical status

**Routine follow-up congenitally corrected TGA**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological stage</td>
<td>A</td>
</tr>
<tr>
<td>Echo (TTE)</td>
<td>12-24</td>
</tr>
<tr>
<td>CMR or CCTA</td>
<td>36-60</td>
</tr>
<tr>
<td>CTA Chest or MRA Chest</td>
<td>36-60</td>
</tr>
</tbody>
</table>

**CD-11.3.11: Fontan Palliation of Single Ventricle Physiology**

- Including Tricuspid Atresia and Double Inlet Left Ventricle, HLHS, HRHS, PA, Mitral atresia, AVC unbalanced, single ventricle, DIRV, pulmonary atresia, HLHS, Glen procedure, TA, double outlet right ventricle (DORV), and single ventricle physiology

- Initial studies-Diagnosis, clinical changes, consideration of surgery
  - Echocardiogram (TTE) at time of diagnosis and with any new symptoms
  - CMR or CCTA can be done annually (vs. based on below chart) on individuals who have prior issues that were equivocal on echo, and the data is required (i.e. very poor windows)
    - Cardiac catheterization prior to surgical interventions
  - Echo/CMR or CCTA/MRA Chest or CTA Chest/cath with any new signs or symptoms
V/Q scan or MRA for lung perfusion left vs. right

**Routine follow-up Fontan Palliation of Single Ventricle Physiology**

<table>
<thead>
<tr>
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<th>Physiological stage / intervals for routine imaging (months)</th>
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</tr>
<tr>
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<td>12</td>
</tr>
<tr>
<td>CMR</td>
<td>36</td>
</tr>
<tr>
<td>CT or MR Chest</td>
<td>36</td>
</tr>
</tbody>
</table>

**CD-11.3.12: Severe Pulmonary artery hypertension (PHT) and Eisenmenger syndrome**

- Initial studies-Diagnosis, clinical changes, consideration of surgery
  - Echo (TTE)
    - Initial diagnosis
    - With new signs or symptoms
  - Cardiac cath
    - Echo (TTE) results suggest PHT
    - New signs of symptoms with PTH

**Long term follow-up Severe Pulmonary artery hypertension (PHT) and Eisenmenger syndrome**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Physiological stage / intervals for routine imaging (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiological stage</td>
<td>A</td>
</tr>
<tr>
<td>TTE</td>
<td>12</td>
</tr>
<tr>
<td>CMR or CCT</td>
<td>As needed</td>
</tr>
<tr>
<td>MRA Chest or CTA Chest</td>
<td>As needed</td>
</tr>
<tr>
<td>Cath</td>
<td>As needed</td>
</tr>
</tbody>
</table>

**CD-11.3.13: Coronary artery anomalies**

- Initial studies-Diagnosis, clinical changes, consideration of surgery
  - Echocardiogram (TTE)
    - At baseline
    - Any signs or symptoms
  - Coronary CT/MR/Cath for initial evaluation
  - CA from wrong sinus-baseline stress imaging regardless of symptoms
  - Stress imaging for any cardiac signs or symptoms
  - For Kawasaki guidelines regarding echo, Stress imaging, coronary imaging, See **PEDCD-6: Kawasaki Disease** in the Pediatric Cardiac Imaging Guidelines
CD-11.4: Pregnancy-maternal imaging

Overview

World Health Organization (WHO) classification:

- WHO classification I: No detectable increased risk of maternal mortality and no/mild increase in morbidity.
  - Uncomplicated small or mild pulmonary stenosis
  - Patent Ductus Arteriosus (PDA)
  - Mitral valve prolapse
  - Successfully repaired simple lesions (atrial or ventricular septal defect, patent ductus arteriosus, anomalous pulmonary venous connection)
- WHO classification II: Small increase in maternal risk mortality or moderate increase in morbidity.
  - Unrepaired atrial or ventricular septal defect
  - Unrepaired tetralogy of Fallot
- WHO classification II–III (depending on individual)
  - Mild left ventricular impairment
  - Native or tissue valvular heart disease not considered WHO I or IV
  - Marfan syndrome without aortic dilation
  - Aorta <45 mm in association with bicuspid aortic valve disease
  - Repaired coarctation
- WHO classification III: Significantly increased risk of maternal mortality or severe morbidity. Expert counseling required. If pregnancy is decided upon, intensive specialist cardiac and obstetric monitoring needed throughout pregnancy, childbirth and the puerperium.
  - Mechanical valve
  - Systemic right ventricle
  - Fontan circulation
  - Unrepaired cyanotic heart disease
  - Other complex congenital heart disease
  - Aortic dilation 40–45 mm in Marfan syndrome
  - Aortic dilation 45–50 mm in bicuspid aortic valve disease
- WHO classification IV: Extremely high risk of maternal mortality or severe morbidity; pregnancy contraindicated. If pregnancy occurs, termination should be discussed. If pregnancy continues, care as for WHO class III.
  - Pulmonary arterial hypertension from any cause
  - Severe systemic ventricular dysfunction (LVEF <30%, NYHA functional class III–IV)
  - Severe mitral stenosis; severe symptomatic aortic stenosis
  - Marfan syndrome with aorta dilated >45 mm
  - Aortic dilation >50 mm in aortic disease associated with bicuspid aortic valve
  - Native severe coarctation of the aorta

Congenital heart disease imaging in pregnancy
- Echocardiogram (TTE) when planning pregnancy
- TEE if TTE equivocal
- CMR can be performed prior to planning pregnancy in those lesions were CMR would be routinely performed at some later date
- CTA Chest or MRA Chest of arch if known disease with aortic involvement or if known dilation
- Repeat echocardiogram and MR (can be without gad) can be performed based on the II, III, IV, or other risk factors
- Severe complex CHD, may require echo monthly, or even weekly (every two weeks) (major physiological changes)-may be best as often as needed (Pulmonary hypertension, changes in function, can guide delivery after 24 weeks)
- Echo can be performed if new signs or symptoms during pregnancy
- Post-partum first year can have more frequent imaging
- Stress imaging pre/during pregnancy for individuals with known Coronary artery anomaly, pulmonary hypertension, LVOT obstruction, cardiac dysfunction, single ventricle.
- WHO II, III, IV, can have echo MR CT stress imaging prior to pregnancy,
  - WHO I once echocardiogram during pregnancy
  - WHO II once per trimester
  - WHO II-III every 2 months
  - WHO III/IV monthly
  - Individuals may require more (even weekly) if treatment decision, delivery is considered.

Syndromes that allow cardiac imaging at the time of diagnosis if not previously done. This list is not exhaustive
- De George/velocardiofacial)
- (22q11.2)
- Down syndrome (trisomy 21)
- Holt Oram (TBX5)
- Klinefelter syndrome (47 XXY)
- Noonan (PTPN11, KRAS, SOS1 RAF1, NRAS, BRAF, MAP2K1)
- Turner (45X)
- Williams (7q11.23 deletion)
- Any syndrome associated with congenital heart disease.

Echocardiogram at time of diagnosis (either genetic testing or clinical features)

CMR or CCTA if arch involved in disease.
References
2. ACC/AATS/AHA/ASE/ASNC/HRS/SACI/SCCT/SCMR/STS2019 Appropriate Use Criteria for Multimodality Imaging in the Assessment of Cardiac Structure and Function in Nonvalvular Heart Disease
3. 2018 AHA/ACC Guideline for the Management of Adults With Congenital Heart Disease
5. ACC/AATS/AHA/ASE/ASNC/HRS/SACI/SCCT/SCMR/STS 2019 Appropriate Use Criteria for Multimodality Imaging in the Assessment of Cardiac Structure and Function in Nonvalvular Heart Disease
9. 2015 ACC/AHA/HRS Guideline for the Management of Adult Patients With Supraventricular Tachycardia
11. 2010 ACCF/AATS/ACR/ASA/SACI/SIR/STS/SVM Guidelines for the Diagnosis and Management of Patients With Thoracic Aortic Disease
12. AMPLATZER™ PFO Occluder for the Prevention of Recurrent Ischemic Stroke, sponsors executive summary, circulatory systems devices panel
13. P120021 AMPLATZERTM Patent Foramen Ovale (PFO) Occluder St. Jude Medical, FDA executive summary, Circulatory systems devices panel SUMMARY OF SAFETY AND EFFECTIVENESS DATA (SSED), FDA AMPLATZER
15. Updates on Instructions for Use (IFU) regarding Erosion for the AMPLATZER™ Septal Occluder (ASO) Supplementary Information 16th December 2013 Dear Customer, Following the Field Safety Notice for the AMPLATZER™ Septal Occluder, St. Jude Medical has received several similar questions from physicians.


### CD-12: Cancer Therapeutics-Related Cardiac Dysfunction (CTRCD)

#### CD-12.1: Oncologic Indications for Cancer Therapeutics-Related Cardiac Dysfunction (CTRCD)
**CD-12.1: Oncologic Indications for Cancer Therapeutics-Related Cardiac Dysfunction (CTRCD)**

- MUGA evaluation of LV ejection fraction and wall motion analysis are appropriate - if an echocardiogram is not appropriate and ANY of the following chemotherapy-related indications:
  - Determine LV function in individuals on cardiotoxic chemotherapeutic drugs.
    - The time frame should be determined by the provider, but no more often than baseline and at every 6 weeks.
    - May repeat every 4 weeks if cardiotoxic chemotherapeutic drug is withheld for significant left ventricular cardiac dysfunction.
  - If the LVEF is <50% on echocardiogram than follow up can be done with MUGA at appropriate intervals.

- Echocardiography vs. MUGA for Determining Left Ventricular Ejection Fraction (LVEF) in Individuals on Cardiotoxic Chemotherapy Drugs:
  - eviCore guidelines support using **echocardiography rather than MUGA** for the determination of LVEF and/or wall motion EXCEPT in one of the circumstances described previously in **CD-3.4: MUGA Study – Cardiac Indications**.

**Background and Supporting Information**

- Advantages of Echocardiography in comparison to MUGA in individuals on cardiotoxic chemotherapy:
  - No ionizing radiation
  - No IV access required when echo contrast is not used
  - Allows view of the pericardium to look for effusion
  - Allows estimate of pulmonary pressure
  - May allow visualization of a clot or tumor in the Inferior Vena Cava (IVC) and/or the right heart

**References**

## CD-13: Pre-surgical Cardiac Testing

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CD-13.1: Pre-Surgical Cardiac testing-General Information

- It is important to differentiate requests for preoperative CT imaging before cardiac surgery according to type of procedure planned:
  - Primary cardiac operation-individuals who have not had prior heart surgery
  - Redo procedures-individuals who have had a prior procedure (it is important to determine the type of procedure as this may impact which modality is most appropriate for the pre-operative assessment)
  - Minimally invasive procedures, such as minimally invasive aortic valve operations, minimally invasive or robotic mitral operations, TAVR, Mitraclip or other percutaneous valve procedures (such as valve in valve aortic or mitral, percutaneous tricuspid and TMVR which will be increasing in the future)

- In re-operative cardiac surgery, the benefit of preoperative CT is to assess for aortic calcifications, to evaluate the anatomic relationships in the mediastinum, such as the location of the various cardiac chambers and great vessels and proximity to the sternum, and to assess for the location of prior bypass grafts. Information can then be used to change the operative strategy including non-midline approach, peripheral vascular exposure, and alternative cannulation sites and for establishing cardiopulmonary bypass before re-sternotomy. These technique can result in decreased incidence of intraoperative injury to heart, great vessels and prior bypass grafts and lower rates of postoperative stroke. IV contrast is necessary with these studies to delineate the anatomic structures. However, in individuals with renal insufficiency, the provider might chose to forgo the contrast if does not want to contrast load the individual prior to placing them on the heart-lung machine.

  - Aortic atherosclerosis is recognized as the single most important determinant of postoperative stroke. There is evidence to support that preoperative CT is associated with lower postoperative stroke rates and mortality after primary cardiac surgery.
  - CT Chest without contrast can be performed pre-operatively to allow the surgeon to:
    - Visualize the extent and location of aortic atherosclerosis
    - Change the operative strategy such as those problematic areas are avoided

CD-13.2: Primary cardiac surgery-no previous cardiac surgery

- CT Chest without contrast (CPT® 71250) to evaluate for the presence of ascending aortic calcifications may be indicated prior to primary cardiac surgery when there is documented high risk for aortic calcification including any of the following:
  - Aortic calcification on chest x-ray or other diagnostic test (TEE, fluoroscopy, etc.)
  - Calcific aortic stenosis
  - End stage renal disease (dialysis)

CD-13.3: Re-operative cardiac surgery

- Individuals undergoing re-operative cardiac surgery may undergo ONE of the following tests for preoperative assessment:
  - CT Chest with contrast
CTA Chest
- CCTA only if prior CABG (this might be in addition to CT with contrast as CCTA will not show the extent of the thoracic aorta that needs to be visualized)
- CT Heart usually does not provide the necessary information, and should not be approved routinely.

**CD-13.4: Minimally invasive aortic valve surgery**

- See **CD-4.8: Transcatheter Aortic Valve Replacement (TAVR)**
- For individual undergoing minimally invasive aortic valve surgery and minimally invasive or robotic mitral valve surgery, ONE of the following for preoperative assessment of individual suitability for the approach and for subsequent procedure planning:
  - CTA Chest, CTA Abdomen and Pelvis
  - CT Chest and CT Abdomen and Pelvis with contrast

**CD-13.5: Percutaneous Mitral Valve Repair (mitral valve clip)**

- Percutaneous treatment of mitral regurgitation can be accomplished using venous access to apply a clip device (e.g., Mitraclip® currently FDA approved) to provide edge-to-edge mitral leaflet coaptation, approximating opposing sections of the anterior and posterior mitral valve leaflets. It is indicated for individuals with symptomatic, moderate to severe or severe primary mitral regurgitation whose surgical risks are prohibitive, as well as symptomatic moderate to severe or severe secondary mitral regurgitation who have failed optimal medical therapy. This therapy should include, if indicated, cardiac resynchronization therapy.

- The following imaging may be used to determine if an individual is eligible for the procedure:
  - Transthoracic echo with or without 3D rendering
  - Transesophageal echo with or without 3D rendering
  - Heart catheterization, including right heart cath if requested

- Because this is a venous approach, CTA Abdomen, Chest, and/or Pelvis is **not** indicated.

- Post procedure transthoracic echo (TTE) can be performed at the following intervals:
  - One month
  - Six months
  - One year
References


Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart
Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular
Computed Tomography, Society for Cardiovascular Magnetic Resonance, and Society of Thoracic
chest computed tomography for prevention of stroke in cardiac surgery? Interactive CardioVascular