Common symptoms and symptom complexes are addressed by this tool. Imaging requests for patients with atypical symptoms or clinical presentations that are not specifically addressed will require physician review. Consultation with the referring physician may provide additional insight.

This version incorporates MSI accepted revisions prior to 7/22/11
<table>
<thead>
<tr>
<th>2011 CARDIAC IMAGING GUIDELINE NUMBER and TITLE</th>
<th>ABBREVIATIONS</th>
<th>GLOSSARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD-1~GENERAL GUIDELINES</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>CD-2~ECHOCARDIOGRAPHY (ECHO)</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>CD-3~NUCLEAR CARDIAC IMAGING (MPI)</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>CD-4~ULTRAFAST CT, EBCT, or MULTIDETECTOR CT for CORONARY CALCIUM SCORING</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>CD-5~CARDIAC IMAGING BASED on CORONARY CALCIUM SCORE</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>CD-6~CARDIAC MRI</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>CD-7~CARDIAC PET SCAN</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>CD-8~CT HEART and CORONARY COMPUTED TOMOGRAPHY ANGIOGRAPHY (CCTA)</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>CD-9~DIAGNOSTIC HEART CATHETERIZATION</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>CD-10~PULMONARY ARTERY and VEIN IMAGING</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>CD-11~SYNCOPE</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>CD-12~CONGESTIVE HEART FAILURE</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>CD-13~CARDIAC TRAUMA</td>
<td>55</td>
<td></td>
</tr>
</tbody>
</table>

**EVIDENCE BASED CLINICAL SUPPORT**

| CD-1~GENERAL GUIDELINES                       | 56            |          |
| CD-2~ECHOCARDIOGRAPHY (ECHO)                  | 56            |          |
| CD-3~NUCLEAR CARDIAC IMAGING (MPI)            | 57            |          |
| CD-4~ULTRAFAST CT, EBCT, or MULTIDETECTOR CT for CORONARY CALCIUM SCORING | 58            |          |
| CD-6~CARDIAC MRI                               | 59            |          |
| CD-8~CT HEART and Coronary Computed Tomography Angiography (CCTA) | 61            |          |

**CARDIAC IMAGING GUIDELINE REFERENCES**

64
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<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</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)</td>
</tr>
<tr>
<td>MUGA</td>
<td>multi gated acquisition scan</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>
</tbody>
</table>
## GLOSSARY for CARDIAC GUIDELINES

<table>
<thead>
<tr>
<th><strong>Agatston Score:</strong></th>
<th>a calcium score for the coronary arteries; the only calcium score accepted by MedSolutions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Angina:</strong></td>
<td>principally chest discomfort, exertional (or with emotional stress) and relieved by rest or nitroglycerine (see CD- 8 Evidence Based Clinical Support Table B1 and definitions)</td>
</tr>
<tr>
<td><strong>Anginal variants or equivalents:</strong></td>
<td>a manifestation of myocardial ischemia which is perceived by patients 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></td>
<td>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>Moderate exercise:</strong></td>
<td>the ability of a patient to perform the equivalent of a trot</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>
</tr>
</tbody>
</table>
| **Uninterpretable electrocardiogram (ECG):** | (for stress test purposes, this is very often NOT the same as ABNORMAL ECG), a baseline ECG that renders exercise interpretation invalid due to:  
1. complete LEFT bundle branch block  
2. ventricular paced rhythm  
3. pre-excitation patterns such as Wolff-Parkinson-White  
4. left ventricular hypertrophy with ST segment depression >1mm or any resting ST segment pattern with that change  
5. patient on a digitalis preparation  
6. resting heart rate <50 in patients on beta blocker and/or calcium blocker drug  
Multiple other patterns may be noted (e.g. right bundle branch block, nonspecific ST or T changes, ST elevations), but other than the ECG patterns mentioned above, are considered interpretable. |
| **Volume Score:** | another type of calcium score under consideration for acceptance |
CD-1~GENERAL GUIDELINES

- **CD-1.1 General Issues**
  - Prior to considering cardiac imaging, there should be recent (within 30-60 days) clinical evaluation or documented meaningful contact with the patient (preferably with a recent ECG [within past 30 days or after symptoms started or worsened, whichever is more recent] and chest x-ray, if clinically relevant to the evaluation process). Vital signs, height and weight or BMI or description of general habitus is needed.
  - These guidelines are based upon appropriate imaging in the context of a patient willing to proceed with further imaging, invasive evaluation, or procedures.
    - If the patient has no desire for these, advanced imaging may be curtailed or quite limited.
  - These guidelines are based upon using cardiac imaging to answer a specific clinical question that will affect patient management.
    - If the clinical question (e.g. does the patient have coronary artery disease?) has already been answered based upon previous clinical evaluation or imaging, then additional cardiac imaging is not indicated.
    - Cardiac imaging is not indicated if the results will not affect patient management decisions.
  - Cardiac imaging appropriateness criteria published by professional specialty organizations are not precisely concordant with these guidelines, as there is a large area of “uncertain” benefit for many imaging modalities in the specialty society criteria.
    - Even some of the “appropriate” criteria are open to interpretation, since these criteria are largely consensus-based and not evidence-based.
    - “Appropriateness does not necessarily imply that the test being rated is the initial clinical approach to be taken”*
      
    *J Am Coll Cardiol 2005;46(8):1587-1605

- **CD-1.2 Transplant Patients**
  - Patients who are candidates for any type of organ or bone marrow transplant can undergo imaging stress testing every year (usually stress echo or MPI) prior to transplant.
Patients 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.*

*J Heart Lung Transplant 2007 August;26(8):769-781

Adenosine or other pharmacologic MPI or Dobutamine stress echo 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.*

*Eur Heart J 2001; 22:895-897

There is insufficient evidence to support routine use of Coronary Computed Tomography Angiography (CCTA) in the evaluation of the coronary arteries following heart transplantation.

Echo EF > 60% is the most important determinant of survival; radionuclide ventriculography and exercise ECG were not significant predictors of survival.*

*Eur Heart J 1997;18:692-696

**CD-1.3 Stress Testing**

- Stress testing is generally indicated when there are new or worsening cardiac symptoms.
- **Exceptions:**
  - Stress testing is indicated if asymptomatic with a new abnormality on ECG, or the first ECG ever performed for that patient is abnormal.
  - The type of stress test is determined by whether criteria listed below for **Stress Testing without Imaging** or **Stress Testing with Imaging** are met.
  - Routine MPI or stress echo or stress perfusion cardiac MRI can be performed 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.
  - If previous exercise treadmill stress test was positive, then follow-up studies should consist of exercise treadmill stress tests if ECG is interpretable and patient can exercise.
  - Diabetics should not automatically be categorized as having “silent ischemia”

- **Stress Testing without Imaging** (exercise treadmill test [ETT])
  - Necessary components of a standard exercise treadmill test (ETT) include:
    - ECG that can be interpreted for ischemia
    - Patient capable of exercise on a treadmill or similar device
  - **References:**
    - Am J Cardiol 2010 Nov;106(10):1423-1428
    - Clin Cardiol 2008;31:35-40
    - Ann Intern Med 2007;147:821-828
    - Cardiosource Spotlight July 1, 2008;CS2-CS4
    - Clin Cardiol 2007;30:505-510

- Chest 2001;119:907-925
- Am Heart J 2007;154:285-290
- Am J Cardiol 2008;101:1437-1443

Stress Testing with Imaging:
- Stress Echocardiography [see CD-2.4], MPI [see CD-3.2], or Stress perfusion MRI [see CD-6.3].

Indications Include the Following:

- Recent ECG is uninterpretable for ischemia due to one or more 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 (MPI should be performed rather than stress echo)
  - pre-excitation pattern such as Wolff-Parkinson-White
  - ST segment depression greater than 1 mm (NOT nonspecific ST/T wave changes)
  - Patient on digitalis preparation
  - Resting heart rate less than 50 bpm in patients on beta blocker and/or calcium channel blocker medication
  - NOTE: For stress test purposes, an abnormal ECG does not necessarily mean that it is an uninterpretable ECG for exercise stress testing purposes*
    - *Chest 2001;119:907-925

- Physical inability to perform treadmill or other type of exercise
- History of false positive exercise treadmill test
- Need to evaluate exercise-induced left ventricular dysfunction—segmental or global
  - Examples include the need to assess specific known arterial obstructive lesions, patients presenting with shortness of breath, dyspnea on exertion, unusual fatigue, or patients with hypertrophic obstructive disease.
- Need to evaluate exercise-induced valve dysfunction such as mitral regurgitation due to papillary muscle ischemia
- If the exercise treadmill stress test is equivocal, inconclusive, or inadequate (e.g. double product < 25,000)

Stress testing with imaging can be performed with maximal exercise or chemical stress (dipyridamole, dobutamine, adenosine or adenosine analogs).
- Chemical stress echo testing with dobutamine is not recommended for evaluation of arrhythmias or in the setting of uncontrolled hypertension since dobutamine can exacerbate both.
- Chemical stress echo should also be avoided in the setting of a recent cerebrovascular event.

The use of exercise versus chemical stress does not alter the CPT® codes
used to report these studies.
➢ The need for repeat stress testing with imaging should be carefully considered and may not be indicated if stress testing with imaging has been performed within the past 3 to 6 months, or cardiac catheterization has been performed within the past year.

- **CD-1.4 Hybrid Imaging**
  - SPECT/CT which involves SPECT (MPI) imaging and CT for optimizing location, accuracy, and attenuation correction combines functional and anatomic information.
  - There is currently no evidence-based data to formulate appropriateness criteria for these hybrid scans.

- **CD-1.5 Non-imaging Heart Function (CPT®78414) and Cardiac Shunt Imaging (CPT®78428)**
  - CPT® codes 78414 and 78428 are essentially obsolete and should not be used.
  - Ejection fraction can be obtained by echocardiogram, MPI, blood pool study, cardiac MRI, cardiac CT, or cardiac PET depending on the clinical situation, rather than by the non-imaging heart function study represented by CPT®78414.
  - Echocardiogram is the preferred method for cardiac shunt detection rather than the cardiac shunt imaging study represented by CPT®78428.

- **CD-1.6 External Counterpulsation (ECP)**
  - ECP (sometimes referred to as Enhanced External Counterpulsation® or EECP®) is a therapy aimed at stimulating the formation of collateral circulation to the myocardium in patients with chronic stable angina who are not candidates for invasive methods of revascularization such as coronary bypass surgery or angioplasty/stenting.
  - A course of ECP generally consists of 35 sessions (1 to 2 hour sessions, five days a week for 7 weeks).
  - Since the therapeutic benefit of ECP is enhanced at six months and sustained at 24 months post treatment*, a repeat course of ECP earlier than 1 to 2 years from the last course of ECP is generally not indicated.
    *Am J Cardiol 2004;93(4):461-464
  - The usual procedure code for ECP is G0166, which is an all-inclusive code
    - External cardiac assistance (CPT®92971), ECG rhythm strip and report (CPT®93040 or CPT®93041), pulse oximetry (CPT®94760 or CPT®94761), and plethysmography (CPT®93922 or CPT®93923) should not be separately requested or billed with G0166.
      - MedSolutions does not currently prior authorize procedure code G0166
### CD-2~ECHOCARDIOGRAPHY (ECHO)

- **CD-2.1 Transthoracic Echocardiography (TTE)**
  - **CODING NOTES:** Transthoracic Echocardiography (TTE)
    - **2011 Transthoracic Echo CPT® Codes:**
      - CPT®93303 TTE for congenital cardiac anomalies, complete
      - CPT®93304 TTE for congenital cardiac anomalies, follow-up or limited
      - CPT®93306 TTE with 2-D, M-mode, Doppler and color flow, complete
      - CPT®93307 TTE with 2-D, M-mode, without Doppler or color flow
      - CPT®93308 TTE with 2-D, M-mode, follow-up or limited
    - **2011 Doppler Echocardiography CPT® Codes:**
      - CPT®93320 Doppler echo, pulsed wave and/or spectral display
      - CPT®93321 Doppler echo, pulsed wave and/or spectral display, follow-up or limited study
      - CPT®93325 Doppler echo, color flow velocity mapping
        - CPT®93320 and CPT®93321 should not be requested or billed together
      - Doppler echo may be indicated for the following:
        - Evaluate shortness of breath
        - Evaluate known or suspected valvular disease
        - Evaluate known or suspected hypertrophic obstructive cardiomyopathy such as idiopathic hypertrophic subaortic stenosis (IHSS) or asymmetric septal hypertrophy
    - **The most commonly performed study is a 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.
    - For a complete transthoracic echocardiogram without Doppler, report CPT®93307.
By CPT® criteria, both of the complete transthoracic echo codes (93306 and 93307) require: “2-dimensional and, when performed, selected M-mode examination of the:

- left and right atria,
- left and right ventricles,
- the aortic, mitral, and tricuspid valves,
- the pericardium, and
- adjacent portions of the aorta.”

  If it is impossible to image all the listed structures, the report must indicate the reason.

A limited transthoracic echocardiogram should be billed if the report does not “evaluate or document the attempt to evaluate” all of the required structures listed above.

- A limited transthoracic echocardiogram is reported with code 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 recent documented history consistent with a cardiac disorder (e.g. congestive heart failure), recent physical examination and/or relevant laboratory tests such as BNP elevations and worsening elevated BNP in the setting of heart failure should be considered prior to considering the need for imaging.

- The need for repeat transthoracic echocardiography (TTE) is based upon findings in the original study and documentation of the way in which repeat studies will affect patient management.

- The following are indications for which transthoracic echocardiography (TTE) can be performed at least once:

  - **Valve function and structure including:**
    - Mitral valve prolapse
    - Mitral regurgitation
    - Mitral stenosis
    - Aortic regurgitation
    - Aortic stenosis
    - Bicuspid aortic valve
    - Tricuspid valve regurgitation
    - Pulmonary valve regurgitation

- If valve surgery is being considered, TTE to assess aortic, pulmonary or mitral stenosis or regurgitation can be performed once or twice a year. TTE can accurately assess the severity of valve stenosis but is sometimes less accurate in assessing valve regurgitation.

  - **Ventricular function** including global and segmental wall motion for evaluating ejection fraction (EF) and coronary artery disease.
    - Echo can be performed to evaluate cardiomyopathy due to etiologies such as ischemia, alcohol, viral myocarditis, or idiopathic.
    - Echo can be performed before and after chemotherapy known to affect heart function. (see CD-3.7 MUGA Study)

  - **Ventricular structure including:**
    - Infiltrative diseases (e.g. sarcoid, amyloid)
    - Aneurysm with/without thrombus
- Ventricular septal defect (VSD)
- Papillary muscle rupture/dysfunction
- Hypertrophy (including asymmetric septal hypertrophy, spade heart, hypertensive concentric hypertrophy, infiltrative hypertrophy)

- Evaluate atrial or ventricular chamber size (e.g. patients with atrial fibrillation, tachyarrhythmias, or left ventricular dilatation).
- Yearly TTE may be indicated depending on the clinical circumstance.

- Detection of embolic source in patients with recent Transient Ischemic Attack (TIA), stroke, or peripheral vascular emboli.
  - Although transesophageal Echo (TEE) is more accurate in visualizing thrombus in the cardiac chambers and in visualizing the cardiac valves for vegetations (or classic mitral valve fibrinous excrescences), TTE is non-invasive and is indicated as the initial study.
  - Intravenous injected sterile saline contrast can be performed for shunt detection in cases of known or suspected atrial and/or ventricular septal defect and/or patent foramen ovale.
    - This is best assessed using TEE, especially in patients with decompression illness, although TTE is still useful in this setting.

- Evaluation of ASD repair or VSD repair: within the first year of surgery, if stable clinically, routine imaging is not supported.
  - If patients become newly symptomatic more than one year after successful repair of congenital heart disease, TTE is appropriate

- Tumor evaluation including myxomas
- Clot detection
- Evaluation of right ventricular systolic pressure and pulmonary hypertension
- Evaluation of pericardial effusion/pericardial disease including pericardial cysts (cysts are usually benign, most frequently at the right cardiophrenic border, treated by observation [chest CT, cardiac MRI, or TTE] or drainage percutaneously or by open surgery), particularly suspected cardiac tamponade

- Evaluation of congenital heart disease
- Evaluation of endocarditis
  - TTE or TEE is appropriate when there is fever, positive blood cultures indicating bacteremia, or a new murmur.
    - **Note:** lack of visible vegetations does not eliminate the diagnosis.
    - TEE remains a more sensitive technique for identification of small vegetations.

- Complications of pacemaker insertion should be monitored by TTE
  - Screening for first-degree relatives of patients 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.

Reference:

• CD-2.2 Frequency of Echocardiography Testing
  
  o Repeat echocardiograms are no longer supported (annually or otherwise) for evaluation of clinically stable syndromes, including valvular heart disease, evaluation of prosthetic valve, cardiomyopathy, and hypertension.
  
  o **Annual testing can be performed for the following when there is evidence for change in clinical status or to assess interventions (medical or surgical):**
    - Assessment of left ventricular hypertrophy progression or regression
    - Assessment of valve dysfunction
    - Assessment of cardiac chamber size in cardiomyopathy and atrial dysrhythmias
    - Assessment of chronic pericardial effusions
    - Assessment of left ventricular contractility/diastolic function prior to planned medical therapy for heart failure or to evaluate the effectiveness of on-going therapy
      - BNP levels are useful and may alone be sufficient for monitoring in many cases
    - Assessment of aortic dissection
    - Assessment of aortic root dilatation
  
  o **Testing twice a year should not be routine but can be performed for the following:**
    - New or changing (not chronic stable) pericardial effusions
    - Assessment of new/changed medical therapy for congestive heart failure
      - BNP levels are useful and may alone be sufficient for monitoring in many cases
    - Assessment of new/changed medical therapy for hypertension if left ventricular hypertrophy was present
    - Assessment of hypertrophic cardiomyopathy when the results of the echo will potentially change patient management
    - Assessment of critical valvular heart disease when the results of the echo will potentially change patient management
  
  o **New Echo can be performed for the following regardless of number of previous Echo studies:**
    - New cardiac murmurs
    - New myocardial infarction or acute coronary syndrome
    - New congestive heart failure (or new symptoms of dyspnea, orthopnea, paroxysmal nocturnal dyspnea, edema, elevated BNP)
    - New pericardial disease
    - New stroke/transient ischemic attack
    - New aortic dissection (TEE is preferred)
    - New decompression illness
    - Re-evaluation of prosthetic valve with suspected dysfunction or thrombosis or a change in clinical status
CD-2.3 Transesophageal Echocardiography (TEE)

CODING NOTES: Transesophageal Echocardiography (TEE)

2011 Transesophageal Echo CPT® Codes:

- 93312 TEE with 2-D, M-mode, probe placement, image acquisition, interpretation and report
- 93313 TEE probe placement only
- 93314 TEE image acquisition, interpretation, and report only
- 93315 TEE for congenital anomalies with 2-D, M-mode, probe placement, image acquisition, interpretation and report
- 93316 TEE for congenital anomalies, probe placement only
- 93317 TEE for congenital anomalies, image acquisition, interpretation and report only
- 93318 TEE for monitoring purposes, ongoing assessment of cardiac pumping function on an immediate time basis

2011 Doppler Echocardiography CPT® Codes:

- 93320 Doppler echo, pulsed wave and/or spectral display
- 93321 Doppler echo, pulsed wave and/or spectral display, follow-up or limited study
- 93325 Doppler echo, color flow velocity mapping

   The Doppler echo codes, if performed, may be reported with TEE codes: 93312, 93314, 93315, and 93317.

For coding purposes, there are two parts to the TEE service:

1. Placement of the transesophageal probe (transducer)
2. Image acquisition, interpretation, and report

The complete transesophageal echocardiogram service, including both probe placement and image acquisition/interpretation, is reported with code 93312.

Probe placement only is reported with code 93313.

The image acquisition/interpretation only is reported with code 93314.

Physicians use codes 93312, 93313, and/or 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
- Codes 93313 and 93314 should never be used together.
  - If both services are provided, code 93312 is reported.

Hospitals should report TEE procedures using code 93312 (the complete service).

- Codes 93313 and 93314 are not used for hospital billing.

Transesophageal echo is frequently used to monitor patients undergoing cardiac surgery and is reported with code 93318.

The following are indications for which transesophageal echocardiography (TEE) can be performed at least once:

- Limited transthoracic echo window
- Detection of embolic source or intracardiac shunting when TTE is inconclusive

Reference:

- J Am Coll Cardiol 2007 July;50:187-204
• **Examples:** atrial septal defect, ventricular septal defect, patent foramen ovale, aortic cholesterol plaques, thrombus in cardiac chambers, valve vegetations, tumor
  - Evaluation of embolic events when there is an abnormal TTE, abnormal ECG, and a history of atrial fibrillation
  - Need to clarify pathology of the atra/atrial appendage, aorta, mitral/aortic valve beyond the information that other imaging studies have provided
  - Evaluation of cardiac valve dysfunction
    - Differentiation of tricuspid from bicuspid aortic valve
    - Congenital abnormalities
  - The need for repeat TEE studies is based upon findings in the original study and documentation of the way in which repeat studies will affect patient management:
    - TEE is not particularly sensitive for left ventricular assessment since this chamber lies farther from the TEE probe than in transthoracic echo
    - **Exceptions:** the base of the heart in evaluating asymmetric septal hypertrophy or membranous ventricular septal defect
  - Reference:

**CD-2.4 Stress Echocardiography (Stress Echo)**

○ **CD-2.4.1 CODING NOTES: Stress Echocardiography (SE)**
  - **2011 Stress Echo CPT® Codes:**
    - 93350 Echo, transthoracic, with 2-D, M-mode, during rest and stress
    - 93351 Echo, transthoracic, with 2-D, M-mode, during rest and stress including continuous ECG monitoring with physician supervision
  - **2011 Doppler Echocardiography CPT® Codes:**
    - 93320 Doppler echo, pulsed wave and/or spectral display
    - 93321 Doppler echo, pulsed wave and/or spectral display, follow-up or limited study
    - 93325 Doppler echo, color flow velocity mapping
    - SE codes 93350 and 93351 do not include Doppler studies.
    - Providers may code separately for Doppler (codes 93320-93325) when performed with stress echo.
  - Doppler echo may be indicated for the following:
    - Evaluate shortness of breath
    - Evaluate known or suspected valvular disease
    - Evaluate known or suspected hypertrophic obstructive cardiomyopathy such as idiopathic hypertrophic subaortic stenosis (IHSS) or asymmetric septal hypertrophy
  - Providers should use the appropriate stress testing codes from the 93015-93018 series, in addition to 93350 to report the exercise stress portion of the study.
  - Code 93351should not be used in conjunction with 93015-93018 or 93350.

○ **CD-2.4.2 Indications for Stress Echo**
  - New or worsening cardiac symptoms **and** age 50 or greater **and** known diabetes mellitus
  - New or worsening cardiac symptoms with a history of known CAD
Assessment of known or suspected coronary artery disease (CAD) when stress testing with imaging is indicated (e.g. ECG is not interpretable and/or patient is unable to perform exercise--See Stress Testing with Imaging section in CD-1.3 Stress Testing for complete indications for stress testing with imaging)

- Stress echo is effective in establishing the diagnosis of CAD and determining ischemic burden in those with known CAD.
  - Stress echocardiography has similar sensitivity and superior specificity to MPI for evaluation of ischemic heart disease and avoids radiation. *

  *J Am Coll Cardiol 2007;49(2):227-237
  *Journal of the American Society of Echocardiography 2007;20(9):1021-1041

- Patients with 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. Stress testing should proceed based on the following guidelines:
  - CD-2.4 Stress Echocardiography (Stress Echo)
  - CD-3.2 INDICATIONS FOR MPI
  - CD-6.3 Stress Perfusion MRI

Based upon evidence from the literature, MedSolutions’ guidelines support stress echo as the initial imaging modality for the evaluation of coronary artery disease/ischemic heart disease when stress testing with imaging is indicated (e.g. ECG is not interpretable and/or patient is unable to perform exercise--See Stress Testing with Imaging section in CD-1.3 Stress Testing for complete indications for stress testing with imaging)

- Advantages of stress echo over nuclear cardiac (MPI) stress test:
  - Lack of ionizing radiation
  - Shorter imaging times
  - Portability
  - Immediate availability of results
  - Availability of ancillary information about chamber sizes and function, valves, pericardial effusion, aortic root disease, wall thickness
  - Detects balanced ischemia (which can be missed on MPI since MPI measures relative perfusion rather than absolute perfusion)
  - Potentially more accurate in women with large breasts since the echo probe is placed under the breast. MPI may be more likely to produce a false positive result due to attenuation artifact.

- Stress echo can effectively be used in the following conditions (this is not an all-inclusive list of indications):
  - Arrhythmias (supraventricular and ventricular) and palpitations (e.g. to identify an ischemic substrate for malignant arrhythmias)
  - Any chronic (not rate-related) complete left bundle branch block on ECG

  NOTE: Dobutamine stress echo is very useful for evaluation of coronary artery disease in left bundle branch block (LBBB)
Presence of ST depression >1 mm on pre-exercise ECG
Digitalis effect on ECG
Dyspnea on exertion (including evaluation of pulmonary hypertension)
Ischemia-induced valve dysfunction due to papillary muscle dysfunction
Right heart dysfunction
Left ventricular functional abnormalities (including systolic, diastolic, and regional wall motion abnormalities)
ST depression and no other corroborating findings supporting ischemia on treadmill stress testing (suspected false positive) or ST depression thought to be equivocal
Identify segmental wall motion abnormalities consistent with in stent restenosis
Assessing myocardial viability in patients with ischemic ventricular dysfunction (suspected hibernating myocardium) if there is documented evidence that revascularization would not be undertaken without it.

**NOTE:** MRI, cardiac PET, or MPI can also be used to assess myocardial viability depending on physician preference

### References:
- J Am Coll Cardiol 2008;51:1127-1147
- J Am Coll Cardiol 2008;51(11):1127-1147
- International Journal of Cardiovascular Imaging 2001;17:339-345
- Am J Cardiol 2007;100:536-543

### Additional Indications for Stress Echo

**Stress echo is also effective for evaluation of the following (this is not an all-inclusive list of indications):**
- Syncope or pre-syncope
- Edema
- Heart murmur with no known severe valvular disease
- Valvular heart disease
  - Stress echo is useful in identifying patients who are asymptomatic but meet current triggers for valve surgery
  - Both exercise and pharmacologic stress testing should be avoided in patients with severe aortic stenosis unless monitored by a cardiologist
- Right heart dysfunction
- Left ventricular functional abnormalities (including systolic, diastolic, and regional wall motion abnormalities)
- Exercise-induced pulmonary hypertension
- Cardiomyopathies, including obstructive cardiomyopathies
- Radiation exposure concerns, especially in younger females
CD-2.4.3 Conditions in which MPI may be preferred over Stress Echo

- Evidence of ventricular tachycardia
- Ventricular paced rhythm (ventricular pacemakers create altered contraction pattern)
- Pre-excitation pattern such as Wolff-Parkinson-White
- Rate related complete left bundle branch block (not right bundle branch block)
- Resting heart rate <50 due to beta-or calcium channel-blocker medications
- Severe aortic valve dysfunction
- Limited echo window or difficulty visualizing the endocardium documented by prior resting echo or other physician documentation
  - If a recent previous echo has been performed without problems, then arguments for limited echo window may not apply.
- Poorly controlled hypertension—generally above 180 mm Hg systolic (both physical stress and dobutamine stress may exacerbate hypertension during stress echo)
- Poorly controlled atrial fibrillation (resting heart rate >100 bpm) or concern for exercise- or dobutamine-induced tachyarrhythmias.
- Segmental wall motion abnormalities at rest (e.g. due to cardiomyopathy, recent MI, or pulmonary hypertension)
  - **NOTE:** stress echo may not accurately reflect areas of ongoing ischemia in patients who have had an MI within the past month; however after about one month, patients can undergo stress echo to evaluate for new ischemia, if indicated.
- True syncope (not near syncope) in a patient with newly diagnosed or known LV dysfunction, or a known history of coronary artery disease (CAD), or highly likely to have CAD (e.g. three or more traditional risk factors for CAD—hypertension, smoking, abnormal lipid levels, diabetes, known vascular disease, obesity, family history of premature coronary artery disease, metabolic syndrome, elevated high sensitivity CRP level), generally indicates the need for left heart catheterization for further evaluation. MPI may also be appropriate.
- Inability to perform stress echo due to lack of availability of this modality or lack of expertise on the part of the technician and/or physician

**Dobutamine stress echo is contraindicated for the following:**

- Evaluation of arrhythmias
- Patients with uncontrolled or poorly controlled hypertension
- In the setting of a recent cerebrovascular event

**Routine follow-up stress echo**

- Routine follow-up stress echo is not indicated in the majority of stable patients.
- Repeat testing for coronary artery disease before 5 years from any normal coronary disease testing should be reviewed by a Medical Director.
- Repeat testing before 5 years from CABG or 2 years from PCI (stent,
PTCA, etc.) should not be considered unless there is a documented clear change in the character or pattern of symptoms.

- Stress testing should proceed based on the following guidelines:
  - **CD-1.3 Stress Testing**
  - **CD-2.4 Stress Echocardiography (Stress Echo)**
  - **CD-3.2 INDICATIONS FOR MPI**
  - **CD-6.3 Stress Perfusion MRI**

  - **Exception:** routine MPI or stress echo or stress perfusion cardiac MRI can be performed 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.
  - If previous exercise treadmill stress test was positive, then follow-up studies should consist of exercise treadmill stress tests if ECG is interpretable and patient can exercise.
  - Diabetics should not automatically be categorized as having “silent ischemia”

- **CD-2.4.4 Preoperative Stress Echo**
  - Asymptomatic patients, who have had normal coronary angiogram, normal stress test, or previous revascularization within a year, do not need MPI [or stress echo] for preoperative cardiac evaluation.*
    - *J Am Coll Cardiol 2005;46(8):1587-1605
  - If previous cardiac imaging has been performed within the past two years, the results of that imaging should be obtained and the request should be sent for Medical Director review.
  - **Indications for evaluation which may include preoperative stress echo:**
    - New, progressive, or changing angina that is stable for stress testing
    - Worsening or poorly controlled heart failure that is felt to be compensated and the patient is stable for stress testing
    - Severe valvular disease that is stable for stress testing
    - Malignant arrhythmias recently documented
    - Planned high risk surgery (open surgery on the aorta or open peripheral vascular surgery—see Risk Stratification list* below) **and** three out of five clinical risk factors present (High risk surgery counts as one of the three clinical risk factors--see Clinical Risk Factors list** below)
    - The planned surgery is high risk **and** exercise treadmill stress test cannot be performed because ECG is uninterpretable for ischemia or patient cannot adequately exercise on a treadmill or similar device (See **CD-1.3 Stress Testing**)
    - The planned surgery is intermediate risk (see Risk Stratification list* below) **and** one to five clinical risk factors are present (see Clinical Risk Factors list** below) **and** exercise treadmill stress test cannot be performed because ECG is uninterpretable for ischemia or patient cannot adequately exercise on a treadmill or similar device (See **CD-1.3 Stress Testing**)
  - **Preoperative stress echo is NOT indicated if any of the following apply:**

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- Functional capacity is greater than or equal to 4 METs without symptoms
  - Functional capacity greater than or equal to 4 METs means the following:
    - Can walk four blocks without stopping because of limiting symptoms
    - Can climb up two flights of stairs without stopping because of limiting symptoms
    - Can walk on level ground at 4 mph or run a short distance or walk up a hill
    - Can do heavy work around the house, such as scrubbing floors or lifting or moving heavy furniture
    - Can participate in moderate recreational activities, such as golf, bowling, dancing, doubles tennis, or throwing a baseball or football

- The planned surgery is low risk (see Risk Stratification list* below)
- The planned surgery is intermediate risk and no clinical risk factors are present (see Risk Stratification list* and Clinical Risk Factors list** below)
- The planned surgery is high risk with either none or one additional clinical risk factor present and exercise treadmill stress test can be performed (see Risk Stratification list* and Clinical Risk Factors list** below)
- The planned surgery is intermediate risk and one to five clinical risk factors are present and exercise treadmill stress test can be performed (see Risk Stratification list* and Clinical Risk Factors list** below)

- References:
  - J Am Coll Cardiol 2007;50(17):1707-1732
  - Circulation 2009;120:86-95

- *Cardiac Risk Stratification List:
  - High risk (cardiac risk >5%):
    - Open aortic and other major open vascular surgery
    - Open peripheral vascular surgery
  - Intermediate risk (cardiac risk 1%-5%):
    - Open intraperitoneal and intrathoracic surgery
    - Open carotid endarterectomy
    - Head and neck surgery
    - Open orthopedic surgery
    - Open prostate surgery
  - Low risk (cardiac risk <1%):
    - Endoscopic procedures
    - Superficial procedures
    - Cataract surgery
    - Breast surgery
    - Ambulatory surgery
    - Laparoscopic procedures and endovascular procedures that are unlikely to require further extensive surgical intervention are considered low risk surgery
**Clinical Risk Factors that predict risk of cardiac death and nonfatal myocardial infarction at time of noncardiac 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

**References:**

- J Am Coll Cardiol 2007;50(17):1707-1732

If the above criteria for preoperative stress echo are not fulfilled and stress testing is still requested, then stress testing should proceed based on the following guidelines:

- CD-1.3 Stress Testing
- CD-2.4 Stress Echocardiography (Stress Echo)
- CD-3.2 INDICATIONS FOR MPI
- CD-6.3 Stress Perfusion MRI

**CD-2.5 Newer Echocardiography Modalities**

- There is insufficient data currently to generate appropriateness criteria for the use of the following Echo modalities:
  - 3D, 4D, and higher Echo
  - Tissue perfusion Echo
  - Requests for these studies should be referred for Medical Director review.
2011 CARDIAC IMAGING GUIDELINES

CD-3

NUCLEAR CARDIAC IMAGING (MPI)

<table>
<thead>
<tr>
<th>CD-3</th>
<th>NUCLEAR CARDIAC IMAGING (MPI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>General</td>
</tr>
<tr>
<td>3.2</td>
<td>INDICATIONS FOR MPI</td>
</tr>
<tr>
<td>3.3</td>
<td>American College of Cardiology Inappropriate MPI Indications</td>
</tr>
<tr>
<td>3.4</td>
<td>Patients With Known CAD</td>
</tr>
<tr>
<td>3.5</td>
<td>Patients With No Known CAD</td>
</tr>
<tr>
<td>3.6</td>
<td>Preoperative MPI</td>
</tr>
<tr>
<td>3.7</td>
<td>MUGA Study</td>
</tr>
</tbody>
</table>

CD-3~NUCLEAR CARDIAC IMAGING (MPI)

- **CD-3.1 General**
  - Prior to considering cardiac imaging, there should be recent (within 30-60 days) clinical evaluation or documented meaningful contact with the patient (preferably with a recent ECG [within past 30 days or after symptoms started or worsened, whichever is more recent] and chest x-ray, if clinically relevant to the evaluation process).
  - Vital signs, height and weight or BMI or description of general habitus is needed.
    - Effort should be made to obtain copies of reported “abnormal” ECG studies in order to determine whether the ECG is uninterpretable.
    - The most recent stress testing and its findings should be documented.
  - **CODING NOTES:**
    - Providers should separately report stress testing (CPT®93015-93018) when MPI is performed with exercise or pharmacologic stress.
    - Codes for MPI studies (CPT®78451-78454) should not be reported in conjunction with the following studies. Such coding requests should be sent for medical Director review:
      - Planar MUGA studies (CPT® 78472-78473)
      - SPECT MUGA (CPT® 78494)
      - First pass studies (CPT® 78481-78483)
      - **Reference:**
        - CPT® Changes 2010: An Insider’s View, page 159
  - If a decision to perform cardiac catheterization or other angiography has already been made, there is often no need for MPI. These requests should be sent for Medical Director review.
  - Stress echocardiography (where feasible) has similar sensitivity and superior specificity to MPI for evaluation of ischemic heart disease and avoids radiation.* (See [CD-2.4 Stress Echocardiography](#))
    - *Journal of the American Society of Echocardiography 2007;20(9):1021-1041*
- Based on evidence from the literature, MedSolutions guidelines support stress echo as the initial imaging modality when stress testing with imaging is indicated (See **CD-2.4 Stress Echocardiography**).

  - **References:**
    - *J Am Coll Cardiol* 2008;51(11):1127-1147
    - *International Journal of Cardiovascular Imaging* 2001;17:339-345
    - *Am J Cardiol* 2007;100:536-543

- **Radiation Dose and MPI**
  - Sestamibi myocardial perfusion study (MPI): 9-12 mSv
  - Thallium myocardial perfusion study (MPI): 25 mSv
  - Diagnostic conventional coronary angiogram (cath): 5-10 mSv
  - Computed tomography coronary angiography (CTCA): 5-15 mSv
  - CT of Abdomen and pelvis: 8-14 mSv
  - Chest x-ray: <0.1 mSv

  - **Reference:**

- **CD-3.2 INDICATIONS FOR MPI**
  - New or worsening cardiac symptoms and age 50 or greater and known diabetes mellitus
  - New or worsening cardiac symptoms with a history of known CAD
  - Evidence of ventricular tachycardia
  - Ventricular paced rhythm (ventricular pacemakers create altered contraction pattern)
  - Pre-excitation pattern such as Wolff-Parkinson-White
  - Rate related complete left bundle branch block (not right bundle branch block)
    - Since fixed LBBB may cause false positive MPI, dobutamine stress echo may have greater accuracy in this setting, although MPI can be used if requested.
  - Resting heart rate <50 due to beta- or calcium channel-blocker medications
  - Severe aortic valve dysfunction
  - Limited echo window or difficulty visualizing the endocardium documented by prior resting echo or other physician documentation
    - If a recent previous echo has been performed without problems, then arguments for limited echo window may not apply.
  - Poorly controlled hypertension --generally above 180 mm Hg systolic (both physical stress and dobutamine stress may exacerbate hypertension during stress echo)
  - Poorly controlled atrial fibrillation (resting heart rate >100 bpm) or concern for exercise- or dobutamine-induced tachyarrhythmias.
  - Inability to exercise and recent cerebrovascular event (dobutamine stress echo is contraindicated in this circumstance)
  - Segmental wall motion abnormalities at rest (e.g. due to cardiomyopathy, recent MI, or pulmonary hypertension)
    - **NOTE:** stress echo may not accurately reflect areas of ongoing ischemia in patients who have had an MI within the past month; however after about
one month, patients can undergo stress echo to evaluate for new ischemia, if indicated.

- True syncope (not near syncope) in a patient with newly diagnosed or known LV dysfunction, or a known history of coronary artery disease (CAD), or highly likely to have CAD (e.g. three or more traditional risk factors for CAD—hypertension, smoking, abnormal lipid levels, diabetes, known vascular disease, obesity, family history of premature coronary artery disease, metabolic syndrome, elevated high sensitivity CRP level), generally indicates the need for left heart catheterization for further evaluation. MPI may also be appropriate.

- History of false positive exercise treadmill test

- Inability to perform stress echo due to lack of availability of this modality or lack of expertise on the part of the technician and/or physician

- **CD-3.3 American College of Cardiology Inappropriate Indications for MPI**

- **The following table of inappropriate indications** comes from the 2009 ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM Appropriate Use Criteria for Cardiac Radionuclide Imaging*:

  **Table 11. Inappropriate Indications (Median Score 1-3)**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Appropriate Use Score 1-9</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Detection of CAD: Symptomatic Evaluation of Ischemic Equivalent (Nonacute)</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Low pretest probability of CAD</td>
</tr>
<tr>
<td></td>
<td>ECG interpretable AND able to exercise</td>
</tr>
<tr>
<td>10.</td>
<td>Definite ACS (acute coronary syndrome)</td>
</tr>
<tr>
<td><strong>Detection of CAD: Symptomatic Acute Chest Pain</strong></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Low CHD risk (ATP III risk criteria)</td>
</tr>
<tr>
<td>13.</td>
<td>Intermediate CHD (coronary heart disease) risk (ATP III risk criteria)</td>
</tr>
<tr>
<td></td>
<td>ECG interpretable</td>
</tr>
<tr>
<td><strong>Detection of CAD/Risk Assessment Without Ischemic Equivalent Asymptomatic</strong></td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>Low CHD risk (ATP III risk criteria)</td>
</tr>
<tr>
<td><strong>Risk Assessment With Prior Test Results and/or Known Chronic Stable CAD Asymptomatic OR Stable Symptoms Normal Prior Stress Imaging Study</strong></td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>Low CHD risk (ATP III risk criteria)</td>
</tr>
<tr>
<td></td>
<td>Last stress imaging study done less than 2 years ago</td>
</tr>
<tr>
<td>24.</td>
<td>Intermediate to high CHD risk (ATP III risk criteria)</td>
</tr>
<tr>
<td></td>
<td>Last stress imaging study done less than 2 years ago</td>
</tr>
<tr>
<td>25.</td>
<td>Low CHD risk (ATP III risk criteria)</td>
</tr>
<tr>
<td></td>
<td>Last stress imaging study done &gt; or equal to 2 years ago</td>
</tr>
<tr>
<td><strong>Risk Assessment With Prior Test Results and/or Known Chronic Stable CAD Asymptomatic OR Stable Symptoms Abnormal Coronary Angiography OR Abnormal Prior Stress Imaging Study No prior Revascularization</strong></td>
<td></td>
</tr>
<tr>
<td>27.</td>
<td>Known CAD on coronary angiography OR prior abnormal stress imaging study</td>
</tr>
<tr>
<td></td>
<td>Last stress imaging study done less than 2 years ago</td>
</tr>
</tbody>
</table>
Table 11. Inappropriate Indications (Median Score 1-3) Continued

<table>
<thead>
<tr>
<th>Risk Assessment With Prior Test Results and/or Known Chronic Stable CAD</th>
<th>Asymptomatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior Coronary Calcium Agatston Score</td>
<td></td>
</tr>
<tr>
<td>33. • Agatston score less than 100</td>
<td>I(2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Assessment With Prior Test Results and/or Known Chronic Stable CAD</th>
<th>Duke Treadmill Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>37. • Low-risk Duke treadmill score</td>
<td>I(2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Assessment: Preoperative Evaluation for Noncardiac Surgery Without Active Cardiac Conditions</th>
<th>Low-Risk Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>40. • Preoperative evaluation for noncardiac surgery risk assessment</td>
<td>I(1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Assessment: Preoperative Evaluation for Noncardiac Surgery Without Active Cardiac Conditions</th>
<th>Intermediate-Risk Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>41. • Moderate to good functional capacity (&gt; or equal to 4 METs)</td>
<td>I(3)</td>
</tr>
<tr>
<td>42. • No clinical risk factors†</td>
<td>I(2)</td>
</tr>
<tr>
<td>44. • Asymptomatic up to 1 year postnormal catheterization, noninvasive test, or previous revascularization</td>
<td>I(2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Assessment: Preoperative Evaluation for Noncardiac Surgery Without Active Cardiac Conditions</th>
<th>Vascular Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>45. • Moderate to good functional capacity (&gt; or equal to 4 METs)</td>
<td>I(3)</td>
</tr>
<tr>
<td>46. • No clinical risk factors†</td>
<td>I(2)</td>
</tr>
<tr>
<td>48. • Asymptomatic up to 1 year postnormal catheterization, noninvasive test, or previous revascularization</td>
<td>I(2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Assessment: Within 3 Months of an ACS STEMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>49. • Primary PCI with complete revascularization</td>
</tr>
<tr>
<td>51. • Hemodynamically unstable, signs of cardiogenic shock, or mechanical complications</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Assessment: Within 3 Months of an ACS ACS-Absymptomatic Postrevascularization (PCI or CABG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>53. • Evaluation prior to hospital discharge</td>
</tr>
<tr>
<td>54. • Prior to initiation of cardiac rehabilitation (as a stand-alone indication)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Assessment: Within 3 Months of an ACS Cardiac Rehabilitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>59. • Less than 2 years after PCI</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Assessment: Postrevascularization (PCI or CABG) Asymptomatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>59. • Prior to initiation of cardiac rehabilitation (as a stand-alone indication)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evaluation of Ventricular Function Evaluation of LV Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>65. • Routine use of stress FP RNA in conjunction with rest/stress gated SPECT MPI</td>
</tr>
</tbody>
</table>

*Circulation 2009;119:e561-e587
CD-3.4 Patients with Known CAD

- Includes patients with prior cardiac imaging showing CAD and/or patients who have had MI or coronary procedures such as PCI, stenting, or CABG.
- Patients with new or worsening symptoms can undergo MPI or stress echo or stress perfusion MRI.
- Patients with recent equivocal, borderline, or discordant stress testing where ischemia remains a concern can undergo MPI or stress echo or stress perfusion MRI.
- Patients with 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. Stress testing should proceed based on the following guidelines:
  - CD-2.4 Stress Echocardiography (Stress Echo)
  - CD-3.2 INDICATIONS FOR MPI
  - CD-6.3 Stress Perfusion MRI

➢ If there are stable symptoms or no symptoms and the coronary stenosis in question is not in a major coronary branch, stress testing with imaging is not indicated.
  - If stress testing is still requested, then it should proceed based on: CD-1.3 Stress Testing

- True syncope (not near syncope) in a patient with newly diagnosed or known LV dysfunction, or a known history of coronary artery disease (CAD), or highly likely to have CAD (e.g. three or more traditional risk factors for CAD—hypertension, smoking, abnormal lipid levels, diabetes, known vascular disease, obesity, family history of premature coronary artery disease, metabolic syndrome, elevated high sensitivity CRP level), generally indicates the need for left heart catheterization for further evaluation. MPI may also be appropriate.

- Follow-up MPI
  - Within 3 months of an acute coronary syndrome (e.g. ST segment elevation MI [STEMI], unstable angina, non-ST segment elevation MI [NSTEMI]):
    - One MPI can be performed 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
  - Routine follow-up MPI:
    - Routine follow-up MPI is not indicated in the majority of stable patients.
    - Repeat testing for coronary artery disease before 5 years from any normal coronary disease testing should be reviewed by a Medical Director.

- Repeat testing before 5 years from CABG or 2 years from PCI (stent, PTCA, etc.) should not be considered unless there is a documented clear change in the character or pattern of symptoms. Stress testing should proceed based on the following guidelines:
  - CD-1.3 Stress Testing
CD-2.4 Stress Echocardiography (Stress Echo)  
CD-3.2 INDICATIONS FOR MPI  
CD-6.3 Stress Perfusion MRI  

Exception: routine MPI or stress echo or stress perfusion cardiac MRI can be performed 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.

If previous exercise treadmill stress test was positive, then follow-up studies should consist of exercise treadmill stress tests if ECG is interpretable and patient can exercise.

Diabetics should not automatically be categorized as having “silent ischemia”

- **CD-3.5 Patients With no Known CAD**  
  o Stress testing should proceed based on the following guidelines:
    - **CD-1.3 Stress Testing**  
    - **CD-2.4 Stress Echocardiography (Stress Echo)**  
    - **CD-3.2 INDICATIONS FOR MPI**  
    - **CD-6.3 Stress Perfusion MRI**

- **CD-3.6 Preoperative MPI**  
  o Asymptomatic patients, who have had normal coronary angiogram, normal stress test, or previous revascularization within a year, do not need MPI for preoperative cardiac evaluation.*
    
    *J Am Coll Cardiol 2005;46(8):1587-1605

  o If previous cardiac imaging has been performed within the past two years, the results of that imaging should be obtained and the request should be sent for Medical Director review.

  o **Indications for evaluation which may include preoperative MPI:**
    - New, progressive or changing angina that is stable for stress testing
    - Worsening or poorly controlled heart failure that is felt to be compensated and the patient is stable for stress testing
    - Severe valvular disease that is stable for stress testing
    - Malignant arrhythmias recently documented
    - Planned high risk surgery (open surgery on the aorta or open peripheral vascular surgery—see Risk Stratification list* below) and three out of five clinical risk factors present (High risk surgery counts as one of the three clinical risk factors--see Clinical Risk Factors list** below)
      - The planned surgery is high risk (see Risk Stratification list* below) and exercise treadmill stress test cannot be performed because ECG is uninterpretable for ischemia or patient cannot adequately exercise on a treadmill or similar device (see **CD-1.3 Stress Testing**
      - The planned surgery is intermediate risk (see Risk Stratification list* below) and one to five clinical risk factors are present (see Clinical Risk Factors list** below) and exercise treadmill stress test cannot be performed because ECG is uninterpretable for ischemia or patient cannot adequately exercise on a treadmill or similar device. (See **CD-1.3 Stress Testing**
Preoperative MPI is NOT indicated if any of the following apply:

- Functional capacity is greater than or equal to 4 METs without symptoms
  - Functional capacity greater than or equal to 4 METs means the following:
    - Can walk four blocks without stopping because of limiting symptoms
    - Can climb two flights of stairs without stopping because of limiting symptoms
    - Can walk on level ground at 4 mph or run a short distance or walk up a hill
    - Can do heavy work around the house, such as scrubbing floors or lifting or moving heavy furniture
    - Can participate in moderate recreational activities, such as golf, bowling, dancing, doubles tennis, or throwing a baseball or football

- The planned surgery is low risk (see Risk Stratification list* below)
- The planned surgery is intermediate risk and no clinical risk factors are present (see Risk Stratification list* and Clinical Risk Factors list** below)
- The planned surgery is high risk with either none or one additional clinical risk factor present and exercise treadmill stress test can be performed (see Risk Stratification list* and Clinical Risk Factors list** below)
- The planned surgery is intermediate risk and one to five clinical risk factors are present and exercise treadmill stress test can be performed (see Risk Stratification list* and Clinical Risk Factors list** below)

References:

- J Am Coll Cardiol 2007;50(17):1707-1732
- Circulation 2009;120:86-95

Cardiac Risk Stratification List:

- High risk (cardiac risk >5%):
  - Open aortic and other major open vascular surgery
  - Open peripheral vascular surgery
- Intermediate risk (cardiac risk 1%-5%):
  - Open intraperitoneal and intrathoracic surgery
  - Open carotid endarterectomy
  - Head and neck surgery
  - Open orthopedic surgery
  - Open prostate surgery
- Low risk (cardiac risk <1%):
  - Endoscopic procedures
  - Superficial procedures
  - Cataract surgery
  - Breast surgery
  - Ambulatory surgery
  - Laparoscopic procedures and endovascular procedures that are unlikely to require further extensive surgical intervention are considered low risk surgery.

References:

- J Am Coll Cardiol 2007;50(17):1707-1732
**Clinical Risk Factors that predict risk of cardiac death and nonfatal myocardial infarction at time of noncardiac 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

**References:**

- J Am Coll Cardiol 2007;50(17):1707-1732

If the above criteria for preoperative MPI are not fulfilled and stress testing is still requested, then Stress testing should proceed based on the following guidelines:

- CD-1.3 Stress Testing
- CD-2.4 Stress Echocardiography (Stress Echo)
- CD-3.2 INDICATIONS FOR MPI
- CD-6.3 Stress Perfusion MRI

**CD-3.7 MUGA Study**

- MUGA (CPT® 78472 [default code] or CPT® 78494 [SPECT]) is supported in the following circumstances:
  - When a prior echo study demonstrates impaired systolic function and there is a documented clinical need for a quantitative measurement of left ventricular ejection fraction (LVEF).
  - When there are pre-existing left ventricular wall motion abnormalities from ischemic or non-ischemic cardiomyopathies.
  - When imaging quality of an echo is technically limited and prevents accurate assessment of LV function.

- MUGA is not indicated to resolve differences in ejection fraction measurements between Echo and MPI studies unless there is clear documentation as to how quantitative measurement of LVEF will affect patient management (e.g. implantation of an AICD).
- Recent blood transfusions can interfere with MUGA imaging (RBC labeling).
- Cardiac arrhythmias such as atrial fibrillation or frequent ectopic beats interfere with MUGA imaging (difficulty with cardiac gating) and can result in inconsistent timing of cardiac cycles and inconsistent LVEF measurements.
- LV ejection fraction is a constantly changing number and can change without any accompanying change in myocardial function. 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 scan (CPT®78496) may be indicated if there is clear documentation of a concern regarding right ventricular dysfunction or overload.

**ONCOLOGIC STUDIES**

- LV ejection fraction and wall motion analysis are appropriate for the following:
  - **Chemotherapy**
    - Agents such as Adriamycin®, Herceptin®, mitoxantrone (Novantrone®) and others are considered cardiotoxic and can result in myocardial dysfunction and cardiomyopathy*.
      - *Reviews in Cardiovascular Medicine 2008;9(2):75-83
      - *J Clinical Oncology 2006;24:4107-4115
      - *Cancer Drugs Can Cause Heart Damage, Cancer and Chemotherapy. MD Anderson Cancer Center
      - *Neurology 2003;61:1332-1338
    - Patients on active Herceptin® treatment should undergo baseline cardiac monitoring as well as cardiac monitoring at 3, 6, and 9 months.

  - **Echocardiography vs MUGA for Determining Left Ventricular Ejection Fraction (LVEF) in Patients on Cardiotoxic Chemotherapy Drugs:**
    - MedSolutions guidelines support using **echocardiography rather than MUGA** for the determination of LVEF and/or wall motion EXCEPT in the following circumstances:
      - A prior echocardiographic study demonstrates impaired systolic function and there is documented clinical need for a quantitative measurement of LVEF.
      - There are pre-existing left ventricular wall motion abnormalities from ischemic or non-ischemic cardiomyopathies.
      - The imaging quality of an echo is technically limited and prevents accurate assessment of LV function.
  - There is no evidence-based data to support that MUGA is a better imaging study than echo or should be used preferentially in determining LVEF in oncology patients.
    - National Comprehensive Cancer Network (NCCN) Clinical Practice Guidelines in Oncology recommend “cardiac monitoring” but do not specify a preference of one cardiac modality over another.
    - The manufacturer’s prescribing information for Herceptin® states the following in regards to cardiac monitoring:*:
      - Conduct thorough cardiac assessment, including history, physical examination, and determination of LVEF by echocardiogram or MUGA scan. The following schedule is recommended:
        - Baseline LVEF measurement immediately prior to initiation of Herceptin®
        - LVEF measurements every 3 months during and upon completion of Herceptin®
        - Repeat LVEF measurement at 4 week intervals if Herceptin® is withheld for significant left ventricular cardiac dysfunction.
LVEF measurements every 6 months for at least 2 years following completion of Herceptin® as a component of adjuvant therapy.


- **Echocardiography is Supported as the Initial Imaging Modality for LV Function for Most Patients Receiving Cardiotoxic Chemotherapy Drugs for the Following Reasons:**
  - No ionizing radiation
  - Echo is more sensitive to early left ventricular dysfunction associated with chemotherapy
  - No IV access required
  - Allows view of the right ventricle
  - Allows view of the pericardium to look for effusion
  - Allows view of pleural effusions
  - Allows estimate of pulmonary pressure
  - Takes less time and is generally easier to perform than MUGA

- **Indications for MUGA Rather Than Echo:**
  - Previous attempts at echo had a technical or anatomic problem
  - Previous LV ejection fraction determination was less than 50%
  - Pre-existing left ventricular wall motion abnormalities from ischemic heart disease or other cardiomyopathies preclude accurate assessment of LVEF by echo
  - Documentation of need for information given by MUGA that cannot be obtained by echo
  - A prior MUGA is not a reason to approve another MUGA (it is not necessary to compare LVEF by the same modality)

- **CARDIOLOGIC USES of MUGA**
  - AICD placement
    - MUGA may be used to determine eligibility for ICD placement, biventricular pacing, or heart transplantation if echocardiography, catheterization, and/or MPI give conflicting results
  - Congestive heart failure
    - MUGA may be used to measure response to cardiac medications for congestive heart failure if there is a documented clinical need for a quantitative measurement of left ventricular ejection fraction (LVEF) beyond what echocardiography can provide.
2011 CARDIAC IMAGING GUIDELINES

CD-4~ULTRAFAST CT, EBCT, OR MULTIDETECTOR CT FOR CORONARY CALCIUM SCORING (CCS)

- CODING NOTES:
  - CPT® 75571 CT, heart, without contrast with quantitative evaluation of coronary calcium
  - The CPT® codes for Cardiac CT and CCTA (75572-75574) include quantitative and functional assessment (for example, calcium scoring), if performed.
    - CPT® 75571 should not be reported in conjunction with CPT® codes 75572-75574.
  - Certain payers consider coronary calcium scoring investigational, and their coverage policies will take precedence over MedSolutions’ guidelines.
  - Texas Heart Attack Preventive Screening Bill (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) once 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 45-75 or a woman age 55-75
      - 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
  - Although some advocate for the use of CCS in asymptomatic, low risk patients, there is still insufficient evidence-based data to support performing coronary calcium scoring in symptomatic or asymptomatic patients with any degree of CAD risk.*

* J Am Coll Cardiol 2010;56:1864-1894
* J Am Coll Cardiol 2006;48(7):1475-1497

CD-5~CARDIAC IMAGING BASED ON CORONARY CALCIUM SCORE

- Stress testing in individuals who have undergone coronary calcium scoring should proceed based on the following guidelines:
  - CD-1.3 Stress Testing
  - CD-2.4 Stress Echocardiography (Stress Echo)
  - CD-3.2 INDICATIONS FOR MPI
  - CD-6.3 Stress Perfusion MRI
### 2011 Cardiac Imaging Guidelines

<table>
<thead>
<tr>
<th>CD-6</th>
<th>Cardiac MRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>Coding Notes - Cardiac MRI</td>
</tr>
<tr>
<td>6.2</td>
<td>Indications for Cardiac MRI (excluding stress perfusion MRI)</td>
</tr>
<tr>
<td>6.3</td>
<td>Indications for Stress Perfusion Cardiac MRI</td>
</tr>
<tr>
<td>6.4</td>
<td>Aortic Root and Proximal Ascending Aorta</td>
</tr>
<tr>
<td>6.5</td>
<td>Evaluation of Pericardial Effusion - Diagnosis of Pericardial Tamponade</td>
</tr>
</tbody>
</table>

**CD-6~Cardiac MRI**

- All requests for cardiac MRI should be sent for Medical Director review.
- MRI may be contraindicated due to metal implants, claustrophobia, BMI >40 kg/m².

  *Am J Cardiol 2009;104:1540-1546*

- MRA of the coronary arteries is not yet adequately sophisticated to replace coronary angiography in evaluating coronary disease and should not be authorized.
  - **Exceptions**: coronary artery anomalies and Kawasaki Disease are conditions in which coronary MRA is considered useful.
    - (Refer to CD-8.6 Other Indications for CCTA)
      - MRA of the coronary arteries is reported with CPT® 76498, unlisted magnetic resonance procedure (e.g. diagnostic, interventional).
      - All requests for unlisted studies should be sent for Medical Director review.
      - Requests must be accompanied by detailed notes describing the procedure and indications.

- **CD-6.1 Coding Notes - Cardiac MRI**
  - Cardiac MRI CPT® Codes:
    - CPT® 75557 Cardiac MRI for morphology and function without contrast
    - CPT® 75559 Cardiac MRI for morphology and function without contrast materials; with stress imaging
    - CPT® 75561 Cardiac MRI for morphology and function without contrast materials, followed by contrast material(s) and further sequences
    - CPT® 75563 Cardiac MRI for morphology and function without contrast materials, followed by contrast material(s) and further sequences; with stress imaging
    - CPT® 75565 Cardiac MRI for velocity flow mapping
  - The add-on code, CPT® 75565, describes the cardiac MRI blood flow measurement procedure and, when performed, is to be reported in conjunction with CPT® 75557, CPT® 75559, CPT® 75561, or CPT® 75563.
  - **Per the AMA**: Only one procedure in the series CPT® 75557-CPT® 75563 is appropriately reported per session and only one flow velocity measurement (CPT® 75565) may be reported per session.*

CD-6.2 Indications for Cardiac MRI (excluding stress perfusion MRI)

- Myocardial viability study if there is documented evidence that revascularization would not be undertaken without it. Report CPT®75561.
- Assessment of myocardial scar (may be useful for prognostic classification as measured by delayed enhancement using gadolinium). CPT®75561.
  *Circulation 2009;120:2069-2076
- Assessment of global ventricular function and mass if a specific clinical question is left unanswered by another recent cardiac imaging study (e.g. echo, stress echo, MPI, etc.) and the answer to the clinical question will affect management of the patient’s clinical condition.
  - Cardiac MRI is particularly useful in evaluating cardiomyopathy (ischemic, diabetic/hypertrophic/muscular dystrophy), noncompaction, amyloid heart disease, post cardiac transplant, hemochromatosis, post transfusion hemosiderosis, hypertrophic heart disease, myocarditis, cardiac aneurysm, trauma and contusions, and in monitoring cancer chemotherapy effect on the heart (especially if accurate assessment of right ventricular function is documented as necessary).
  - Report CPT®75557 or CPT®75561.
- 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). (See CD-8.6 Other Indications for CCTA for criteria regarding anomalous coronary arteries).
  - Report CPT®75557 or CPT®75561.
  - CPT®71555 (chest MRA) 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.
- Chest MRA 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: chest MRA (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
- Clinical suspicion of arrhythmogenic right ventricular dysplasia or arrhythmogenic cardiomyopathy (ARVD/ARVC) especially if patient has presyncope or syncope if the clinical suspicion is supported by established criteria for ARVD (see CD-6 Evidence Based Clinical Support) or if the patient has documented Brugada’s syndrome, MRI (CPT®75557) is considered the optimal test for this disorder.*
  - If right ventricular abnormalities are already identified by echo or other techniques, MRI may not be necessary.
Young patients with right bundle branch block, unexplained syncope, and “normal” echo can undergo cardiac MRI (CPT®75557 or CPT®75561) to rule out ARVD/ARVC.

* Circulation 2006;113:316-327
* Eur Heart J 1989;10:127-132
* Circulation 2005;112(25):3823-3832

- Pericardial disease (constrictive pericarditis versus restrictive and perimyocarditis). Report CPT®75561. MRI should not be utilized to ‘diagnose’ pericarditis but only to answer the question regarding possible constriction or restriction suggested clinically or by other techniques.
- Evaluate cardiac tumor or mass (e.g. in sarcoidosis or tuberous sclerosis). Report CPT®75561.
- Anomalous coronary arteries: Cardiac MRI (CPT®75561) or CTA (CPT®75574) (which is still favored) is much better at detecting this than conventional angiography. (See CD-8.6 Other Indications for CCTA for criteria regarding anomalous coronary arteries).
- Fabry’s disease: late enhancement MRI may predict the effect of enzyme replacement therapy on myocardial changes that occur with this disease. Report CPT®75561.

- Aortic dissection. CPT®71555 (MRA chest) can be reported and add CPT®74185 (MRA abdomen) if dissection extends beyond ascending aorta.
- Valvular disease including Leibman-Sachs endocarditis, other endocarditis, and assessing valve abnormalities associated with ankylosing spondylitis. Transthoracic echo or transesophageal echo is supported initially.
  - For cardiac MRI report CPT®75561 in conjunction with CPT®75565.
  - Alternatively, cardiac CT (CPT®75574) can be reported.
- Pulmonary vein anatomy for planned ablation procedures in patients with atrial fibrillation.

  - See also:
    - CD-10 Pulmonary Artery and Vein Imaging for guidelines on follow-up imaging after ablation procedure
    - CD-8.7 Indications for Cardiac CT
  - Report either cardiac MRI (CPT®75557) or chest MRV (CPT®71555) but not both
- Rule out cardiac thrombus. Report CPT®75557.*
  * J Am Coll Radiol 2006;3:665-676
  * J Am Coll Cardiol 2006;48(7):1475-1497
- Evaluation of right ventricular function (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.
- To evaluate for 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.
• CD-6.3 Indications for Stress Perfusion Cardiac MRI (Stress MRI)
  
  o Coding Notes:
    1. Report CPT®75559 (or CPT®75563 if viability study is done as part of the procedure)
    2. Report CPT®75560 or CPT®75561 (with CPT®75565 if there is a documented indication to clarify or precisely quantitate a valve or shunt flow abnormality seen on a recent echo).
  
  o New or worsening cardiac symptoms and age 50 or greater and known diabetes mellitus
  
  o New or worsening cardiac symptoms with a history of known CAD
  
  o Evidence of ventricular tachycardia
  
  o Ventricular paced rhythm (ventricular pacemakers create altered contraction pattern)
  
  o Pre-excitation pattern such as Wolff-Parkinson-White
  
  o Rate related complete left bundle branch block (not right bundle branch block)
  
  o Resting heart rate <50 due to beta- or calcium channel-blocker medications
  
  o Severe aortic valve dysfunction
  
  o Limited echo window or difficulty visualizing the endocardium documented by prior resting echo or other physician documentation
    1. If a recent previous echo has been performed without problems, then arguments for limited echo window may not apply.
  
  o Poorly controlled hypertension --generally above 180 mm Hg systolic (both physical stress and dobutamine stress may exacerbate hypertension during stress echo)
  
  o Inability to exercise and recent cerebrovascular event (dobutamine stress echo is contraindicated in this circumstance)
  
  o Segmental wall motion abnormalities at rest (e.g. due to cardiomyopathy, recent MI, or pulmonary hypertension)
    1. NOTE: stress echo may not accurately reflect areas of ongoing ischemia in patients who have had an MI within the past month; however after about one month, patients can undergo stress echo to evaluate for new ischemia, if indicated.
  
  o True syncope (not near syncope) in a patient with newly diagnosed or known LV dysfunction, or a known history of coronary artery disease (CAD), or highly likely to have CAD, generally indicates the need for left heart catheterization for further evaluation. Stress perfusion MRI may also be appropriate.
  
  o History of false positive exercise treadmill test
  
  o Patients with recent equivocal, borderline, or discordant stress testing where ischemia remains a concern can undergo MPI or stress echo or stress perfusion MRI.
  
  o Patients with 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. Stress testing should proceed based on the following guidelines:

  **CD-2.4 Stress Echocardiography (Stress Echo), CD-3.2 INDICATIONS FOR MPI** and **CD-6.3 Stress Perfusion MRI**
If there are stable symptoms or no symptoms and the coronary stenosis in question is not in a major coronary branch, stress testing with imaging is not indicated.

- If stress testing is still requested, then it should proceed based on: **CD-1.3 Stress Testing**

**Routine follow-up stress MRI**

- Routine follow-up stress MRI is not indicated in the majority of stable patients.
- Repeat testing for coronary artery disease before 5 years from any normal coronary disease testing should be reviewed by a Medical Director.
- Repeat testing before 5 years from CABG or 2 years from PCI (stent, PTCA, etc.) should not be considered unless there is a documented clear change in the character or pattern of symptoms.

Stress testing should proceed based on the following guidelines:

- **CD-1.3 Stress Testing**
- **CD-2.4 Stress Echocardiography (Stress Echo)**
- **CD-3.2 INDICATIONS FOR MPI**
- **CD-6.3 Stress Perfusion MRI**

**Exception:** routine stress perfusion cardiac MRI can be performed 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

- If previous exercise treadmill stress test was positive, then follow-up studies should consist of exercise treadmill stress tests if ECG is interpretable and patient can exercise.
- Diabetics should not automatically be categorized as having “silent ischemia”

**CD-6.4 Aortic Root and Proximal Ascending Aorta**

- The aortic root and proximal ascending aorta can be adequately evaluated during a cardiac MRI.
- For screening due to family history of aortic aneurysm or dissection:
  - See CH-30 Thoracic Aortic Dissection or Aneurysm in the Chest Imaging Guidelines.
- If a patient (e.g. Marfan’s or Loeys-Dietz syndrome) with known ascending aortic aneurysm needs a cardiac MRI to evaluate another problem and the physician wishes to evaluate the ascending aorta, this evaluation should be included with the cardiac MRI interpretation. If the ascending aortic aneurysm is quite distal, near the arch, it is appropriate to include the chest MRI code (CPT®71551) or thoracic MRA code (CPT®71555).

**CD-6.5 Evaluation of Pericardial Effusion or Diagnosis of Pericardial Tamponade**

- Echocardiogram is the initial imaging study of choice to evaluate pericardial effusions or diagnose pericardial tamponade.
- However, contrast enhanced cardiac MRI (CPT®75561) is useful for evaluating pericarditis, neoplastic effusion, tamponade or myocardial infiltration if a specific clinical question is left unanswered by another recent imaging study and the answer to the clinical question will affect management of the patient’s clinical condition
Cancers that can metastasize to the pericardium or myocardium and can cause a malignant effusion include lung, breast, renal cell, lymphoma and melanoma.
All requests for cardiac PET scan should be sent for Medical Director review.

Benefits, coverage policies, and eligibility issues pertaining to each patient’s health plan take precedence over MedSolutions’ guidelines.

Certain imaging studies described in these guidelines are considered investigational by various payers, and their coverage policies will take precedence over MedSolutions’ guidelines.

CPT®78492 should be used for stress cardiac PET scans used to determine ischemia (i.e. coronary artery disease).

- This study uses rubidium tracer most often and is similar to, but more sensitive than, MPI.
- In most circumstances, cardiac PET does not need to replace other modalities (such as exercise stress treadmill, stress echo, MPI, or stress perfusion MRI for ischemia testing).
  - The following guidelines should be followed:
    - CD-1.3 Stress Testing
    - CD-2.4 Stress Echocardiography (Stress Echo)
    - CD-3.2 INDICATIONS FOR MPI
    - CD-6.3 Stress Perfusion MRI

- There are circumstances in which cardiac PET can be useful:
  - Cardiac PET is more accurate than MPI in obese patients (for example BMI>35 kg/m²) or those with large breasts or implants, in differentiating ischemia from attenuation artifact.
  - Cardiac PET can be useful in patients who have an equivocal nuclear perfusion (MPI) stress test if results of the PET will affect patient management.
    - PET demonstrated unequivocal normal perfusion in as many as 77% of a subset of women with equivocal nuclear perfusion studies.*
      - *J Am Coll Cardiol 2006;48:1029-1039

CPT®78459 should be used for cardiac PET scans used to determine myocardial viability when a previous study has shown severe left ventricular dysfunction in an individual who is under consideration for revascularization.

- This study uses FDG tracer and is used to determine metabolically active myocardium. A reduction of FDG uptake indicates nonviable tissue.
- With the excellent results given by cardiac MRI in viability studies, this application for PET is diminishing.

- Radiation exposure from cardiac PET is slightly lower than from SPECT MPI exposure although data is limited.
  - Radiation exposure from cardiac PET/CCTA (CCTA=coronary computed tomography angiography) is high enough to raise concerns.
  - PET/CT in which CT is used only for attenuation correction has a much lower radiation exposure. The radiation exposure is slightly higher than that of PET alone.
PET (CPT®78459) is useful for identifying and monitoring response to therapy for cardiac sarcoid. The diagnosis should be established or strongly suspected prior to imaging.*


Reference:
- Circulation 2007;116:1290-1305
8.1 General

- Certain payers consider coronary calcium scoring and/or cardiac CT and Coronary Computed Tomography Angiography (CCTA) investigational, and their coverage policies will take precedence over MedSolutions’ guidelines.
- Most payers require cardiac CT studies to be performed on a 64-slice or greater CT scanner.
- Metal artifact reduces the accuracy of CCTA. Devices that can cause this issue include, but are not limited to, surgical clips, pacemaker devices, defibrillator devices and tissue expanders.
- Cardiac testing that does not involve exposure to ionizing radiation should be strongly considered.
  - Multislice CT is associated with a non-negligible risk for cancer, especially in women and younger patients.*

*JAMA 2007; 298:317-323

- Contraindications to CCTA include:
  - Irregular heart rhythms (e.g. atrial fibrillation/flutter, frequent irregular premature ventricular contractions or premature atrial contractions, and high grade heart block)
  - Very obese patients (body mass index >40 kg/m²)
  - Elevated calcium score
    - CCTA should not be performed if there is extensive coronary calcification (calcium score >1000).
  - Renal insufficiency
  - Inability to follow breath holding instructions
  - Heart rate over 75 beats per minute
➢ Allergy to iodine contrast material

- **CD-8.2 CT Used For Coronary Calcium Scoring (CCS)**
  - Also see CD-4 Ultrafast, EBCT, or Multidetector CT for Coronary Calcium Scoring (CCS) and for guidelines related to the Texas Heart Attack Preventive Screening Bill (HR 1290).
  - Coronary Calcium Scoring: Although some advocate for the use of CCS in asymptomatic, low risk patients, there is still insufficient evidence-based data to support performing coronary calcium scoring in symptomatic or asymptomatic patients with any degree of CAD risk.

  ➢ **References:**
    - *J Am Coll Cardiol* 2010;56:1864-1894
    - *J Am Coll Cardiol* 2006;48(7):1475-1497
  - The optimal interval for obtaining repeat coronary calcium scoring has not yet been determined.

- **CD-8.3 CCTA in the Asymptomatic Patient**
  - CCTA should not be used in asymptomatic patients

  ➢ **References:**
    - *Circulation* 2006;114:1761-1791
    - [http://circ.ahajournals.org/cgi/content/full/114/16/1761](http://circ.ahajournals.org/cgi/content/full/114/16/1761)
    - Accessed November 29, 2006
    - *J Am Coll Cardiol* 2004;44:1224-1229
  - There is insufficient evidence to support routine use of CCTA in the evaluation of the coronary arteries following heart transplantation.

- **CD-8.4 CCTA in the Symptomatic Patient**
  - The high negative predictive value (98%-99%) of CCTA in ruling out significant coronary artery disease has been confirmed on multiple studies.
  - If CCTA shows no significant coronary artery disease, then in general, no further cardiac imaging is necessary.
  - CCTA using a 64-slice or greater CT scanner can be used for the following:
    - To evaluate chest pain in patients with very low, low, or intermediate pretest probability of CAD (See Table B1 in CD-8 Evidence Based Clinical Support section) when the patient cannot perform or has contraindications to exercise and chemical stress testing (i.e. exercise treadmill stress test, stress echo, MPI, and stress MRI).
    - To exclude coronary artery disease in patients with low or very low pretest probability of CAD if stress test results (e.g. exercise treadmill, stress echo, or MPI, or stress MRI) are uninterpretable, equivocal, or are felt to be falsely positive
    - To exclude coronary artery disease in patients with intermediate pretest probability of CAD (See Table B1 in CD-8 Evidence Based Clinical Support section) if recent exercise treadmill stress test or stress echo is uninterpretable or equivocal and CCTA will replace performance of MPI, stress MRI, cardiac PET, or invasive coronary angiogram.
  - To exclude coronary artery disease in patients with intermediate pretest probability of CAD (See Table B1 in CD-8 Evidence Based Clinical Support section) if recent MPI is uninterpretable or equivocal and CCTA will replace performance of cardiac PET or invasive coronary angiogram.
  - Can be considered in patients with low or intermediate risk for CAD
(See Table B1 in CD-8 Evidence Based Clinical Support section) who have persistent symptoms and a recent normal stress test if CCTA will likely replace performance of invasive coronary angiogram.

- Can be considered in order to evaluate graft patency after CABG in patients with new or worsening symptoms, when only graft patency is a concern and imaging of the native coronary artery anatomy is not needed, and CCTA will likely replace performance of an imaging stress test and/or invasive coronary angiogram.
  - CCTA is not generally indicated in patients with high risk for CAD—rather, these patients should undergo conventional coronary angiography, especially if an interventional procedure (e.g. PCI) is anticipated.
    - **Exception:** CCTA may be indicated in symptomatic high risk patients with stress imaging tests that show ischemia, in whom conventional coronary angiography has been unsuccessful.
  - There is insufficient data to support performing “triple rule out” studies to exclude coronary artery disease, aortic dissection and pulmonary embolism in a patient with chest pain.
    - Requests for “triple rule out” should be sent for Medical Director review.
    - In the Chest Imaging Guidelines, also see:
      - CH-29 Pulmonary Embolism
      - CH-32 Thoracic Aortic Dissection or Aneurysm
  - If coronary artery disease is present on CCTA and no functional stress test has been performed, exercise treadmill stress test, stress echocardiogram, MPI, or stress MRI is needed to determine whether the coronary artery stenosis seen on CCTA is causing functional ischemia.
    - For guidelines regarding which functional stress test would be appropriate:
      - See CD-1.3 Stress Testing
      - See CD-2.4 Stress Echocardiography (Stress Echo)
      - See CD-3.2 INDICATIONS FOR MPI
      - See CD-6.3 Indications for Stress Perfusion Cardiac MRI
  - There are no data to support performing serial follow-up CCTA studies in symptomatic or asymptomatic patients.
    - Serial imaging studies to evaluate for coronary artery disease should follow the guidelines in CD-3.4 Patients With Known CAD.

- **CD-8.5 CCTA in Patients with Previous Coronary Artery Procedures**
  - **Post-CABG:**
    - Requests for CCTA in post-bypass patients should be sent for Medical Director review.
  - **Re-do CABG:**
    - CCTA can be helpful in post-bypass patients who are going to undergo re-do bypass surgery in order to identify whether bypass grafts such as the mammary are located directly beneath the sternum, so that alternative ways to enter the chest can be planned. The precise course of the LAD (including an intramyocardial route) and the relationship of target vessels to intercostal spaces can be accurately determined by CCTA. However, not every patient who is scheduled for re-do surgery needs a CCTA,
and there are no evidence-based data that performing CCTA in these patients improves health outcome.

- **Post-coronary Stent Placement:**
  - Current evidence does not support CCTA in the evaluation of coronary stent patency. Metal artifact limits accuracy.
  - **References:**
    - *J Am Coll Cardiol* 2010;56:1864-1894
    - *Circulation* 2006;114:1761-1791
      - http://circ.ahajournals.org/cgi/content/full/114/16/1761
      - Accessed November 29, 2006

- **CD-8.6 Other Indications for CCTA**
  - Evaluating coronary artery anomalies and other complex congenital heart disease of cardiac chambers or great vessels is an appropriate indication for CCTA.
    - Report CPT®75574 for evaluating coronary artery anomalies.
    - Report CPT®75573 for congenital heart disease
      - Can add CPT®71275 (chest CTA) to evaluate great vessels
      - In cases of anomalous pulmonary venous return, can add CT abdomen and pelvis
    - The use of CCTA to rule out anomalous coronary artery(ies) should be limited to patients who need to have an anomalous coronary artery mapped prior to an invasive procedure, or who have not had a previous imaging study that clearly demonstrates an anomalous coronary artery and/or shows the anomalous artery to be patent and who are less than age 40 with a history that includes one or more of the following (aortic root echocardiography or cardiac MRI can also be considered to avoid radiation exposure):
      - 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
      - Unexplained syncope (not presyncope)
        - Patients should have had a thorough negative evaluation for syncope as outlined in [HD-32 Syncope](#) in the Head Imaging Guidelines and [CD-11 Syncope](#) (e.g. echocardiogram, cardiac evaluation for postural blood pressure changes, resting low blood pressure, or low heart rate, MPI study, exercise treadmill test, stress echocardiogram, or stress MRI, consideration for situational syncope) prior to considering CCTA.
        - Unexplained new onset of heart failure (e.g. without atherosclerotic coronary disease or other known causes for cardiomyopathy) if CCTA will replace conventional invasive coronary angiography.
        - Documented ventricular tachycardia (6 beat runs or greater) if CCTA will replace conventional invasive coronary angiography.
        - Equivocal coronary artery anatomy on conventional cardiac catheterization
      - The presence of other congenital heart disease is not a separate indication for CCTA to rule out anomalous coronary artery(ies).
o Evaluation of coronary artery status in patients with new onset heart failure is an appropriate indication for CCTA (CPT®75574) if CCTA will replace conventional invasive coronary angiography.

o Patients with dilated cardiomyopathy who have at least intermediate coronary risk can undergo CCTA* if CCTA will replace conventional invasive coronary angiography.

  *JACC 2007 May;49:2044-2050

o CCTA (CPT®75574) for preoperative assessment of the coronary arteries in patients who are going to undergo surgery for aortic dissection, aortic aneurysm, or valvular surgery can be performed if CCTA will replace invasive coronary angiography.

o Vasculitis/Takayasu's/Kawasaki's disease can be imaged with coronary CCTA (CPT®75574).

o Cardiac trauma: chest CTA (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.*

  ➢ Also see CD-13 Cardiac Trauma

  *Am J Cardiol 2006;98:402-406

• CD-8.7 Indications for Cardiac CT (CPT®75572)

o Cardiac CT (CPT®75572) is a useful study to accurately identify coronary veins for lead placement in patients needing biventricular pacemaker or automatic implantable cardioverter defibrillator (AICD) devices.

o Congenital heart disease assessment using CPT®75573 or CPT®71275 is supported in adults.

o Cardiac CT (CPT®75572) can be performed for preoperative evaluation of pulmonary veins in patients in whom pulmonary vein isolation procedure (ablation) for atrial fibrillation is planned and for follow-up studies. CPT®75572 is the preferred code but CPT®71275 (CTV chest) is acceptable if requested. In addition, chest MRV (CPT®71555) can be performed rather than CT.

  ➢ See also:

  ➢ CD-10 Pulmonary Artery and Vein Imaging for guidelines on follow-up imaging after ablation procedure

  ➢ CD-6.2 Indications for Cardiac MRI

o Cardiac CT (CPT®75572) can be used to assess cardiac tumor or mass, pericardial mass, pericarditis/constrictive pericarditis, complications of cardiac surgery, etc., if echocardiogram is inconclusive.

o Cardiac CT (CPT®75572) can be used to evaluate cardiac thrombus in patients with technically limited echocardiogram, MRI, or TEE.

o Cardiac CT (CPT®75572) can be used to evaluate clinical suspicion of arrhythmogenic right ventricular dysplasia or arrhythmogenic cardiomyopathy (ARVD/ARVC), especially if patient has presyncope or syncope if the clinical suspicion is supported by established criteria for ARVD (see CD-6 Evidence Based Clinical Support) or if the patient has documented Brugada’s syndrome.

  ➢ If right ventricular abnormalities are already identified by echo or other techniques, cardiac CT may not be necessary.
- Young patients with right bundle branch block, unexplained syncope, and "normal" echo can undergo cardiac MRI (CPT®75557 or CPT®75561) or cardiac CT (CPT®75572) to rule out ARVD/ARVC.
  - Native aortic abnormalities can be investigated with cardiac CT (CPT®75572) if echocardiogram is indeterminate.
  - Cardiac CT may be helpful in the evaluation of recurrent laryngeal nerve palsy due to cardiac chamber enlargement.

- **CD-8.8 Unproven Uses of Cardiac CT and CCTA**
  - There is insufficient data to support the routine use of cardiac CT and/or CCTA for the following:
    - As the first test in evaluating symptomatic patients (e.g. chest pain)
      - See [CD-8.4 CCTA in the Symptomatic Patient](#) for exceptions
    - To evaluate chest pain in an intermediate or high risk patient when a stress test (exercise treadmill, stress echo, MPI, cardiac MRI, cardiac PET) is clearly positive or negative.
    - Preoperative assessment for non-cardiac, nonvascular surgery (See [CD-3.6 Preoperative MPI](#))
    - There is insufficient data to support the routine use of CCTA for evaluation of peripheral arteries, iliac arteries, and/or aorta prior to minimally invasive or robotic surgery.
    - There is no data to support performing serial follow-up CCTA studies in symptomatic or asymptomatic patients.
    - Serial imaging studies to evaluate for coronary artery disease should follow the guidelines in [CD-3.4 Patients With Known CAD](#).
    - Identification of plaque composition and morphology is possible with CCTA, especially using 64-slice scanners. However, this technique currently has limited sensitivity, and the reproducibility of the measure has not been reported.
      - Therefore, the use of CCTA for determining plaque morphology or for quantification of coronary atherosclerotic plaque burden is not recommended at this time.*
        - *Circulation 2006;114:1761-1791
        - [http://circ.ahajournals.org/cgi/content/full/114/16/1761](http://circ.ahajournals.org/cgi/content/full/114/16/1761)
        - Accessed November 29, 2006
    - Evaluation of left ventricular function following myocardial infarction or in chronic heart failure.
    - Myocardial perfusion and viability studies.
    - Evaluation of patients with postoperative native or prosthetic cardiac valves who have technically limited echocardiograms, MRI or TEE.
      - Patients with indeterminate echocardiogram should undergo MUGA (CPT®78472 or 78494) or cardiac MRI (see [CD-3.7 MUGA Study](#) and [CD-6 Cardiac MRI](#)).

- **CD-8.9 Radiation Dose and CCTA**
  - Radiation dosage for CCTA varies by facility and the particular protocol used. The American College of Radiology Clinical Statement on Noninvasive Cardiac Imaging states that "as a general rule a multi-detector CT scan encompassing the heart should not result in an effective dose of greater than 12 mSv".*

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**RETURN**

Page 45 of 71
64-slice CT scanners can deliver a radiation dose from 15-25 mSv (especially in women due to breast tissue density).

Multislice CT is associated with a non-negligible risk for cancer, especially in women and younger patients.*

*JAMA 2007; 298:317-323

Sophisticated gating and other techniques can reduce the radiation dose of cardiac CT studies to less than 5 mSv. Application of these techniques is increasing nationwide.


Dual source scanners decrease radiation exposure by approximately one third.

Conventional coronary angiography typically delivers a radiation dose of 3 to 6 mSv*

*J Am Coll Cardiol 2007;50(15):1469-1475

Newer imaging technologies will allow for reduced radiation exposure

**CD-8.10 CODING NOTES: CARDIAC CT and CCTA**

2011 Cardiac CT and CCTA CPT® codes:

- **CPT®75571** CT, heart, without contrast with quantitative evaluation of coronary calcium

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

- **CPT®75573** CT, heart, with contrast material, for evaluation of cardiac structure and morphology in the setting of congenital heart disease (including 3D image post processing, assessment of cardiac LV function, RV structure and function and evaluation of venous structures, if performed)

- **CPT®75574** CT, heart, coronary arteries and bypass grafts (when present), with contrast material, including 3D image post processing (including evaluation of cardiac structure and morphology, assessment of cardiac function, and evaluation of venous structures, if performed)

The codes for contrast studies above (75572-75574), include quantitative and functional assessment (for example, calcium scoring), if performed.

CPT® 75571 should not be reported in conjunction with CPT® codes 75572-75574.

Assessment of cardiac function, if performed, is not reported separately.

3D rendering (CPT®76376 or CPT®76377) and nuclear medicine codes for ventricular function or ejection fraction should not be reported in conjunction with coding for Cardiac CT and CCTA.

Coronary imaging is not included in the code definition for CPT®71275

The AMA description for CPT®71275 reads: “CTA Chest (non-coronary), with contrast material(s), including noncontrast images, if performed, and image postprocessing.”
CD-9

9.1 CODING NOTES: Heart Catheterization

There are two sets of 2011 CPT® cardiac catheterization codes known as “code families”:

- **Congenital Heart Disease**
  - The code set for congenital heart disease (93530-93533) has not changed.
  - 2011 codes 93563-93568 are used when contrast injections are performed in conjunction with cardiac catheterization for congenital anomalies (93563-93568).
  - **NOTE:** Anomalous coronary arteries, patent foramen ovale, mitral valve prolapse, and bicuspid aortic valve should be reported with codes: 93451-93464, 93566-93568) and should not be grouped with congenital heart disease.

- **All Other Conditions (All conditions other than congenital heart disease)**
  - 2010 cardiac catheterization codes 93501 and 93508 – 93529 have been deleted. Effective 01/01/2011, these procedures are reported with codes: 93451-93461.
  - The 2011 cardiac catheterization codes, (93452-93461) (for all conditions other than congenital heart disease) include contrast injections, imaging supervision, interpretation, and report for imaging typically performed. Codes for coronary catheter placements (93454-93461) include intraprocedural injections for coronary angiography, imaging supervision, and interpretation.
  - Codes for catheter placements in bypass grafts (93455, 93457, 93459, and 93461) include intraprocedural injections for bypass graft angiography, imaging supervision, and interpretation.
  - 2010 injection codes 93539-93545 have been deleted.
  - 2011 injection codes 93563-93565 should **not** be used in conjunction with 93452-93461.
The simplified table below lists the codes for cardiac catheterization performed for all conditions other than congenital heart disease:

<table>
<thead>
<tr>
<th>Cardiac Catheterization Procedure</th>
<th>CPT® Code</th>
</tr>
</thead>
<tbody>
<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>
</tr>
<tr>
<td>Native coronary artery catheterization</td>
<td>93454</td>
</tr>
<tr>
<td>With grafts</td>
<td>93455</td>
</tr>
<tr>
<td>With RHC</td>
<td>93456</td>
</tr>
<tr>
<td>With RHC and bypass grafts</td>
<td>93457</td>
</tr>
<tr>
<td>With LHC</td>
<td>93458</td>
</tr>
<tr>
<td>With LHC and bypass grafts</td>
<td>93459</td>
</tr>
<tr>
<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>
</tbody>
</table>

Table courtesy of Coding Strategies, Inc. All Rights Reserved. Used with permission.

- Cardiac catheterization (93451-93461) includes all “roadmapping” angiography necessary to place the catheters, including any injections and imaging supervision, interpretation, and report.
- The codes 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: used for right ventricular or right atrial angiography performed in conjunction with cardiac catheterization for congenital and noncongenital heart disease (CPT® Codes: 93451-93461, 93350-93533)
  - CPT®93567: used for aortography
  - CPT®93568: used for pulmonary angiography
  - For angiography of noncoronary arteries and veins, performed as a distinct service, CPT® instructs to use appropriate codes from the Radiology and Vascular Injection Procedures section.
- Coding a cardiac catheterization with a combined coronary artery interventional procedure
  - The CPT® codes for coronary interventions include coronary artery catheterization and coronary angiograms taken to determine catheter position or to evaluate the therapeutic results. This type of imaging is considered an integral part of the intervention and should not be coded separately.
  - When a diagnostic cardiac catheterization has been performed recently, it is usually not appropriate to bill for a second diagnostic catheterization at the time of the therapeutic intervention.
  - Example: this scenario can arise when a diagnostic cardiac catheterization has been performed by a cardiologist who does not perform coronary artery interventions such as angioplasty/stenting, and it is determined that angioplasty/stenting is needed. Patient is then
scheduled for the angioplasty/stenting and cardiac cath is performed as part of that procedure.

- It would be appropriate to request or bill for a second diagnostic cardiac cath along with the therapeutic intervention under the following circumstances:
  - No prior or recent study is available to guide therapy
  - Patient’s condition has significantly changed
  - 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

- **Left heart catheterization report**
  - The printed report of the left heart catheterization should describe hemodynamics, coronary calcifications, coronary artery stenosis, aortic and mitral valve function/dysfunction, and segmental and global left ventricular wall motion.

- **CD-9.2 Diagnostic Left Heart Catheterization (LHC)**
  - Diagnostic left heart catheterization (LHC) is an invasive procedure with major complication rate of less than 1%-2% and mortality of 0.08%.*
  - These guidelines apply to patients with chronic stable conditions or new but stable conditions.
    - These guidelines **do not** apply to patients in the acute setting (acute coronary syndrome) or patients with unstable angina. These patients should be handled as a medical emergency.
    - Incidental iliac/femoral artery angiography may be useful when dissection or obstruction to the passage of the catheter/guidewire is encountered.
    - Incidental renal arteriography may be considered if criteria outlined in **AB-41 Renovascular Hypertension** in the Abdomen Imaging Guidelines are met.
  - **Indications for Diagnostic Left Heart Catheterization:**
    - Identifying 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.
    - Clinical diagnosis or suspicion of unstable, accelerating, or worsening angina, even in the absence of noninvasive cardiac testing.
    - Identifying disease when there are persistent symptoms indicative of CAD and results of noninvasive cardiac studies are equivocal or nondiagnostic and symptoms are not responding adequately to optimized medical therapy.
      - Symptoms can include typical angina (e.g. exertional chest pain), atypical angina (e.g. arm or jaw pain, chest pressure or tightness), or angina equivalent (e.g. shortness of breath)
    - Identifying disease that is unresponsive to optimized medical therapy and
for which invasive procedures are needed to provide pain relief.

- **Optimized Medical Therapy** 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 (if no contraindication and patient can tolerate), angiotensin converting enzyme (ACE) inhibitors/angiotensin receptor blocking (ARB) agents (if no contraindication and patient can tolerate)*

*Am J Cardiol 2007 Dec;100(11):1635-1643

- Evaluating the presence and/or extent of coronary artery disease suggested by noninvasive imaging studies if the results of catheterization will change patient management.
- Evaluating the cause of left ventricular dysfunction (congestive heart failure) in patients suspected of having coronary artery disease that is treatable using invasive procedures.
- Patients in whom non-invasive testing raised concerns that a large amount of myocardium (>10%) may be in jeopardy.
  - **NOTE:** This subgroup of patients from the COURAGE trial did better with percutaneous revascularization. However, it is prudent to note that subgroup analysis with secondary conclusions as part of a bigger study with other aims is subject to bias.
- True syncope (not near syncope) in a patient with newly diagnosed or known LV dysfunction, or a known history of coronary artery disease (CAD), or highly likely to have CAD.
- If 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:
  - Suspicion of cardiomyopathy, endocarditis, or myocarditis
  - Significant/serious ventricular arrhythmia
  - Evaluating progression of known CAD when symptoms are worsening
  - Evaluation of coronary grafts
  - Evaluation of previously placed coronary artery stents
  - Evaluation of structural disease
- Ruling out coronary artery disease prior to planned non-coronary cardiac or great vessel surgery (cardiac valve surgery, aortic dissection, aortic aneurysm, congenital disease repair such as atrial septal defect, etc.)
- Assessment of cardiac transplant for rejection
  - **Diagnostic left heart catheterization is NOT indicated for the following where pump function has already been determined by other means:**
    - Prior to initiation of medical therapy in stable patients who have had coronary artery disease previously diagnosed by other means.
    - Prior to a reasonable trial of optimized medical therapy in stable patients with coronary artery disease diagnosed by other means.
      *Am J Cardiol 2009 July;104(1):1-4
    - Patients in whom catheterization will not change management decisions (e.g. patients who are unwilling or unable to proceed with invasive procedures such as angioplasty, stenting, or surgery or prior catheterization that showed patient was not a candidate for
revascularization).

- Surveillance imaging
- Screening for coronary artery disease
  - There must be objective evidence of coronary artery disease/cardiac ischemia by elevated cardiac enzymes, ECG, and/or noninvasive cardiac imaging.

- **NOTE:** A positive stress test should not automatically lead to cardiac catheterization, since angioplasty/stenting should no longer be considered first-line therapy for stable coronary artery disease.

- **CD-9.3 Diagnostic Right Heart Catheterization (RHC)**
  - Right heart catheterization (RHC) is performed most commonly from catheterization of the femoral vein, although subclavian or internal jugular vein approaches can also be used. Any number of catheters can be utilized including a Swan Ganz catheter. The catheter is typically guided by fluoroscopy as well as hemodynamic measures.
  - Technically, a RHC is also performed when interatrial septal puncture is performed for atrial fibrillation ablation procedures, or when aortic stenosis prevents retrograde catheterization of the left ventricle and antegrade catheterization is desired via the left atrium, through the mitral valve and into the left ventricle.
  - Traditionally, the right heart catheterization includes a full oximetry run including samples from the superior vena cava (SVC), HRA (high right atrium), MRA (mid right atrium), LRA (low right atrium), and inferior vena cava (IVC), right ventricular (RV) inflow, RV apex, RV outflow, main pulmonary artery (PA), branch PA and pulmonary capillary wedge pressure. This is performed for detection and quantification of shunts. Pressure measurements are made and are done simultaneously with aortic and left ventricular pressures.
  - Many times, the right heart catheter is used to probe the interatrial septum to discover and cross a patent foramen ovale (PFO) or atrial septal defect (ASD).
  - Cardiac outputs are calculated by several techniques including thermodilution.

  - **Indications for Diagnostic Right Heart Catheterization:**
    - 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)
      - Traditional hemodynamic criteria for constrictive pericarditis are the following:
        - Elevated left and right ventricular diastolic pressures equalized within 5 mm Hg
        - Right ventricular systolic pressure less than 55 mm Hg
        - Mean right arterial pressure greater than 15 mm Hg
Right ventricular end-diastolic pressure greater than one third of the right ventricular systolic pressure (narrow pulse pressure)
  ➢ Valvular disease
  ➢ Right heart failure
  ➢ Left heart failure

- **Indications for Combined Right and Left Heart Catheterization:**
  ➢ Preoperative evaluation for valve surgery
  ➢ Newly diagnosed or worsening cardiomyopathy
CD-10~PULMONARY ARTERY and VEIN IMAGING

- **Pulmonary Artery Hypertension (PAH)**
  - CT or CTA or MRA of the 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.
  - Also see:
    - PVD-5 Pulmonary Artery Hypertension in the Peripheral Vascular Disease Imaging Guidelines
    - CH-29 Pulmonary Embolism in the Chest Imaging Guidelines.
  - Reference:
    - Radiology 2007;243:70-79

- **Pulmonary Vein Imaging**
  - A preoperative cardiac MRI (CPT®75557) or, chest MRV (CPT®71555), or chest CTV (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.
  - A routine post-procedure MRI or cardiac CT can be performed 3 months after ablation.
    - If no pulmonary vein stenosis is present, no further follow-up imaging is required.
    - The routine follow-up study is due to a 1%-2% incidence of asymptomatic pulmonary vein stenosis following ablation procedures. These patients may benefit from treatment (anti-inflammatory medication, angioplasty or stenting), although there are no large, prospective studies to help establish guidelines in this area.
  - Patients who have symptoms (usually shortness of breath) following ablation should be imaged at 1, 3, 6, and 12 months post-ablation.
    - The majority (81%) of pulmonary vein stenosis remain stable over1 year. Progression occurs in 8.8% and regression occurs in a small percentage.

CD-11~SYNCOPE

- Also see HD-32 Syncope in the Head Imaging Guidelines.
- **Evaluation of syncope**:
  - Echocardiogram should be performed initially to look for valvular or cardiomyopathic dysfunction.
  - Cardiac evaluation for postural blood pressure changes (which have the highest yield and affect management the most*), resting low blood pressure, low heart rate, or serious dysrhythmias should be performed prior to considering advanced imaging or stress testing.
    - *Arch Intern Med 2009 July;169(14):1299-1305

- Stress testing should proceed based on the following guidelines:
  - CD-1.3 Stress Testing
  - CD-2.4 Stress Echocardiography (Stress Echo)
CD-3.2 INDICATIONS FOR MPI

- True syncope (not near syncope) in a patient with newly diagnosed or known LV dysfunction, or a known history of coronary artery disease (CAD), or highly likely to have CAD (e.g. three or more traditional risk factors for CAD—hypertension, smoking, abnormal lipid levels, diabetes, known vascular disease, obesity, family history of premature coronary artery disease, metabolic syndrome, elevated high sensitivity CRP level), generally indicates the need for left heart catheterization for further evaluation. MPI or other stress testing with imaging may also be appropriate.

- Cardiac MRI (CPT®75561) or CCTA (see CD-8.10 for CPT® codes) can be considered if there is concern for anomalous coronary arteries, infiltrative heart disease or certain types of cardiomyopathy (see CD-6 Cardiac MRI and CD-8.6 Other Indications for CCTA).

- Cardiac MRI (CPT®7557) can be performed to evaluate pre-syncope or syncope in patients with suspected ARVD/ARVC if the clinical suspicion is supported by established criteria for ARVD (see CD-6 Evidence Based Clinical Support) or if the patient has documented Brugada’s syndrome.
  - If right ventricular abnormalities are already identified by echo or other techniques, MRI may not be necessary.
  - Young patients with right bundle branch block, unexplained syncope, and “normal” echo can undergo cardiac MRI (CPT®75557 or CPT®75561) to rule out ARVD/ARVC.

- Duchenne muscular dystrophy: usually imaged by echocardiogram but evaluation for ischemic or cardiomyopathic changes using MPI or (typically) cardiac MRI (CPT®75557 or CPT®75561) can be performed (See CD-6 Cardiac MRI).

CD-12~CONGESTIVE HEART FAILURE (CHF)

- Cardiac CT should not be used for evaluation of left ventricular function following myocardial infarction or in chronic heart failure mostly out of concern for radiation exposure.
  - Patients with indeterminate echocardiogram should undergo MUGA (CPT®78472 or 78494) or cardiac MRI (CPT®75557).
  - In patients with CHF undergoing CCTA for an appropriate indication, (see CD-8 CT Heart and CCTA), additional CT imaging for ventricular function will not add significant radiation.

- MPI imaging, echocardiogram, and/or ideally cardiac MRI (which is the most accurate in assessing cardiac pump function) (CPT®75557) can be used to assess patients with CHF.
  - Where there is evidence of arteriovenous fistula with “high output” heart failure, CT scans of the chest, abdomen and pelvis with contrast (CPT®71260 and CPT®74177) can be performed. Chest and/or abdominal MRA (CPT®71555 and/or CPT®74185) may also be useful.

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

• Post-cardiac transplant heart failure should be assessed by echocardiogram or cardiac MRI (CPT®75557 or CPT®75561).

CD-13~CARDIAC TRAUMA

• Echocardiographic modalities (TTE, TEE) are the fastest modalities to assess cardiac trauma.

• Cardiac MRI (CPT®75557, CPT®75561, can add CPT®75565 depending on physician request) can be performed in stable patients.
  o CPT®71555 (chest MRA) can be added if there is suspicion of vascular trauma distal to the root of the great vessels.

• Chest CTA (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. *

  *Am J Cardiol 2006;98:402-406
Cardiac imaging is used for diagnostic (e.g. surveillance or risk-stratification), or treatment (e.g. in patients with known coronary disease) purposes. Surveillance and risk-stratification can often be done with non-imaging studies and these should be considered primarily in patients with known disease. Whereas imaging may have incremental prognostic value it does not make substantial enough outcome difference to be easily supportable in patients with known disease.

“A definition of an imaging test’s appropriateness must include test performance characteristics for a clinical indication, the potential negative consequences of imaging, an understanding of the implicit impact of cost on clinical decision making, and an explicit understanding of how the test results might lead to care that could improve the patient’s chances for better survival or improved health status.”¹

MedSolutions seeks to identify the most appropriate (from multiple viewpoints) test for the appropriate patient at the appropriate time. MedSolutions’ guidelines are based upon using cardiac imaging to answer a specific clinical question that affects patient management. Therefore “an appropriate imaging study is one in which the expected incremental information, combined with clinical judgment, exceeds the expected negative consequences by a sufficiently wide margin for a specific indication that the procedure is generally considered acceptable care and a reasonable approach for the indication.”¹

In following this philosophy, MedSolutions considers both inherent risks and downstream effects, including costs. As such, if the imaging study requested provides no significant diagnostic benefit over standard clinical judgment and care or alternative diagnostic studies, then cost considerations should contribute to deeming the procedure inappropriate. In the case of MPI versus stress echo, MedSolutions believes that the evidence from the literature ²,³,⁴,⁵, ⁶ supports stress echo as the initial imaging modality when stress testing with imaging is indicated. It offers higher specificity²,⁶, versatility in that it shows a more extensive evaluation of cardiac anatomy and function, greater patient comfort (does not require intravenous access or the discomfort of nuclear imaging camera/table demands) and at a lower cost. Additionally due to its higher specificity, it reduces ‘downstream’ costs created by the need for further clarification (e.g. tissue attenuation or patient movement during imaging). Most importantly, it avoids exposing patients to ionizing radiation.

In support of standard exercise treadmill stress testing as the initial diagnostic test, MedSolutions takes into account the pre test likelihood of disease, the baseline ECG, and the question being asked. More specifically, it is determined whether the test is for the diagnosis of unknown coronary artery disease versus functional

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capacity determination, evaluation of dyspnea, or the evaluation of exercise induced arrhythmias. The inherent inaccuracies of this modality are also taken into account.\(^8,9,10\)

When there is the need for imaging (above standard exercise treadmill testing), MedSolutions supports the testing modality that meets the above criteria. If there are reasons that this modality cannot be utilized, approval for alternative modalities is offered. However, if all other aspects of testing are equivalent in sensitivity and specificity, availability and expertise, then patient comfort and cost containment must also be considered above and beyond the ‘medical appropriateness’ of society published guidelines. This leads to our guidance towards stress echocardiography. The ultimate objective of MedSolutions’ reviews is to improve patient care and health outcomes in a cost-effective manner.

- **References:**
  - \(^1\) *J Am Coll Cardiol* 2005;46 (8):1587-1605
  - \(^2\) *Am J Med* 2008 May;121(5):358-359
  - \(^3\) *J Am Coll Cardiol* 2007;49:227-237
  - \(^4\) *Am J Cardiol* 2007;100:1744-1749
  - \(^5\) *Am J Cardiol* 2007;99:1193-1195
  - \(^8\) *Clin Cardiol* 2008;31:35-40
  - \(^9\) *Arch Intern Med* 2008;168(2):174-179
  - \(^10\) *Am J Cardiol* 2008;101:1437-1443

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**Evidence Based Clinical Support**

**CD-3~NUCLEAR CARDIAC IMAGING (MPI)**

- The U.S. Preventive Services Task Force (USPSTF) found insufficient evidence to recommend for or against screening with ECG, exercise treadmill testing or EBCT for coronary artery stenosis in asymptomatic adults at increased risk for coronary heart disease events.

- Exercise treadmill stress test: Sensitivity 68% Specificity 77%
  - Stress Echo: Sensitivity 76% Specificity 88%
  - MPI: Sensitivity 88% Specificity 77%
  - PET: Sensitivity 91% Specificity 82%
  - **Reference:**
    - \(^1\) *Am J Med* 2008 May;121(5):358-359

- **Positive exercise treadmill stress test (for ischemia) is defined as:**
  - ECG ST depression of >1 mm
    - **Exception:** women over age 45 may have false-positive ST depression
  - exercise-induced angina
  - drop in systolic blood pressure >10 mm Hg with exercise
  - development of ventricular tachycardia with exercise
• If a previous exercise treadmill stress test was positive and follow-up stress tests are indicated, then these follow-up studies should consist of exercise treadmill stress tests if the patient can exercise. Electrocardiographic interpretive ability is not really critical since the diagnosis of CAD has already been made. Other information obtained during the stress test such as the presence of arrhythmias, blood pressure and heart rate response, symptoms, and exercise capacity should provide sufficient prognostic and patient management data.
• From a study of 7,456 patients with normal MPI study followed for 665+/− 200 days:
  o The predicted rate of cardiac death or nonfatal myocardial infarction (MI) in patients with no history or previous coronary artery disease (i.e. no previous MI or revascularization) was <1% per year in the two years following normal MPI in nondiabetic males and females age 80 and older, in diabetic males age 80 and older and in diabetic females age 60 and older.
  o The predicted rate of cardiac death or nonfatal MI in patients with a history of CAD (i.e. previous MI or revascularization) was <1% per year in males (nondiabetic and diabetic) age 50 or greater, in females with diabetes age 50 or greater and in nondiabetic females age 80 or greater. *
    
    *J Am Coll Cardiol 2003;41:1329-1340
  o Historically, a normal MPI study is considered to indicate low risk if the event rate (cardiac death or nonfatal MI) is below 1% per year.
• Women first develop anginal symptoms an average of 10 years later than men and have their first myocardial infarction (MI) an average of 20 years later than men. Women with typical angina have a high prevalence of coronary artery disease (CAD): 60% – 72%. Women with atypical symptoms have a very low prevalence of CAD: 2 %– 7%. There is an extremely low risk of CAD in premenopausal women with atypical chest pain. Women with persisting chest pain syndrome despite normal cardiac imaging are thought to have a poor prognosis with higher risk of subsequent cardiac events. Cardiac disease in women is thought by some to be quite a different disease relative to that seen in men. *
    
    *Am J Cardiol 1995;75:52D-60D
• In women with typical angina, 50% of premenopausal versus 90% of older women will have significant coronary artery disease. There is a sharp rise in coronary heart disease morbidity and mortality in women after age 70.
• Recent evidence reveals that instituting medical therapy such as Enalapril and Carvedilol at the beginning of chemotherapy may substantially lessen or eliminate cardiac toxicity from chemotherapy.*
• Left ventricular imaging may be indicated in patients who have both early and late troponin level elevations.*
    

**Evidence Based Clinical Support**

CD-4~ULTRAFAST CT, EBCT, or MULTIDETECTOR CT for CORONARY CALCIUM SCORING

• Among 1743 unselected asymptomatic men and women who were screened for coronary artery calcium and followed for a mean of 2.5 years, 30.3% subsequently reported chest pain. Coronary artery calcium was seen in 340
patients (19.5%). The proportion of patients who had coronary artery calcium were similar among those who had no chest pain, noncardiac pain, atypical pain, or cardiac chest pain.*

*Am J Cardiol 2005;96:61-63

- A study evaluating coronary calcium scores from electron beam tomography scanning (EBCT) in 1,795 asymptomatic subjects from 1997 – 2000 (age range 62-85 years old) showed that the risk of coronary artery disease increased with increasing calcium score. The mean follow up was 3.3 years. The multivariate-adjusted relative risk of coronary events was 3.1 for calcium scores 101 – 400, 4.6 for calcium scores 401 to 1000 and 8.0 for calcium scores >1000 compared with calcium scores of 0 – 100. Risk prediction based on the cardiovascular risk factors improved when coronary calcification was added. The author concluded that coronary calcification is strong and independent predictor of coronary heart disease.*

*Circulation 2005;112:572-577

- Publications such as the SHAPE task force advocate using imaging such as coronary calcium scoring for general population screening, since current risk assessment tools are imperfect. There is no current outcome data to confirm the cost-effectiveness of this approach.
  - The task force also recommends carotid intimal-media thickness measurement which is performed with ultrasound, does not require radiation, and is much less expensive to perform.

### Evidence Based Clinical Support

**CD-6~CARDIAC MRI**

- Contrast-enhanced cardiac MRI is an excellent imaging study to determine the extent of cardiac damage following a myocardial infarction (MI). Hyper enhancement on T1-weighted delayed contrast-enhanced MRI only occurs in necrotic, irreversibly injured myocardium, irrespective of the age of the infarct. The regional extent of hyper enhancement across the left ventricular wall has been shown to predict functional improvement of stunned or hibernating myocardium, with the likelihood of functional improvement decreasing with increasing segmental extent of hyper enhancement.
- Viability study: In instances in which segments of LV demonstrated decreased wall motion (i.e. stunned or hibernating myocardium), but are shown to have viable myocardium that involves at least 50% of wall thickness, studies have demonstrated that these segments are likely to benefit from revascularization with full recovery of cardiac function.* Thus, MRI is very good at determining whether there has been a subendocardial MI versus a transmural MI. In this respect, MRI is being used to replace both nuclear cardiac stress testing and PET scan for myocardial viability imaging.

*J Am Coll Cardiol 2003;42:895-901

  - Family history
- Familial disease confirmed at necropsy or surgery (Major criterion)
- Family history of premature sudden death (<35 years old) caused by suspected ARVD (Minor criterion)
- Family history (clinical diagnosis based on present criteria) (Minor criterion)
  - ECG depolarization/conduction abnormalities
    - Epsilon waves or localized prolongation (≥110 ms) of the QRS complex in the right precordial leads (V1-V3) (Major criterion)
    - Late potentials seen on signal averaged ECG (Minor criterion)
  - ECG repolarization abnormalities
    - Inverted T waves in right precordial leads (V2 and V3) in patients aged >12 y and in the absence of right bundle branch block (Minor criterion)
- Arrhythmias
  - Sustained or nonsustained left bundle branch block type ventricular tachycardia documented on ECG or Holter monitoring, or during exercise testing (Minor criterion)
  - Frequent ventricular extrasystoles (>1000/24 h on Holter monitoring) (Minor criterion)
- Global or regional dysfunction and structural alterations
  - Severe dilatation and reduction of RV ejection fraction with no (or only mild) LV involvement (Major criterion)
  - Localized RV aneurysms (akinetic or dyskinetic areas with diastolic bulging) (Major criterion)
  - Severe segmental dilatation of the right ventricle (Major criterion)
  - Mild global RV dilatation or ejection fraction reduction with normal left ventricle (Minor criterion)
  - Mild segmental dilatation of the right ventricle (Minor criterion)
  - Regional RV hypokinesia (Minor criterion)
- Tissue characteristics of walls
  - Fibrofatty replacement of myocardium on endomyocardial biopsy (Major criterion)
- The diagnosis of ARVD/ARVC requires the presence of 2 major criteria or 1 major plus 2 minor or 4 minor criteria

*The American Journal of Medicine 2008;121:674-681

- SSFP cine MRI provides an excellent assessment of valvular morphology and motion. Semi-quantitative assessment of gradients and regurgitation is increasingly being assessed by cine CMR.
- Cardiac MRI can reveal myocarditis in specific ways and can help differentiate this from other processes such as MI.
- The degree of valvular calcification is not easily evaluated with MRI.
- Transesophageal echocardiography (TEE) is best for demonstrating valve vegetations in endocarditis.
- MRI is useful in diagnosing paravalvular abscesses associated with endocarditis. These paravalvular abscesses are difficult to demonstrate by echocardiogram.
- Patients with prosthetic valves can be imaged safely in high-field magnets.
- Patients with coronary stents can safely undergo MRI.
- MRI can quantify many aspects of cardiac function, including ventricular volumes, ejection fraction, cardiac output, shunt ratio, valvular pressure...
gradients, and regurgitation fractions. However, measuring valve function with velocity studies by MRI can be complex. Conventional Echo gives accurate information regarding the valves and is easier to perform.

- Tuberous sclerosis involves benign tumors of the heart and other organs. Usually these are best assessed using cardiac MRI although cardiac CT can also be used.

### Evidence Based Clinical Support

CD-8-CT of the HEART and Coronary Computed Tomography Angiography (CCTA)

#### Table B1. Pre-Test Probability of CAD by Age, Gender, and Symptoms

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

**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.

ACCF/ASNC 2005 Appropriateness Criteria*

*J Am Coll Cardiol 2005;46(8):1587-1605

- Angina as defined by the ACC/AHA 2002 Guideline Update for Exercise Testing:*
  - **Typical angina (definite)**: 1) Substernal chest pain or discomfort that is 2) provoked by exertion or emotional stress and 3) relieved by rest and/or nitroglycerin.
  - **Atypical angina (probable)**: Chest pain or discomfort 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.

*J Am Coll Cardiol 2002;40:1531-1540

- Risk factors associated with a higher risk of coronary heart disease events such as a nonfatal myocardial infarction and coronary death include:
  - Older age
  - Male gender
  - High blood pressure
  - Smoking
  - Abnormal lipid levels (increased total serum cholesterol and LDL; low serum HDL; increased serum triglycerides)
- Diabetes
- Known vascular disease
- Renal failure
- Obesity
- Family history of premature coronary artery disease
- Metabolic syndrome
- Sleep apnea
- Elevated high sensitivity CRP level

- Men <50 years old and women < 60 years old who have no other risk factors for coronary heart disease (less than 5% -10% 10 year risk) are considered to be at low risk.

- Coronary artery disease remains the leading cause of death in Western nations. One-third of all conventional coronary angiograms in the U.S. are performed in conjunction with an interventional procedure, while the rest are performed only for verification of the presence and degree of coronary artery disease. Therefore, development of a reliable noninvasive imaging study of the coronary arteries for detection of coronary artery disease is a high priority.

- In reality, there still is no "gold standard" for the evaluation of coronary disease.

- CT coronary angiography is emerging as a potentially useful imaging study with a variety of applications. However, the standard of reference for diagnosis of coronary artery disease remains conventional coronary angiography.*

- Conventional coronary angiography gives high spatial resolution and the option of direct performance of interventions such as balloon dilatation or coronary stent placement.

  *Radiology 2004;232:18-37

- Noninvasive imaging of the coronary arteries is complex due to their small size, tortuosity, and cardiac motion. The overall diagnostic quality of noninvasive CT coronary angiography is largely dependent on spatial resolution, the patient’s heart rate during the exam, the choice of appropriate reconstruction time points in the cardiac cycle, calcium interference, and contrast enhancement.

- Heart rate greater than 70-75 bpm, or variation of heart rate during scanning, consistently induces motion artifact and produces less consistent and reproducible imaging results. It is recommended that the heart rate of patients with persistently irregular heart rates (such as atrial fibrillation) result in interscan discontinuities that prohibit evaluation of CT angiographic images for coronary artery stenosis.*

  *Radiology 2004;232:18-37

- Heart rates greater than 70 bpm that do not respond to heart rate slowing medicines limit the accuracy of CCTA. In this setting, CCTA may need to be reconsidered for another imaging modality.

- Other considerations for obtaining a high quality cardiac CCTA:
  - Patients must be able to hold still for a number of minutes and follow breathing instructions closely.
  - Patients should be able to take Nitroglycerin and have no medications that would contraindicate their taking Nitroglycerin
  - Erectile dysfunction drugs are a contraindication to taking Nitroglycerin
  - Patients should not have an iodine allergy or should be prepped for possible allergy reaction to contrast
Patients should be able to lift both arms above their shoulders.
Any of the above considerations place an obvious limitation on CCTA imaging and should be considered a potential contraindication for CCTA.

Currently there is a lack of standardization of the protocols in use for coronary CCTA. The consistent and reproducible visualization of the right coronary artery, the circumflex coronary artery, and the small side branches is difficult because of these vessels' complex motion during the cardiac cycle. For optimal visualization retrospective reconstruction (rendering) data of different coronary arteries is recommended.*

*Radiology 2004;232:7-17
*J Am Coll Radiol 2006;3(9):677-685

Knowledge of imaging techniques regarding multiplanar reformation (MPR), oblique MPR, maximum-intensity projection, shaded surface display, and direct volume rendering is necessary. Different clinical examinations such as stent evaluation, stenosis evaluation and bypass evaluation, require different visualization techniques. Errors such as findings of false stenoses can be avoided by means of accurate and appropriate use of software features. Training regarding the capabilities of the software and the background of the different techniques and their possible pitfalls is necessary.*

*Cardiol Clin 2003;21(4):549-559

Careful custom tailoring of the contrast bolus for achieving adequate, consistent, and homogeneous contrast attenuation over the entire course of the coronary arteries in order to facilitate imaging is needed. Optimal contrast attenuation within the vessel is high enough to allow lesion detection but not so high that it obscures calcified coronary artery wall lesions.*

*Radiology 2004;232:18-37

High risk patients, if they receive CCTA, may be running an unacceptably high risk of having to have angiography which results in double contrast and essentially double radiation dose which is a major reason to avoid this test in those patients.

A prospective, single center study evaluating 1,384 coronary artery segments in 103 patients showed that, compared with invasive coronary angiography for detection of significant lesions (>50% stenosis), segment-based sensitivity, specificity, and positive and negative predictive values of 16-slice CCTA were 95%, 98% 87% and 99%, respectively.*

*JAMA 2005;293:2471-2478

Recent data* suggests that coronary calcium scoring may be appropriate in:
- Asymptomatic patients with an intermediate risk for developing CAD
- Low risk patients with a first degree relative with CAD (especially siblings under age 50)

*J Am Coll Cardiol 2010;56:1864-1894
CARDIAC IMAGING GUIDELINE REFERENCES

CD-1~GENERAL GUIDELINES
CD-1.1~General Issues

CD-1.2~Transplant Patients

CD-1.3~Stress Testing
- Mieres JH and Blumenthal RS. Does the treadmill test work in women? Cardiosource Spotlight July 1, 2008;CS2-CS4
- Tavel ME. Stress testing in cardiac evaluation: Current concepts with emphasis on the ECG. Chest 2001;119:907-925.

CD-1.6 External Counterpulsation (ECP)

CD-2~ECHOCARDIOGRAPHY (ECHO)
CD-2.1~Transthoracic Echocardiography (TTE)
CD-2.2~Frequency of Echocardiography Testing


CD-2.3~Transesophageal Echocardiography (TEE)


CD-2.4~STRESS ECHOCARDIOGRAPHY (Stress Echo)

CD-2.4.2~Indications for Stress Echo

- Bangalore S, Yao SS, Chaudhry FA. Usefulness of stress echocardiography for risk stratification and prognosis of patients with left ventricular hypertrophy. Am J Cardiol 2007;100:536-543.

CD-2.4.4~Preoperative Stress Echo


CD-3~NUCLEAR CARDIAC IMAGING (MPI)

CD-3.1~General


Bangalore S, Yao SS, Chaudhry FA. Usefulness of stress echocardiography for risk stratification and prognosis of patients with left ventricular hypertrophy. *Am J Cardiol* 2007;100:536-543.


**CD-3.3~American College of Cardiology inappropriate indications for MPI**


**CD-3.4~Patients with Known CAD**


**CD-3.6~Preoperative MPI**


**CD-3.7~MUGA Study**


*Cancer Drugs Can Cause Heart Damage.*


**CD-4~ULTRAFAST CT, EBCT, or MULTIDETECTOR CT for CORONARY CALCIUM SCORING**


**CD-6~CARDIAC MRI**


CD-7~CARDIAC PET SCAN


CD-8~CT of the HEART and CORONARY COMPUTED TOMOGRAPHY ANGIOGRAPHY (CCTA)

CD-8.1~General


CD-8.2~CT Used For Coronary Calcium Scoring


CD-8.3~CCTA in the Asymptomatic Patient


CD-8.5~CCTA in Patients with Previous Coronary Artery Procedures

CD-8.6~Other Indications for CCTA


CD-8.8~Unproven Uses of Cardiac CT and CCTA


CD-8.9~Radiation Dose and Coronary CCTA


CD-8.10~CPT® Coding


CD-9~DIAGNOSTIC HEART CATHETERIZATION


CD-10~PULMONARY ARTERY and VEIN IMAGING


CD-11~SYNCOPE


CD-13~CARDIAC TRAUMA

EVIDENCE BASED CLINICAL SUPPORT REFERENCES

CD-2~Echocardiography (ECHO), Evidence Based Clinical Support


CD-3~Nuclear Cardiac Imaging (MPI), Evidence Based Clinical Support

- Cerqueira MD. Diagnostic testing strategies for coronary artery disease: special issues related to gender. Am J Cardiol 1995;75:52D-60D.

CD-4~Ultrafast CT, EBCT, or Multidetector CT for Coronary Calcium Scoring, Evidence Based Clinical Support


**CD-6~Cardiac MRI, Evidence Based Clinical Support**

**CD-8~CT of the Heart and CCTA, Evidence Based Clinical Support**