

CIGNA MEDICAL COVERAGE POLICIES - RADIOLOGY

Cardiac Imaging Guidelines

Effective Date: March 1, 2025



Instructions for use

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

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

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

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

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

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

CPT® (Current Procedural Terminology) is a registered trademark of the American Medical Association (AMA). CPT® five-digit codes, nomenclature and other data are copyright 2024 American Medical Association. All Rights Reserved. No fee schedules, basic units, relative values or related listings are included in the CPT book. AMA does not directly or indirectly practice medicine or dispense medical services. AMA assumes no liability for the data contained herein or not contained herein.

Table of Contents

Guideline	Page
General Information.....	3
Stress Testing.....	15
Echocardiography (ECHO).....	27
Nuclear Cardiac Imaging.....	58
Cardiac CT.....	72
Cardiac MRI.....	92
Cardiac PET.....	103
Diagnostic Heart Catheterization.....	113
Adult Congenital Heart Disease.....	135
Maternal Imaging in Cardiovascular Disease.....	175
Condition Specific Imaging.....	190

General Information

Guideline	Page
General Information	4
General Guidelines (CD-1.0).....	9
References (CD-1).....	13

General Information

v1.0.2025

Abbreviations for the Cardiac Imaging Guidelines

Abbreviation	Description
ACC	American College of Cardiology
ACS	acute coronary syndrome
AHA	American Heart Association
ASCOT	Anglo-Scandinavian Cardiac Outcomes Trial
ASD	atrial septal defect
BMI	body mass index
CABG	coronary artery bypass grafting
CAD	coronary artery disease
CAD-RADS	The Coronary Artery Disease Reporting and Data System
CHF	congestive heart failure
COPD	chronic obstructive pulmonary disease
CT	computed tomography
CCTA	coronary computed tomography angiography
CTA	computed tomography angiography
CTV	computed tomography venography
EBCT	electron beam computed tomography
ECP	external counterpulsation (also known as EECP)

Abbreviation	Description
ECG	electrocardiogram
ECP	external counterpulsation
ETT	exercise treadmill stress test
FDG	Fluorodeoxyglucose, a radiopharmaceutical used to measure myocardial metabolism
HCM	hypertrophic cardiomyopathy
IV	intravenous
LAD	left anterior descending coronary artery
LDL-C	low density lipoprotein cholesterol
LHC	left heart catheterization
LV	left ventricle
LVEF	left ventricular ejection fraction
MI	myocardial infarction
MPI	myocardial perfusion imaging (SPECT study, nuclear cardiac study)
MRA	magnetic resonance angiography
MRI	magnetic resonance imaging
mSv	millisievert (a unit of radiation exposure) equal to an effective dose of a joule of energy per kilogram of recipient mass
MUGA	multi gated acquisition scan of the cardiac blood pool
PCI	percutaneous coronary intervention (includes percutaneous coronary angioplasty (PTCA) and coronary artery stenting)

Abbreviation	Description
PET	positron emission tomography
PTCA	percutaneous coronary angioplasty
RHC	right heart catheterization
SPECT	single photon emission computed tomography
TEE	transesophageal echocardiogram
TIA	Transient Ischemic Attack
VSD	ventricular septal defect

Glossary

Agatston Score	a nationally recognized calcium score for the coronary arteries based on Hounsfield units and size (area) of the coronary calcium
Angina	principally chest discomfort, exertional (or with emotional stress) and relieved by rest or nitroglycerin
Anginal variants or equivalents	a manifestation of myocardial ischemia which is perceived by individuals to be (otherwise unexplained) dyspnea, unusual fatigue, more often seen in females and may be unassociated with chest pain
ARVD/ARVC – Arrhythmogenic Right Ventricular Dysplasia/ Cardiomyopathy	a potentially lethal inherited disease with syncope and rhythm disturbances, including sudden death, as presenting manifestations
BNP	B-type natriuretic peptide, blood test used to diagnose and track heart failure (n-T-pro-BNP is a variant of this test)
Brugada Syndrome	an electrocardiographic pattern that is unique and might be a marker for significant life-threatening dysrhythmias

Double Product (Rate Pressure Product)	an index of cardiac oxygen consumption, is the systolic blood pressure times heart rate, generally calculated at peak exercise; over 25000 means an adequate stress load was performed
Fabry's Disease	an infiltrative cardiomyopathy, can cause heart failure and arrhythmias
Fatigue	a subjective feeling of weakness, tiredness or exhaustion. Exertional fatigue is acute in nature, with rapid onset, short duration, and short recovery period.
Hibernating myocardium	viable but poorly functioning or non-functioning myocardium which likely could benefit from intervention to improve myocardial blood supply
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 (optional), angiotensin-converting enzyme (ACE) inhibitors/angiotensin receptor blocking (ARB) agents (optional)
Platypnea	shortness of breath when upright or seated (the opposite of orthopnea) and can indicate cardiac malformations, shunt or tumor
Silent ischemia	absence of ischemic symptoms or signs prior to objective demonstration of ischemia by stress testing and/or demonstration of obstructive CAD
Syncope	loss of consciousness; near-syncope is not syncope
Takotsubo cardiomyopathy	apical dyskinesis oftentimes associated with extreme stress and usually thought to be reversible
Troponin	a marker for ischemic injury, primarily cardiac

Practice Estimate of Effective Radiation Dose chart for Selected Imaging Studies

Imaging Study	Estimate of Effective Radiation Dose
Sestamibi myocardial perfusion study (MPI) PET myocardial perfusion study: Rubidium-82 NH3	9-12 mSv 3 mSv 2 mSv
Thallium myocardial perfusion study (MPI)	22-31 mSv
Diagnostic conventional coronary angiogram (cath)	5-10 mSv
Computed tomography coronary angiography (CTCA) (with prospective gating)	5-15 mSv Less than 5 mSv
CT Abdomen and Pelvis	8-14 mSv
Chest x-ray	<0.1 mSv

General Guidelines (CD-1.0)

CD.GG.0001.0.A

v1.0.2025

General Guidelines

- A pertinent clinical evaluation since the onset or change in symptoms is required prior to considering advanced imaging, which includes:
 - Relevant history and physical examination and appropriate laboratory studies and non-advanced imaging modalities, such as recent ECG (within 60 days), chest x-ray or ECHO/ultrasound, after symptoms started or worsened.
 - Effort should be made to obtain copies of reported “abnormal” ECG studies in order to determine whether the ECG is uninterpretable for ischemia on ETT
 - Most recent previous stress testing and its findings should be obtained
 - Other meaningful contact (telephone call, electronic mail or messaging) by an established individual can substitute for a face-to-face clinical evaluation.
 - A recent clinical evaluation documenting any subjective findings (complaints, changes in behavior) or objective findings (clinical exam findings).
 - Other meaningful contact (telephone call, electronic mail or messaging) by an established individual can substitute for a face-to-face clinical evaluation such as requests based on new increased or worsening symptoms (within the last 60 days).
 - Some conditions may require a face to face evaluation as discussed in the applicable condition -specific guideline sections (such as requests based on new physical exam findings).
 - A recent clinical evaluation may be unnecessary if the individual is undergoing a guideline -supported, scheduled follow -up imaging or other designated procedural evaluation.
 - Exceptions due to routine surveillance indications are addressed in the applicable condition -specific guideline sections
 - Vital signs, height and weight, or BMI, or description of general habitus is needed.
 - Clinical question to be answered by advanced imaging that will affect management of the individual’s clinical condition.
- Cardiac imaging is not indicated if the results will not affect clinical management decisions. If a decision to perform cardiac catheterization or other angiography has already been made, there is often no need for imaging stress testing
- Assessment of ischemic symptoms (if present) based on the descriptions below following this section.

Ischemic evaluation

- For the purposes of guideline sections addressing ischemic evaluation, symptoms can be defined as the following:
 - **Cardiac chest pain/pressure/tightness (likely anginal symptoms):**¹ Chest/epigastric/shoulder/ arm/jaw pain, chest pressure/discomfort occurring with exertion or emotional stress and relieved by rest, nitroglycerin, or both.
 - **Less-likely anginal symptoms:** Symptoms including dyspnea or fatigue when not exertional and not relieved by rest/nitroglycerin; also includes generalized fatigue or chest discomfort occurring in a time course not suggestive of angina (eg, resolves spontaneously within seconds or lasts for an extended period and is unrelated to exertion)
 - **Noncardiac explanation:** An alternative diagnosis, such as gastroesophageal reflux, chest trauma, anemia, chronic obstructive pulmonary disease, or pleurisy, is present and is the most likely explanation for the patient's symptoms
 - **Anginal equivalents:** (individuals with previously documented CAD only):
 - Symptoms consistent with individual's known angina pattern in an individual with a history of CABG or PCI
 - Dyspnea on exertion
 - Fatigue (overwhelming sense of exhaustion causing a decreased capacity for physical activity or mental work)
- Other signs and symptoms suggestive of potential cardiac etiology:
 - Dyspnea
 - Orthopnea
 - Paroxysmal nocturnal dyspnea
 - Heartburn unrelated to meals/nausea and vomiting
 - Palpitations
 - Syncope
 - Heart failure
- Chest pain remains the predominant symptom reported by females among those diagnosed with an acute coronary syndrome.
- For the purpose of this guideline, evidence documenting the presence of obstructive CAD includes any of the following:
 - Prior heart catheterization or CCTA revealing any of the following:
 - $\geq 40\%$ stenosis of the left main coronary artery
 - $\geq 50\%$ stenosis for other coronary arteries
 - Significant stenosis defined by an FFR of ≤ 0.80
 - History of a prior PCI or CABG

¹ Multimodality Writing Group for Chronic Coronary Disease, Winchester DE, Maron DJ, et al. ACC/AHA/ASE/ASNC/ASPC/HFSA/HRS/SCAI/SCCT/SCMR/STS 2023 Multimodality Appropriate Use Criteria for the Detection and Risk Assessment of Chronic Coronary Disease. J Am Coll Cardiol. 2023;81(25):2445-2467. doi:10.1016/j.jacc.2023.03.411.

- For the purpose of this guideline, evidence documenting the presence of non-obstructive CAD includes prior heart catheterization or CCTA revealing any of the following:
 - <40% stenosis of the left main coronary artery
 - <50% stenosis for other coronary arteries
 - FFR >0.8
- ²The Coronary Artery Disease Reporting and Data System (CAD-RADS) classification of percentage luminal diameter coronary artery stenosis on coronary CT angiography (CCTA) is as follows:
 - CAD-RADS 0: 0%
 - CAD-RADS 1: 1 to 24%
 - CAD-RADS 2: 25 to 49%
 - CAD-RADS 3: 50 to 69%
 - CAD-RADS 4: 70 to 99% or ≥50% left main coronary artery stenosis
 - CAD-RADS 5: 100% (total occlusion)
- For the purposes of this guideline, evidence documenting a prior MI includes any of the following:
 - Presence of diagnostic Q waves on an ECG
 - A fixed perfusion defect on MPI
 - Akinetic or dyskinetic wall motion on echocardiogram
 - Area of Late Gadolinium Enhancement (LGE) on cardiac MRI suggesting scar
- Findings that may alter the ECG changes during exercise or are uninterpretable for ischemia on a stress test:
 - Complete Left Bundle Branch Block (bifascicular block involving right bundle branch and left anterior hemiblock does not render ECG uninterpretable for ischemia)
 - Ventricular paced rhythm
 - Pre-excitation pattern such as Wolff-Parkinson-White
 - ≥1.0 mm ST segment depression (NOT nonspecific ST/T wave changes)
 - LVH with repolarization abnormalities, also called LVH with strain (NOT without repolarization abnormalities or by voltage criteria)
 - T wave inversion in at least two contiguous inferior and/or lateral leads. This includes leads II, AVF, V5 or V6. (T wave inversion isolated in lead III or T wave inversion in lead V1 and V2 are not included).
 - Individual on digitalis preparation

The Exercise Treadmill Test (ETT)

- Necessary components of an ETT include:
 - ECG that can be interpreted for ischemia.

² Fletcher GF, Ades PA, Kligfield P, et al. Exercise standards for testing and training: a scientific statement from the American Heart Association. *Circulation*. 2013;128(8):873-934. doi:10.1161/CIR.0b013e31829b5b44.

- Individual capable of exercise to achieve target heart rate on a treadmill or similar device (5 METs or greater; see functional capacity below). Target heart rate is calculated as 85% of the maximum age predicted heart rate (MPHR). MPHR is estimated as 220 minus the individual's age.
- An abnormal ETT (exercise treadmill test) includes at least one of the following:
 - ST segment depression (horizontal or downsloping, ≥ 1.0 mm below baseline)
 - Development of chest pain
 - Drop in systolic blood pressure >10 mmHg during exercise
 - Non-sustained ventricular tachycardia ≥ 3 consecutive ventricular beats at a rate of >100 beats per minute
 - Sustained ventricular tachycardia (ventricular rhythm at rate >100 beats/minute lasting >30 seconds or requiring termination due to hemodynamic compromise in <30 seconds)
- Functional capacity ≥ 5 METs equates to the following:
 - Can walk four blocks without stopping
 - Can walk up a hill
 - Can climb one flight of stairs without stopping
 - Can perform heavy work around the house
 - Can walk 4 mph at a brisk pace

Background and Supporting Information

An observational study found that, compared with the Duke Activity Status Index, subjective assessment by clinicians generally underestimated exercise capacity

Upsloping ST segment depression is not considered to be an abnormal ETT finding because of its low specificity.

References (CD-1)

CD.GG.0001.0.A

v1.0.2025

1. Fihn SD, Gardin JM, Abrams J, et al. 2012 ACCF/AHA/ACP/AATS/PCNA/SCAI/STS Guideline for the Diagnosis and Management of Patients with Stable Ischemic Heart Disease: Executive Summary. *Circulation*. 2012;126(25):3097-3137. doi:10.1161/cir.0b013e3182776f83.
2. Qaseem A, Fihn SD, Williams S, et al. A. Diagnosis of Stable Ischemic Heart Disease: Summary of a Clinical Practice Guideline from the American College of Physicians/American College of Cardiology Foundation/American Heart Association/American Association for Thoracic Surgery/Preventive Cardiovascular Nurses Association/Society of Thoracic Surgeons. *Annals of Internal Medicine*. 2012;157(10):729. doi:10.7326/0003-4819-157-10-201211200-00010.
3. Rybicki FJ, Udelson JE, Peacock WF, et al. 2015 ACR/ACC/AHA/AATS/ACEP/ASNC/NASCI/SAEM/SCCT/SCMR/SCPC/SNMMI/STR/STS Appropriate Utilization of Cardiovascular Imaging in Emergency Department Patients with Chest Pain. *J Am Coll Cardiol*. 2016;67(7):853-879. doi:10.1016/j.jacc.2015.09.011.
4. Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery. *J Am Coll Cardiol*. 2014;64(22):e77-e137. doi:10.1016/j.jacc.2014.07.944.
5. Ho PM, Rumsfeld JS, Peterson PN. Chest pain on exercise treadmill test predicts future cardiac hospitalizations. *Clin Cardiol* 2007; 30:505-510. doi:10.1002/clc.20139.
6. Sechtem U. Do heart transplant recipients need annual coronary angiography? *Eu Heart J* 2001; 22:895-897. doi:10.1053/euhj.2001.2660.
7. Tavel ME. Stress testing in cardiac evaluation: Current concepts with emphasis on the ECG. *Chest* 2001; 119:907-925. doi:10.1378/chest.119.3.907.
8. Wolk MJ, Bailey SR, Doherty JU, et al. ACCF/AHA/ASE/ASNC/HFSA/HRS/SCAI/SCCT/SCMR/STS. 2013 Multi-modality appropriate use criteria for the detection and risk assessment of stable ischemic heart disease: a report of the American College of Cardiology Foundation, Appropriate Use Criteria Task Force, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and Society of Thoracic Surgeons. *J Am Coll Cardiol* 2014; 63: forthcoming. doi:10.1016/j.jacc.2013.11.009.
9. Blank P, Scheopf UJ, Leipsic JA. CT in transcatheter aortic valve replacement. *Radiology*, 2013; 269(3). doi:10.1148/radiol.13120696.
10. Leipsic JA, Blanke P, Hanley M, et al. ACR Appropriateness Criteria[®] Imaging for Transcatheter Aortic Valve Replacement. *J Am Coll Radiol*. 2017;14(11). doi:10.1016/j.jacr.2017.08.046.
11. Mieres JH, Gulati M, Bairey Merz N, et al. American Heart Association Cardiac Imaging Committee of the Council on Clinical Cardiology, Cardiovascular Imaging and Intervention Committee of the Council on Cardiovascular Radiology. Role of Noninvasive Testing in the Clinical Evaluation of Women with Suspected Ischemic Heart Disease A Consensus Statement from the American Heart Association. *Circulation*. 2014; 130(4):350. doi:10.1161/CIR.0000000000000061.
12. American College of Cardiology Foundation Appropriate Use Criteria Task Force, American Society of Echocardiography, American Heart Association, et al. ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/SCCT/SCMR 2011 Appropriate Use Criteria for Echocardiography. A Report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, American Society of Echocardiography, American Heart Association, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Critical Care Medicine, Society of Cardiovascular Computed Tomography, and Society for Cardiovascular Magnetic Resonance Endorsed by the American College of Chest Physicians. *J Am Coll Cardiol* 2011; 57:1126. doi:10.1016/j.echo.2010.12.008.
13. Melon CC, Eshtiaghi P, Luksun WJ, et al. Validated questionnaire vs physicians' judgment to estimate preoperative exercise capacity. *JAMA Intern Med* 2014; 174:1507. doi:10.1001/jamainternmed.2014.2914.

14. Taqueti V, Dorbala S, Wolinsky D. Myocardial perfusion imaging in women for the evaluation of stable ischemic heart disease-state-of-the-evidence and clinical recommendations. *Journal of Nuclear Cardiology*. June 2017. doi.org/10.1007/s12350-017-0926-8.
15. Chamberlain JJ, Johnson EL, Leal S, et al. Cardiovascular Disease and Risk Management: Review of the American Diabetes Association Standards of Medical Care in Diabetes 2018. *Annals of Internal Medicine*. 2018;168(9):640. doi:10.7326/m18-0222.
16. Bateman TM, Dilisizian V, Beanlands RS, Depuey EG, Heller GV, Wolinsky DA. American Society of Nuclear Cardiology and Society of Nuclear Medicine and Molecular Imaging Joint Position Statement on the Clinical Indications for Myocardial Perfusion PET. *Journal of Nuclear Medicine*. 2016;57(10):1654-1656. doi:10.2967/jnumed.116.180448.
17. U.S. Food and Drug Administration. PROLEUKIN® (aldesleukin) for injection, for intravenous infusion. U.S. Food and Drug Administration Website. <https://www.accessdata.fda.gov>.
18. Gulati M, Levy PD, Mukherjee D, et al. 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines [published correction appears in *Circulation*. 2021 Nov 30;144(22):e455]. *Circulation*. 2021;144(22):e368-e454. doi:10.1161/CIR.0000000000001029.
19. Kidney Disease: Improving Global Outcomes (KDIGO) Kidney Transplant Candidate Work Group. KDIGO Clinical Practice Guideline on the Evaluation and Management of Candidates for Kidney Transplantation. *Transplantation*. 2020;104: S1 – S103.
20. Wenger NK, Lloyd-Jones DM, Elkind MSV, et al. Call to Action for Cardiovascular Disease in Women: Epidemiology, Awareness, Access, and Delivery of Equitable Health Care: A Presidential Advisory From the American Heart Association. *Circulation*. 2022;145(23):e1059-e1071. doi:10.1161/CIR.0000000000001071.
21. Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;130(24):e278-e333. doi:10.1161/CIR.0000000000000106.
22. Schwarze ML, Barnato AE, Rathouz PJ, et al. Development of a List of High-Risk Operations for Patients 65 Years and Older. *JAMA Surg*. 2015;150(4):325–331. doi:10.1001/jamasurg.2014.1819.
23. Cury RC, Leipsic J, Abbara S, et al. CAD-RADS™ 2.0 - 2022 Coronary Artery Disease-Reporting and Data System: An Expert Consensus Document of the Society of Cardiovascular Computed Tomography (SCCT), the American College of Cardiology (ACC), the American College of Radiology (ACR), and the North America Society of Cardiovascular Imaging (NASCI). *J Cardiovasc Comput Tomogr*. 2022;16(6):536-557. doi:10.1016/j.jcct.2022.07.002.
24. Fletcher GF, Ades PA, Kligfield P, et al. Exercise standards for testing and training: a scientific statement from the American Heart Association. *Circulation*. 2013;128(8):873-934. doi:10.1161/CIR.0b013e31829b5b44.
25. Multimodality Writing Group for Chronic Coronary Disease, Winchester DE, Maron DJ, et al. ACC/AHA/ASE/ASNC/ASPC/HFSA/HRS/SCAI/SCCT/SCMR/STS 2023 Multimodality Appropriate Use Criteria for the Detection and Risk Assessment of Chronic Coronary Disease. *J Am Coll Cardiol*. 2023;81(25):2445-2467. doi:10.1016/j.jacc.2023.03.410.
26. Cohn PF, Fox KM, Daly C. Silent myocardial ischemia. *Circulation*. 2003 Sep 9;108(10):1263-77. doi: 10.1161/01.CIR.0000088001.59265.EE.
27. Peled Y, Ducharme A, Kittleson M, et al. International Society For Heart And Lung Transplantation Guidelines For The Evaluation and Care Of Cardiac Transplant Candidates-2024. *J Heart Lung Transplant*. 2024 Jul 30:S1053-2498(24)01679-6. doi: 10.1016/j.healun.2024.05.010.

Stress Testing

Guideline	Page
Stress Testing with Imaging (CD-1.4).....	16
Stress Testing with Imaging - Preoperative (CD-1.5).....	21
Transplant (CD-1.6).....	23
References (CD-1).....	25

Stress Testing with Imaging (CD-1.4)

CD.ST.0001.4.A

v1.0.2025

General information

- Imaging Stress Tests include any one of the following:
 - Stress Echocardiography see **Stress Echocardiography (Stress Echo) – Coding (CD-2.7)**
 - SPECT MPI see **Myocardial Perfusion Imaging (MPI) – Coding (CD-3.1)**
 - Stress perfusion MRI see **Cardiac MRI – Indications for Stress MRI (CD-5.3)**
 - PET Perfusion see **Cardiac PET-Perfusion-Indications (CD-6.2)**
- Stress testing with imaging can be performed with maximal exercise or chemical stress (adenosine, dipyridamole, dobutamine, or regadenoson) and does not alter the CPT® codes used to report these studies.

Stress Testing with Imaging - Coding

Stress echo, SPECT MPI or stress MRI

Codes Addressed	CPT®
Cardiac MRI for morphology and function without contrast, with stress imaging	75559
Cardiac MRI for morphology and function without and with contrast, with stress imaging	75563
MPI, tomographic (SPECT) including attenuation correction, qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); single study, at rest or stress (exercise or pharmacologic)	78451
MPI, tomographic (SPECT) (including attenuation correction, qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); multiple studies, at rest and/or stress (exercise or pharmacologic) and/or redistribution and/or rest reinjection	78452

Codes Addressed	CPT®
Echocardiography (TTE), (2D), with or without m-mode, during rest and cardiovascular stress, with interpretation and report	93350
Echocardiography (TTE), (2D), m-mode, during rest and cardiovascular stress test using treadmill, bicycle exercise and/or pharmacologically induced stress, with interpretation	93351

Cardiac perfusion PET

Codes addressed	CPT®
Myocardial imaging, positron emission tomography (PET), perfusion study (including ventricular wall motion[s] and/or ejection fraction[s], when performed); single study, at rest or stress (exercise or pharmacologic), with concurrently acquired computed tomography transmission scan	78430
Myocardial imaging, positron emission tomography (PET), perfusion study (including ventricular wall motion[s] and/or ejection fraction[s], when performed); multiple studies at rest and stress (exercise or pharmacologic), with concurrently acquired computed tomography transmission scan	78431
Myocardial imaging, positron emission tomography (PET), perfusion study (including ventricular wall motion[s] and/or ejection fraction[s], when performed); single study at rest or stress (exercise or pharmacologic)	78491
Myocardial imaging, positron emission tomography (PET), perfusion study (including ventricular wall motion[s] and/or ejection fraction[s], when performed); multiple studies at rest and stress (exercise or pharmacologic)	78492

Stress Testing with Imaging - Indications

Stress test with imaging (Stress echo, SPECT MPI, or stress MRI) is considered medically necessary when conditions have been met for **any** of the following indications:

Likely anginal symptoms

New, recurrent or worsening likely anginal symptoms as defined in **General Guidelines (CD-1.0)**

Symptomatic with known CAD

Prior history of PCI (percutaneous coronary intervention) or CABG (coronary artery bypass graft surgery) or a history of obstructive CAD as defined in **General Guidelines (CD-1.0)** and **either** of the following:

- Likely anginal symptoms as defined in **General Guidelines (CD-1.0)**
- Symptoms similar to prior ischemic episode

Symptomatic with uninterpretable ECG

New, recurrent, or worsening symptoms of chest pain, or exertional dyspnea, or exertional fatigue and resting ECG is uninterpretable for ischemia due to **any** of the following:

- Complete Left Bundle Branch Block (bifascicular block involving right bundle branch and left anterior hemiblock does not render ECG uninterpretable for ischemia)
- Ventricular paced rhythm
- Pre-excitation pattern such as Wolff-Parkinson-White
- Greater or equal to 1.0 mm ST segment depression (NOT nonspecific ST/T wave changes)
- LVH with repolarization abnormalities, also called LVH with strain (NOT without repolarization abnormalities or by voltage criteria)
- T wave inversion in at least two contiguous inferior and/or lateral leads. This includes leads II, AVF, V5 or V6. (T wave inversion isolated in lead III or T wave inversion in lead V1 and V2 are not included)
- Individual on digitalis preparation

Symptomatic with inconclusive or abnormal ETT or elevated CAC

New, recurrent or worsening symptoms of chest pain, or exertional dyspnea, or exertional fatigue and any of the following:

- Inconclusive ETT (exercise treadmill test) due to any of the following:
 - <85% maximum predicted heart rate achieved
 - Exercise ECG is uninterpretable for ischemia (for example due to development of rate-related left bundle branch block during exercise)
- Abnormal ETT as defined in **General Guidelines (CD-1.0)**
- Coronary artery calcium (CAC) score ≥ 100

Heart failure or left ventricular systolic dysfunction

Stress test with imaging is indicated to evaluate heart failure or left ventricular systolic dysfunction when there is documentation of **any** of the following:

- New or worsening heart failure
- New left ventricular systolic dysfunction (left ventricular ejection fraction <50%)

- Worsening left ventricular systolic dysfunction (decline in left ventricular ejection fraction $\geq 10\%$)
- Significant ischemic ventricular dysfunction (suspected hibernating myocardium) to assess myocardial viability when there are persistent symptoms or heart failure and revascularization is being considered.

Note:

MRI, cardiac PET, SPECT MPI, or Dobutamine stress echo can be used to assess myocardial viability depending on physician preference. See also **Cardiac PET – Metabolic – Indications (CD-6.4)**

Syncope or arrhythmia

Stress test with imaging is indicated for **any** of the following:

- Syncope of suspected ischemic etiology not otherwise explained
- Sustained ventricular tachycardia (ventricular rhythm at rate >100 beats/minute lasting >30 seconds or requiring termination due to hemodynamic compromise in <30 seconds).
- Non-sustained ventricular tachycardia ≥ 3 consecutive ventricular beats at rate >100 beats/minute
- Frequent PVCs (premature ventricular contractions) >30 PVCs per hour
- Prior to starting a Class IC antiarrhythmic agent (flecainide or propafenone) to assess for CAD and annually while taking the medication

With or without symptoms for moderate coronary artery stenosis

Stress test with imaging is indicated to evaluate the functional significance of moderate stenosis when there is documentation of **either** of the following:

- CCTA (coronary computed tomography angiography) with moderate stenosis (50 to 69% - CAD-RADS 3 as defined in **General Guidelines CD-1.0**)
- Invasive coronary angiography with intermediate severity stenosis and invasive physiological testing has not been done

Without symptoms

Stress test with imaging is indicated for any of the following:

- Prior to starting Interleukin-2
- An uninterpretable ECG as described in **General Guidelines (CD 1.0)** that has not been previously evaluated
- Every 2 years if there is a history of silent ischemia (absence of ischemic symptoms or signs prior to objective demonstration of ischemia by stress testing and/or demonstration of obstructive CAD as defined in **General Guidelines (CD-1.0)**)

- Prior to starting a Class IC antiarrhythmic agent (flecainide or propafenone) to assess for CAD and annually while taking the medication
- Asymptomatic individual who has an ischemic EKG response on ETT (horizontal or downsloping ST depression ≥ 1.0 mm below baseline).

Cardiac perfusion PET

Stress test with imaging using cardiac perfusion PET (CPT® 78430, 78431, 78491, 78492) is indicated in place of stress echo, SPECT MPI, or stress MRI when **any** of the above indications for stress testing with imaging (symptomatic or regardless of symptoms) have been met **and** there is documentation of **one** of the following:

- Individual is severely obese
- Individual has large breasts or implants
- Individual incapable of exercise due to physical (musculoskeletal or neurological) inability to achieve target heart rate.

Note: Target heart rate is calculated as 85% of the maximum age predicted heart rate (MPHR). MPHR is estimated as 220 minus the individual's age. See **Cardiac PET – Perfusion – Indications (CD-6.2)** for additional indications for cardiac PET perfusion

Evidence Discussion

Appropriate Use Criteria from major professional societies including the American College of Cardiology and the American Heart Association support the use of myocardial perfusion imaging (MPI) with single photon emission computed tomography (SPECT) for patients with signs or symptoms consistent with coronary artery disease (CAD) such as typical angina. In addition, they support the use of SPECT perfusion imaging in symptomatic patients with known CAD and those with prior interventions such as coronary artery bypass surgery, coronary stenting, and preoperative risk stratification. These guidelines balance the appropriate testing of patients with SPECT versus unnecessary and potentially harmful testing and downstream procedures.

Also, as supported by society guidelines, use of SPECT is indicated in detection of cardiac transthyretin amyloidosis (ATTR) after light chain amyloidosis (AL) is ruled out by appropriate blood and urine testing.

Stress Testing with Imaging - Preoperative (CD-1.5)

CD.ST.0001.5.A

v1.0.2025

- There are **2** steps that determine the need for imaging stress testing in (stable) pre-operative individuals:
 - Step1: Would the individual qualify for imaging stress testing independent of planned surgery?
 - If yes, proceed to stress testing guidelines **Stress Testing with Imaging – Indications (CD-1.4)**
 - If no, go to step 2
 - Step 2: Is the surgery considered high, moderate or low-risk? (see **Table-2**) If high or moderate-risk, proceed below. If low-risk, there is no evidence to determine a need for preoperative cardiac testing.
 - **High-Risk Surgery:** All individuals in this category should receive an imaging stress test if there has not been an imaging stress test within 1 year unless the individual has developed new cardiac symptoms or a new change in the EKG since the last stress test.
 - **Intermediate-Risk Surgery:** One or more clinical risk factors and unable to perform an ETT per guidelines if there has not been an imaging stress test within 1 year unless the individual has developed new cardiac symptoms or a new change in the EKG since the last stress test.
 - **Low-Risk:** Preoperative imaging stress testing is not supported.
 - Clinical Risk Factors (for cardiac death and non-fatal MI at time of non-cardiac 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

Table-2 Cardiac Risk Stratification List

High-Risk (> 5%)	Intermediate-Risk (1-5%)	Low-Risk (<1%)
<ul style="list-style-type: none"> • Open aortic and other major open vascular surgery • Open peripheral vascular surgery • Esophagectomy • Pneumonectomy • Open intraperitoneal and/or intrathoracic surgery with organ resection 	<ul style="list-style-type: none"> • Open intraperitoneal and/or intrathoracic surgery without major organ resection • Open carotid endarterectomy • Head and neck surgery • Open orthopedic surgery • Open prostate surgery 	<ul style="list-style-type: none"> • Endoscopic procedures • Superficial procedures • Cataract surgery • Breast surgery • Ambulatory surgery • Laparoscopic and endovascular procedures that are unlikely to require further extensive surgical intervention

Evidence Discussion

Appropriate Use Criteria from major professional societies including the American College of Cardiology and the American Heart Association support the use of myocardial perfusion imaging (MPI) with single photon emission computed tomography (SPECT) for patients with signs or symptoms consistent with coronary artery disease (CAD) such as typical angina. In addition, they support the use of SPECT perfusion imaging in symptomatic patients with known CAD and those with prior interventions such as coronary artery bypass surgery, coronary stenting, and preoperative risk stratification. These guidelines balance the appropriate testing of patients with SPECT versus unnecessary and potentially harmful testing and downstream procedures.

Also, as supported by society guidelines, use of SPECT is indicated in detection of cardiac transthyretin amyloidosis (ATTR) after light chain amyloidosis (AL) is ruled out by appropriate blood and urine testing.

Transplant (CD-1.6)

CD.ST.0001.6.A

v1.0.2025

Non-cardiac transplant

- Stress Testing in individuals for Non-Cardiac Transplant
 - Candidates for any type of organ, bone marrow, or stem cell transplant can undergo imaging stress testing every year (stress echo, SPECT MPI, stress MRI, or stress cardiac PET perfusion per the transplant center's protocol) prior to transplant. See **Kidney Transplant, Pre-Transplant Imaging Studies (AB-42.5)**.
 - An imaging stress test can be repeated annually after transplant for at least two years or within one year of a prior cardiac imaging study if there is evidence of progressive vasculopathy.
 - After two consecutive normal imaging stress tests, repeated testing is not supported more often than every other year without evidence for progressive vasculopathy or new symptoms.
 - Stress testing after five years may proceed according to normal patterns of consideration.

Cardiac transplant

- Pre-Cardiac Transplant evaluation
 - The following modalities are indicated for an individual being evaluated for cardiac transplant:
 - CT chest (CPT® 71250 or 71260) **and**
 - Abdominal imaging with: Ultrasound abdomen (CPT® 76700 or 76705) or CT abdomen (CPT® 74150 or 74160) and/or MRI abdomen (CPT® 74181 or 74183) **and**
 - Right heart catheterization (CPT® 93451) or Right and left heart catheterization (CPT® 93453)
- Post-Cardiac transplant assessment of transplant CAD:
 - **One** of the following imaging studies may be performed annually:
 - SPECT MPI (78451, 78452)
 - Stress ECHO (93350, 93351)
 - Stress MRI (75559, 75563)
 - Cardiac PET perfusion (CPT 78430, 78431, 78491, 78492)

Background and Supporting Information

Individuals who have undergone organ transplant are at increased risk for ischemic heart disease secondary to their medication. Risk of vasculopathy is 7% at one-year, 32% at five years and 53% at ten years.

For individuals being evaluated for cardiac transplant, MRI may be performed as the initial abdominal imaging modality or for further evaluation after initial abdominal imaging with Ultrasound or CT.

Evidence Discussion

Stress testing with imaging is indicated to exclude the presence of significant coronary artery disease as part of evaluating candidacy for any type of organ, bone marrow, or stem cell transplant. While on the transplant waiting list, stress testing with imaging is indicated annually to exclude progression of coronary artery disease. Stress testing with any imaging modality (stress echo, SPECT MPI, stress MRI, or stress cardiac PET perfusion) is supported per the transplant center's protocol. Recommendations regarding stress testing with imaging for pre-transplant evaluation are provided in established evidence-based medical specialty organization guidelines.

Stress testing with imaging also has a role in surveillance following cardiac transplant to evaluate for development of obstructive coronary artery disease due to cardiac allograft vasculopathy. Stress testing with any imaging modality (stress echo, SPECT MPI, stress MRI, or stress cardiac PET perfusion) is indicated annually post cardiac transplant. Recommendations regarding stress testing with imaging for post cardiac transplant surveillance are provided in established evidence-based medical specialty organization guidelines.

References (CD-1)

v1.0.2025

1. Fihn SD, Gardin JM, Abrams J, et al. 2012 ACCF/AHA/ACP/AATS/PCNA/SCAI/STS Guideline for the Diagnosis and Management of Patients with Stable Ischemic Heart Disease: Executive Summary. *Circulation*. 2012;126(25):3097-3137. doi:10.1161/cir.0b013e3182776f83.
2. Qaseem A, Fihn SD, Williams S, et al. A. Diagnosis of Stable Ischemic Heart Disease: Summary of a Clinical Practice Guideline from the American College of Physicians/American College of Cardiology Foundation/American Heart Association/American Association for Thoracic Surgery/Preventive Cardiovascular Nurses Association/Society of Thoracic Surgeons. *Annals of Internal Medicine*. 2012;157(10):729. doi:10.7326/0003-4819-157-10-201211200-00010.
3. Rybicki FJ, Udelson JE, Peacock WF, et al. 2015 ACR/ACC/AHA/AATS/ACEP/ASNC/NASCI/SAEM/SCCT/SCMR/SCPC/SNMMI/STR/STS Appropriate Utilization of Cardiovascular Imaging in Emergency Department Patients with Chest Pain. *J Am Coll Cardiol*. 2016;67(7):853-879. doi:10.1016/j.jacc.2015.09.011.
4. Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery. *J Am Coll Cardiol*. 2014;64(22):e77-e137. doi:10.1016/j.jacc.2014.07.944.
5. Ho PM, Rumsfeld JS, Peterson PN. Chest pain on exercise treadmill test predicts future cardiac hospitalizations. *Clin Cardiol* 2007; 30:505-510. doi:10.1002/clc.20139.
6. Sechtem U. Do heart transplant recipients need annual coronary angiography? *Eu Heart J* 2001; 22:895-897. doi:10.1053/euhj.2001.2660.
7. Tavel ME. Stress testing in cardiac evaluation: Current concepts with emphasis on the ECG. *Chest* 2001; 119:907-925. doi:10.1378/chest.119.3.907.
8. Wolk MJ, Bailey SR, Doherty JU, et al. ACCF/AHA/ASE/ASNC/HFSA/HRS/SCAI/SCCT/SCMR/STS. 2013 Multi-modality appropriate use criteria for the detection and risk assessment of stable ischemic heart disease: a report of the American College of Cardiology Foundation, Appropriate Use Criteria Task Force, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and Society of Thoracic Surgeons. *J Am Coll Cardiol* 2014; 63: forthcoming. doi:10.1016/j.jacc.2013.11.009.
9. Blank P, Scheopf UJ, Leipsic JA. CT in transcatheter aortic valve replacement. *Radiology*, 2013; 269(3). doi:10.1148/radiol.13120696.
10. Leipsic JA, Blanke P, Hanley M, et al. ACR Appropriateness Criteria[®] Imaging for Transcatheter Aortic Valve Replacement. *J Am Coll Radiol*. 2017;14(11). doi:10.1016/j.jacr.2017.08.046.
11. Mieres JH, Gulati M, Bairey Merz N, et al. American Heart Association Cardiac Imaging Committee of the Council on Clinical Cardiology, Cardiovascular Imaging and Intervention Committee of the Council on Cardiovascular Radiology. Role of Noninvasive Testing in the Clinical Evaluation of Women with Suspected Ischemic Heart Disease A Consensus Statement from the American Heart Association. *Circulation*. 2014; 130(4):350. doi:10.1161/CIR.0000000000000061.
12. American College of Cardiology Foundation Appropriate Use Criteria Task Force, American Society of Echocardiography, American Heart Association, et al. ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/SCCT/SCMR 2011 Appropriate Use Criteria for Echocardiography. A Report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, American Society of Echocardiography, American Heart Association, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Critical Care Medicine, Society of Cardiovascular Computed Tomography, and Society for Cardiovascular Magnetic Resonance Endorsed by the American College of Chest Physicians. *J Am Coll Cardiol* 2011; 57:1126. doi:10.1016/j.echo.2010.12.008.
13. Melon CC, Eshtiaghi P, Luksun WJ, et al. Validated questionnaire vs physicians' judgment to estimate preoperative exercise capacity. *JAMA Intern Med* 2014; 174:1507. doi:10.1001/jamainternmed.2014.2914.
14. Taqueti V, Dorbala S, Wolinsky D. Myocardial perfusion imaging in women for the evaluation of stable ischemic heart disease-state-of-the-evidence and clinical recommendations. *Journal of Nuclear Cardiology*. June 2017. doi.org/10.1007/s12350-017-0926-8.

15. Chamberlain JJ, Johnson EL, Leal S, et al. Cardiovascular Disease and Risk Management: Review of the American Diabetes Association Standards of Medical Care in Diabetes 2018. *Annals of Internal Medicine*. 2018;168(9):640. doi:10.7326/m18-0222.
16. Bateman TM, Dilsizian V, Beanlands RS, Depuey EG, Heller GV, Wolinsky DA. American Society of Nuclear Cardiology and Society of Nuclear Medicine and Molecular Imaging Joint Position Statement on the Clinical Indications for Myocardial Perfusion PET. *Journal of Nuclear Medicine*. 2016;57(10):1654-1656. doi:10.2967/jnumed.116.180448.
17. U.S. Food and Drug Administration. PROLEUKIN® (aldesleukin) for injection, for intravenous infusion. U.S. Food and Drug Administration Website. <https://www.accessdata.fda.gov>.
18. Gulati M, Levy PD, Mukherjee D, et al. 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines [published correction appears in *Circulation*. 2021 Nov 30;144(22):e455]. *Circulation*. 2021;144(22):e368-e454. doi:10.1161/CIR.0000000000001029.
19. Kidney Disease: Improving Global Outcomes (KDIGO) Kidney Transplant Candidate Work Group. KDIGO Clinical Practice Guideline on the Evaluation and Management of Candidates for Kidney Transplantation. *Transplantation*. 2020;104: S1 – S103.
20. Wenger NK, Lloyd-Jones DM, Elkind MSV, et al. Call to Action for Cardiovascular Disease in Women: Epidemiology, Awareness, Access, and Delivery of Equitable Health Care: A Presidential Advisory From the American Heart Association. *Circulation*. 2022;145(23):e1059-e1071. doi:10.1161/CIR.0000000000001071.
21. Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;130(24):e278-e333. doi:10.1161/CIR.0000000000000106.
22. Schwarze ML, Barnato AE, Rathouz PJ, et al. Development of a List of High-Risk Operations for Patients 65 Years and Older. *JAMA Surg*. 2015;150(4):325–331. doi:10.1001/jamasurg.2014.1819.
23. Cury RC, Leipsic J, Abbara S, et al. CAD-RADS™ 2.0 - 2022 Coronary Artery Disease-Reporting and Data System: An Expert Consensus Document of the Society of Cardiovascular Computed Tomography (SCCT), the American College of Cardiology (ACC), the American College of Radiology (ACR), and the North America Society of Cardiovascular Imaging (NASCI). *J Cardiovasc Comput Tomogr*. 2022;16(6):536-557. doi:10.1016/j.jcct.2022.07.002.
24. Fletcher GF, Ades PA, Kligfield P, et al. Exercise standards for testing and training: a scientific statement from the American Heart Association. *Circulation*. 2013;128(8):873-934. doi:10.1161/CIR.0b013e31829b5b44.
25. Multimodality Writing Group for Chronic Coronary Disease, Winchester DE, Maron DJ, et al. ACC/AHA/ASE/ASNC/ASPC/HFSA/HRS/SCAI/SCCT/SCMR/STS 2023 Multimodality Appropriate Use Criteria for the Detection and Risk Assessment of Chronic Coronary Disease. *J Am Coll Cardiol*. 2023;81(25):2445-2467. doi:10.1016/j.jacc.2023.03.410.
26. Cohn PF, Fox KM, Daly C. Silent myocardial ischemia. *Circulation*. 2003 Sep 9;108(10):1263-77. doi:10.1161/01.CIR.0000088001.59265.EE.
27. Peled Y, Ducharme A, Kittleson M, et al. International Society For Heart And Lung Transplantation Guidelines For The Evaluation and Care Of Cardiac Transplant Candidates-2024. *J Heart Lung Transplant*. 2024 Jul 30:S1053-2498(24)01679-6. doi: 10.1016/j.healun.2024.05.010.

Echocardiography (ECHO)

Guideline	Page
Transthoracic Echocardiogram (TTE) - Coding (CD-2.1).....	28
Transthoracic Echocardiography (TTE) Indications/initial evaluation (CD-2.2).....	32
Frequency of Echocardiography Testing (CD-2.3).....	35
References (CD-2).....	43
Transesophageal Echocardiography (TEE) (CD-2.4) (CD-2.5).....	45
Stress echocardiography (stress echo) (CD-2.6) (CD-2.7).....	49
3D Echocardiography (CD-2.8)(CD-2.9).....	52
Myocardial strain imaging (CD-2.12).....	54
References (CD-2).....	55

Transthoracic Echocardiogram (TTE) - Coding (CD-2.1)

CD.EC.0002.1.A

v1.0.2025

Transthoracic Echocardiography (TTE) - Coding

Transthoracic Echocardiography

Description	CPT®
TTE for congenital cardiac anomalies, complete	93303
TTE for congenital cardiac anomalies, follow-up or limited	93304
TTE with 2-D, M-mode, Doppler and color flow, complete	93306
TTE with 2-D, M-mode, without Doppler or color flow	93307
TTE with 2-D, M-mode, follow-up or limited	93308

3D Echocardiography

Description	CPT®
3D rendering with interpretation and reporting of computed tomography, magnetic resonance imaging, ultrasound, or other tomographic modality with image postprocessing under concurrent supervision; not requiring image postprocessing on an independent workstation	76376
3D rendering with interpretation and reporting of computed tomography, magnetic resonance imaging, ultrasound, or other tomographic modality with image postprocessing under concurrent supervision; requiring image postprocessing on an independent workstation	76377

Description	CPT®
3D echocardiographic imaging and postprocessing during transesophageal echocardiography, or during transthoracic echocardiography for congenital cardiac anomalies, for the assessment of cardiac structure(s) (eg, cardiac chambers and valves, left atrial appendage, interatrial septum, interventricular septum) and function, when performed (List separately in addition to code for echocardiographic imaging) Code with (93303-93304, 93312, 93314, 93315, 93317, 93350-93351)	+93319

Doppler Echocardiography

Description	CPT®
Doppler echo, pulsed wave and/or spectral display	+93320
Doppler echo, pulsed wave and/or spectral display, follow-up or limited study	+93321
Doppler echo, color flow velocity mapping	+93325
CPT® 93320 and CPT® 93321 should not be requested or billed together	

C Codes

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

C Code	Transthoracic Echocardiography	CPT®
C8921	TTE for congenital cardiac anomalies, complete	93303
C8922	TTE for congenital cardiac anomalies, follow-up or limited	93304
C8929	TTE with 2-D, M-mode, Doppler and color flow, complete	93306
C8923	TTE with 2-D, M-mode, without Doppler or color flow	93307
C8924	TTE with 2-D, M-mode, follow-up or limited	93308

Myocardial strain imaging

Description	CPT®
Myocardial strain imaging using speckle tracking-derived assessment of myocardial mechanics (List separately in addition to codes for echocardiography imaging)	+93356

Investigational codes

Description	CPT®
Myocardial contrast perfusion echocardiography, at rest or with stress, for assessment of myocardial ischemia or viability	0439T
Noninvasive detection of heart failure derived from augmentative analysis of an echocardiogram that demonstrated preserved ejection fraction, with interpretation and report by a physician or other qualified health care professional	0932T

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

- Complete transthoracic echocardiogram with spectral and color flow Doppler (CPT® 93306).
 - 93306 includes the Doppler exams, so CPT® codes 93320-93325 should not be assigned together with CPT® 93306.
 - Doppler codes (CPT® 93320, CPT® 93321, and CPT® 93325) are 'add-on codes' (as denoted by the + sign) and are assigned in addition to code for the primary procedure.
- For a 2D transthoracic echocardiogram without Doppler, report CPT® 93307.
- Limited transthoracic echocardiogram (CPT® 93308) should be billed if the report does not "evaluate or document the attempt to evaluate" all of the required structures.
 - A limited transthoracic echocardiogram is reported with CPT® 93308.
 - CPT® 93321 (not CPT® 93308 if Doppler is included in the study. CPT® 93325 can be reported with CPT® 93308 if color flow Doppler is included in the study.
 - A limited congenital transthoracic echocardiogram is reported with CPT® 93304.
- Doppler echo may be used for evaluation of the following:
 - Shortness of breath
 - Known or suspected valvular disease
 - Known or suspected hypertrophic obstructive cardiomyopathy
 - Shunt detection

Background and Supporting Information

- Providers performing echo on a pediatric individual, may not know what procedure codes they will be reporting until the initial study is completed.
- If a congenital issue is found on the initial echo, a complete echo is reported with codes CPT® 93303, CPT® 93320, and CPT® 93325 because CPT® 93303 does NOT include Doppler and color flow mapping.
- If no congenital issue is discovered, then CPT® 93306 is reported alone and includes 2-D, Doppler, and color flow mapping.
- Since providers may not know the appropriate code/s that will be reported at the time of the pre-authorization request, they may request all 4 codes (CPT® 93303, CPT® 93320, CPT® 93325, and CPT® 93306).
- CPT® 76376 and CPT® 76377 are not unique to 3D Echo. These codes also apply to 3D rendering of MRI and CT studies, see **3D Echocardiography – Coding (CD-2.9)**
- CPT® 93325 may also be used with fetal echocardiography
- CPT® 93319 3D echo imaging post-processing of TEE or TTE to evaluate congenital cardiac abnormalities. see **3D Echocardiography – Coding (CD-2.9)**

Myocardial contrast perfusion echocardiography (CD-2.11)

(CPT® 0439T)

- Investigational see **Transthoracic Echocardiography (TTE) – Coding (CD-2.1)**

Detection of heart failure with preserved ejection fraction

Noninvasive detection of heart failure derived from augmentative analysis of an echocardiogram

Artificial intelligence (AI) applications are being used to extract patterns from medical images in an effort to add clinically relevant information to that obtained by physician interpretation of images. AI algorithms have been employed in the software analysis of echocardiograms in an effort to aid detection of heart failure. Further studies are needed to evaluate the accuracy, reliability and clinical efficacy of these applications.

- CPT® 0932T Noninvasive detection of heart failure derived from augmentative analysis of an echocardiogram is considered experimental, investigational, or unproven at this time

Transthoracic Echocardiography (TTE) Indications/initial evaluation (CD-2.2)

CD.EC.0002.2.A

v1.0.2025

Transthoracic Echocardiography (TTE) is indicated for the initial evaluation of **any** of the following:

Symptoms or signs suggesting cardiovascular disease

- Chest pain/discomfort
- Dyspnea/shortness of breath, or hypoxemia
- Palpitations
- Presyncope/Syncope
- Headache with transcranial Doppler evidence of a shunt or high-degree of suspicion for embolic process
- Dependent lower extremity edema
- Abnormal precordial or peripheral pulse
- New or changing heart murmur or click
- Suspected hypertensive heart disease (initial evaluation)
- Initial evaluation of known/suspected heart failure based on symptoms and/or signs
- Suspected endocarditis with any:
 - Fever
 - Peripheral stigmata of endocarditis
 - New murmur
- History of rheumatic heart disease
- Suspected pericardial diseases
- Suspected cardiac injury due to blunt chest trauma

Diagnostic tests suggesting cardiovascular disease

- Newly diagnosed RBBB or LBBB
- Frequent VPCs defined as occurring more frequently than 30 times per hour or occurring in a pattern of bigeminy, trigeminy, or runs of ventricular tachycardia
- Non sustained or sustained ventricular tachycardia (VT)
- Ventricular fibrillation (VF)
- Newly diagnosed atrial fibrillation/flutter
- Cardiomegaly on a Chest X ray or other imaging

- Elevated level of cardiac biomarkers (Creatinine Kinase isoforms, Troponin I or T, Brain Natriuretic Peptide (BNP), N Terminal pro b-type natriuretic peptide (NT-proBNP) above the normal reference range as defined by the local laboratory assays)
- Initial evaluation of known/suspected heart failure based on diagnostic tests
- Suspected inherited or acquired cardiomyopathy (e.g., restrictive, infiltrative, dilated, hypertrophic)
- Suspected pulmonary hypertension. See **Pulmonary Hypertension CD-8.1**
 - ECG changes of right ventricular hypertrophy
 - Right ventricular hypertrophy or pulmonary artery dilation on other imaging
 - Pulmonary embolism with persistent or new symptoms
- Dilated aortic root and/or ascending aorta seen on other imaging
- Suspected endocarditis with positive blood cultures indicating bacteremia
- Suspected pericardial diseases
- Cardiac mass suspected on other imaging
- To rule out intra-cardiac thrombus in individuals with left ventricular systolic dysfunction prior to undergoing catheter ablation of ventricular arrhythmia.
- ≥6 weeks post myocardial infarction

Extra-cardiac conditions and therapies associated with cardiovascular disease or risk

- CONDITIONS
 - Initial cardiac evaluation of a known systemic, congenital, or acquired disease that could be associated with structural heart disease
 - At risk for developing iron-overload cardiomyopathy (hereditary hemochromatosis or hereditary or acquired hematologic conditions requiring multiple transfusions)
 - Known or suspected connective tissue disease or a genetic condition that predisposes to an aortic aneurysm or dissection (may repeat every two years if negative) See **Screening for Vascular related genetic connective tissue Disorders PVD-2.2**
 - At risk for pulmonary hypertension. See **Pulmonary Hypertension CD-8.1**
 - Scleroderma
 - Lupus
 - Mixed connective tissue disease
 - Hereditary Hemorrhagic Telangiectasia
 - Individuals with pulmonary hypertension mutations (e.g., BMPR2)
 - Suspected pulmonary hypertension in the presence of:
 - Liver disease
 - Lung disease

- HIV
- Newly diagnosed or strongly suspected cerebral ischemia or peripheral embolic event
- THERAPIES
 - Use of anorectic drugs, ergot derivatives, or other agents associated with valvular heart disease
 - Pre-procedure evaluation for TIPS (transjugular intrahepatic portosystemic shunt) See **Hepatic Arteries and Veins AB-43.1**
 - Prior to solid organ transplant or hematopoietic stem cell transplant
 - Prior to exposure to cardiotoxic medications or radiation therapy. See **Cardiotoxic agent/Cancer Therapeutics-Related Cardiac Dysfunction CD-12.1**

Inherited cardiovascular conditions

- Individual has first degree relative diagnosed with thoracic aortic aneurysm or dissection (may repeat every two years if negative). See **Screening for Vascular related genetic connective tissue Disorders PVD-2.2, Thoracic Aortic Aneurysm PVD-6.2**
- Individual has first degree relative diagnosed with Bicuspid aortic valve. See **Screening for TAA in individuals with bicuspid aortic valves PVD-2.3**
- Individual has diagnosed first degree relative or member is genotype positive for an inherited cardiomyopathy including any of the following:
 - Hypertrophic cardiomyopathy
 - Non compaction cardiomyopathy
 - Familial Dilated Cardiomyopathy
 - Arrhythmogenic Cardiomyopathy (e.g., ARVC)

Additional indications

- One repeat echo can be approved if requested for contrast study (for evaluation of shunts or for left ventricular cavity opacification) when the results of the initial study indicate the need for contrast but contrast was not administered at the initial study.
- Evaluation of congenital heart disease: see **Adult Congenital Heart Disease CD-11** and **Congenital Heart Disease PEDCD-2** in the Pediatric Cardiology imaging guidelines

Frequency of Echocardiography Testing (CD-2.3)

CD.EC.0002.3.A
v1.0.2025

Repeat testing by interval

Repeat Transthoracic Echocardiography (TTE) is indicated for **any** of the following:

Every 3 years

Valvular heart disease (See also below indications for Valve surgery or intervention)

- Bicuspid aortic valve
- Mild aortic stenosis or aortic valve sclerosis without stenosis
- Mild aortic or mitral regurgitation
- Any mitral stenosis that is not severe, mitral valve area $>1.5 \text{ cm}^2$
- Rheumatic valve changes with commissural fusion
- Valve surgery including **any** of the following:
 - Surgical valve repair
 - Mechanical valve replacement
 - Bioprosthetic valve replacement when <10 years since implant

Cardiomyopathy

- First degree relative with a diagnosis of inherited cardiomyopathy including:
 - Hypertrophic Cardiomyopathy
 - Familial Dilated Cardiomyopathy
 - Idiopathic Dilated Cardiomyopathy
- Individuals genotype-positive for:
 - Familial Dilated Cardiomyopathy
 - Arrhythmogenic Cardiomyopathy (e.g., ARVC)

Every 2 years

Vascular disease

- First degree relative with known thoracic aortic aneurysm or dissection a repeat echo is allowed every two years when both:
 - Prior aortic imaging (echo, CT, MR) is negative

- Last aortic imaging was ≥ 2 years. See **Screening for Vascular related genetic connective tissue Disorders (PVD-2.2)**

Every year

Valvular heart disease

(See also below indications for Valve surgery or intervention)

- Moderate or severe regurgitation
- Moderate or severe stenosis
- Significant valve deformity (regardless of extent of regurgitation or stenosis) when there is documentation of either:
 - Thickened myxomatous valve
 - Bileaflet prolapse
- Surgical bioprosthetic valve replacement when ≥ 10 years since implant
- Post-transcatheter valve repair or replacement

Cardiomyopathy/heart failure

- Left ventricular systolic dysfunction to evaluate the effectiveness of ongoing therapy
- Hypertrophic cardiomyopathy see **Hypertrophic Cardiomyopathy CD-14**
- Frequent right ventricular pacing $>40\%$
- Chronic LBBB
- Left ventricular non-compaction cardiomyopathy
- At risk for developing iron-overload cardiomyopathy (hereditary hemochromatosis or hereditary or acquired hematologic conditions requiring multiple transfusions)
- Inherited neuromuscular, metabolic, hematologic or cutaneous syndromes that are known to be associated with the development of cardiomyopathy

Pericardial disease

- Chronic pericardial effusions when findings would potentially alter therapy

Vascular disease

- Aortic root dilatation that has not yet been repaired See **Thoracic aortic aneurysm PVD 6.2** and
- For post-repair see **Post-Aortic Endovascular/Open Surgery Surveillance Studies PVD-6.8**

At risk for pulmonary Hypertension

See **Pulmonary Hypertension CD-8.1**

- Systemic Sclerosis or Scleroderma
- Individuals with pulmonary hypertension mutations (e.g., BMPR2)

- First-degree relatives of individuals with pulmonary hypertension
- Connective tissue disorder with symptoms consistent with pulmonary hypertension
- Individuals with TR velocity ≥ 2.8 m/s, with no other findings on additional testing
- Individuals being treated with medications associated with pulmonary hypertension
- Individuals who have a concern documented for pulmonary hypertension and had a negative echocardiogram but still show signs or symptoms of pulmonary hypertension

Every 6 months or twice a year

Valvular heart disease

- Asymptomatic, severe mitral regurgitation if valve surgery is being considered

Pulmonary Hypertension

- See below indications for Pulmonary Hypertension (See **Pulmonary Hypertension CD-8.1**)
- Surveillance of stable individuals with moderate or severe pulmonary hypertension (pulmonary artery systolic pressure ≥ 50 mmHg)

Anytime

Repeat transthoracic echocardiogram is indicated **anytime** (without regard for the number or timing of previous ECHO studies) if there is a change in clinical status, or new signs and symptoms with documentation of **any** of the following:

- Cardiac murmurs
- Myocardial infarction or acute coronary syndrome
- Congestive heart failure (new or worsening):
 - New symptoms of dyspnea
 - Orthopnea
 - Paroxysmal nocturnal dyspnea
 - Elevated BNP
- Known pericardial disease with clinical concern for cardiac tamponade or pericardial constriction
- Infective endocarditis for any of the following:
 - Repeat imaging within 5–7 days for initially negative or inconclusive imaging when clinical suspicion of endocarditis remains high
 - New or worsening symptoms or signs of endocarditis
 - As needed to guide changes in antibiotic therapy
 - At completion of antibiotic therapy
- Stroke/transient ischemic attack
- Decompression illness

- Prosthetic valve dysfunction or thrombosis
- Cardiac transplant
- Individuals with Left Ventricular Assist Device (LVAD)
- See also section on **Repeat testing per condition** below and **Left ventricular assist devices (LVAD) (CD-9.4)**

Repeat testing per condition

Repeat Transthoracic Echocardiography (TTE) is indicated for **any** of the following:

Valve surgery or intervention

Repeat Transthoracic Echocardiography (TTE) is indicated for any of the following:

Surgical valve repair or mechanical valve replacement

- 6 weeks post-surgery to establish baseline
- Surveillance every 3 years after surgery

Surgical bioprosthetic valve replacement

- 6 weeks post-surgery to establish baseline
- Surveillance every 3 years after surgery until 10 years
- Then annually

TAVR follow-up

- One week after procedure to establish baseline
- 1 month post-procedure
- 1 year post-procedure
- Then annually

Mitral Valve Repair (mitral valve clip) follow-up

- 1 month post-procedure
- 6 months post-procedure
- 1 year post-procedure
- Then annually

Transcatheter Tricuspid Valve Replacement follow-up

- TTE (CPT® 93306) is indicated post-procedure at the following intervals:
 - 1 month
 - 6 months
 - 1 year
 - Then annually

See also **Transcatheter Aortic Valve Replacement (TAVR) (CD-4.8)**

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

PFO closure, TIPS, Cardiac device therapy, LVAD

Repeat Transthoracic Echocardiography (TTE) is indicated for any of the following:

• PFO Closure

- Pre-operative evaluation for closure of PFO
- Post-procedural evaluation of PFO repair
- 6 month follow-up after PFO repair
- Annually if there is a residual shunt on post-operative imaging

For ASD closure see **ASD-Atrial septal defects (CD 11.2.1)**

• TIPS (transjugular intrahepatic portosystemic shunt) See Hepatic Arteries and Veins (AB 43.1)

- One time post-procedure for routine follow-up
- **Any time** post-procedure (either):
 - For new signs or symptoms
 - For concern for new or worsening pulmonary hypertension or heart failure

• Cardiac device therapy

- Re-evaluation is indicated 3 months after revascularization or maximally tolerated optimal medical therapy to determine either:
 - Candidacy for device therapy
 - Optimal choice of device
- One time follow up within 12 months of implantation of a CRT-D device

• Left ventricular assist device (LVAD) see Left ventricular assist devices (LVAD) (CD-9.4)

- Prior to implant
- Routine Post-implant at the following intervals:
 - 2 weeks
 - One month
 - Three months
 - Six months
 - Twelve months
 - Every 6 months thereafter

Pulmonary hypertension

Repeat Transthoracic Echocardiography (TTE) is indicated for individuals with known pulmonary hypertension for any of the following:

• Routine follow up

- Every 6 months for surveillance of stable individuals with moderate or severe pulmonary hypertension (pulmonary artery systolic pressure ≥ 50 mm Hg)

• Pregnancy

- Prior to planned pregnancy
- During pregnancy as often as requested by the provider
- **Pre-procedure**
 - Prior to planned intubation (e.g., for elective surgery)
- **Clinical/therapy change:**
 - Anytime, without regard for the number or timing of previous ECHO studies to evaluate either:
 - Change in therapy
 - Change in clinical findings or symptoms
 - Therapy changes:
 - At baseline
 - Then every 3 months

See also **Pulmonary Hypertension CD-8.1**

Hypertrophic Cardiomyopathy (HCM)

Repeat Transthoracic Echocardiography (TTE) is indicated for individuals with hypertrophic cardiomyopathy for any of the following:

- **Surveillance imaging**
 - Every year
- **Mavacamten: Initiation of treatment**
 - Baseline at the beginning of treatment
 - 4 weeks after treatment initiation
 - 8 weeks after treatment initiation
 - 12 weeks after treatment initiation
 - Then every 12 weeks while on mavacamten
- **Mavacamten: Changes in treatment**
 - 4 weeks after any interruption of treatment (any missed dose)
 - After any dosage change (including restart of treatment):
 - 4 weeks after dosage change
 - 12 weeks after dosage change
 - After initiating a weak CYP2C19 inhibitor (e.g., omeprazole) or moderate CYP3A4 inhibitor (e.g., ciprofloxacin):
 - 4 weeks after start of medication
 - 12 weeks after start of medication
 - At any time regardless of timing of prior echo when there are new cardiac signs or symptoms, or worsening of clinical status
- **Post- Septal Reduction Therapy (SRT)**
 - Within 3 to 6 months after surgical myectomy or alcohol septal ablation

See also **Hypertrophic Cardiomyopathy CD-14**

Cardiac Transplant

Anytime (without regard for the number or timing of previous ECHO studies) when there is a history of cardiac transplant, per transplant center protocol

Cardiotoxic Agents

For re-evaluation in an individual previously or currently undergoing therapy with cardiotoxic agents or radiation therapy follow **Cardiotoxic agent/Cancer Therapeutics-Related Cardiac Dysfunction (CD-12.1)**

Background and Supporting Information

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

Evidence Discussion (CD-2.1 - CD-2.3)

Transthoracic Echo

- Transthoracic echocardiogram (TTE) is an ultrasonic examination of the heart through the chest wall. Given that sound waves are used (sonography) there is no exposure to ionizing radiation or possible complications related to contrast induced nephropathy.
- It is readily accessible and transportable allowing for the test to be performed at multiple different locations with no need for blood work.
- TTE is widely accepted as initial imaging modality of choice for the general evaluation of cardiac and pericardial structure and function.
- Multiple evidence based professional society guidelines indicate that TTE can be appropriately used for the evaluation of multiple cardiac issues including but not limited to evaluation of cardiac symptoms, dyspnea and pulmonary hypertension.
- A complete comprehensive TTE will utilize multiple acoustic windows and incorporate 2- dimensional imaging with appropriate data; including measurements with color and spectral Doppler imaging.
- The test is performed and interpreted by qualified individuals in a facility that is accredited in performing echocardiograms.

- TTE is the primary imaging tool for screening of family members with thoracic aortic disease as well as genetic syndromes that are associated with thoracic aortic aneurysms and dissection. It is not indicated for screening of asymptomatic individuals in the general public in the absence of family history of cardiac, vascular, or associated connective tissue disorder.
- TTE offers real time hemodynamic assessment which may be used in the guidance of therapeutic interventions.
- Repeat echocardiograms may be done for the surveillance of known valvular heart disease, cardiomyopathies, pulmonary hypertension, and cardiotoxic agents. The need for surveillance echocardiograms are dependent on factors such as morphology, severity, family history of cardiomyopathies, timing of surgery, left ventricular function, symptoms, and for follow up of post cardiac structural interventions. Timing of surveillance echocardiograms are in alignment with recommendations from various national and international medical specialty organization guidelines and Appropriate Use Criteria based on studies which analyzed progression of valvular disease and timing of invasive intervention.

References (CD-2)

CD.EC.0002.3.A

v1.0.2025

1. Kottam A et al. American Heart Association Council on Cardiovascular Radiology and Intervention. State-of-the-Art Imaging of Infiltrative Cardiomyopathies: A Scientific Statement From the American Heart Association. *Circ Cardiovasc Imaging*. 2023 Nov;16(11):e000081. doi: 10.1161/HCI.0000000000000081.
2. Delgado V et al. ESC Scientific Document Group. 2023 ESC Guidelines for the management of endocarditis. *Eur Heart J*. 2023 Oct 14;44(39):3948-4042. doi: 10.1093/eurheartj/ehad193. Erratum in: *Eur Heart J*. 2023 Sep 20.
3. Arbelo E et al. ESC Scientific Document Group. 2023 ESC Guidelines for the management of cardiomyopathies. *Eur Heart J*. 2023 Oct 1;44(37):3503-3626. doi: 10.1093/eurheartj/ehad194.
4. McDonagh TA et al ESC Scientific Document Group. 2023 Focused Update of the 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. *Eur Heart J*. 2023 Oct 1;44(37):3627-3639. doi: 10.1093/eurheartj/ehad195. Chung MK, et al. 2023 HRS/APHRS/LAHRs guideline on cardiac physiologic pacing for the avoidance and mitigation of heart failure. *Heart Rhythm*. 2023 May 15:S1547-5271(23)02026-X. doi: 10.1016/j.hrthm.2023.03.1538.
5. Isselbacher EM et al. 2022 ACC/AHA Guideline for the Diagnosis and Management of Aortic Disease: A Report of the American Heart Association/American College of Cardiology Joint Committee on Clinical Practice Guidelines. *Circulation*. 2022 Dec 13;146(24):e334-e482. doi: 10.1161/CIR.0000000000001106. Epub 2022 Nov 2.
6. Heidenreich PA, Bozkurt B, Aguilar D, et al.. 2022 AHA/ACC/HFSA guideline for the management of heart failure: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation*. 2022 May 3;145:e895-e1032. doi: 10.1161/CIR.0000000000001063
7. Writing Committee Members; Otto CM, 2020 ACC/AHA Guideline for the Management of Patients With Valvular Heart Disease: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J Am Coll Cardiol*. 2021 Feb 2;77(4):e25-e197.
8. Ommen SR et al. 2020 AHA/ACC Guideline for the Diagnosis and Treatment of Patients With Hypertrophic Cardiomyopathy: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation*. 2020 Dec 22;142(25):e558-e631. doi: 10.1161/CIR.0000000000000937. Epub 2020 Nov 20.
9. Doherty JU et al. ACC/AATS/AHA/ASE/ASNC/HRS/SCAI/SCCT/SCMR/STS 2019 Appropriate Use Criteria for Multimodality Imaging in the Assessment of Cardiac Structure and Function in Nonvalvular Heart Disease. *J Am Coll Cardiol*. 2019 Feb 5;73(4):488-516. doi: 10.1016/j.jacc.2018.10.038. Epub 2019 Jan 7.
10. Doherty JU et al. ACC/AATS/AHA/ASE/ASNC/HRS/SCAI/SCCT/SCMR/STS 2017 Appropriate Use Criteria for Multimodality Imaging in Valvular Heart Disease. *J Am Coll Cardiol*. 2017 Sep 26;70(13):1647-1672. doi: 10.1016/j.jacc.2017.07.732. Epub 2017 Sep 1.
11. Faqih SA, Noto-Kadou-Kaza B, Abouamrane LM, Mtiou N, El Khayat S, Zamd M, Medkouri G, Benganem MG, Ramdani B. Pulmonary hypertension: prevalence and risk factors. *Int J Cardiol Heart Vasc*. 2016 May 9;11:87-89.
12. Adler Yet al. 2015 ESC Guidelines for the diagnosis and management of pericardial diseases. *Eur Heart J*. 2015 Nov 7;36(42):2921-2964. doi: 10.1093/eurheartj/ehv318. Epub 2015 Aug 29.
13. Douglas, Pamela S et al. ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/SCCT/SCMR 2011 Appropriate Use Criteria for Echocardiography. *J Am Soc Echocardiogr*. 2011 Mar;24(3):229-67.
14. Edwards EVOQUE Tricuspid Valve Replacement System FDA Approval <https://www.fda.gov/medical-devices/recently-approved-devices/edwards-evoque-tricuspid-valve-replacement-system-p230013>
15. Barreiro-Pérez M, González-Ferreiro R, Caneiro-Queija B, et al. Transcatheter Tricuspid Valve Replacement: Illustrative Case Reports and Review of State-of-Art. *J Clin Med*. 2023 Feb 9;12(4):1371. doi: 10.3390/jcm12041371.

16. Kodali S, Hahn RT, George I, et al.; TRISCEND Investigators. Transfemoral Tricuspid Valve Replacement in Patients With Tricuspid Regurgitation: TRISCEND Study 30-Day Results. *JACC Cardiovasc Interv.* 2022 Mar 14;15(5):471-480. doi: 10.1016/j.jcin.2022.01.016.
17. Kodali S, Hahn RT, Makkar R, et al. Transfemoral tricuspid valve replacement and one-year outcomes: the TRISCEND study. *Eur Heart J.* 2023 Dec 7;44(46):4862-4873. doi: 10.1093/eurheartj/ehad667.
18. Webb JG, Chuang AM, Meier D, et al. Transcatheter Tricuspid Valve Replacement With the EVOQUE System: 1-Year Outcomes of a Multicenter, First-in-Human Experience. *JACC Cardiovasc Interv.* 2022 Mar 14;15(5):481-491. doi: 10.1016/j.jcin.2022.01.280.
19. Oh NA, Kampaktsis PN, Gallo M, Guariento A, Weixler V, Staffa SJ, Avgerinos DV, Colli A, Doulamis IP. An updated meta-analysis of MitraClip versus surgery for mitral regurgitation. *Ann Cardiothorac Surg.* 2021 Jan;10(1):1-14. doi: 10.21037/acs-2020-mv-24.
20. McKellar SH, Harkness J, Reid BB, Sekaran NK, May HT, Whisenant BK. Residual or recurrent mitral regurgitation predicts mortality following transcatheter edge-to-edge mitral valve repair. *JTCVS Open.* 2023 Oct 31;16:191-206. doi: 10.1016/j.xjon.2023.10.019.
21. Edwards EVOQUE Tricuspid Valve Replacement System FDA Approval www.fda.gov/medical-devices/recently-approved-devices/edwards-evoque-tricuspid-valve-replacement-system-p230013.
22. Barreiro-Pérez M, González-Ferreiro R, Caneiro-Queija B, et al. Transcatheter Tricuspid Valve Replacement: Illustrative Case Reports and Review of State-of-Art. *J Clin Med.* 2023 Feb 9;12(4):1371. doi: 10.3390/jcm12041371.
23. Kodali S, Hahn RT, George I, et al.; TRISCEND Investigators. Transfemoral Tricuspid Valve Replacement in Patients With Tricuspid Regurgitation: TRISCEND Study 30-Day Results. *JACC Cardiovasc Interv.* 2022 Mar 14;15(5):471-480. doi: 10.1016/j.jcin.2022.01.016.
24. Kodali S, Hahn RT, Makkar R, et al. Transfemoral tricuspid valve replacement and one-year outcomes: the TRISCEND study. *Eur Heart J.* 2023 Dec 7;44(46):4862-4873. doi: 10.1093/eurheartj/ehad667.
25. Webb JG, Chuang AM, Meier D, et al. Transcatheter Tricuspid Valve Replacement With the EVOQUE System: 1-Year Outcomes of a Multicenter, First-in-Human Experience. *JACC Cardiovasc Interv.* 2022 Mar 14;15(5):481-491. doi: 10.1016/j.jcin.2022.01.280.
26. Oh NA, Kampaktsis PN, Gallo M, Guariento A, Weixler V, Staffa SJ, Avgerinos DV, Colli A, Doulamis IP. An updated meta-analysis of MitraClip versus surgery for mitral regurgitation. *Ann Cardiothorac Surg.* 2021 Jan;10(1):1-14. doi: 10.21037/acs-2020-mv-24.
27. McKellar SH, Harkness J, Reid BB, Sekaran NK, May HT, Whisenant BK. Residual or recurrent mitral regurgitation predicts mortality following transcatheter edge-to-edge mitral valve repair. *JTCVS Open.* 2023 Oct 31;16:191-206. doi: 10.1016/j.xjon.2023.10.019.

Transesophageal Echocardiography (TEE) (CD-2.4) (CD-2.5)

CD.EC.0002.5.A

v1.0.2025

Transesophageal echocardiography (TEE) - coding (CD-2.4)

TEE coding

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

Doppler Echocardiography

Description	CPT®
Doppler echo, pulsed wave and/or spectral display	+93320
Doppler echo, pulsed wave and/or spectral display, follow-up or limited study	+93321
Doppler echo, color flow velocity mapping	+93325
Doppler echo, if performed, may be reported separately in addition to the primary TEE codes: CPT® 93312, CPT® 93314, CPT® 93315, and CPT® 93317	

C codes

HCPCS	Description	CPT®
C8925	TEE with 2-D, M-mode, probe placement, image acquisition, interpretation and report	93312
C8926	TEE for congenital anomalies with 2-D, M-mode, probe placement, image acquisition, interpretation and report	93315
C8927	TEE for monitoring purposes, ongoing assessment of cardiac pumping function on an immediate time basis	93318

- The complete transesophageal echocardiogram service, including both (1) probe (transducer) placement and (2) image acquisition/interpretation, is reported with CPT® 93312.
 - Probe placement only is reported with CPT® 93313.
 - The image acquisition/interpretation only is reported with CPT® 93314.
- Physicians assign codes CPT® 93312, CPT® 93313, and/or CPT® 93314 to report professional services if the test is performed in a hospital or other facility where the physician cannot bill globally.
 - Modifier -26 (professional component) is appended to the appropriate code
 - CPT® 93313 and CPT® 93314 should never be used together. If both services are provided, CPT® 93312 is reported.
- Hospitals should report TEE procedures using CPT® 93312 (the complete service). CPT® 93313 and CPT® 93314 are not used for hospital billing.
- Monitoring of patients undergoing cardiac surgery is CPT® 93318.

Transesophageal echocardiography (TEE) - indications (CD-2.5)

TEE (CPT® 93312, 93320, and 93325) is indicated when there is documentation of **any** of the following:

- Limited transthoracic echo window when further information is needed to guide management (e.g. suspected or confirmed endocarditis, suspected intracardiac mass, etc.)
- Assessing valvular dysfunction, especially mitral regurgitation, when TTE is inadequate and intervention is being considered to repair/replace valve.
- Evaluation of cardiac mass, suspected tumor or thrombus
- Pre-procedural assessment of PFO/ASD
- Pre-operative evaluation prior to planned LVAD implant

- Embolic source or intracardiac shunting when TTE is inconclusive
 - Examples: atrial septal defect, ventricular septal defect, patent foramen ovale, aortic cholesterol plaques, thrombus in cardiac chambers, valve vegetation, tumor
- Embolic events when there is an abnormal TTE or a history of atrial fibrillation
 - Clarify atria/atrial appendage, aorta, mitral/aortic valve beyond the information that other imaging studies have provided
- Cardiac valve dysfunction
 - Differentiation of tricuspid from bicuspid aortic valve in setting of aortic enlargement or significant stenosis or significant regurgitation
 - Congenital abnormalities
- Assessing for left atrial thrombus prior to cardioversion of atrial fibrillation or atrial flutter.
- Assessing for left atrial thrombus prior to planned atrial fibrillation ablation/pulmonary vein isolation procedure.
- For initial imaging of ascending and descending thoracic aortic aneurysms.
- For repeat imaging or established thoracic aneurysms, TEE is indicated **only** when imaging with CT or MR is contraindicated.
- TEE is indicated for the evaluation of individuals with hypertrophic cardiomyopathy if TTE is inconclusive for **any** of the following:
 - Mitral regurgitation secondary to structural abnormalities of the mitral valve
 - Subaortic membrane or aortic valve stenosis
 - Pre-procedure planning for surgical myectomy or alcohol septal ablation
- Left atrial appendage (LAA) Closure device (e.g., WATCHMAN®)
 - Pre-procedural evaluation with or without 3D imaging
 - Repeat TEE 45 days post procedure
 - If the TEE at 45 days showed a peri-device gap ≥ 5 mm or Device Related Thrombus, another follow up TEE, usually 3- 6 months can be performed before the one year surveillance
 - 1 year post-procedure
 - See also **Percutaneous Mitral Valve Repair (mitral valve clip) (CD-13.5)**

Evidence Discussion (CD-2.4 and CD-2.5)

- Transesophageal echocardiogram (TEE) is a semi-invasive ultrasonic examination of the heart through the esophagus. Due to the proximity of the esophagus to the heart and great vessels, it allows for additional and more accurate information than transthoracic echocardiography for several specific diagnoses, catheter based cardiac interventions and cardiac surgery.
- TEE is utilized not only for diagnostic purposes but also for dynamic decision making with cardioversions, surgical intervention and assessment of surgical repair.

- TEE has become an essential imaging tool for pediatric and adult cardiologists, cardiac surgeons and anesthesiologists and is used in outpatient and inpatient settings as well as operating rooms.
- The test is performed and interpreted by physicians that have demonstrated both cognitive and technical competence in TEE.
- TEE is readily accessible, has no ionizing radiation exposure and does not require use of IV contrast.
- There are relative and absolute contraindications which are reviewed prior to insertion of the TEE probe which include and are not limited to esophageal pathology, coagulopathy and cervical spine injury.

Stress echocardiography (stress echo) (CD-2.6) (CD-2.7)

CD.EC.0002.7.A

v1.0.2025

Stress echo – coding (CD-2.6)

Associated codes

Stress Echocardiography	CPT®
Echo, transthoracic, with (2D), includes M-mode, during rest and exercise stress test and/or pharmacologically induced stress, with report; ³	93350
Echo, transthoracic, with (2D), includes M-mode, during rest and exercise stress test and/or pharmacologically induced stress, with report: including performance of continuous electrocardiographic monitoring, with physician supervision ³	93351
Doppler Echocardiography	
Doppler echo, pulsed wave and/or spectral display ⁴	+93320
Doppler echo, pulsed wave and/or spectral display, follow-up/limited study	+93321
Doppler echo, color flow velocity mapping ⁴	+93325

Associated HCPCS codes

CPT®	Stress Echocardiography	HCPCS
93350	Echo, transthoracic, with (2D), includes M-mode, during rest and exercise stress test and/or pharmacologically induced stress, with report; ⁵	C8928

³ CPT® 93350 and CPT® 93351 do not include Doppler studies

⁴ Doppler echo (CPT® +93320 and CPT® +93325), if performed, may be reported separately in addition to the primary SE codes: CPT® 93350 or CPT® 93351.

⁵ CPT® 93350 and CPT® 93351 do not include Doppler studies

CPT®	Stress Echocardiography	HCPCS
93351	Echo, transthoracic, with (2D), includes M-mode, during rest and exercise stress test and/or pharmacologically induced stress, with report: including performance of continuous electrocardiographic monitoring, with physician supervision ⁵	C8930

Stress echo-indications other than ruling out CAD (CD-2.7)

CPT® 93350 or 93351

- See: **Stress Testing with Imaging – Indications (CD-1.4)**
- In addition to the evaluation of CAD, stress echo can be used to evaluate the following conditions:
 - Dyspnea on exertion (specifically to evaluate pulmonary hypertension)
 - Right heart dysfunction
 - Valvular heart disease when the outcome would affect a therapeutic or interventional decision
 - Pulmonary hypertension when the outcome will measure response to therapy and/or prognostic information
 - Hypertrophic cardiomyopathy (as defined in **Obstructive Hypertrophic Cardiomyopathy (HCM) (CD-12.3)** for **either** of the following:
 - Exercise stress echo (CPT® 93351 or 93350) is indicated for the detection and quantification of dynamic left ventricular outflow tract obstruction in symptomatic individuals with HCM who do **not** have a resting or provokable outflow tract gradient ≥ 50 mm Hg on TTE.
 - Stress echo can be repeated when there is documentation of **any** of the following:
 - In 1 to 2 years if the resting or provokable outflow tract gradient is < 30 mm Hg on prior stress echo
 - Worsening symptoms
 - There has been a therapeutic change (i.e., change in medication, surgical procedure performed).
- In general spectral Doppler (CPT® 93320 or 93321) and color-flow Doppler (CPT® 93325) are necessary in the evaluation of the above conditions and can be added to the stress echo code.

Evidence Discussion (CD-2.6 and CD-2.7)

- Stress echocardiography (SE) is a ultrasonic examination of the heart through the chest wall during rest and stress. Given the ultrasound modality, there is no exposure to ionizing radiation or concern for contrast induced renal failure.
- SE is used to assess for global and regional systolic function and evaluation of valvular function at rest and during stress. This allows for non-invasive diagnosis and management of coronary artery disease, various cardiomyopathies, pulmonary hypertension and valvular heart disease.
- A complete comprehensive stress echo will incorporate 2- dimensional imaging with multiple acquisition windows during rest and stress and may also incorporate color and spectral Doppler imaging. This provides a dynamic evaluation of myocardial and valvular structure and function under physiological (exercise) or pharmacological stress.
- The test is performed and interpreted by qualified individuals in a facility that is proficient in echocardiograms in compliance with published criteria for quality cardiac diagnostic testing.

3D Echocardiography (CD-2.8)(CD-2.9)

CD.EC.0002.9.A

v1.0.2025

3D echocardiography – coding (CD-2.8)

Description	CPT®
3D rendering with interpretation and reporting of computed tomography, magnetic resonance imaging, ultrasound, or other tomographic modality with image postprocessing under concurrent supervision; not requiring image postprocessing on an independent workstation	76376
3D rendering with interpretation and reporting of computed tomography, magnetic resonance imaging, ultrasound, or other tomographic modality with image postprocessing under concurrent supervision; requiring image postprocessing on an independent workstation	76377
3D echocardiographic imaging and postprocessing during transesophageal echocardiography, or during transthoracic echocardiography for congenital cardiac anomalies, for the assessment of cardiac structure(s) (eg, cardiac chambers and valves, left atrial appendage, interatrial septum, interventricular septum) and function, when performed (List separately in addition to code for echocardiographic imaging) Code with (93303-93304, 93312, 93314, 93315, 93317, 93350-93351)	+93319

3D echocardiography – indications (CD-2.9)

Echocardiography with 3-dimensional (3D) rendering is becoming universally available, yet its utility remains limited based on the current literature.

- CPT® 93319 with one of the following (CPT® 93303, 93304, 93312, 93314, 93315, or 93317) for congenital cardiac abnormalities
- 3D Echo (CPT® 76376 or CPT® 76377) may be indicated when a primary echocardiogram is approved and **one** of the following is needed:
 - Left ventricular volume and ejection fraction assessment when measurements are needed for treatment decision (e.g., implantation of ICD, alteration in cardiotoxic chemotherapy)

- Mitral valve anatomy specifically related to mitral valve stenosis
- Pre-procedural evaluation of left atrial appendage occlusion (e.g., WATCHMAN®)
- Pre-operative evaluation for LVAD implant
- Guidance of transcatheter procedures such as:
 - Mitral valve clipping
 - TAVR
 - Left atrial appendage closure device (e.g ., WATCHMAN®)

Evidence Discussion (CD-2.8 and CD-2.9)

- 3D echocardiography (3DE) is a newer modality of ultrasonic examination of the heart through the chest wall or through the esophagus that is added on to either a transthoracic or transesophageal echocardiogram.
- This allows for both real-time and post-processed 3 dimensional analysis of the cardiac structures and function. This produces images that are less constrained than that of 2-dimensional echocardiograms.
- 3DE is readily accessible and transportable allowing for the test to be done at multiple different locations with no need for blood work or IV line insertion.
- 3DE has become important in pre-surgical planning, guidance of catheter intervention and functional assessment of the heart in various cardiac conditions including but not limited to congenital heart disease, valvular disease and structural heart disease.

Myocardial strain imaging (CD-2.12)

CD.EC.0002.12.A

v1.0.2025

CPT® 93356

- Myocardial strain imaging (CPT® 93356, speckle tracking longitudinal strain) is indicated for the initial evaluation of LVH, in addition to the primary echocardiogram, when there is documentation of **both**:
 - Unclear etiology
 - Concern for infiltrative cardiomyopathy
- See myocardial strain imaging in **Cardiotoxic Agent-Related Cardiac Dysfunction (CD-12)**
- Myocardial strain imaging (CPT® 93356) in addition to the primary echocardiogram in individuals receiving therapy with cardiotoxic agents for ANY of the following:
 - Initial evaluation-prior to treatment with EITHER:
 - Medications that could result in cardiotoxicity/heart failure
 - Radiation that could result in cardiotoxicity/heart failure
 - Re-evaluation of an individual previously or currently undergoing therapy as per echocardiogram parameters. See **Cardiotoxic agent/Cancer Therapeutics-Related Cardiac Dysfunction (CD-12.1)**
 - Re-evaluation of an individual undergoing therapy with worsening symptoms

Evidence Discussion

- Myocardial strain imaging or speckle-tracking echocardiography (STE) is a modern ultrasound technique that is an adjunct to traditional transthoracic echocardiography to evaluate myocardial deformation.
- Given the ultrasound modality, there is no exposure to ionizing radiation or concern for contrast induced renal failure.
- The main areas of application of this technique has been in the assessment of myocardial mechanics, ischemic heart disease, cardiomyopathies, LV diastolic dysfunction, and in detecting subclinical myocardial dysfunction in patients undergoing chemotherapy for cancer or in those affected by heart valve diseases.
- STE is considered the optimal deformation parameter for the detection of subclinical LV dysfunction which allows for clinical intervention prior to reduction in LVEF particularly useful in the field of cardio-oncology.

References (CD-2)

CD.EC.0002.A

v1.0.2025

1. Douglas PS, Khandheria B, Stainback RF, et al. ACCF/AHA/ACEP/AHA/ASNC/SCAI/SCCT/SCMR 2008 appropriateness criteria for stress echocardiography: a report of the American College of Cardiology Foundation Appropriateness Criteria Task Force, American Society of Echocardiography, American College of Emergency Physicians, American Heart Association, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society for Cardiovascular Magnetic Resonance: endorsed by the Heart Rhythm Society and the Society of Critical Care Medicine. *Circulation*. 2008;117(11):1478-1497. doi:10.1161/CIRCULATIONAHA.107.189097.
2. Pellikka PA, Nagueh SF, Elhendy AA, Kuehl CA, Sawada SG. American Society of Echocardiography Recommendations for Performance, Interpretation, and Application of Stress Echocardiography. *J Am Soc Echocardiogr*. 2007;20(9):1021-1041. doi:10.1016/j.echo.2007.07.003.
3. Holmes DR, Mack MJ, Kaul S, et al. 2012 ACCF/AATS/SCAI/STS Expert Consensus Document on Transcatheter Aortic Valve Replacement. *The Annals of Thoracic Surgery*. 2012;93(4):1340-1395. doi:10.1016/j.athoracsur.2012.01.084.
4. Wolk MJ, Bailey SR, Doherty JU, et al. ACCF/AHA/ASE/ASNC/HFSA/HRS/SCAI/SCCT/SCMR/STS 2013 Multimodality Appropriate Use Criteria for the Detection and Risk Assessment of Stable Ischemic Heart Disease. *J Am Coll Cardiol*. 2014;63(4):380-406. doi:10.1016/j.jacc.2013.11.009.
5. Doherty JU, Kort S, Mehran R, Schoenhagen P, Soman P. ACC/AATS/AHA/ASE/ASNC/HRS/SCAI/SCCT/SCMR/STS 2017 Appropriate Use Criteria for Multimodality Imaging in Valvular Heart Disease. *J Am Coll Cardiol* 2017;70(13):1647-1672. doi:10.1016/j.jacc.2017.07.732.
6. Khanna D, Gladue H, Channick R, et al. Recommendations for Screening and Detection of Connective Tissue Disease-Associated Pulmonary Arterial Hypertension. *Arthritis & Rheumatism*. 2013;65(12):3194-3201. doi:10.1002/art.38172.
7. Simonneau G, Gatzoulis MA, Adatia I, et al. Updated Clinical Classification of Pulmonary Hypertension. *J Am Coll Cardiol*. 2013;62(25). doi:10.1016/j.jacc.2013.10.029.
8. Tolle JJ, Waxman AB, Horn TLV, Pappagianopoulos PP, Systrom DM. Exercise-Induced Pulmonary Arterial Hypertension. *Circulation*. 2008;118(21):2183-2189. doi:10.1161/circulationaha.108.787101.
9. Vainrib AF, Harb SC, Jaber W, et al. Left Atrial Appendage Occlusion/Exclusion: Procedural Image Guidance with Transesophageal Echocardiography. *J Am Soc Echocardiogr*. 2018;31(4):454-474. doi:10.1016/j.echo.2017.09.014.
10. Lentine KL, Costa SP, Weir MR, et al. Cardiac Disease Evaluation and Management Among Kidney and Liver Transplantation Candidates. *Circulation*. 2012;126(5):617-663. doi:10.1161/cir.0b013e31823eb07a.
11. Stainback RF, Estep JD, Agler DA, et al. Echocardiography in the Management of Patients with Left Ventricular Assist Devices: Recommendations from the American Society of Echocardiography. *J Am Soc Echocardiogr*. 2015;28(8):853-909. doi:10.1016/j.echo.2015.05.008.
12. Sachdeva R, Valente AM, Armstrong AK, et al. ACC/AHA/ASE/HRS/ISACHD/SCAI/SCCT/SCMR/SOPE 2020 Appropriate Use Criteria for Multimodality Imaging During the Follow-Up Care of Patients with Congenital Heart Disease. *J Am Coll Cardiol*. 2020;75(6):657-703. doi:10.1016/j.jacc.2019.10.002.
13. Stout KK, Daniels CJ, Aboulhosn JA, et al. 2018 AHA/ACC Guideline for the Management of Adults with Congenital Heart Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation*. 2019;139(14). doi:10.1161/cir.0000000000000603.
14. Otto CM, Nishimura RA, Bonow RO, et al. 2020 ACC/AHA Guideline for the Management of Patients with Valvular Heart Disease: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation*. 2021;143(5). doi:10.1161/cir.0000000000000923.
15. Hiratzka LF, Bakris GL, Beckman JA, et al. 2010 ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM Guidelines for the diagnosis and management of patients with thoracic aortic disease. A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, American Association for Thoracic Surgery, American College of Radiology, American Stroke Association, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society of

- Interventional Radiology, Society of Thoracic Surgeons, and Society for Vascular Medicine [published correction appears in *J Am Coll Cardiol*. 2013 Sep 10;62(11):1039-40]. *J Am Coll Cardiol*. 2010;55(14):e27-e129. doi:10.1016/j.jacc.2010.02.015.
16. Ge Y, Gupta S, Fentanes E, et al. Role of Cardiac CT in Pre-Procedure Planning for Transcatheter Mitral Valve Replacement. *JACC: Cardiovasc Imag*. 2021. doi:10.1016/j.jcmg.2020.12.018.
 17. Blanke P, Weir-McCall JR, Achenbach S, et al. Computed Tomography Imaging in the Context of Transcatheter Aortic Valve Implantation (TAVI)/Transcatheter Aortic Valve Replacement (TAVR). *JACC: Cardiovasc Imag*. 2019;12(1):1-24. doi:10.1016/j.jcmg.2018.12.003.
 18. Doherty JU, Kort S, Mehran R, et al. ACC/AATS/AHA/ASE/ASNC/HRS/SCAI/SCCT/SCMR/STS 2019 Appropriate Use Criteria for Multimodality Imaging in the Assessment of Cardiac Structure and Function in Nonvalvular Heart Disease: A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and the Society of Thoracic Surgeons. *J Am Coll Cardiol*. 2019;73(4):488-516. doi:10.1016/j.jacc.2018.10.038.
 19. Behr ER, Dalageorgou C, Christiansen M, et al. Sudden arrhythmic death syndrome: familial evaluation identifies inheritable heart disease in the majority of families. *Eur Heart J*. 2008;29(13):1670-1680. doi:10.1093/eurheartj/ehn219.
 20. Emery MS, Kovacs RJ. Sudden Cardiac Death in Athletes. *JACC Heart Fail*. 2018;6(1):30-40. doi:10.1016/j.jchf.2017.07.014.
 21. Ommen SR, Mital S, Burke MA, et al. 2020 AHA/ACC Guideline for the Diagnosis and Treatment of Patients With Hypertrophic Cardiomyopathy: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *J Am Coll Cardiol*. 2020;76(25):e159-e240. doi:10.1016/j.jacc.2020.08.045.
 22. Sweet M, Taylor MR, Mestroni L. Diagnosis, prevalence, and screening of familial dilated cardiomyopathy. *Expert Opin Orphan Drugs*. 2015;3(8):869-876. doi:10.1517/21678707.2015.1057498.
 23. TeRiele, Anneline, James, Cynthia, Approach to family screening in arrhythmogenic right ventricular dysplasia/ Cardiomyopathy. *Eur Heart J*. (2016) 37, 755-763 doi:10.1093/eurheartj/ehv387.
 24. Tanaka H. Efficacy of echocardiography for differential diagnosis of left ventricular hypertrophy: special focus on speckle-tracking longitudinal strain. *J Echocardiogr*. 2021;19(2):71-79. doi:10.1007/s12574-020-00508-3.
 25. Nagueh SF, Phelan D, Abraham T, et al. Recommendations for Multimodality Cardiovascular Imaging of Patients with Hypertrophic Cardiomyopathy: An Update from the American Society of Echocardiography, in Collaboration with the American Society of Nuclear Cardiology, the Society for Cardiovascular Magnetic Resonance, and the Society of Cardiovascular Computed Tomography. *J Am Soc Echocardiogr*. 2022;35(6):533-569. doi:10.1016/j.echo.2022.03.012.
 26. Chung MK, Patton KK, Lau CP, et al. 2023 HRS/APHRS/LAHRs guideline on cardiac physiologic pacing for the avoidance and mitigation of heart failure [published online ahead of print, 2023 May 20]. *Heart Rhythm*. 2023;S1547-5271(23)02026-X. doi:10.1016/j.hrthm.2023.03.1538.
 27. Cronin EM, Bogun FM, Maury P, et al. 2019 HRS/EHRA/APHRS/LAHRs expert consensus statement on catheter ablation of ventricular arrhythmias: Executive summary. *Heart Rhythm*. Jan 2020;17(1):e155-e205. doi:10.1016/j.hrthm.2019.03.015.
 28. Faqih SA, Noto-Kadou-Kaza B, Abouamrane LM, Mtiou N, El Khayat S, Zamd M, Medkouri G, Benghanem MG, Ramdani B. Pulmonary hypertension: prevalence and risk factors. *Int J Cardiol Heart Vasc*. 2016 May 9;11:87-89.
 29. Heidenreich PA, Bozkurt B, Aguilar D, et al. 2022 AHA/ACC/HFSA guideline for the management of heart failure: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation*. 2022;145:e895–e1032. doi: 10.1161/CIR.0000000000001063.
 30. Shovlin CL, Condliffe R, Donaldson JW on behalf of the British Thoracic Society, et al. British Thoracic Society Clinical Statement on Pulmonary Arteriovenous Malformations. *Thorax* 2017;72:1154-1163. doi:10.1136/thoraxjnl-2017-210764.
 31. Cheng XS, VanWagner LB, Costa SP, et al. Emerging Evidence on Coronary Heart Disease Screening in Kidney and Liver Transplantation Candidates: A Scientific Statement From the American Heart Association:

- Endorsed by the American Society of Transplantation. *Circulation*. 2022;146(21):e299-e324. doi:10.1161/CIR.0000000000001104.
32. Humbert M, Kovacs G, Hoeper M, et al. 2022 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension: Developed by the task force for the diagnosis and treatment of pulmonary hypertension of the European Society of Cardiology (ESC) and the European Respiratory Society (ERS). Endorsed by the International Society for Heart and Lung Transplantation (ISHLT) and the European Reference Network on rare respiratory diseases (ERN-LUNG). *Eu Heart J* 2022; 43(38) 3618–3731. doi.org/10.1093/eurheartj/ehac237.
 33. Billey C, Billet S, Robic MA, et al. A Prospective Study Identifying Predictive Factors of Cardiac Decompensation After Transjugular Intrahepatic Portosystemic Shunt: The Toulouse Algorithm, *Hepatology* 2019; 70(6)1928-1941. doi.org/10.1002/hep.30934.
 34. Boie JR, Thornburg BG, Asrani SK, et al. North American Practice-Based Recommendations for Transjugular Intrahepatic Portosystemic Shunts in Portal Hypertension. *Clinical Gastroenterology and Hepatology* 2022;20(8)1636-1662. doi.org/10.1016/j.cgh.2021.07.018.
 35. Ommen SR, Ho CY, Asif IM, et al. 2024 AHA/ACC/AMSSM/HRS/PACES/SCMR Guideline for the Management of Hypertrophic Cardiomyopathy: A Report of the American Heart Association/American College of Cardiology Joint Committee on Clinical Practice Guidelines. *Circulation*. 2024 May 8. doi: 10.1161/CIR.0000000000001250.

Nuclear Cardiac Imaging

Guideline	Page
Myocardial Perfusion Imaging (MPI)(CD-3.1)(CD-3.2).....	59
MUGA – Coding (CD-3.3).....	61
MUGA Study – Cardiac Indications (CD-3.4).....	63
Myocardial Sympathetic Innervation Imaging in Heart Failure (CD-3.6).....	65
Myocardial Tc-99m Pyrophosphate Imaging (CD-3.7).....	66
Non-imaging Heart Function and Cardiac Shunt Imaging (CD-1.7).....	69
References (CD-3).....	70

Myocardial Perfusion Imaging (MPI) (CD-3.1)(CD-3.2)

CD.NC.0003.1.A

v1.0.2025

MPI – Coding (CD-3.1)

Nuclear Cardiac Imaging Procedure Codes

Myocardial Perfusion Imaging (MPI)	CPT®
MPI, tomographic (SPECT) (including attenuation correction, qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); single study, at rest or stress (exercise or pharmacologic)	78451
MPI, tomographic (SPECT) (including attenuation correction, qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); multiple studies, at rest and/or stress (exercise or pharmacologic) and/or redistribution and/or rest reinjection	78452
Absolute quantitation of myocardial blood flow (AQMBF), single-photon emission computed tomography (SPECT), with exercise or pharmacologic stress, and at rest, when performed (List separately in addition to code for primary procedure)	+0742T

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

- **Multi-day Studies:** In the absence of written payer guidelines to the contrary, it is not appropriate to bill separately for the rest and stress segments of MPI even if performed on separate calendar dates. A single code is assigned to define the entire procedure on the date all portions of the study are completed.

Note:

3D rendering should not be billed in conjunction with MPI.

MPI – Indications (CD-3.2)

See: **Stress Testing with Imaging – Indications (CD-1.4)**

Absolute quantitation of myocardial blood flow (AQMBF)(SPECT)

AQMBF obtained by CZT-SPECT is considered experimental, investigational, or unproven at this time.

Evidence Discussion

Appropriate Use Criteria from major professional societies including the American College of Cardiology and the American Heart Association support the use of myocardial perfusion imaging (MPI) with single photon emission computed tomography (SPECT) for patients with signs or symptoms consistent with coronary artery disease (CAD) such as typical angina. In addition, they support the use of SPECT perfusion imaging in symptomatic patients with known CAD and those with prior interventions such as coronary artery bypass surgery, coronary stenting, and preoperative risk stratification. These guidelines balance the appropriate testing of patients with SPECT versus unnecessary and potentially harmful testing and downstream procedures.

Also, as supported by society guidelines, use of SPECT is indicated in detection of cardiac transthyretin amyloidosis (ATTR) after light chain amyloidosis (AL) is ruled out by appropriate blood and urine testing.

MUGA – Coding (CD-3.3)

CD.NC.0003.3.A

v1.0.2025

Cardiac blood pool imaging, or radionuclide ventriculography, can be used to evaluate ventricular function. Cardiac blood pool imaging includes first pass studies (CPT® 78481 and 78483) as well as gated equilibrium studies (CPT® 78472, 78473, 78494, and +78496).

Gated equilibrium studies can also be referred to as multi-gated acquisition (MUGA) scan or equilibrium radionuclide angiography (ERNA). Imaging for gated equilibrium studies can be planar or three-dimensional (single photon emission computed tomography, SPECT).

Of note, all cardiac blood pool imaging is synchronized with electrocardiographic RR interval (EKG-gated); thus, regular rhythm is required for accurate LV assessment.

Gated Equilibrium Studies – Planar	CPT®
Cardiac blood pool imaging, gated equilibrium; planar, single study at rest or stress, wall motion study plus ejection fraction, with or without quantitative processing	78472
Cardiac blood pool imaging, gated equilibrium; planar, multiple studies, wall motion study plus ejection fraction, at rest and stress, with or without additional quantification	78473
Gated Equilibrium Studies - SPECT	CPT®
Cardiac blood pool imaging, gated equilibrium, SPECT, at rest, wall motion study plus ejection fraction, with or without quantitative processing	78494
First Pass studies	CPT®
Cardiac blood pool imaging (planar), first pass technique; single study, at rest or with stress (exercise and/or pharmacologic), wall motion study plus ejection fraction, with or without quantification	78481

Gated Equilibrium Studies – Planar	CPT®
Cardiac blood pool imaging (planar), first pass technique; multiple studies, at rest and with stress (exercise and/or pharmacologic), wall motion study plus ejection fraction, with or without quantification	78483
Cardiac blood pool imaging, gated equilibrium, single study, at rest, with right ventricular ejection fraction by first pass technique (List separately in addition to code for primary procedure) This CPT code is an add-on code to 78472.	+78496

- The technique employed for a MUGA service guides the code assignment.
 - CPT® 78472 is used for a planar MUGA scan at rest or stress
 - CPT® 78473 for planar MUGA scans, multiple studies at rest and stress.
- Planar MUGA studies (CPT® 78472 and CPT® 78473) should not be reported in conjunction with:
 - SPECT MPI (CPT® 78451 - CPT® 78454)
 - First pass studies (CPT® 78481- CPT® 78483)
 - SPECT MUGA (CPT® 78494).
- CPT® +78496 is assigned only in conjunction with CPT® 78472.

MUGA Study – Cardiac Indications (CD-3.4)

CD.NC.0003.4.A

v1.0.2025

MUGA (Multi Gated Acquisition) – Blood Pool Imaging Indications

- Echocardiography is the preferred method of following left ventricular systolic function.
- MUGA may be indicated when a recent ECHO, as indicated in **Transthoracic Echocardiography (TTE) – Indications (CD-2.2)** and/or **Frequency of Echocardiography Testing (CD 2.3)**, was technically limited and prevented accurate assessment of left ventricular function.
- MUGA is indicated when there is a significant discrepancy between LVEF assessment by ECHO and another modality (i.e., one study reports normal LVEF and the other, a reduced LVEF) AND there is clear documentation as to how quantitative measurement of LVEF will affect individual management (e.g., implantation of an ICD, alteration in cardiotoxic chemotherapy, etc.).
- MUGA may be performed in place of an ECHO in the following circumstances:
 - To determine candidacy for ICD/CRT and/or to determine optimal choice of device in individuals who meet criteria for ICD based on ejection fraction and other criteria.
 - When previously or currently undergoing therapy with potentially cardiotoxic agents, including chemotherapy and radiation, AND a history of previous low LV ejection fraction (LVEF <50%). See **Cardiotoxic agent/Cancer Therapeutics-Related Cardiac Dysfunction (CD-12.1)**
- MUGA is **not** indicated when requested simply to compare LVEF by the same modality, a prior MUGA is not a reason to approve another MUGA.

Right ventricular first pass study

- (CPT® 78472 and 78496) may be performed when ECHO is technically limited and prevents accurate assessment of RV function AND when further information about RV function is needed to guide management (e.g. established/diagnosed pulmonary hypertension, suspected or confirmed pulmonary embolus).

First pass studies

- First pass studies (CPT® 78481 and CPT® 78483) may be approved in place of MUGA when indications are met for MUGA and/or there is need for information that cannot be obtained by MUGA.

- First pass studies, (CPT® 78481 and CPT® 78483), MUGA (CPT® 78472 and CPT® 78473) and SPECT MUGA (CPT® 78494) should not be reported in conjunction with MPI codes.

Evidence Discussion

Multi-gated acquisition (MUGA) imaging (also referred to as radionuclide angiography, gated blood pool scan, equilibrium radionuclide angiography) is a method to measure ejection fraction and wall motion of the heart.

Appropriate Use Criteria from major professional societies including the American College of Cardiology and the American Heart Association support the use of planar imaging and/or single photon emission computed tomography (SPECT) of labeled red blood cells for patients who require accurate assessment of ejection fraction and/or wall motion when echocardiography or other imaging approaches are inadequate or disparate. This includes patients with cardiomyopathy and those exposed to cardio-toxic agents.

Myocardial Sympathetic Innervation Imaging in Heart Failure (CD-3.6)

CD.NC.0003.6.A

v1.0.2025

- Nuclear imaging using I-123-meta-iodobenzylguanidine (I-123-mIBG) in an attempt to image increased myocardial sympathetic activity is considered to be experimental and investigational.
- The AMA has established the following set of Category III codes to report these studies:
 - CPT® 0331T Myocardial sympathetic innervation imaging, planar qualitative and quantitative assessment
 - CPT® 0332T Myocardial sympathetic innervation imaging, planar qualitative and quantitative assessment; with tomographic SPECT.

Background and Supporting Information

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

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

Evidence Discussion

I-123-meta-iodobenzylguanidine (MIBG) imaging of the sympathetic nerve activity of the heart has been proposed and approved for the identification of patients with heart failure. However, its clinical utility has not found widespread acceptance and its clinical usefulness remains in question. There are no societal guidelines for its routine use. The guidelines contain many other imaging platforms such as echocardiography, magnetic resonance imaging, perfusion and metabolic imaging that have proven superior for the diagnosis and management of patients with heart failure.

Myocardial Tc-99m Pyrophosphate Imaging (CD-3.7)

CD.NC.0003.7.A

v1.0.2025

Coding

MUGA (Multi Gated Acquisition) – Blood Pool Imaging	CPT®
Myocardial Imaging, infarct avid, planar, qualitative or quantitative	78466
Myocardial Imaging, infarct avid, planar, qualitative or quantitative with ejection fraction by first pass technique	78468
Myocardial Imaging, infarct avid, planar, qualitative or quantitative tomographic SPECT with or without quantification	78469
Radiopharmaceutical Localization Imaging Limited area	78800
Radiopharmaceutical Localization Imaging SPECT Note: When reporting CPT® 78803, planar imaging of a limited area or multiple areas should be included with the SPECT	78803
Radiopharmaceutical localization of tumor, inflammatory process or distribution of radiopharmaceutical agent(s) (includes vascular flow and blood pool imaging, when performed); tomographic (SPECT) with concurrently acquired computed tomography (CT) transmission scan for anatomical review, localization and determination/detection of pathology, single area (e.g., head, neck, chest, pelvis), single-day imaging	78830

- Historically this method of imaging the myocardium was used to identify recent infarction, hence, the term "infarct-avid scan." Although still available, the sensitivity and specificity for identifying infarcted myocardial tissue are variable and the current use for this indication is limited. See **Cardiac MRI (CD-5)**.
- Tc-99m pyrophosphate imaging (CPT® 78469, 78803, or 78830) is indicated to identify cardiac amyloidosis.

- Chest SPECT and planar imaging may be used, as well as whole-body imaging for identification of systemic ATTR (transthyretin) amyloidosis.
- For a single planar imaging session alone (without a SPECT study), report CPT® 78800 Radiopharmaceutical Localization Imaging Limited are

Indications - Cardiac Amyloidosis (CD-3.8)

Tc-99m pyrophosphate imaging (CPT® 78469, 78803, or 78830) is indicated for **any** of the following:

- For diagnosis of ATTR amyloidosis in an individual undergoing evaluation for kidney transplant when **both**:
 - There is known systemic amyloidosis
 - Cardiac MRI (CMR) is either contraindicated or indeterminate. See **Kidney Transplant, Pre-Transplant Imaging Studies (AB-42.5)**.
- For diagnosis of ATTR amyloidosis after negative screening for presence of a monoclonal light chain to exclude AL amyloidosis:
 - Serum kappa/lambda free light chain ratio (not SPEP)
 - Abnormal if ratio is <0.26 or >1.65
 - Serum and urine immunofixation electrophoresis (IFE)
 - Abnormal if monoclonal protein detected
- Diagnosis of cardiac ATTR in an individual with cardiac MRI or echocardiography findings consistent with or suggestive of cardiac amyloidosis
- Diagnosis of an individual with suspected cardiac ATTR amyloidosis when there is a contraindications to CMR such as renal insufficiency or an implantable cardiac device

Note:

Cardiac follow-up should be based on Echocardiogram, Tn, NT-proBNP, clinical exam and symptom

Background and Supporting Information

- The following conditions would raise high index of suspicion:
 - Left ventricular hypertrophy but low voltage on ECG
 - Heart failure with preserved ejection fraction and an increase in left ventricular wall thickness.
 - Unexplained heart failure with preserved ejection fraction and concomitant right heart failure in an individual over the age of 60
 - Individuals, especially elderly males, with signs/symptoms of heart failure and any of the following:
 - Lumbar spinal stenosis

- Spontaneous biceps tendon rupture
- Bilateral carpal tunnel syndrome
- Atrial arrhythmia in the absence of usual risk factors
- Known or suspected familial amyloidosis.
- Low flow, low gradient aortic stenosis

Evidence Discussion

Appropriate Use Criteria from major professional societies including the American College of Cardiology and the American Heart Association support the use of myocardial perfusion imaging (MPI) with single photon emission computed tomography (SPECT) for patients with signs or symptoms consistent with coronary artery disease (CAD) such as typical angina. In addition, they support the use of SPECT perfusion imaging in symptomatic patients with known CAD and those with prior interventions such as coronary artery bypass surgery, coronary stenting, and preoperative risk stratification. These guidelines balance the appropriate testing of patients with SPECT versus unnecessary and potentially harmful testing and downstream procedures.

Also, as supported by society guidelines, use of SPECT is indicated in detection of cardiac transthyretin amyloidosis (ATTR) after light chain amyloidosis (AL) is ruled out by appropriate blood and urine testing.

Non-imaging Heart Function and Cardiac Shunt Imaging (CD-1.7)

CD.NC.0001.7.A

v1.0.2025

- Procedures reported with CPT® 78414 and CPT® 78428 are essentially obsolete and should not be performed in lieu of other preferred modalities.
- Echocardiogram is the preferred method for cardiac shunt detection, rather than the cardiac shunt imaging study described by CPT® 78428.
- Ejection fraction can be obtained by echocardiogram, SPECT MPI, MUGA study, cardiac MRI, cardiac CT, or cardiac PET depending on the clinical situation, rather than by the non-imaging heart function study described by CPT® 78414.

Evidence Discussion

Non-imaging Heart Function and Cardiac Shunt Imaging radionuclide techniques are no longer in use in current clinical practice. These techniques have been rendered obsolete and have been replaced by other cardiac imaging modalities that provide far superior structural and functional information to guide clinical management decisions. The preferred cardiac imaging modalities in current clinical use that have replaced the obsolete techniques include echocardiography echocardiogram, SPECT MPI, MUGA study, cardiac MRI, cardiac CT, and cardiac PET.

References (CD-3)

v1.0.2025

1. American Association of Physicists in Medicine (AAPM) Report 96, January 2008. Report of AAPM Task Group 23, "The measurement, reporting and management of radiation dose in CT." https://www.aapm.org/pubs/reports/RPT_96.pdf.
2. Boden WE, O'Rourke RA, Teo KK, et al. Impact of optimal medical therapy with or without percutaneous coronary intervention on long-term cardiovascular end points in patients with stable coronary artery disease (from the COURAGE trial). *Am J Cardiol*, 2009 July; 104(1):1-4. doi.org/10.1016/j.amjcard.2009.02.059.
3. Guarneri V, Lenihan DJ, Valero V, et al. Long-term cardiac tolerability of trastuzumab in metastatic breast cancer: the M.D. Anderson Cancer Center experience. *J Clinical Oncology* 2006 Sept; 24:4107-4115. doi:10.1200/JCO.2005.04.9551.
4. Hendel RC, Berman DS, Carli MFD, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. *J Am Coll Cardiol*. 2009;53(23):2201-2229. doi:10.1016/j.jacc.2009.02.013.
5. Highlights of Prescribing Information HERCEPTIN® (trastuzumab) for injection, for intravenous use Initial U.S. Approval: 1998. Revised: April 2017. <http://www.gene.com/gene/products/information/pdf/herceptin-prescribing.pdf>.
6. Sciammarella MG, Gerson M, Buxton AE, et al. ASNC/SNMMI Model Coverage Policy: Myocardial sympathetic innervation imaging: Iodine-123 meta-iodobenzylguanidine ((123)I-mIBG). *J Nucl Cardiol*. 2015;22(4):804-811. doi:10.1007/s12350-015-0202-8.
7. Bokhari S, Castano A, Pozniakoff T, et al. (99m)Tc-pyrophosphate scintigraphy for differentiating light-chain cardiac amyloidosis from the transthyretin-related familial and senile cardiac amyloidosis. *Circ Cardiovasc Imaging* 2013; 6:195. doi:10.1161/CIRCIMAGING.112.000132.
8. Plana JC, Galderisi M, Barac A, et al. Expert consensus for multimodality imaging evaluation of adult patients during and after cancer therapy: a report from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. *European Heart Journal - Cardiovascular Imaging*. 2014;15(10):1063-1093. doi:10.1093/ehjci/jeu192.
9. Dorbala S, Bokhari S, Miller E, et al. 99mTechnetium-Pyrophosphate Imaging for Transthyretin Cardiac Amyloidosis. *ASNC PRACTICE POINTS 2016*. <https://www.asnc.org/Files/Practice%20Resources/Practice%20Points/ASNC%20Practice%20Point-99mTechnetiumPyrophosphateImaging2016.pdf>.
10. Rapezzi C, Quarta CC, Guidalotti PL, et al. Role of 99mTc-DPD Scintigraphy in Diagnosis and Prognosis of Hereditary Transthyretin-Related Cardiac Amyloidosis. *JACC: Cardiovascular Imaging*. 2011;4(6):659-670. doi:10.1016/j.jcmg.2011.03.016.
11. Dorbala S, Ananthasubramaniam K, Armstrong IS, et al. Single Photon Emission Computed Tomography (SPECT) Myocardial Perfusion Imaging Guidelines: Instrumentation, Acquisition, Processing, and Interpretation. *J Nuc Cardiol*. 2018. doi:10.1007/s12350-018-1283-y.
12. Doherty JU, Kort S, Mehran R, et al. ACC/AATS/AHA/ASE/ASNC/HRS/SCAI/SCCT/SCMR/STS 2019 Appropriate Use Criteria for Multimodality Imaging in the Assessment of Cardiac Structure and Function in Nonvalvular Heart Disease. *J Am Coll Cardiol*. 2019;73(4):488-516. doi:10.1016/j.jacc.2018.10.038.
13. Witteles RM, Liedtke M. AL Amyloidosis for the Cardiologist and Oncologist. *JACC: CardioOncology*. 2019;1(1):117-130. doi:10.1016/j.jacc.2019.08.002.
14. Ruberg FL, Grogan M, Hanna M, Kelly JW, Maurer MS. Transthyretin Amyloid Cardiomyopathy. *J Am Coll Cardiol*. 2019;73(22):2872-2891. doi:10.1016/j.jacc.2019.04.003.
15. Dorbala S, Cuddy S, Falk RH. How to Image Cardiac Amyloidosis. *JACC: Cardiovascular Imaging*. 2020;13(6):1368-1383. doi:10.1016/j.jcmg.2019.07.015.
16. Jitendra M. MUGA scan (CPT code 78472, 78473, 78494) Coding Tips. Medical Coding Guide. <https://www.americanmedicalcoding.com/muga-scan-cpt-code/>. Published November 10, 2020.
17. Kittleson MM, Maurer MS, Ambardekar AV, et al. Cardiac Amyloidosis: Evolving Diagnosis and Management: A Scientific Statement From the American Heart Association [published correction appears in *Circulation*. 2021 Jul 6;144(1):e10] [published correction appears in *Circulation*. 2021 Jul 6;144(1):e11]. *Circulation*. 2020;142(1):e7-e22. doi:10.1161/CIR.0000000000000792.

18. Kidney Disease: Improving Global Outcomes (KDIGO) Kidney Transplant Candidate Work Group. KDIGO Clinical Practice Guideline on the Evaluation and Management of Candidates for Kidney Transplantation. *Transplantation*. 2020;104: S1 – S103.
19. Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on practice guidelines. *J Am Coll Cardiol* 2014; 64:e77.
20. Winchester DE, Maron DJ, Blankstein R, et al. ACC/AHA/ASE/ASNC/ASPC/HFSA/HRS/SCAI/SCCT/SCMR/STS 2023 Multimodality Appropriate Use Criteria for the Detection and Risk Assessment of Chronic Coronary Disease: A Report of the American College of Cardiology Solution Set Oversight Committee, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, American Society of Preventive Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and Society of Thoracic Surgeons. *J Am Coll Cardiol* 2023;May 25:[Epub ahead of print].
21. Blanke P, Weir-McCall JR, Achenbach S, et al. Computed tomography imaging in the context of transcatheter aortic valve implantation (TAVI) / transcatheter aortic valve replacement (TAVR): An expert consensus document of the Society of Cardiovascular Computed Tomography. *J Cardiovasc Comput Tomogr*. 2019;13(1):1-20. doi:10.1016/j.jcct.2018.11.008.
22. Saraste A, Stähle M, Roivainen A, Knuuti J. Molecular Imaging of Heart Failure: An Update and Future Trends. *Semin Nucl Med*. 2024 Apr 11:S0001-2998(24)00028-X. doi: 10.1053/j.semnuclmed.2024.03.005. Epub ahead of print. PMID: 38609753.
23. Tamaki N, Manabe O. Current status and perspectives of nuclear cardiology. *Ann Nucl Med*. 2024 Jan;38(1):20-30. doi: 10.1007/s12149-023-01878-1. Epub 2023 Oct 27. PMID: 37891375.
24. Bailly M, Thibault F, Courtehoux M, Metrard G, Ribeiro MJ. Impact of attenuation correction for CZT-SPECT measurement of myocardial blood flow. *J Nucl Cardiol*. 2021;28(6):2560-2568. doi:10.1007/s12350-020-02075-7.
25. Acampa W, Zampella E, Assante R, et al. Quantification of myocardial perfusion reserve by CZT-SPECT: A head to head comparison with 82Rubidium PET imaging. *J Nucl Cardiol*. 2021;28(6):2827-2839. doi:10.1007/s12350-020-02129-w.
26. Wang L, Zheng Y, Zhang J, et al. Diagnostic value of quantitative myocardial blood flow assessment by NaI(Tl) SPECT in detecting significant stenosis: a prospective, multi-center study [published online ahead of print, 2022 Aug 15]. *J Nucl Cardiol*. 2022; doi:10.1007/s12350-022-03085-3.
27. Pang Z, Wang J, Li S, Chen Y, Wang X, Li J. Diagnostic analysis of new quantitative parameters of low-dose dynamic myocardial perfusion imaging with CZT SPECT in the detection of suspected or known coronary artery disease. *Int J Cardiovasc Imaging*. 2021 Jan;37(1):367-378. doi: 10.1007/s10554-020-01962-x. Epub 2020 Sep 10. PMID: 32914404; PMCID: PMC7878253.

Cardiac CT

Guideline	Page
Cardiac CT and CTA - General information and coding (CD-4.1).....	73
CT for Coronary Calcium Scoring (CD-4.2).....	76
CCTA – Indications for CCTA (CD-4.3).....	78
CCTA – Regardless of symptoms (CD-4.4).....	80
Fractional Flow Reserve by Computed Tomography (CD-4.5).....	82
CT heart for evaluation of cardiac structure and morphology (CD-4.6).....	84
CT Heart for Congenital Heart Disease (CD-4.7).....	85
Transcatheter aortic valve replacement (TAVR) (CD-4.8).....	86
3D Predictive model generation for pre-planning of cardiac procedure (CD-4.9).....	88
References (CD-4).....	89

Cardiac CT and CTA - General information and coding (CD-4.1)

CD.CT.0004.1.A

v1.0.2025

Associated Codes

Cardiac Imaging Procedure Codes

Cardiac CT and CCTA	CPT®
<p>CT, heart, without contrast, with quantitative evaluation of coronary calcium</p> <ul style="list-style-type: none"> The code set for Cardiac CT and CCTA (CPT® 75572-CPT® 75574), include quantitative and functional assessment (for example, calcium scoring) if performed CPT® 75571 describes a non-contrast CT of the heart with calcium scoring and should be reported only when calcium scoring is performed as a stand-alone procedure. <ul style="list-style-type: none"> Can be used to report a preliminary non-contrast scan which indicates an excessive amount of calcium such that the original scheduled study must be discontinued. CPT® 75571 should not be reported in conjunction with any of the contrast CT/CTA codes (CPT® 75572- CPT® 75574). 	75571
CT, heart, with contrast, for evaluation of cardiac structure and morphology (including 3D image post-processing, assessment of cardiac function, and evaluation of venous structures, if performed).	75572
Computed tomography, 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 left ventricular [LV] cardiac function, right ventricular [RV] structure and function and evaluation of vascular structures, if performed).	75573
CTA, heart, coronary arteries and bypass grafts (when present), with contrast, including 3D image post-processing (including 3D image post-processing, assessment of cardiac function, and evaluation of venous structures, if performed).	75574

Cardiac CT and CCTA	CPT®
Noninvasive estimate of coronary fractional flow reserve (FFR) derived from augmentative software analysis of the data set from a coronary computed tomography angiography, with interpretation and report by a physician or other qualified health care professional	75580
Automated quantification and characterization of coronary atherosclerotic plaque to assess severity of coronary disease, using data from coronary computed tomographic angiography; data preparation and transmission, computerized analysis of data, with review of computerized analysis output to reconcile discordant data, interpretation and report	0623T
Automated quantification and characterization of coronary atherosclerotic plaque to assess severity of coronary disease, using data from coronary computed tomographic angiography; data preparation and transmission	0624T
Automated quantification and characterization of coronary atherosclerotic plaque to assess severity of coronary disease, using data from coronary computed tomographic angiography; computerized analysis of data from coronary computed tomographic angiography	0625T
Automated quantification and characterization of coronary atherosclerotic plaque to assess severity of coronary disease, using data from coronary computed tomographic angiography; review of computerized analysis output to reconcile discordant data, interpretation and report	0626T

Cardiac CT and CTA - General information (CD-4.1)

- Only one code from the set: CPT® 75572 - CPT® 75574 can be reported per encounter.
- CPT® 75574 includes evaluation of cardiac structure and morphology when performed; therefore, additional code/s should not be assigned.
- Automated quantification and characterization of coronary atherosclerotic plaque (CPT® 0623T, 0624T, 0625T, 0626T) is a service in which coronary computed tomographic angiography (CCTA) data are analyzed using computerized algorithms to assess the extent and severity of coronary artery disease. The use of automated quantification and characterization of coronary atherosclerotic plaque is considered investigational and experimental at this time.

Background and Supporting Information

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

3D rendering should not be billed in conjunction with Cardiac CT and CCTA.

CT for Coronary Calcium Scoring (CD-4.2)

CD.CT.0004.2.A

v1.0.2025

CPT® 75571

Coronary artery calcium score (CPT® 75571) is **not** supported for evaluation of CAD in symptomatic individuals.

CT Calcium Scoring-Asymptomatic and for CAD Screening

- Coronary artery calcium score (CPT® 75571) is indicated when there is documentation of **all** of the following:
 - Results will impact risk-based decisions for preventive interventions
 - An LDL-C level ≥ 70 mg/dL (1.8 mmol/L) AND < 190 mg/dL (4.9 mmol/L)
 - Individual is an adult age 40-75
 - 10-year ASCVD risk including pooled cohort equation is between 5.0% to 19.9%
 - There is no documented CAD
 - Individual is not currently on a statin
 - Individual is not a smoker
 - There is no history of diabetes
 - There is no family history of premature CAD
 - There has been no calcium score performed in the previous 5 years
 - There has been no prior calcium score > 0
- Coronary calcium scoring is **not** indicated in someone with known CAD.

CT Calcium Scoring For Low Gradient Aortic Stenosis

- Coronary artery calcium score (CPT® 75571) is indicated in low gradient aortic stenosis when symptomatic, severe aortic stenosis is suspected. Low gradient aortic stenosis is defined as an AVA < 1 and a mean gradient < 40 mmHg.

Evidence Discussion

The identification of coronary artery calcium (CAC) on a non-contrast computed tomography signifies the presence of coronary atherosclerosis and predicts major cardiac events independent of clinical risk factors. Measuring CAC score has been widely adopted to assist in the risk reclassification of coronary heart disease and to serve as an arbitrator for statin and aspirin therapy initiation. Whilst this general

screening strategy brings precision to risk assessment, the most cost effective implementation algorithm has not been studied systematically. This is reflected in the variation of major global and inter-societal guidelines for CAC scoring with unknown public health and economic ramification.¹ Based on moderate quality, non-randomized evidence, the American College of Cardiology and the American Heart Association have specified the following clinical scenarios where CAC scoring is most likely to impact risk-based decision for preventive interventions:

- An LDL-C level ≥ 70 mg/dL (1.8 mmol/L) AND < 190 mg/dL (4.9 mmol/L)
- Individual is an adult age 40-75
- 10-year Atherosclerotic Cardiovascular Disease (ASCVD) risk including pooled cohort equation is between 5.0% to 19.9%
- There is no documented coronary artery disease (CAD)
- Individual is not currently on a statin
- Individual is not a smoker
- There is no history of diabetes
- There is no family history of premature CAD
- There has been no calcium score performed in the previous 5 years
- There has been no prior calcium score > 0

In addition to CAC, the degree of calcification of the aortic valve has been demonstrated to correlate with the degree of aortic stenosis and prognosis. The utility of calcium scoring has been extended to the aortic valve in the setting of symptomatic, low gradient aortic stenosis (defined as an aortic valve area of less than 1 cm² and mean gradient of less than 40 mmHg), when severe aortic stenosis is suspected.

CCTA – Indications for CCTA (CD-4.3)

CD.CT.0004.3.A

v1.0.2025

CPT® 75574

CCTA is indicated for any of the following:

- New, recurrent or worsening likely anginal symptoms as defined in **General Guidelines (CD-1.0)**
- New, recurrent or worsening symptoms of chest pain, or exertional dyspnea, or exertional fatigue and any of the following:
 - Persistent symptoms after a normal stress test
 - Equivocal, borderline, abnormal or discordant prior noninvasive evaluation where obstructive coronary artery disease remains a concern (<90 days)
 - Abnormal rest ECG findings, such as a new LBBB, or T-wave inversions, when ischemia is a concern
 - A prior CABG when **only** graft patency is a concern
- Evaluation of an individual under the age of 40 for suspected anomalous coronary artery(ies) or for treatment planning when there is a history of one or more of the following:
 - Syncopal episodes during strenuous activities
 - Persistent chest pain brought on by exertion or emotional stress, and normal stress test
 - Full sibling(s) with history of sudden death syndrome before age 40 or with documented anomalous coronary artery
 - Resuscitated sudden death and contraindications for conventional coronary angiography
 - Prior nondiagnostic coronary angiography in determining the course of the anomalous coronary artery in relation to the great vessels, origin of a coronary artery or bypass graft location (any):
 - Anomalies of origin:
 - LCA or the RCA arising from the pulmonary artery;
 - Interarterial course between the pulmonary artery and the aorta of either the RCA arising from the left sinus of Valsalva or the LCA arising from the right sinus of Valsalva
 - Anomalies of course:
 - Myocardial bridging
 - Anomalies of termination:
 - Coronary artery fistula

- Initial imaging study in individuals with hypertrophic cardiomyopathy and stable anginal symptoms.
 - Chest discomfort is common in individuals with hypertrophic cardiomyopathy. The incidence of false positive myocardial perfusion imaging abnormalities is higher in these individuals, whereas the incidence of severe coronary artery stenosis is low.
- Individuals who have recovered from unexplained sudden cardiac arrest in lieu of invasive coronary angiography (**both**):
 - Confirm the presence or absence of ischemic heart disease
 - Exclude the presence of an anomalous coronary artery.

CCTA – Regardless of symptoms (CD-4.4)

CD.CT.0004.4.A

v1.0.2025

CPT® 75574

- Evaluation of newly diagnosed congestive heart failure or cardiomyopathy (all):
 - No prior history of coronary artery disease, the ejection fraction is <50 percent
 - No contraindications to cardiac CT angiography.
 - No cardiac catheterization, SPECT, cardiac PET, or stress echocardiogram has been performed since the diagnosis of congestive heart failure or cardiomyopathy.
- Unclear coronary artery anatomy despite conventional cardiac catheterization
- Re-do CABG (**either**)
 - Assess bypass graft patency
 - Evaluate the location of the left internal mammary artery (LIMA) and or right internal mammary artery (RIMA) prior to repeat bypass surgery
- Follow-up Left main stent one time at 6-12 months
- Pre-procedural planning for Percutaneous Coronary Intervention (PCI) of Chronic Total Occlusion (CTO)
- Evaluate coronary artery anomalies and other complex congenital heart disease of cardiac chambers or great vessels:
 - To evaluate the great vessels, CTA Chest (CPT® 71275) can be performed instead of CCTA or in addition to CCTA.
 - For anomalous pulmonary venous return, can add CT Abdomen and Pelvis with contrast (CPT® 74177).
 - See **Adult Congenital Heart Disease CD-11** for lesion specific imaging
- When CCTA will replace conventional invasive coronary angiography for any of the following:
 - Ventricular tachycardia (6-beat runs or greater)
 - Delayed presentation or retrospective evaluation of suspected Takotsubo syndrome (stress cardiomyopathy)
 - Preoperative assessment of the coronary arteries in planned surgery for any of the following:
 - Aortic dissection
 - Aortic aneurysm
 - Valvular surgery

- Liver transplant (for initial pre-transplant evaluation and may be repeated once in 3 years)
- To assess for coronary involvement in individuals with systemic vasculitis (e.g. Giant Cell Arteritis, Takayasu's, Kawasaki's disease) when there are clinical features suggestive of underlying vasculitis including:
 - Unexplained elevated cardiac markers (erythrocyte sedimentation rate, C-reactive protein)
 - Constitutional symptoms (fever, chills, night sweats, weight loss)
 - Multiple visceral infarcts in the absence of embolic etiology
- Cardiac Trauma see also **Cardiac Trauma – Imaging (CD-10.1)**
- Preoperative assessment for planned liver or kidney transplant

Fractional Flow Reserve by Computed Tomography (CD-4.5)

CD.CT.0004.5.A

v1.0.2025

CPT® 75580

Fractional flow reserve (FFR) is typically measured using invasive techniques. FFR can be obtained noninvasively from coronary computed tomography angiography data (FFR-CT).

- Indications for FFR-CT:
 - To further assess CAD seen on a recent CCTA that is of uncertain physiologic significance

Evidence Discussion (CD-4.3 - CD-4.5)

Coronary Computed Tomography Angiography (CCTA) provides non-invasive anatomic coronary imaging with excellent sensitivity for detecting coronary plaques and stenosis. However, artifacts can significantly lower the specificity, which potentially leads to higher healthcare resource utilization. Notwithstanding this concern, the ability to characterize coronary plaques and stenosis on a CCTA proved to be advantageous over functional stress testing, with respect to diagnostic characteristics and prognostication, as demonstrated by high quality evidence, including multiple randomized trials.

To ensure a clinically meaningful study, in addition to paying meticulous attention to the scanner functionality and protocol selection, careful patient selection is imperative. Based on the known performance characteristics of CCTA and high quality clinical trials from Europe and North American, there is general agreement between the American and European guidelines to focus CCTA testing on the following general categories:

- Likely anginal symptoms with no known coronary artery disease (CAD)
- Absence of symptoms or less likely anginal symptoms with no known CAD, when objective evidence of cardiac structure or function abnormality is present.
- Information about specific coronary artery abnormalities, such as left main coronary stent and bypass graft patency, congenital coronary anomaly, non-atherosclerotic coronary disease may potentially alter clinical management decision.
- CCTA will replace conventional invasive coronary angiography when the likelihood of coronary intervention is not high based on clinical assessment

CTA derived fractional flow reserve (FFR_{ct}) is one of the value added technologies that have been shown to improve the accuracy of CAD diagnosis over and above CCTA

alone. While it modestly adds negative predictive value to CCTA by excluding critical coronary lesion with a FFRct value > 0.8 , the positive predictive value is inadequate to confer confidence to locate lesions with significant stenosis. Effective adoption of this technology, therefore is contingent upon ensuring optimal CCTA image quality and a mindful patient selection process, for example, avoid applying FFRct to those with left main coronary disease $\geq 50\%$ or those with critical triple vessel disease.

CT heart for evaluation of cardiac structure and morphology (CD-4.6)

CD.CT.0004.6.A

v1.0.2025

CPT® 75572 - Indications

- Cardiac vein identification for lead placement in left ventricular pacing
- To evaluate the anatomy of the pulmonary veins prior to a pulmonary vein isolation (ablation) procedure for atrial fibrillation in place of any of the following:
 - MRI Cardiac (CPT® 75557 or CPT® 75561), MRV Chest (CPT® 71555), or CTV Chest (CPT® 71275)
 - Post-procedure between 3-6 months after ablation

Note:

See also **Pulmonary Vein Imaging – Indications (CD-8.2)**

- If echocardiogram is inconclusive for:
 - Cardiac or pericardial tumor or mass
 - Cardiac thrombus
 - Pericarditis/constrictive pericarditis
 - Complications of cardiac surgery
- In place of MRI when there is clinical suspicion of arrhythmogenic right ventricular dysplasia or arrhythmogenic cardiomyopathy (ARVD/ARVC) if the clinical suspicion is supported by established criteria for ARVD-see **Cardiac MRI – Indications (excluding Stress MRI) (CD-5.2)**
- Recurrent laryngeal nerve palsy due to cardiac chamber enlargement.
- CT Cardiac (CPT® 75572) can be performed instead of TEE for assessment of left atrial appendage (LAA) occlusion device or to assess for thrombus, see: **Transesophageal Echocardiography (TEE) – Indications (CD-2.5)**

Background and Supporting Information

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

Repeat testing is indicated post pulmonary vein isolation procedure because of a 1%-2% incidence of asymptomatic pulmonary vein stenosis

CT Heart for Congenital Heart Disease (CD-4.7)

CD.CT.0004.7.A
v1.0.2025

CPT® 75573

- Coronary artery anomaly evaluation
 - A cardiac catheterization was performed, and not all coronary arteries were identified.
- Thoracic arteriovenous anomaly evaluation
 - A MRI Cardiac or CT angiogram Chest was performed and suggested congenital heart disease.
- Complex adult congenital heart disease evaluation
 - No CT Cardiac or MRI Cardiac has been performed, and there is a contraindication to MRI Cardiac.
 - A CT Cardiac or MRI Cardiac was performed one year ago or more.
- See also section **Adult Congenital Heart Disease (CD-11)**

Transcatheter aortic valve replacement (TAVR) (CD-4.8)

CD.CT.0004.8.A

v1.0.2025

Transcatheter aortic valve replacement (TAVR)

Pre-TAVR imaging

Pre-aortic valve replacement

- Once the decision has been made for aortic valve replacement, the following may be used to determine if an individual is a candidate for TAVR:
 - CTA Chest (CPT® 71275), Abdomen and Pelvis (combination code CPT® 74174) are indicated, and
 - CT Cardiac (CPT® 75572) is indicated to measure the aortic annulus or
 - Coronary CTA (CCTA CPT® 75574) is indicated to both measure the aortic annulus and assess the coronary arteries in lieu of heart catheterization
- A repeat diagnostic left heart catheterization is **not** medically necessary when the individual is undergoing a transcatheter aortic valve replacement (TAVR).

Transfemoral access not feasible

Alternative imaging can be obtained to evaluate vascular access for TAVR in individuals for whom it is documented either via the office note or prior imaging that transfemoral access would not be feasible due to **any** of the following exclusion criteria:

- Small vessels
- Highly calcified vessels
- Stenosed or occluded vessels
- Prior aortoiliac vascular intervention

Imaging is indicated based on the documented intended access site (transaxillary or transcarotid) and should be of the involved body areas. The following studies are indicated based on the documented planned access site:

- CTA of the Head (CPT® 70496) and/or Neck (CPT® 70498) for transcarotid access
- CTA of the Chest (CPT® 71275) and/or Upper extremity (CPT® 73206) for transaxillary access

Post-TAVR imaging

CT Cardiac (CPT® 75572) is indicated:

- If any of the post-TAVR TTEs are indeterminate or raises a concern about any of the following:
 - Valve thrombosis
 - Infective endocarditis
 - Structural degeneration
- When a Valve in Valve implantation or surgical re-do AVR is being contemplated
- Routine CT surveillance or follow up for incidental Hypoattenuated Leaflet Thickening (HALT) with or without restricted leaflet motion, also referred to as Hypoattenuation Affecting Motion (HAM) is NOT recommended

Evidence Discussion (CD-4.6 - CD-4.8)

The ability of the cardiac CT technology to provide a tomographic view of the cardiovascular system has resulted in its ubiquitous adoption in the pre-procedure planning for almost all cardiac structural interventions. Specifically, cardiac CT circumvents the image window limitation of echocardiography, it allows high definition visualization of the posterior structures and facilitates pre-procedural planning for pulmonary vein isolation, coronary sinus pacer leads insertion and left atrial appendage occlusion device implantation, among other trans-catheter structural interventions.

The success of a Trans-catheter Aortic Valve Replacement (TAVR) procedure is contingent upon a meticulous pre-TAVR planning imaging study where cardiac CT allows accurate annulus sizing, coronary heights measurement, and calcification distribution evaluation, in addition to access site planning. Post-operatively, clinically suspected complications such as thrombus formation, infective endocarditis or structural degeneration can be confirmed on a cardiac CT; a routine surveillance strategy, however, is not supported because of unclear or even potentially harmful outcome of treating incidental findings.

In non-interventional settings, cardiac CT provides an alternative to cardiac MRI when structural information cannot be adequately obtained by an echocardiography. Most notably, the evaluation of a cardiac mass, extent of pericardial disease, complex congenital heart disease and cardiomyopathy, can be performed by a cardiac CT when cardiac MRI is not available or contraindicated.

3D Predictive model generation for pre-planning of cardiac procedure (CD-4.9)

CD.CT.0004.9.A

v1.0.2025

Coding

Description	HCPCS
3D predictive model generation for pre-planning of a cardiac procedure, using data from cardiac computed tomographic angiography with report	C9793

Criteria

3D predictive model generation for pre-planning of a cardiac procedure, using data from cardiac computed tomographic angiography is considered to be experimental, investigational or unproven.

Background and Supporting Information

Cardiac Computed Tomography Angiography is a 3D imaging acquisition, viewing and reporting system. Standard Cardiac Computed Tomography Angiography includes the viewing of 3D images. Currently, there is not enough data to support the use of 3D predictive model generation for pre-planning of cardiac procedures (CPT® C9793). It has not been shown to improve outcomes when compared with standard Cardiac Computed Tomography Angiography.

References (CD-4)

v1.0.2025

1. Taylor AJ, Cerqueira M, Hodgson JM, et al. ACCF/SCCT/ACR/AHA/ASE/ASNC/ NASCI/SCAI/SCMR 2010 appropriate use criteria for cardiac computed tomography: a report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, the Society of Cardiovascular Computed Tomography, the American College of Echocardiography, the American Society of Nuclear Cardiology, the North American Society for Cardiovascular Imaging, the Society for Cardiovascular Angiography and Interventions, and the Society for Cardiovascular Magnetic Resonance. *J Am Coll Cardiol* 2010; 56:1864-1894. doi:10.1016/j.jacc.2010.07.005.
2. Curry SJ, Krist AH, Owens DK, et al. Risk Assessment for Cardiovascular Disease with Nontraditional Risk Factors. *Jama*. 2018;320(3):272-280. doi:10.1001/jama.2018.8359.
3. Boden WE, O'Rourke RA, Teo KK, et al. Impact of Optimal Medical Therapy With or Without Percutaneous Coronary Intervention on Long-Term Cardiovascular End Points in Patients With Stable Coronary Artery Disease (from the COURAGE Trial). *J Am Coll Cardiol*. 2009;104(1):1-4. doi:10.1016/j.amjcard.2009.02.059.
4. Einstein AJ, Henzlova MJ, Rajagopalan S. Estimating Risk of Cancer Associated with Radiation Exposure From 64-Slice Computed Tomography Coronary Angiography. *Jama*. 2007;298(3):317. doi:10.1001/jama.298.3.317.
5. Schlosser T, Konorza T, Hunold P, et al. Noninvasive visualization of coronary artery bypass grafts using 16-detector row computed tomography. *J Am Coll Cardiol*, 2004; 44:1224-1229. doi:10.1016/j.jacc.2003.09.075.
6. Douglas PS, DeBruyne B, Pontone G, Patel MR, et al. 1-year outcomes of FFRct-guided care in patients with suspected coronary disease: The PLATFORM Study. *J Am Coll Cardiol*, 2016; 68:435-45. doi:10.1016/j.jacc.2016.05.056.
7. Norgaard B, Leipsic J, Gaur S, et al. Diagnostic performance of noninvasive fractional flow reserve derived from coronary computed tomography angiography in suspected coronary artery disease. *J Am Coll Cardiol*, 2014; 63:1145-55. doi:10.1016/j.jacc.2013.11.043.
8. Ko BS, Cameron JD, Munnur RK, Wong DTL, et al. Cardiac CT: atherosclerosis to acute coronary syndrome. *J Am Coll Cardiol*. December 2016;4(6). doi:10.3978/j.issn.2223-3652.2014.11.03.
9. Holmes D Jr, Mack M, Kaul S, et al. 2012 ACCF/AATS/SCAI/STS expert consensus document on transcatheter aortic valve replacement. *J Am Coll Cardiol*, 2012; 59:1200. doi:10.1016/j.jacc.2012.01.001.
10. NICE medical technology advisory committee. Overview: HeartFlow FFRCT for estimating fractional flow reserve from coronary CT angiography: Guidance. NICE: National Institute for health and care excellence. <https://www.nice.org.uk/guidance/mtg32>. Published February 2017.
11. American College of Cardiology Foundation Task Force on Expert Consensus Documents, Mark DB, Berman DS, et al. ACCF/ACR/AHA/NASCI/SAIP/SCAI/SCCT 2010 expert consensus document on coronary computed tomographic angiography: a report of the American College of Cardiology Foundation Task Force on Expert Consensus Documents. *J Am Coll Cardiol*. 2010; 55:2663. doi:10.1161/CIR.0b013e3181d4b618.
12. Doherty JU, Kort S, Mehran R, Schoenhagen P, Soman P. ACC/AATS/AHA/ASE/ASNC/HRS/SCAI/SCCT/SCMR/STS 2017 Appropriate Use Criteria for Multimodality Imaging in Valvular Heart Disease. *Journal of Nuclear Cardiology*. 2017;24(6):2043-2063. doi:10.1007/s12350-017-1070-1.
13. The Medicare Learning Network[®]. MEDICARE PREVENTIVE SERVICES. Preventive Services Chart Medicare Learning Network[®]. ICN MLN006559. https://www.cms.gov/Medicare/Prevention/PrevntionGenInfo/medicare-preventive-services/MPS-QuickReferenceChart-1.html#CARDIO_DIS. Published June 2019.
14. Grundy SM, Stone NJ, Bailey AL, et al. 2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA Guideline on the Management of Blood Cholesterol: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation*. 2019;139(25). doi:10.1161/cir.0000000000000625.
15. Arnett DK, Blumenthal RS, Albert MA, et al. 2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease. *Circulation*. 2019;140(11):e596-e646. doi:10.1161/cir.0000000000000678.
16. Korsholm K, Berti S, Iriart X, et al. Expert Recommendations on Cardiac Computed Tomography for Planning Transcatheter Left Atrial Appendage Occlusion. *JACC: Cardiovascular Interventions*. 2020;13(3):277-292. doi:10.1016/j.jcin.2019.08.054.

17. Koster MJ, Warrington KJ. Vasculitis of the Coronary Arteries. *American College of Cardiology Latest in Cardiology*. <https://www.acc.org/latest-in-cardiology/articles/2019/03/13/06/50/vasculitis-of-the-coronary-arteries>. Published March 13, 2019. Accessed July 29, 2020.
18. Opolski MP, Staruch AD, Jakubczyk M, et al. CT Angiography for the Detection of Coronary Artery Stenoses in Patients Referred for Cardiac Valve Surgery. *JACC: Cardiovascular Imaging*. 2016;9(9):1059-1070. doi:10.1016/j.jcmg.2015.09.028.
19. Stout KK, Daniels CJ, Aboulhosn JA, et al. 2018 AHA/ACC Guideline for the Management of Adults with Congenital Heart Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation*. 2019;139(14). doi:10.1161/cir.0000000000000603.
20. Al-Khatib SM, Stevenson WG, Ackerman MJ, et al. 2017 AHA/ACC/HRS Guideline for Management of Patients with Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death. *Circulation*. 2018;138(13):e272-e391. doi:10.1161/cir.0000000000000549.
21. Gräni C, Buechel RR, Kaufmann PA, Kwong RY. Multimodality Imaging in Individuals with Anomalous Coronary Arteries. *JACC: Cardiovascular Imaging*. 2017;10(4):471-481. doi:10.1016/j.jcmg.2017.02.004.
22. Kim SY, Seo JB, Do K-H, et al. Coronary Artery Anomalies: Classification and ECG-gated Multi-Detector Row CT Findings with Angiographic Correlation. *RadioGraphics*. 2006;26(2):317-333. doi:10.1148/rg.262055068.
23. Ghadri JR, Kazakauskaitė E, Braunschweig S, et al. Congenital coronary anomalies detected by coronary computed tomography compared to invasive coronary angiography. *BMC Cardiovascular Disorders*. 2014;14(1). doi:10.1186/1471-2261-14-81.
24. Shariat M, Thavendiranathan P, Nguyen E, et al. Utility of coronary CT angiography in outpatients with hypertrophic cardiomyopathy presenting with angina symptoms. *J Cardiovasc Comput Tomogr*. 2014;8(6):429-437. doi:10.1016/j.jcct.2014.09.007.
25. Lyon AR, Bossone E, Schneider B, et al. Current state of knowledge on Takotsubo syndrome: a Position Statement from the Taskforce on Takotsubo Syndrome of the Heart Failure Association of the European Society of Cardiology. *European Journal of Heart Failure*. 2015;18(1):8-27. doi:10.1002/ehf.424.
26. Levine A, Hecht HS. Cardiac CT Angiography in Congestive Heart Failure. *Journal of Nuclear Medicine*. 2015;56(Supplement_4). doi:10.2967/jnumed.114.150441.
27. Hecht H, Blaha MJ, Berman DS, et al. Clinical indications for coronary artery calcium scoring in asymptomatic patients: Expert consensus statement from the Society of Cardiovascular Computed Tomography. *J Cardiovasc Comput Tomogr*. 2017;11(2):157-168. doi:10.1016/j.jcct.2017.02.010.
28. Williams MC, Kwiecinski J, Doris M, et al. Low-Attenuation Noncalcified Plaque on Coronary Computed Tomography Angiography Predicts Myocardial Infarction. *Circulation*. 2020;141(18):1452-1462. doi:10.1161/circulationaha.119.044720.
29. Daghm M, Bing R, Fayad ZA, Dweck MR. Noninvasive Imaging to Assess Atherosclerotic Plaque Composition and Disease Activity. *JACC: Cardiovascular Imaging*. 2020;13(4):1055-1068. doi:10.1016/j.jcmg.2019.03.033.
30. Shaw LJ, Blankstein R, Bax JJ, et al. Society of Cardiovascular Computed Tomography / North American Society of Cardiovascular Imaging – Expert Consensus Document on Coronary CT Imaging of Atherosclerotic Plaque. *J Cardiovasc Comput Tomogr*. 2020. doi:10.1016/j.jcct.2020.11.002.
31. Writing Committee Members, Otto CM, Nishimura RA, et al. 2020 ACC/AHA Guideline for the Management of Patients With Valvular Heart Disease: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines [published correction appears in *J Am Coll Cardiol*. 2021 Feb 2;77(4):509] [published correction appears in *J Am Coll Cardiol*. 2021 Mar 9;77(9):1275]. *J Am Coll Cardiol*. 2021;77(4):e25-e197. doi:10.1016/j.jacc.2020.11.018
32. Blanke P, Weir-McCall JR, Achenbach S, et al. Computed tomography imaging in the context of transcatheter aortic valve implantation (TAVI) / transcatheter aortic valve replacement (TAVR): An expert consensus document of the Society of Cardiovascular Computed Tomography. *J Cardiovasc Comput Tomogr*. 2019;13(1):1-20. doi:10.1016/j.jcct.2018.11.008.
33. Cheng XS, VanWagner LB, Costa SP, et al. Emerging Evidence on Coronary Heart Disease Screening in Kidney and Liver Transplantation Candidates: A Scientific Statement from the American Heart Association. *Circulation*. 2022 Oct. 146:e299–e324. doi.org/10.1161/CIR.0000000000001104.
34. Kumamaru KK, Kondo T, Kumamaru H, et al. Repeat Coronary Computed Tomographic Angiography in Patients with a Prior Scan Excluding Significant Stenosis. *Circ Cardiovasc Imaging*. 2014;7:788-795. doi.org/10.1161/CIRCIMAGING.113.001549.

35. VanWagner LB, Harinstein ME, Runo JR, et al. Multidisciplinary approach to cardiac and pulmonary vascular disease risk assessment in liver transplantation: An evaluation of the evidence and consensus recommendations. *Am J Transplant*. 2018;18:30–42. doi.org/10.1111/ajt.14531.
36. Löffler AI, Gonzalez JA, Sundararaman SK, et al. Coronary Computed Tomography Angiography Demonstrates a High Burden of Coronary Artery Disease Despite Low-Risk Nuclear Studies in Pre–Liver Transplant Evaluation. *Liver Transplantation*. 2020 November; 26(11): 1398–1408. doi.org/10.1002/lt.25869.
37. Halvorsen S, Mehilli J, Cassese S, et al. 2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery. *Eur Heart J*. 2022;43(39):3826-3924. doi:10.1093/eurheartj/ehac270.
38. Multimodality Writing Group for Chronic Coronary Disease; Winchester DE, Maron DJ, Blankstein R, Chang IC, Kirtane AJ, Kwong RY, Pellikka PA, Prutkin JM, Russell R, Sandhu AT. ACC/AHA/ASE/ASNC/ASPC/HFSA/HRS/SCAI/SCCT/SCMR/STS 2023 Multimodality Appropriate Use Criteria for the Detection and Risk Assessment of Chronic Coronary Disease. *J Am Coll Cardiol*. 2023 Jun 27;81(25):2445-2467. doi: 10.1016/j.jacc.2023.03.410.
39. Virani SS et al. 2023 AHA/ACC/ACCP/ASPC/NLA/PCNA Guideline for the Management of Patients With Chronic Coronary Disease: A Report of the American Heart Association/American College of Cardiology Joint Committee on Clinical Practice Guidelines. *Circulation*. 2023 Aug 29;148(9):e9-e119. doi: 10.1161/CIR.0000000000001168. Epub 2023 Jul 20. Erratum in: *Circulation*. 2023 Sep 26;148(13):e148. Erratum in: *Circulation*. 2023 Dec 5;148(23):e186.
40. Yu MM et al. Prognostic value of coronary CT angiography in heart failure patients with preserved ejection fraction. *Eur Radiol*. 2023 May;33(5):3052-3063. doi: 10.1007/s00330-022-09380-4.
41. Sachdeva R, Armstrong AK, Arnaout R, et al. Novel Techniques in Imaging Congenital Heart Disease: JACC Scientific Statement. *J Am Coll Cardiol*. 2024;83(1):63-81. doi:10.1016/j.jacc.2023.10.025.
42. Jone P, Gearhart A, Lei H. et al. Artificial Intelligence in Congenital Heart Disease: Current State and Prospects. *JACC Adv*. 2022 Dec, 1 (5) . doi:10.1016/j.jacadv.2022.100153.
43. Yu CW, Lee HJ, Suh J, Lee NH, Park SM, Park TK, Yang JH, Song YB, Hahn JY, Choi SH, Gwon HC, Lee SH, Choe YH, Kim SM, Choi JH. Coronary Computed Tomography Angiography Predicts Guidewire Crossing and Success of Percutaneous Intervention for Chronic Total Occlusion: Korean Multicenter CTO CT Registry Score as a Tool for Assessing Difficulty in Chronic Total Occlusion Percutaneous Coronary Intervention. *Circ Cardiovasc Imaging*. 2017 Apr;10(4):e005800. doi: 0.1161/CIRCIMAGING.116.005800.
44. Hong SJ, Kim BK, Cho I, Kim HY, Rha SW, Lee SH, Park SM, Kim YH, Chang HJ, Ahn CM, Kim JS, Ko YG, Choi D, Hong MK, Jang Y; CT-CTO Investigators. Effect of Coronary CTA on Chronic Total Occlusion Percutaneous Coronary Intervention: A Randomized Trial. *JACC Cardiovasc Imaging*. 2021 Oct;14(10):1993-2004. doi: 10.1016/j.jcmg.2021.04.013.
45. Liang S, Bai Y, Zhang J, Wang A, Li J, Diao K, He Y. The added value of coronary CTA in chronic total occlusion percutaneous coronary intervention: a systematic review and meta-analysis. *Eur Radiol*. 2024 Jun;34(6):4041-4052. doi: 10.1007/s00330-023-10341-8.

Cardiac MRI

Guideline	Page
Cardiac MRI and Cardiac Indications for MRA Chest (CD-5.2).....	93
Cardiac Stress MRI - (CD-5.3).....	100
References (CD-5).....	102

Cardiac MRI and Cardiac Indications for MRA Chest (CD-5.2)

CD.MRI.0005.2.A

v1.0.2025

Cardiac MRI – Coding

Cardiac Imaging Procedure Codes

Cardiac MRI	CPT®/HCPCS
Cardiac magnetic resonance imaging for morphology and function without contrast	75557
Cardiac magnetic resonance imaging for morphology and function without and with contrast and further sequences	75561
Cardiac magnetic resonance imaging for velocity flow mapping (List separately in addition to code for primary procedure)	+75565
Cardiac magnetic resonance imaging for morphology and function, quantification of segmental dysfunction; with stress imaging	C9763
Quantitative magnetic resonance for analysis of tissue composition (eg, fat, iron, water content), including multiparametric data acquisition, data preparation and transmission, interpretation and report, obtained without diagnostic MRI examination of the same anatomy (eg, organ, gland, tissue, target structure) during the same session; single organ	0648T
Quantitative magnetic resonance for analysis of tissue composition (eg, fat, iron, water content), including multiparametric data acquisition, data preparation and transmission, interpretation and report, obtained with diagnostic MRI examination of the same anatomy (eg, organ, gland, tissue, target structure); single organ (List separately in addition to code for primary procedure)	+0649T

Cardiac MRI	CPT®/HCPCS
Quantitative magnetic resonance for analysis of tissue composition (eg, fat, iron, water content), including multiparametric data acquisition, data preparation and transmission, interpretation and report, obtained without diagnostic MRI examination of the same anatomy (eg, organ, gland, tissue, target structure) during the same session; multiple organs	0697T
Quantitative magnetic resonance for analysis of tissue composition (eg, fat, iron, water content), including multiparametric data acquisition, data preparation and transmission, interpretation and report, obtained with diagnostic MRI examination of the same anatomy (eg, organ, gland, tissue, target structure); multiple organs (List separately in addition to code for primary procedure)	+0698T

- Only one procedure code from the set (CPT® 75557- CPT® 75563) should be reported per session.
- Only one flow velocity measurement (CPT® +75565) should be reported per session when indicated.

Cardiac MRI and Cardiac Indications for MRA Chest

Indications (excluding Stress MRI)

- Assess myocardial viability (to differentiate hibernating myocardium from scar) when necessary to determine if revascularization should be performed (CPT® 75561)
- Assessment of global ventricular function, myocardial composition and mass if a specific clinical question is left unanswered by a recent echocardiogram and results will affect individual management (CPT® 75557 or CPT® 75561). Particularly useful in evaluating:
 - Cardiomyopathy (ischemic, diabetic, hypertrophic, or muscular dystrophy)
 - Non-compaction
 - Infiltrative heart disease such as amyloid, iron overload cardiomyopathy (hemosiderosis, hemochromatosis)
 - Post cardiac transplant
 - Hypertrophic cardiomyopathy
 - Suspected acute myocarditis, cardiac aneurysm, trauma, and contusions
 - Monitoring cancer chemotherapy effect on the heart (especially if an accurate assessment of right ventricular function is documented as necessary).

- Pre and post-operative congenital heart disease assessment see **Adult Congenital Heart Disease (CD-11)** for defect specific indications (CPT® 75557 or CPT® 75561).
 - MRA Chest (CPT® 71555) may be added if the aorta or pulmonary artery need to be visualized beyond the root.
 - May add 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 when there is documentation of **either** of the following:
 - Significant valvular disease that may require intervention
 - Intracardiac flow disturbances (e.g., ASD, VSD)
- MRA Chest (CPT® 71555) is indicated for the following:
 - Thoracic aortic dissection see **Aortic Dissection and Other Aortic Conditions (PVD-6.7)** in the Peripheral Vascular Disease Imaging Guidelines
 - Coarctation of the aorta see:
 - **Coarctation of the Aorta (CD-11.3.2)** for adults
 - **Aortic Coarctation and IAA (interrupted aortic arch) (PEDCD-2.4.11)** for infants and children in the Pediatric Cardiac Imaging Guideline
 - Thoracic aortic aneurysm see **Thoracic Aortic Aneurysm (TAA) (PVD-6.2)** in the Peripheral Vascular Disease Imaging Guidelines.
- Coarctation of the aorta
 - Adults: see **Coarctation of the Aorta (CD-11.3.2)**
 - Infants and children: see **Aortic Coarctation and IAA (interrupted aortic arch) (PEDCD-2.4.11)** in the Pediatric Cardiac Imaging Guideline
- Arrhythmogenic right ventricular dysplasia or arrhythmogenic right ventricular cardiomyopathy (ARVD/ARVC) suspicion (CPT® 75557 or CPT® 75561) must have one of the following:
 - Non-sustained or sustained VT of LBBB morphology OR >500 PVC's over 24 hours on event recorder or Holter monitor.
 - ARVD/ARVC confirmed in a first-degree relative either by criteria, autopsy, pathogenic genetic mutation or sudden death <35 years of age with suspected ARVD/ARVC.
 - Inverted T waves in right precordial leads (V1, V2 and V3) or beyond in individuals >14 years of age in the absence of complete RBBB
 - Right ventricular akinesis, dyskinesis or aneurysm noted on echo or RV angiography.
- Differentiate constrictive pericarditis from restrictive cardiomyopathy (CPT® 75561).
- Evaluate cardiac tumor or mass when echocardiogram is inconclusive (CPT® 75557 or 75561)
- Evaluate valvular heart disease when echocardiogram is inconclusive:
 - CPT® 75557 or CPT® 75561
 - May add CPT® 75565 when there is documentation of either of the following:

- Significant valvular disease that may require intervention
- Intracardiac flow disturbances (e.g., ASD, VSD)
- MRI Cardiac (CPT® 75557 or CPT® 75561) **or** chest MRV (CPT® 71555), but not both, for pulmonary vein anatomy for planned ablation procedures in individuals with atrial fibrillation. See **Pulmonary Vein Imaging – Indications (CD-8.2)** for guidelines on follow-up imaging after ablation procedure.
- Suspected cardiac thrombus when echocardiogram is inconclusive (CPT® 75557).
- Right ventricular function evaluation (CPT® 75557 in conjunction with CPT® +75565) if there has been a recent ECHO and there is documented need to perform Cardiac MRI in order to resolve an unanswered question about flow dynamics.
- Cardiac MRI (CPT® 75557 or CPT® 75561) and CMR velocity flow mapping (CPT® 75565) for preoperative evaluation prior to planned LVAD implant
- 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 about flow dynamics
- Conditions that would **not** require an echo prior to an MRI:
 - Detect anomalous coronary arteries (CPT® 75561)
 - Assess coronary arteries in Kawasaki disease
 - Fabry disease
 - Late enhancement MRI may predict the effect of enzyme replacement therapy on myocardial changes that occur with this disease (CPT® 75561)
 - Initial evaluation for cardiac sarcoidosis

Non-indications

C9762-Cardiac magnetic resonance imaging for morphology and function, quantification of segmental dysfunction; with strain imaging. The use of CMR strain imaging for the quantification of segmental dysfunction is considered investigational and experimental at this time.

Quantitative analysis of myocardial tissue composition by MRI (CPT® codes 0648T, 0649T, 0697T and 0698T) are, considered experimental, investigational, or unproven at this time. There is insufficient clinical data to support their use.

Background and Supporting Information

CCTA (CPT® 75574) is better at detecting anomalous coronary arteries than conventional angiography.

Cardiac MRI – Aortic Root and Proximal Ascending Aorta

- See **Thoracic Aortic Aneurysm (TAA) (PVD-6.2)** in the Peripheral Vascular Disease imaging guidelines

Cardiac MRI – Duchenne Muscular Dystrophy (DMD)

Cardiac MRI (CPT® 75557 or 75561-does not include CPT® 75565 or 71555 unless otherwise indicated)

- Asymptomatic individual with documented DMD can have annual surveillance cardiac MRI starting at 6 years old (yearly echo is recommended prior to age 6)
- Asymptomatic, documented carrier of DMD can have cardiac MRI every 3 years starting at 18

Cardiac MRI – Evaluation of Pericardial Effusion or Diagnosis of Pericardial Tamponade

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

Cardiac MRI – Myocarditis

Clinical evaluation of suspected myocarditis

Initial testing for suspected myocarditis should consist of an electrocardiogram, measurement of cardiac troponin, and an echocardiogram.

Cardiac MRI is indicated for suspected myocarditis in the presence of **all** of the following:

- New onset or persisting symptoms suggestive of myocarditis documented by **any** of the following:
 - Dyspnea
 - Chest pain
 - Palpitations
 - Syncope
 - Effort intolerance
- Evidence for recent or ongoing myocardial injury documented by **any** of the following results on initial screening:

- Ventricular dysfunction noted on any cardiac imaging study, or
- New or persisting ECG abnormalities suspicious for myocarditis
 - ST changes, T wave changes, Q waves, or
 - conduction abnormalities, such as LBBB or AV block, or
 - VT or VF
- Elevated troponin
- Strong suspicion for viral etiology of myocardial injury with documentation of **both**:
 - Recent systemic viral disease, recent mRNA COVID-19 vaccination, or prior myocarditis
 - No evidence of coronary ischemia as documented by **any** of the following:
 - Lack of risk factors for CAD
 - Age under 35 years
 - Negative cardiac imaging study, such as MPI, CCTA, cath

Return to Play Screening for athletes at risk for myocarditis

Cardiac MRI is indicated for **Return to Play Screening** for athletes when there is documentation of **both** of the following:

- Individual has a history of a clinical condition associated with myocarditis (i.e., COVID-19 infection or recent mRNA COVID-19 vaccination)
- Initial screening has been performed with documentation of **either** of the following:
 - Initial screening (ECG, troponin, and TTE) showed evidence for recent or ongoing myocardial injury (as defined above in Clinical Evaluation of Suspected Myocarditis) with ongoing symptoms concerning for myocarditis (dyspnea, chest pain, palpitations, syncope, or effort intolerance).
 - Normal results of initial screening with persistent or new onset symptoms concerning for myocarditis.

Background and Supporting Information

As noted in the "2022 ACC expert consensus decision pathway on cardiovascular sequelae of COVID-19 in adults" and the 2017 "Sports cardiology: core curriculum for providing cardiovascular care to competitive athletes and highly active people", an athlete is defined as an individual who places a high premium on exercise training, competition, and sports achievement.

Evidence Discussion

- Guidelines and appropriate use criteria support the use of transthoracic echocardiogram (TTE) as the initial study for a broad range of cardiac conditions. TTE can be used to evaluate cardiac morphology and function, and provides information necessary to diagnose and guide treatment in conditions including heart

failure and cardiomyopathy, ischemic heart disease, and valvular dysfunction. TTE is also used to initially assess intracardiac and extracardiac structures, including suspected cardiac masses, sources of emboli, and pericardial conditions. TEE visualizes portions of the great vessels and provides initial imaging of these structures.

- TTE has significant advantages over other imaging modalities: it is easily accessible and even portable, provides no exposure to radiation, is inexpensive, and has minimal, if any risks.
- Like TTE, MRI assesses cardiac morphology and function; additionally, MRI provides information regarding myocardial perfusion, metabolism, and tissue composition.
- When questions remain unanswered after TTE, MRI can provide additional information due to its ability to assess myocardial composition and mass; these characteristics make cardiac MRI especially useful in the settings of cardiomyopathy, non-compaction, infiltrative heart disease, post cardiac transplant, cardiac masses, pericardial disease, and myocarditis.
- Beyond imaging with TTE, MRI can provide improved visualization of valvular pathology, because images are not limited by body habitus, is of high spatial resolution, can more accurately quantify the magnitude of valve insufficiency and stenosis, and can assess the effects of valve dysfunction on ventricular mass or volume. Qualities of MRI that augment evaluation of valvular disease may also improve visualization of intracardiac shunts over TTE alone.
- Advantages of MRI assessment of the great vessels include avoidance of ionizing radiation, provision of excellent spatial resolution of structures, and is not limited by body habitus.
- Conditions that are better evaluated initially by MRI, include coronary artery anomalies, and diseases of abnormal myocardial composition: Arrhythmogenic right ventricular dysplasia, Fabry disease, cardiac sarcoidosis, and Duchenne Muscular Dystrophy.
- When TTE and other less advanced imaging provide the information necessary to diagnose and treat cardiovascular conditions, MRI is not indicated.
- Disadvantages of MRI include being less accessible, and possibly being incompatible for use in those with implanted devices. The gadolinium contrast agents used in MRI require precautions in those with advanced renal disease and severe liver disease.
- The decision to use MR imaging is made in the context of other testing; duplication of information should be avoided, and more readily available modalities with lower risk, initially considered. An assessment should be made as to whether additional testing will provide complementary diagnostic, therapeutic, or prognostic information that will optimize care.

Cardiac Stress MRI - (CD-5.3)

CD.MRI.0005.3.A

v1.0.2025

Cardiac Stress MRI – Coding

Cardiac Imaging Procedure Codes

Cardiac MRI	CPT®/HCPCS
Cardiac magnetic resonance imaging for morphology and function without contrast; with stress imaging	75559
Cardiac magnetic resonance imaging for morphology and function without and with contrast and further sequences; with stress imaging	75563
Cardiac magnetic resonance imaging for velocity flow mapping (List separately in addition to code for primary procedure)	+75565
Cardiac magnetic resonance imaging for morphology and function, quantification of segmental dysfunction; with stress imaging	C9763
Noninvasive determination of absolute quantitation of myocardial blood flow (AQMBF), derived from augmentative algorithmic analysis of the dataset acquired via contrast cardiac magnetic resonance (CMR), pharmacologic stress, with interpretation and report by a physician or other qualified health care professional (List separately in addition to code for primary procedure)	+0899T
Noninvasive estimate of absolute quantitation of myocardial blood flow (AQMBF), derived from assistive algorithmic analysis of the dataset acquired via contrast cardiac magnetic resonance (CMR), pharmacologic stress, with interpretation and report by a physician or other qualified health care professional (List separately in addition to code for primary procedure)	+0900T

- Only one procedure code from the set (CPT® 75557- CPT® 75563) should be reported per session.
- Only one flow velocity measurement (CPT® +75565) should be reported per session when indicated.

- C9763-Cardiac magnetic resonance imaging for morphology and function, quantification of segmental dysfunction; with stress imaging. The use of stress CMR for the quantification of segmental dysfunction is considered investigational and experimental at this time.

Indications for Cardiac Stress MRI

Indications

- Indications for Stress MRI see **Stress Testing with Imaging – Indications (CD-1.4)**.
- If a nuclear perfusion (MPI) stress test was performed and was equivocal, a stress MRI is indicated.

Non-indications for Cardiac Stress MRI

Absolute quantitation of myocardial blood flow (AQMBF)

Absolute quantitation of myocardial blood flow (AQMBF) obtained by cardiac magnetic resonance imaging (CMR) (CPT® 0899T and 0900T) is considered experimental, investigational, or unproven at this time.

Quantification of segmental dysfunction

C9763-Cardiac magnetic resonance imaging for morphology and function, quantification of segmental dysfunction; with stress imaging. The use of stress CMR for the quantification of segmental dysfunction is considered investigational and experimental at this time.

References (CD-5)

v1.0.2025

1. Hamdan A, Charalampos K, Roettgen R, et al. Magnetic resonance imaging versus computed tomography for characterization of pulmonary vein morphology before radiofrequency catheter ablation of atrial fibrillation. *Am J Cardiol*, 2009; 104:1540-1546. doi:10.1016/j.amjcard.2009.07.029.
2. Hendel RC, Kramer CM, Patel MR, et al. ACCF/ACR/SCCT/SCMR/ ASNC/NASCI/SCAI/SIR 2006 Appropriateness Criteria for computed tomography and cardiac magnetic resonance imaging. *J Am Coll Cardiol*, 2006; 48(7):1475-1497. Accessed November 30, 2017. doi:10.1016/j.jacc.2006.07.003.
3. Doherty JU, Kort S, Mehran R, et al. ACC/AATS/AHA/ASE/ASNC/HRS/SCAI/SCCT/SCMR/STS 2019 Appropriate Use Criteria for Multimodality Imaging in the Assessment of Cardiac Structure and Function in Nonvalvular Heart Disease. *J Am Coll Cardiol*. 2019;73(4):488-516. doi:10.1016/j.jacc.2018.10.038.
4. Hundley WG, Bluemke DA, Finn JP, et al. ACCF/ACR/AHA/NASCI/SCMR 2010 Expert Consensus Document on Cardiovascular Magnetic Resonance. *J Am Coll Cardiol*. 2010;55(23):2614-2662. doi:10.1016/j.jacc.2009.11.011.
5. Friedrich MG, Sechtem U, Schulz-Menger J, et al. Cardiovascular Magnetic Resonance in Myocarditis: A JACC White Paper. *J Am Coll Cardiol*. 2009;53(17):1475-1487. doi:10.1016/j.jacc.2009.02.007.
6. Riele AST, Tandri H, Sanborn DM, Bluemke DA. Noninvasive Multimodality Imaging in ARVD/C. *JACC: Cardiovasc Imaging*. 2015;8(5):597-611. doi:10.1016/j.jcmg.2015.02.007.
7. Verhaert D, Richards K, Rafael-Fortney JA, Raman SV. Cardiac involvement in patients with muscular dystrophies: magnetic resonance imaging phenotype and genotypic considerations. *Circ Cardiovasc Imaging*. 2011;4(1):67-76. doi:10.1161/CIRCIMAGING.110.960740.
8. Feingold B, Mahle WT, Auerbach S, et al. Management of Cardiac Involvement Associated With Neuromuscular Diseases: A Scientific Statement From the American Heart Association. *Circulation*. 2017;136(13). doi:10.1161/cir.0000000000000526
9. Mah ML, Cripe L, Slawinski MK, et al. Duchenne and Becker muscular dystrophy carriers: Evidence of cardiomyopathy by exercise and cardiac MRI testing. *International Journal of Cardiology*. 2020;316:257-265. doi:10.1016/j.ijcard.2020.05.052
10. Power LC, O'Grady GL, Hornung TS, Jefferies C, Gusso S, Hofman PL. Imaging the heart to detect cardiomyopathy in Duchenne muscular dystrophy: A review. *Neuromuscular Disorders*. 2018;28(9):717-730. doi:10.1016/j.nmd.2018.05.011
11. Hor KN, Mah ML, Johnston P, Cripe TP, Cripe LH. Advances in the diagnosis and management of cardiomyopathy in Duchenne muscular dystrophy. *Neuromuscular Disorders*. 2018;28(9):711-716. doi:10.1016/j.nmd.2018.06.014.
12. Birnkrant DJ, Bushby K, Bann CM, et al. Diagnosis and management of Duchenne muscular dystrophy, part 2: respiratory, cardiac, bone health, and orthopaedic management. *The Lancet Neurology*. 2018;17(4):347-361. doi:10.1016/s1474-4422(18)30025-5.
13. Baggish AL, Battle RW, Beckerman JG, et al. Sports Cardiology: Core Curriculum for Providing Cardiovascular Care to Competitive Athletes and Highly Active People. *J Am Coll Cardiol*. 2017;70(15):1902-1918. doi:10.1016/j.jacc.2017.08.055.
14. Ammirati E, Frigerio M, Adler ED, et al. Management of Acute Myocarditis and Chronic Inflammatory Cardiomyopathy: An Expert Consensus Document. *Circ Heart Fail*. 2020;13(11):e007405. doi:10.1161/CIRCHEARTFAILURE.120.007405.
15. Gluckman TJ, Bhave NM, et al. 2022 ACC Expert Consensus Decision Pathway on Cardiovascular Sequelae of COVID-19 in Adults: Myocarditis and Other Myocardial Involvement, Post-Acute Sequelae of SARS-CoV-2 Infection, and Return to Play: A Report of the American College of Cardiology Solution Set Oversight Committee. *J Am Coll Cardiol*. 2022;79(17):1717-1756. doi:10.1016/j.jacc.2022.02.003.
16. Gewirtz H. CMR quantitative measurements of myocardial blood flow: Not ready for routine clinical application. *J Nucl Cardiol*. 2021 Aug;28(4):1267-1270. doi: 10.1007/s12350-019-01812-x.
17. Li XM, Jiang L, Min CY, Yan WF, Shen MT, Liu XJ, Guo YK, Yang ZG. Myocardial Perfusion Imaging by Cardiovascular Magnetic Resonance: Research Progress and Current Implementation. *Curr Probl Cardiol*. 2023 Jun;48(6):101665. doi: 10.1016/j.cpcardi.2023.101665.

Cardiac PET

Guideline	Page
Cardiac PET – Coding (CD-6.1).....	104
Cardiac PET – Perfusion – Indications (CD-6.2).....	106
Cardiac PET – Absolute Quantitation of Myocardial Blood Flow (AQMBF) (CD-6.3).....	107
References.....	109
Cardiac PET – Metabolic – Indications (CD-6.4).....	110
FDG PET/CT for infections (CD-6.5).....	111
References (CD-6).....	112

Cardiac PET – Coding (CD-6.1)

CD.PET.0006.1.A

v1.0.2025

Cardiac Imaging Procedure Codes

Cardiac PET	CPT®
Myocardial imaging, positron emission tomography (PET), metabolic evaluation study (including ventricular wall motion[s] and/or ejection fraction[s], when performed), single study	78459
Myocardial imaging, positron emission tomography (PET), perfusion study (including ventricular wall motion[s] and/or ejection fraction[s], when performed); single study at rest or stress (exercise or pharmacologic)	78491
Myocardial imaging, positron emission tomography (PET), perfusion study (including ventricular wall motion[s] and/or ejection fraction[s], when performed); multiple studies at rest and stress (exercise or pharmacologic)	78492
Myocardial imaging, positron emission tomography (PET), metabolic evaluation study (including ventricular wall motion[s] and/or ejection fraction[s], when performed), single study; with concurrently acquired computed tomography transmission scan	78429
Myocardial imaging, positron emission tomography (PET), perfusion study (including ventricular wall motion[s] and/or ejection fraction[s], when performed); single study, at rest or stress (exercise or pharmacologic), with concurrently acquired computed tomography transmission scan	78430
Myocardial imaging, positron emission tomography (PET), perfusion study (including ventricular wall motion[s] and/or ejection fraction[s], when performed); multiple studies at rest and stress (exercise or pharmacologic), with concurrently acquired computed tomography transmission scan	78431

Cardiac PET	CPT®
Myocardial imaging, positron emission tomography (PET), combined perfusion with metabolic evaluation study (including ventricular wall motion[s] and/or ejection fraction[s], when performed), dual radiotracer (e.g., myocardial viability);	78432
Myocardial imaging, positron emission tomography (PET), combined perfusion with metabolic evaluation study (including ventricular wall motion[s] and/or ejection fraction[s], when performed), dual radiotracer (e.g., myocardial viability); with concurrently acquired computed tomography transmission scan	78433
Absolute quantitation of myocardial blood flow (AQMBF), positron emission tomography (PET), rest and pharmacologic stress (List separately in addition to code for primary procedure)	+78434
Positron emission tomography (PET) with concurrently acquired computed tomography (CT) for attenuation correction and anatomical localization imaging; skull base to mid-thigh	78815

- 3D rendering should not be billed in conjunction with PET.
- Separate codes for such related services as treadmill testing (CPT® 93015-CPT® 93018) and radiopharmaceuticals should be assigned in addition to perfusion PET. These services are paid according to each individual payer.

Cardiac PET – Perfusion – Indications (CD-6.2)

CD.PET.0006.2.A

v1.0.2025

CPT® 78430, CPT® 78431, CPT® 78491 and CPT® 78492

- Meets all of the criteria for an imaging stress test in **Stress Testing with Imaging (CD-1.4)** and additionally any one of the following:
 - Individual is severely obese
 - Individual has large breasts or implants
 - Individual incapable of exercise due to physical (musculoskeletal or neurological) inability to achieve target heart rate. Target heart rate is calculated as 85% of the maximum age predicted heart rate (MPHR). MPHR is estimated as 220 minus the individual's age
- Equivocal nuclear perfusion (SPECT MPI) stress test
- Routine use in post heart transplant assessment of transplant CAD

Cardiac PET – Absolute Quantitation of Myocardial Blood Flow (AQMBF) (CD-6.3)

CD.PET.0006.3.A

v1.0.2025

Absolute Quantitation of Myocardial Blood Flow (CPT® 78434)

Quantitation of myocardial blood flow at rest and with stress in ml/g/min and the calculation of myocardial perfusion reserve (the ratio of stress to rest flow) can be used for diagnosis and prognosis of coronary artery disease and cardiac endothelial dysfunction that can be seen in diabetes, left ventricular hypertrophy, heart transplantation vasculopathy among other conditions.

- AQMBF with PET (CPT® 78434) is an add-on procedure that is indicated when one of the following apply:
 - Primary study Myocardial PET rest/stress perfusion (CPT® 78492 or 78431 only) has been approved
 - Primary study Myocardial PET rest/stress perfusion (CPT® 78492 or 78431 only) has been ordered and is being approved at the same time (see- **Cardiac PET - Perfusion - Indications (CD-6.2)** or **Stress Testing with Imaging - Indications (CD-1.4)**).

Background and Supporting Information

Despite its utility, AQMBF is a technically challenging measurement. Variables include:

- Different tracers (N-13 ammonia vs Rb-82 Cl) give different values
- Different mathematical models used (static vs dynamic)
- Different stressors are used that give different hyperemic flow results (adenosine vs dipyridamole vs regadenoson)
- Data can be collected in 2D vs 3D modes. Saturation of crystals is more problematic in 3D.
- Cardiac, respiratory and patient motion can degrade measurement accuracy .
- Different vendor software is used by different reading labs.
- Resting blood flow can be elevated due to pain, anxiety, lack of vagal tone, hypertension, etc. and can be normalized by using the rate pressure product (RPP) for calculation of myocardial perfusion reserve (MBF) the ratio of myocardial hyperemic flow/rest flow.

eviCore along with the American Society of Nuclear Medicine, the American College of Cardiology, and the Society of Nuclear Medicine and Metabolic Imaging agree that to minimize the above listed variables, AQMBF should only be approved when performed by **(all)**:

- Laboratories that are Intersocietal Accreditation Commission (IAC), American College of Radiology (ACR), or Joint Commission cardiac PET accredited.
- Interpreting physician(s) must be Board certified in Nuclear Cardiology (CBNC), Nuclear Medicine (ABNM), or Radiology (ABR) and have additional training in measuring AQMBF.
- Individual laboratories should have a standard protocol (same tracer, camera, software, stressor, model etc.) for use for all patients.
- Reports should contain rest myocardial blood flow (MBF) and stress MBF in ml/g/min, and myocardial blood flow reserve (MBFR) reported as the ratio of stress to rest MBF (with normal limits).
- Laboratories should have the ability to perform rate-pressure-product (RPP) correction of resting MBF when resting MBF is elevated due to elevated resting RPP and include mention of the true measured resting MBF and MBFR as well as the RPP-corrected resting MBF and RPP-corrected MBFR in the conclusions of the report.
- Health plans will be responsible for verifying requirements.

Evidence Discussion (CD-6.2 and CD-6.3)

Myocardial perfusion imaging (MPI) is used for the diagnosis of coronary artery disease (CAD). Results of MPI have a high level of sensitivity and specificity. Positron emission tomography (PET) is one imaging modality that allows the performance of MPI and also has the ability to measure absolute myocardial blood flow (AQMBF) (CPT 78434) in ml/g/min. This has been shown to add to the diagnosis of CAD and aid in treatment decisions.

As supported by the ACC/AHA Appropriate Use Criteria, the use of MPI with PET is indicated for patients with signs or symptoms that would be consistent with CAD such as typical angina or other typical or atypical symptoms in patients with known CAD or prior interventions such as coronary artery bypass surgery or coronary stenting. This balances the appropriate testing of patients with PET versus unnecessary and potentially harmful testing and downstream procedures.

References

CD.PET.0006.3.A

v1.0.2025

1. Bateman TM, Heller GV, Beanlands R, et al. Practical guide for interpreting and reporting cardiac PET measurements of myocardial blood flow: an Information Statement from the American Society of Nuclear Cardiology, and the Society of Nuclear Medicine and Molecular Imaging. *J Nucl Cardiol*. 2021;28(2):768-787. doi:10.1007/s12350-021-02552-7.
2. Murthy VL, Bateman TM, Beanlands RS, et al. Clinical Quantification of Myocardial Blood Flow Using PET: Joint Position Paper of the SNMMI Cardiovascular Council and the ASNC. *J Nucl Med*. 2018;59(2):273-293. doi:10.2967/jnumed.117.201368.
3. Patel KK, Spertus JA, Chan PS, et al. Myocardial blood flow reserve assessed by positron emission tomography myocardial perfusion imaging identifies patients with a survival benefit from early revascularization. *Eur Heart J*. 2020;41(6):759-768. doi:10.1093/eurheartj/ehz389.
4. Ngo V, Martineau P, Harel F, Pelletier-Galarneau M. Improving Detection of CAD and Prognosis with PET/CT Quantitative Absolute Myocardial Blood Flow Measurements. *Curr Cardiol Rep*. 2022 Dec;24(12):1855-1864. doi: 10.1007/s11886-022-01805-2. Epub 2022 Nov 8. PMID: 36348147.

Cardiac PET – Metabolic – Indications (CD-6.4)

CD.PET.0006.4.A

v1.0.2025

- Cardiac PET Metabolic and cardiac SPECT or PET perfusion (CPT® 78429 or CPT® 78459 and CPT® 78451, or CPT® 78432, or CPT® 78433)
 - To determine myocardial viability when a previous study has shown significant left ventricular dysfunction when under consideration for revascularization
- To diagnose strongly suspected cardiac sarcoid or monitor response to therapy for established cardiac sarcoid see **Cardiac Sarcoidosis (CD-3.9)**

FDG PET/CT for infections (CD-6.5)

CD.PET.0006.5.A

v1.0.2025

- FDG PET/CT (CPT® 78815 or CPT® 78429) is indicated in the assessment of suspected prosthetic heart valve endocarditis when there is documentation of **both** of the following:
 - TTE and/or TEE are equivocal or non-diagnostic
 - Suspicion for prosthetic heart valve endocarditis remains high (all):
 - C-reactive protein ≥ 40 mg/L
 - No evidence of prolonged antibiotic therapy
 - The implantation was ≥ 3 months ago and there is no evidence of surgical adhesives used during the valve implantation
- FDG PET/CT for LVAD driveline infection (CPT® 78815 or 78429)
 - Early infection detection for LVAD drivelines is desirable, since once the infection extends to the cannula and pump pocket, eradication becomes difficult. CT findings are nonspecific and metal device artifacts of the driveline itself affects sensitivity.
 - FDG PET/CT is indicated for suspected LVAD infection if other studies and examination remain inconclusive.

References (CD-6)

v1.0.2025

1. Einstein AJ, Moser KW, Thompson RC, et al. Radiation Dose to Patients from Cardiac Diagnostic Imaging. *Circulation*. 2007;116(11):1290-1305. doi:10.1161/circulationaha.107.688101.
2. Youssef G, Mylonas I, Leung E, et al. The Use of 18F-FDG PET in the Diagnosis of Cardiac Sarcoidosis: A Systematic Review and Metaanalysis Including the Ontario Experience. *Journal of Nuclear Medicine*. <http://jnm.snmjournals.org/content/53/2/241.long>. Published February 1, 2012.
3. Blankstein R, Osborne M, Naya M, et al. Cardiac Positron Emission Tomography Enhances Prognostic Assessments of Patients with Suspected Cardiac Sarcoidosis. *Journal of the American College of Cardiology*. 2014;63(4):329-336. doi:10.1016/j.jacc.2013.09.022.
4. Habib G, Lancellotti P, Antunes MJ, et al. 2015 ESC Guidelines for the management of infective endocarditis. *European Heart Journal*. 2015;36(44):3075-3128. doi:10.1093/eurheartj/ehv319.
5. Swart LE, Gomes A, Scholtens AM, et al. Improving the Diagnostic Performance of 18 F-Fluorodeoxyglucose Positron-Emission Tomography/Computed Tomography in Prosthetic Heart Valve Endocarditis. *Circulation*. 2018;138(14):1412-1427. doi:10.1161/circulationaha.118.035032.
6. Kim J, Feller ED, Chen W, Liang Y, Dilsizian V. FDG PET/CT for Early Detection and Localization of Left Ventricular Assist Device Infection. *JACC: Cardiovascular Imaging*. 2019;12(4):722-729. doi:10.1016/j.jcmg.2018.01.024.
7. Tam MC, Patel VN, Weinberg RL, et al. Diagnostic Accuracy of FDG PET/CT in Suspected LVAD Infections. *JACC: Cardiovascular Imaging*. 2020;13(5):1191-1202. doi:10.1016/j.jcmg.2019.04.024.
8. Harnett DT, Hazra S, Maze R, et al. Clinical performance of Rb-82 myocardial perfusion PET and Tc-99m-based SPECT in patients with extreme obesity. *J Nucl Cardiol*. 2017;26(1):275-283. doi:10.1007/s12350-017-0855-6.
9. Defining Adult Overweight and Obesity. Centers for Disease Control and Prevention. <https://www.cdc.gov/obesity/adult/defining.html>. Published March 3, 2021.
10. Gulati M, Levy PD, Mukherjee D, et al. 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines [published correction appears in *Circulation*. 2021 Nov 30;144(22):e455]. *Circulation*. 2021;144(22):e368-e454. doi:10.1161/CIR.0000000000001029

Diagnostic Heart Catheterization

Guideline	Page
LHC – Unstable/Active Coronary Artery Syndromes (CD-7.3.1).....	114
Diagnostic Heart Catheterization – Coding (CD-7.1) (CD-7.2).....	115
Diagnostic Left Heart Catheterization (LHC) (CD-7.3).....	118
Right Heart Catheterization and Right and Left Heart Catheterization without Coronary Angiography (CD-7.4).....	125
Combined Right and Left Heart Catheterization Indications (CD-7.5).....	127
Planned (Staged) Coronary Interventions (CD-7.6).....	128
Evaluation of Conditions other than Coronary Artery Disease (CD-7.7).....	130
References (CD-7).....	132

LHC – Unstable/Active Coronary Artery Syndromes (CD-7.3.1)

CD.DHC.0008.A

v1.0.2025

Diagnostic Left Heart Catheterization (LHC) is indicated for individuals in acute settings or with **active** unstable angina and should be handled as medical emergencies.

- LHC may be indicated for new onset, accelerating, or worsening ischemic symptoms suggestive of acute coronary syndrome (ACS) occurring at rest, or with minimal exertion resolving with rest, including:
 - Cardiac chest pain (typical angina) with or without new onset, evolving ischemic EKG changes
 - Symptoms consistent with the known angina pattern in an individual with a history of CABG or PCI
- Left and right heart cath may be indicated in place of a left heart cath if the above criteria has been met and there is documentation of any of the following:
 - The major component of the individual's symptoms is dyspnea
 - Newly diagnosed or worsening cardiomyopathy
 - For surgical planning prior to any of the following:
 - Heart valve surgery
 - Congenital heart defect repair
 - Lung transplant
 - Liver transplant

Diagnostic Heart Catheterization – Coding (CD-7.1) (CD-7.2)

CD.DHC.0007.1.A

v1.0.2025

Diagnostic Heart Catheterization – Code Sets (CD-7.1)

Cardiac Catheterization Procedure Codes

Cardiac Cath Procedure	CPT®
Congenital Heart Disease Code “Set”	93593-93597
Right heart catheterization for congenital heart defect(s) including imaging guidance by the proceduralist to advance the catheter to the target zone; normal native connections	93593
Right heart catheterization for congenital heart defect(s) including imaging guidance by the proceduralist to advance the catheter to the target zone; abnormal native connections	93594
Left heart catheterization for congenital heart defect(s) including imaging guidance by the proceduralist to advance the catheter to the target zone, normal or abnormal native connections	93595
Right and left heart catheterization for congenital heart defect(s) including imaging guidance by the proceduralist to advance the catheter to the target zone(s); normal native connections	93596
Right and left heart catheterization for congenital heart defect(s) including imaging guidance by the proceduralist to advance the catheter to the target zone(s); abnormal native connections	93597
Anomalous coronary arteries, patent foramen ovale, mitral valve prolapse, and bicuspid aortic valve	93451-93464, 93566-93568

Cardiac Cath Procedure	CPT®
RHC without LHC or coronaries	93451
LHC without RHC or coronaries	93452
RHC and retrograde LHC without coronaries	93453
Native coronary artery catheterization;	93454
with bypass grafts	93455
with RHC	93456
with RHC and bypass grafts	93457
with LHC	93458
with LHC and bypass grafts	93459
with RHC and LHC	93460
with RHC and LHC and bypass grafts	93461
LHC by trans-septal or apical puncture	+93462
Angiography of non-coronary arteries and veins performed as a distinct service	Select appropriate codes from the Radiology and Vascular Injection Procedures sections.

- CPT® 93593 to 93597 are indicated for invasive evaluation of congenital heart disease. See specific conditions in **Adult Congenital Heart Disease (CD-11)**

Diagnostic Heart Catheterization – Coding Notes (CD-7.2)

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

- Cardiac catheterization (CPT® 93452-CPT® 93461) (for all conditions other than congenital heart disease) includes contrast injections, imaging supervision, interpretation and report for imaging typically performed.
- Catheter placements in native coronaries or bypass grafts (CPT® 93454-CPT® 93461) include intraprocedural injections for bypass graft angiography, imaging supervision and interpretation.
- Injection codes CPT® 93563-CPT® 93565 should not be used in conjunction with CPT® 93452-CPT® 93461.
- Codes CPT® 93451-CPT® 93461 do not include contrast injections and imaging supervision, interpretation and report for imaging that is separately identified by the following specific procedure codes: CPT® 93566, CPT® 93567 and CPT® 93568.
- Separate diagnostic cardiac catheterization codes should only be assigned in conjunction with interventional procedures in the following circumstances:
 - No prior or recent diagnostic catheterization is available to guide therapy
 - Individual's condition has significantly changed since the last diagnostic cath
 - The treatment plan may be affected
 - Other vessels may be identified for treatment
 - Further establishment of a diagnosis from a non-invasive study is necessary

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

CD.DHC.0007.3.A

v1.0.2025

Stable Established CAD Post Revascularization with CABG or PCI (CD-7.3.2)

Note: These guidelines apply to individuals with stable conditions and who are not in the acute setting (acute coronary syndrome or unstable angina).

- Diagnostic Left Heart Catheterization (LHC) is indicated in individuals with established Coronary Artery Disease (CAD) post revascularization by percutaneous coronary intervention (PCI) or coronary artery bypass graft surgery (CABG) when there is documentation of **one** of the following:
 - New, recurrent, or worsening ischemic symptoms similar to prior ischemic episode.
 - New, recurrent, or worsening likely anginal symptoms as defined in **General Guidelines (CD-1.0)**
 - New, recurrent, or worsening symptoms of chest pain, or exertional dyspnea, or exertional fatigue AND intermediate or high-risk findings on non-invasive stress testing as documented by one of the following:
 - Cardiac chest pain induced by exercise treadmill testing or dobutamine stress testing
 - Exercise treadmill testing inducing any of the following:
 - At least 1 mm downsloping ST-depression
 - 2 mm horizontal ST-depression
 - At least 1 mm ST-elevation in two leads
 - Ventricular tachycardia of at least 3 consecutive beats
 - Myocardial perfusion imaging (SPECT or PET) with $\geq 5\%$ reversible ischemic burden
 - Stress echo with at least 2 segments of inducible ischemia
 - Severe stress induced left ventricular dysfunction (drop in left ventricular ejection fraction with stress $\geq 10\%$)
 - New left ventricular systolic dysfunction (left ventricular ejection fraction $< 50\%$)
 - Worsening left ventricular systolic dysfunction (decline in left ventricular ejection fraction $\geq 10\%$)
 - New or worsened congestive heart failure

- Ventricular fibrillation
- Sustained ventricular tachycardia
- Left and right heart cath may be indicated in place of a left heart cath if the above criteria has been met and there is documentation of **any** of the following:
 - The major component of the individual's symptoms is dyspnea
 - Newly diagnosed or worsening cardiomyopathy
 - For surgical planning prior to any of the following:
 - Heart valve surgery
 - Congenital heart defect repair
 - Lung transplant
 - Liver transplant

Stable Symptomatic Suspected or Established Coronary Artery Disease (CD-7.3.3)

For the purpose of this guideline, likely anginal symptoms is defined in **General Guidelines (CD-1.0)**

- Diagnostic left heart catheterization to screen for coronary artery disease (CAD) in asymptomatic individuals who are not anticipating other cardiac procedures is **not** indicated
- LHC with coronary arteriography (CPT® 93454, 93455, 93458, 93459) is indicated when there is documentation of one of the following:
 - New onset, persistent, or worsening of likely anginal symptoms and either:
 - Symptomatic failure of a 12 week trial of OMT including as tolerated all of the following:
 - Anti-platelet therapy
 - Statin and/or other lipid-lowering therapy
 - Anti-anginal therapy implemented to pursue a goal heart rate of 60 beats per minute or less
 - Anti-hypertensive therapy as may be indicated to pursue a goal systolic blood pressure (sbp) of less than 140 mmHg and a goal diastolic blood pressure (DBP) of less than 90 mmHg
 - Worsening of likely anginal symptoms during 12 week trial of OMT
 - New onset, persistent, or worsening of likely anginal symptoms and documentation of **both** of the following:
 - Established CAD per **General Guidelines (CD- 1.0)** or age ≥ 50 years and/or ≥ 2 CAD risk factors (diabetes mellitus, smoking, family history of premature CAD, hypertension, dyslipidemia), and

- Likely anginal symptoms at a low level of exercise or at rest despite optimal medical therapy
- LHC may be indicated irrespective of OMT for symptomatic individuals who also have high-risk findings on Coronary CT Angiography See **CCTA - Indications for CCTA (CD-4.3)**, to include any of the following:
 - Left main coronary artery stenosis $\geq 40\%$
 - Proximal or mid left anterior descending coronary artery stenosis $\geq 70\%$
 - Proximal or mid double-vessel coronary artery stenosis $\geq 60\%$
 - Proximal or mid triple-vessel coronary artery stenosis $\geq 50\%$
 - CT-FFR measured to be ≤ 0.8 in the proximal or mid segment of any coronary artery irrespective of degree of stenosis
- LHC may be indicated irrespective of OMT for symptomatic individuals who have BOTH likely anginal symptoms and high-risk findings on non-invasive stress testing including any of the following:
 - Cardiac chest pain induced by exercise treadmill testing or dobutamine stress testing
 - Myocardial perfusion imaging with $\geq 10\%$ reversible ischemic burden
 - Stress echo with at least 3 segments of inducible ischemia
 - Exercise treadmill testing inducing at least 2.5 mm downsloping ST-depression or 3 mm horizontal ST-depression in two leads
 - Ventricular tachycardia of at least 3 consecutive beats induced by an exercise treadmill test
- LHC may be indicated for any of the following if coronary artery disease is suspected:
 - New or worsened congestive heart failure
 - New left ventricular systolic dysfunction (left ventricular ejection fraction $< 50\%$)
 - Worsening left ventricular systolic dysfunction (decline in left ventricular ejection fraction $\geq 10\%$)
 - Ventricular fibrillation or sustained ventricular tachycardia
- Left and right heart cath may be indicated in place of a left heart cath if the above criteria has been met and there is documentation of any of the following:
 - The major component of the individual's symptoms is dyspnea
 - Newly diagnosed or worsening cardiomyopathy
 - For surgical planning prior to any of the following:
 - Heart valve surgery
 - Congenital heart defect repair
 - Lung transplant
 - Liver transplant

Background and Supporting Information

In addition to OMT, physician-guided behavioral modification therapy (BMT) is recommended including all of the following:

- Mediterranean diet
- Moderate intensity physical activity for at least thirty minutes per day at least five times per week as possible
- Attempts at smoking cessation to include at least one of the following:
 - Cognitive behavioral therapy
 - Nicotine withdrawal replacement therapy

Exclusion of Significant Coronary Artery Disease Involvement in other Cardiac Pathology (CD-7.3.4)

- LHC is indicated when the etiology is unclear for **any** of the following if coronary artery disease is suspected:
 - New or worsened congestive heart failure
 - New left ventricular systolic dysfunction (left ventricular ejection fraction <50%)
 - Worsening left ventricular systolic dysfunction (decline in left ventricular ejection fraction $\geq 10\%$)
 - Ventricular fibrillation or sustained ventricular tachycardia
 - Unheralded syncope (not near syncope)
 - Suspected myocarditis
- Left and right heart cath may be indicated in place of a left heart cath if the above criteria has been met and there is documentation of any of the following:
 - The major component of the individual's symptoms is dyspnea
 - Newly diagnosed or worsening cardiomyopathy
 - For surgical planning prior to any of the following:
 - Heart valve surgery
 - Congenital heart defect repair
 - Lung transplant
 - Liver transplant

Evaluation of structural heart disease (CD-7.3.5)

Left heart catheterization with coronary arteriography (CPT[®] 93458 or CPT[®] 93454) is indicated for any of the following

- Evaluation prior to planned invasive procedure or surgery

- Ruling out coronary artery disease prior to planned non-coronary cardiac or great vessel surgery including any of the following:
 - Cardiac valve surgery
 - Surgical myectomy for hypertrophic cardiomyopathy
 - Aortic dissection
 - Aortic aneurysm
 - Congenital disease repair such as atrial septal defect
- Pre-organ transplant (non-cardiac) - in place of stress imaging for initial pre-transplant evaluation (per the transplant center's protocol) **or** if stress imaging is positive for ischemia. Repeat periodic screening while on a transplant waiting list (in the absence of other clinical indications) is not supported. See **Kidney Transplant, Pre-Transplant Imaging Studies (AB-42.5)**.
- Prior to catheter ablation of ventricular arrhythmia at one of the following sites:
 - Sinus of Valsalva
 - Coronary venous system
 - Epicardium
- Valvular heart disease when either:
 - There is a discrepancy between the clinical findings (history, physical exam, and non-invasive test results)
 - Valvular surgery is being considered.
- Suspected pericardial disease.
- Previous cardiac transplant:
 - Per transplant center protocol
 - To assess for accelerated coronary artery disease associated with cardiac transplantation.
- Left and right heart cath may be indicated in place of a left heart cath if the above criteria has been met and there is documentation of any of the following:
 - The major component of the individual's symptoms is dyspnea
 - Newly diagnosed or worsening cardiomyopathy
 - For surgical planning prior to any of the following:
 - Heart valve surgery
 - Congenital heart defect repair
 - Lung transplant
 - Liver transplant

Evidence Discussion (CD-7.3.2 - CD-7.3.5)

Medical specialty organization guidelines recommend guideline directed medical therapy as the cornerstone of management of chronic coronary artery disease. These recommendations are based on a large body of evidence; including multiple large

randomized controlled clinical trials (COURAGE, ISCHEMIA, and BARI-2D), and meta-analyses that demonstrate a significant improvement in angina symptoms, and cardiac events with guideline directed medical therapy. These trials further demonstrate that there is no improvement in survival or cardiac events with routine revascularization compared to guideline directed medical therapy.

Management options for coronary artery disease should account for the risks of invasive coronary angiography weighed against the benefits. Invasive coronary angiography is associated with cardiac (e.g. coronary artery injury and myocardial infarction) and extra-cardiac (e.g. vascular access site bleeding, ischemic stroke, and contrast-mediated acute kidney injury) risks. Invasive coronary angiography should be utilized as the treatment option when there is a favorable benefit-to-risk assessment.

Based on medical specialty organization guidelines and Appropriate Use Criteria⁴, indications for invasive coronary angiography include the following:

- Angina despite guideline directed medical therapy
- Angina with high-risk findings on stress testing
- New left ventricular systolic dysfunction or heart failure of suspected ischemic etiology
- Known coronary artery disease with prior revascularization with recurrent angina
- Prior to non-coronary cardiac surgery, major vascular surgery, or organ transplant

Angiography-Derived Fractional Flow Reserve (CD-7.3.6)

Coding

Description	HCPCS
Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural injection(s) for coronary angiography, imaging supervision and interpretation with left heart catheterization including intraprocedural injection(s) for left ventriculography, when performed and intraprocedural coronary fractional flow reserve (FFR) with 3d functional mapping of color-coded FFR values for the coronary tree, derived from coronary angiogram data, for real-time review and interpretation of possible atherosclerotic stenosis(es) intervention	C7557

Criteria

Angiography-Derived Fractional Flow Reserve based on three-dimensional reconstruction of angiographic images is considered to be experimental, investigational, or unproven.

Background and Supporting Information

Fractional flow reserve (FFR) is an index of the physiological significance of a coronary artery stenosis. It is derived by using a coronary artery pressure guidewire to measure the distal coronary artery pressure. Angiography-Derived Fractional Flow Reserve is an alternative approach to derive FFR without the use of a coronary artery pressure guidewire, based on three-dimensional reconstruction of angiographic images.

Mathematical modeling based on hemodynamic laws is then applied to the three-dimensional reconstruction to derive the pressure dynamics along the coronary artery, with results displayed in a color-coded map. Further research is needed to evaluate the accuracy and applicability of Angiography-Derived Fractional Flow Reserve.

Right Heart Catheterization and Right and Left Heart Catheterization without Coronary Angiography (CD-7.4)

CD.DHC.0007.4.A

v1.0.2025

- Diagnostic right heart catheterization (CPT® 93451) OR Diagnostic right and left heart catheterization without coronary angiography (CPT® 93453) is indicated when results will impact the diagnosis and management of **any** of the following:
 - Atrial septal defect (ASD) including shunt detection and quantification
 - Ventricular septal defect (VSD) including shunt detection and quantification
 - Patent foramen ovale (PFO)
 - Anomalous pulmonary venous return
 - Congenital defects including persistent left vena cava
 - Pulmonary hypertension
 - Pericardial diseases (constrictive or restrictive pericarditis)
 - Valvular disease
 - Right heart failure
 - Left heart failure
 - Newly diagnosed or worsening cardiomyopathy
 - Preoperative evaluation for valve surgery
 - During a left heart cath where the etiology of the symptoms remains unclear
 - Pre-lung transplant to assess pulmonary pressures
 - Uncertain intravascular volume status with an unclear etiology
 - Prior to LVAD implant and post LVAD implant as needed for hemodynamic assessment to guide changes to therapy
 - Assessment post-cardiac transplant
 - For routine endomyocardial biopsy
 - Assess for rejection
 - Assess pulmonary artery pressure
 - Can be done per the institution protocol or anytime organ rejection is suspected and biopsy is needed for assessment
 - Evaluation of right ventricular morphology.
 - Suspected arrhythmogenic right ventricular dysplasia.

Background and Supporting Information

General information RHC (CPT® 93451)

- It is performed most commonly from the femoral vein, less often through the subclavian, brachial, or internal jugular vein and inter-atrial septal puncture approach.
- It includes a full oximetry for detection and quantification of shunts.
- Cardiac outputs are calculated by several techniques including the Fick thermodilution

Combined Right and Left Heart Catheterization Indications (CD-7.5)

CD.DHC.0007.5.A

v1.0.2025

Combined Right and Left Heart Catheterization (CPT® 93460 or CPT® 93461) is indicated for the following:

- Preoperative evaluation for valve surgery
- The indications for **Diagnostic Left Heart Catheterization (LHC) (CD-7.3)** are met and **any** of the following are present:
 - The major component of the individual's symptoms is dyspnea
 - The indications are met according to **Right Heart Catheterization (RHC) (CD-7.4)**
 - Newly diagnosed or worsening cardiomyopathy
- See **Right Heart Catheterization and Right and Left Heart Catheterization without Coronary Angiography (CD- 7.4)** for CPT® 93453

Evidence Discussion (CD-7.4 and CD-7.5)

Diagnostic right heart catheterization or right and left heart catheterization is performed for functional hemodynamic evaluation and may be combined with cardiac angiography for structural cardiac imaging and coronary angiography for anatomical evaluation of the coronary arteries. Diagnostic right heart catheterization or right and left heart catheterization is indicated in selected situations to obtain specific clinical information required for management decisions if it was not provided by non-invasive evaluation. This may be indicated in selected situations for management of valvular heart disease, myocardial disease, pericardial disease, congenital heart disease, pulmonary hypertension, heart failure, and post-cardiac transplantation. These indications are addressed in established evidence-based medical specialty organization guidelines pertaining to these conditions. If the clinical information required for management decisions was already provided by non-invasive evaluation, diagnostic heart catheterization does not add to management and moreover carries cardiac and extra-cardiac risks including coronary artery injury, myocardial infarction, vascular access site bleeding, ischemic stroke, and contrast-mediated acute kidney injury.

Planned (Staged) Coronary Interventions (CD-7.6)

CD.DHC.0007.6.A

v1.0.2025

- Planned (Staged) Coronary Interventions applies to individuals with clinically stable symptoms if there is documentation of a recent diagnostic catheterization finding of a significant lesion that was not intervened as part of the initial procedure and the documentation explicitly states that a subsequent procedure will be performed for planned/staged PCI of that lesion.
- The CPT® codes for percutaneous coronary interventions (PCI) include the following imaging services necessary for the procedure(s):
 - Contrast injection, angiography, 'road-mapping', and fluoroscopic guidance
 - Vessel measurement
 - Angiography following coronary angioplasty, stent placement, and atherectomy
- Separate codes for these services should not be assigned in addition to the PCI code/s because the services are already included.
- A repeat diagnostic left heart catheterization is not medically necessary when the individual is undergoing a planned staged percutaneous coronary intervention.

Planned coronary artery lesion assessment

A repeat complete diagnostic left heart catheterization is not medically necessary for the purpose of coronary artery lesion assessment using any of the following:

- Intravascular ultrasound (IVUS)
- Optical coherence tomography (OCT)
- Fractional flow reserve (FFR)
- Instantaneous wave-free ratio (iFR)

Evidence Discussion

Diagnostic cardiac catheterization with coronary angiography is performed prior to an interventional percutaneous coronary intervention (PCI) procedure. PCI may be performed on the same day as the diagnostic coronary angiogram (ad-hoc PCI) or on a later day (planned staged PCI). Diagnostic coronary angiogram is required only once prior to the interventional procedure. A repeat diagnostic coronary angiogram is not medically necessary prior to a planned staged percutaneous coronary intervention. A repeat diagnostic coronary angiogram does not add to the findings of the initial diagnostic coronary angiogram and moreover carries cardiac and extra-cardiac risks

including coronary artery injury and myocardial infarction, vascular access site bleeding, ischemic stroke, and contrast-mediated acute kidney injury.

Evaluation of Conditions other than Coronary Artery Disease (CD-7.7)

CD.DHC.0077.A

v1.0.2025

- Right and left heart catheterization (CPT® 93453) is indicated for any of the following:
 - Preoperative assessment prior to planned valvular surgery
 - Evaluation of pulmonary hypertension out of proportion to or unexplained by the severity of valvular disease documented by other non-invasive imaging modalities (i.e., echo, CMR)
 - Left ventricular dysfunction out of proportion to the severity of valvular disease documented by other non-invasive imaging modalities
 - Suspected pericardial tamponade as documented by clinical findings or other non-invasive imaging modalities
 - Suspected, or clinical uncertainty, between constrictive pericarditis vs. restrictive cardiomyopathy physiology when there are questions left unanswered by other cardiac non-invasive imaging modalities
 - Known or suspected cardiomyopathy with or without heart failure documented by prior advanced imaging
 - Re-evaluation of known cardiomyopathy for any of the following:
 - Change in clinical status
 - Change in cardiac exam
 - When required to guide therapy
 - Hypertrophic Cardiomyopathy
 - Subvalvular aortic stenosis
- Right and left heart catheterization (CPT® 93453) is indicated when there is uncertainty between clinical impression and other non-invasive imaging modalities to evaluate the following valvular diseases:
 - Mitral stenosis
 - Mitral regurgitation
 - Aortic stenosis
 - Aortic regurgitation
- Left heart catheterization (CPT® 93452) for hemodynamic evaluation of the left ventricle and aorta is indicated to evaluate aortic stenosis when there is uncertainty between the clinical impression and non-invasive imaging modality findings.

Evidence Discussion

Diagnostic right heart catheterization or right and left heart catheterization is performed for functional hemodynamic evaluation and may be combined with cardiac angiography for structural cardiac imaging and coronary angiography for anatomical evaluation of the coronary arteries. Diagnostic right heart catheterization or right and left heart catheterization is indicated in selected situations to obtain specific clinical information required for management decisions if it was not provided by non-invasive evaluation. This may be indicated in selected situations for management of valvular heart disease, myocardial disease, pericardial disease, congenital heart disease, pulmonary hypertension, heart failure, and post-cardiac transplantation. These indications are addressed in established evidence-based medical specialty organization guidelines pertaining to these conditions. If the clinical information required for management decisions was already provided by non-invasive evaluation, diagnostic heart catheterization does not add to management and moreover carries cardiac and extra-cardiac risks including coronary artery injury, myocardial infarction, vascular access site bleeding, ischemic stroke, and contrast-mediated acute kidney injury.

References (CD-7)

v1.0.2025

1. Amsterdam EA, Wenger NK, Brindis RG, et al. 2014 AHA/ACC Guideline for the Management of Patients with Non-ST-Elevation Acute Coronary Syndromes: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;130(25):2354-2394. doi:10.1161/cir.000000000000133.
2. Levine GN, Bates ER, Bittl JA, et al. 2016 ACC/AHA Guideline Focused Update on Duration of Dual Antiplatelet Therapy in Patients With Coronary Artery Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines: An Update of the 2011 ACCF/AHA/SCAI Guideline for Percutaneous Coronary Intervention, 2011 ACCF/AHA Guideline for Coronary Artery Bypass Graft Surgery, 2012 ACC/AHA/ACP/AATS/PCNA/SCAI/STS Guideline for the Diagnosis and Management of Patients with Stable Ischemic Heart Disease, 2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction, 2014 AHA/ACC Guideline for the Management of Patients With Non-ST-Elevation Acute Coronary Syndromes, and 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery. *Circulation*. 2016;134(10). doi:10.1161/cir.0000000000000404.
3. Fihn SD, Gardin JM, Abrams J, et al. 2012 ACCF/AHA/ACP/AATS/PCNA/SCAI/STS Guideline for the Diagnosis and Management of Patients with Stable Ischemic Heart Disease. *J Am Coll Cardiol*. 2012;60(24). doi:10.1016/j.jacc.2012.07.013.
4. Fihn SD, Blankenship JC, Alexander KP, et al. 2014 ACC/AHA/AATS/PCNA/SCAI/STS Focused Update of the Guideline for the Diagnosis and Management of Patients with Stable Ischemic Heart Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines, and the American Association for Thoracic Surgery, Preventive Cardiovascular Nurses Association, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. *Circulation*. 2014;130(19):1749-1767. doi:10.1161/cir.0000000000000095.
5. Boden WE, O'Rourke RA, Teo KK, et al. Impact of Optimal Medical Therapy With or Without Percutaneous Coronary Intervention on Long-Term Cardiovascular End Points in Patients With Stable Coronary Artery Disease (from the COURAGE Trial). *Am J Cardiol*. 2009;104(1):1-4. doi:10.1016/j.amjcard.2009.02.059.
6. Whelton PK, Carey RM, Aronow WS, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol* 2018;71:e127-248. doi:10.1016/j.jacc.2017.11.00.
7. Maron DJ, Hochman JS, Reynolds HR, et al. Initial Invasive or Conservative Strategy for Stable Coronary Disease. *N Engl J Med*. 2020;382(15):1395-1407. doi:10.1056/nejmoa1915922.
8. Neumann FJ, Sousa-Uva M, Ahlsson A, et al. 2018 ESC/EACTS Guidelines on myocardial revascularization. *European Heart Journal*. 2018;40(2):87-165. doi:10.1093/eurheartj/ehy394.
9. Gulati M, Levy PD, Mukherjee D, et al. 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines [published correction appears in *Circulation*. 2021 Nov 30;144(22):e455]. *Circulation*. 2021;144(22):e368-e454. doi:10.1161/CIR.0000000000001029.
10. Patel MR, Bailey SR, Bonow RO, et al. ACCF/SCAI/AATS/AHA/ASE/ASNC/HFSA/HRS/SCCM/SCCT/SCMR/STS 2012 appropriate use criteria for diagnostic catheterization: American College of Cardiology Foundation Appropriate Use Criteria Task Force Society for Cardiovascular Angiography and Interventions American Association for Thoracic Surgery American Heart Association, American Society of Echocardiography American Society of Nuclear Cardiology Heart Failure Society of America Heart Rhythm Society, Society of Critical Care Medicine Society of Cardiovascular Computed Tomography Society for Cardiovascular Magnetic Resonance Society of Thoracic Surgeons. *Catheter Cardiovasc Interv*. 2012;80(3):E50-E81. doi:10.1002/ccd.24467.
11. Nishimura RA, Carabello BA. Hemodynamics in the cardiac catheterization laboratory of the 21st century. *Circulation*. 2012;125(17):2138-2150. doi:10.1161/CIRCULATIONAHA.111.060319.
12. Patel MR, Calhoun JH, Dehmer GJ, et al. ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2017 Appropriate Use Criteria for Coronary Revascularization in Patients With Stable Ischemic Heart Disease: A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic

- Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society of Thoracic Surgeons [published correction appears in *J Am Coll Cardiol*. 2018 Apr 13;:]. *J Am Coll Cardiol*. 2017;69(17):2212-2241. doi:10.1016/j.jacc.2017.02.001.
13. Kidney Disease: Improving Global Outcomes (KDIGO) Kidney Transplant Candidate Work Group. KDIGO Clinical Practice Guideline on the Evaluation and Management of Candidates for Kidney Transplantation. *Transplantation*. 2020;104: S1 – S103.
 14. Spitzer E, McFadden E, Vranckx P, et al. Defining Staged Procedures for Percutaneous Coronary Intervention Trials. *J Am Coll Cardiol Interv*. 2018 May, 11 (9) 823–832. <https://doi.org/10.1016/j.jcin.2018.03.044>.
 15. Multimodality Writing Group for Chronic Coronary Disease, Winchester DE, Maron DJ, et al. ACC/AHA/ASE/ASNC/ASPC/HFSA/HRS/SCAI/SCCT/SCMR/STS 2023 Multimodality Appropriate Use Criteria for the Detection and Risk Assessment of Chronic Coronary Disease. *J Am Coll Cardiol*. 2023;81(25):2445-2467. doi:10.1016/j.jacc.2023.03.410.
 16. D'Avila A, Gutierrez P, Scanavacca M, et al. Effects of radiofrequency pulses delivered in the vicinity of the coronary arteries: implications for nonsurgical transthoracic epicardial catheter ablation to treat ventricular tachycardia. *Pacing Clin Electrophysiol* 2002;25:1488–1495.
 17. Cronin EM, Bogun FM, Maury P, et al. 2019 HRS/EHRA/APHRs/LAHRs expert consensus statement on catheter ablation of ventricular arrhythmias. *Heart Rhythm*. 2020 Jan;17(1):e2-e154.
 18. Yamada T, McElderry HT, Doppalapudi H, et al. Idiopathic ventricular arrhythmias originating from the aortic root prevalence, electrocardiographic and electrophysiologic characteristics, and results of radiofrequency catheter ablation. *J Am Coll Cardiol* 2008; 52:139–147.
 19. Baman TS, Ilg KJ, Gupta SK, et al. Mapping and ablation of epicardial idiopathic ventricular arrhythmias from within the coronary venous system. *Circ Arrhythm Electrophysiol* 2010;3:274–279.
 20. Cheng XS, VanWagner LB, Costa SP, et al. Emerging Evidence on Coronary Heart Disease Screening in Kidney and Liver Transplantation Candidates: A Scientific Statement From the American Heart Association: Endorsed by the American Society of Transplantation. *Circulation*. 2022;146(21):e299-e324. doi:10.1161/CIR.0000000000001104.
 21. VanWagner LB, Harinstein ME, Runo JR, et al. Multidisciplinary approach to cardiac and pulmonary vascular disease risk assessment in liver transplantation: An evaluation of the evidence and consensus recommendations. *Am J Transplant*. 2018;18(1):30-42. doi:10.1111/ajt.14531.
 22. Patel MR, Calhoun JH, Dehmer GJ, et al. ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2017 Appropriate Use Criteria for Coronary Revascularization in Patients With Stable Ischemic Heart Disease: A Report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society of Thoracic Surgeons [published correction appears in *J Am Coll Cardiol*. 2018 Apr 13;:]. *J Am Coll Cardiol*. 2017;69(17):2212-2241. doi:10.1016/j.jacc.2017.02.001.
 23. Humbert M, Kovacs G, Hoeper M, et al. 2022 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension: Developed by the task force for the diagnosis and treatment of pulmonary hypertension of the European Society of Cardiology (ESC) and the European Respiratory Society (ERS). Endorsed by the International Society for Heart and Lung Transplantation (ISHLT) and the European Reference Network on rare respiratory diseases (ERN-LUNG). *Eur Heart J* 2022;43(38):3618–3731. doi.org/10.1093/eurheartj/ehac237.
 24. Morris PD, Curzen N, Gunn JP. Angiography-Derived Fractional Flow Reserve: More or Less Physiology? *J Am Heart Assoc*. 2020 Mar 17;9(6):e015586. doi: 10.1161/JAHA.119.015586.
 25. Witberg G et al. Clinical Outcomes of FFRangio-Guided Treatment for Coronary Artery Disease. *JACC Cardiovasc Interv*. 2022 Feb 28;15(4):468-470. doi: 10.1016/j.jcin.2021.11.039.
 26. Arefinia F et al. Non-invasive fractional flow reserve estimation using deep learning on intermediate left anterior descending coronary artery lesion angiography images. *Sci Rep*. 2024 Jan 20;14(1):1818. doi: 10.1038/s41598-024-52360-5.
 27. Advancing Cath Lab Results With FFRangio Coronary Physiology Assessment (ALL-RISE) ClinicalTrials.gov Identifier: NCT05893498. Study Start: 2023-06-21. Primary Completion (Estimated): 2024-12. ClinicalTrials.gov.

28. Ommen SR, Ho CY, Asif IM, et al. 2024 AHA/ACC/AMSSM/HRS/PACES/SCMR Guideline for the Management of Hypertrophic Cardiomyopathy: A Report of the American Heart Association/American College of Cardiology Joint Committee on Clinical Practice Guidelines. *Circulation*. 2024 May 8. doi: 10.1161/CIR.0000000000001250.

Adult Congenital Heart Disease

Guideline	Page
Congenital heart disease – General Information (CD-11.1).....	136
ASD-Atrial septal defects (CD-11.2.1).....	144
Anomalous Pulmonary Venous Connections (CD-11.2.2).....	146
Ventricular Septal Defect (VSD) (CD-11.2.3).....	147
Atrioventricular Septal Defect (AV Canal, AVSD, endocardial cushion defect) (CD-11.2.4).....	148
Patent Ductus Arteriosus (PDA) (CD-11.2.5).....	149
Cor Triatriatum (CD-11.2.6).....	150
Congenital Mitral Stenosis (CD-11.2.7).....	151
Subaortic Stenosis (SAS) (CD-11.2.8).....	152
Congenital Valvular Aortic Stenosis (CD-11.2.9).....	153
Aortic disease in Turner Syndrome (CD-11.2.10)	155
Supravalvular Aortic Stenosis (CD-11.3.1).....	156
Coarctation of the Aorta (CD-11.3.2).....	157
Valvular Pulmonary Stenosis (CD-11.3.3).....	159
Branch and Peripheral pulmonary stenosis (CD-11.3.4).....	161
Double chambered RV (CD-11.3.5).....	163
Ebstein Anomaly (CD-11.3.6).....	164
Tetralogy of Fallot (TOF, VSD with PS) (CD-11.3.7).....	165
Right Ventricle-to-Pulmonary Artery Conduit (CD-11.3.8).....	167
Transposition of the great arteries (TGA) (CD-11.3.9).....	168
Congenitally corrected TGA (CD-11.3.10).....	169
Fontan Palliation of Single Ventricle Physiology (CD-11.3.11).....	170
Severe Pulmonary Artery Hypertension (PH) and Eisenmenger Syndrome (CD-11.3.12).....	171
Coronary artery anomalies (CD-11.3.13).....	172
References (CD-11).....	173

Congenital heart disease – General Information (CD-11.1)

CD.CHD.0011.1.A

v1.0.2025

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

Definitions (CD-11.1.1)

Physiological stages (A, B, C, D)

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

Characteristics	Physiological stage			
	A	B	C	D
NYHA functional class	I	II	III	IV
Hemodynamic or anatomic sequelae	None	Mild ventricular enlargement of dysfunction, small shunt	Moderate or greater, ventricular dysfunction. Any venous or arterial stenosis	Moderate or greater, ventricular dysfunction. Any venous or arterial stenosis
Valvular	None	Mild	Moderate or greater	
Aortic enlargement	None	Mild	Moderate	Severe

Characteristics	Physiological stage			
	A	B	C	D
Exercise capacity limitation	Normal	Abnormal objective cardiac limitation	Moderate	Severe
Renal hepatic pulmonary dysfunction	None		Mild but responsive to medication	Refractory to treatment
Cyanosis/hypoxemia	None		Mild	Severe
Arrhythmias	None	Arrhythmia not requiring treatment	Needs rx	Refractory to rx
Pulmonary hypertension	None		Mild to moderate	Severe or Eisenmenger

- CHD Anatomic classification
 - Class I-Simple
 - Native disease
 - Isolated small ASD
 - Isolated small VSD
 - Mild isolated pulmonic stenosis
 - Repaired conditions
 - Previously ligated or occluded ductus arteriosus
 - Repaired secundum ASD or sinus venosus defect without significant residual shunt or chamber enlargement
 - Repaired VSD without significant residual shunt or chamber enlargement
 - Class II-Moderate Complexity
 - Repaired or unrepaired conditions
 - Aorto-left ventricular fistula
 - Anomalous pulmonary venous connection, partial or total
 - Anomalous coronary artery arising from the pulmonary artery
 - Anomalous aortic origin of a coronary artery from the opposite sinus

- AVSD (partial or complete, including primum ASD)
- Congenital aortic valve disease
- Congenital mitral valve disease
- Coarctation of the aorta
- Ebstein anomaly (disease spectrum includes mild, moderate, and severe variations)
- Infundibular right ventricular outflow obstruction
- Ostium primum ASD
- Moderate and large unrepaired secundum ASD
- Moderate and large persistently patent ductus arteriosus
- Pulmonary valve regurgitation (moderate or greater)
- Pulmonary valve stenosis (moderate or greater)
- Peripheral pulmonary stenosis
- Sinus of Valsalva fistula/aneurysm
- Sinus venosus defect
- Subvalvular aortic stenosis (excluding HCM; HCM not addressed in these guidelines)
- Supravalvular aortic stenosis
- Straddling atrioventricular valve
- Repaired tetralogy of Fallot
- VSD with associated abnormality and/or moderate or greater shunt
- Class III- Great Complexity (or Complex)
 - Cyanotic congenital heart defect (unrepaired or palliated, all forms)
 - Double-outlet ventricle
 - Fontan procedure
 - Interrupted aortic arch
 - Mitral atresia
 - Single ventricle (including double inlet left ventricle, tricuspid atresia, hypoplastic left heart, any other anatomic abnormality with a functionally single ventricle)
 - Pulmonary atresia (all forms)
 - TGA (classic or d-TGA; CCTGA or I-TGA)
 - Truncus arteriosus
 - Other abnormalities of atrioventricular and ventriculoarterial connection (i.e., crisscross heart, isomerism, heterotaxy syndromes, ventricular inversion)

Modalities (CD-11.1.2)

- Echocardiogram- transthoracic (TTE) or transesophageal (TEE)

- Transthoracic echocardiography (TTE) is an indispensable tool in the initial and serial follow-up evaluation to identify abnormalities and changes that commonly influence management decisions.
- Cardiac MRI (CMR)
 - CMR plays a valuable role in assessment of RV size and function, because it provides data that are reproducible and more reliable than data obtained with alternative imaging techniques
 - For intracardiac congenital heart disease, CMR will typically include flow velocity mapping for shunts and flow assessment.
 - Imaging that only requires aortic arch imaging, does not require intracardiac CMR, only MRA Chest.
- Cardiac Computed Tomography (CCT) and Cardiac Computed Tomography Angiography (CCTA)
 - The most important disadvantage of CCT (including CT angiography) as an imaging technique is the associated exposure to ionizing radiation.
- Cardiac catheterization
 - (hemodynamic and/or angiographic) in individuals with adult CHD AP classification II and III, or interventional cardiac catheterization in individuals with adult CHD AP classification I to III should be performed by, or in collaboration with, cardiologists with expertise in adult CHD
- Exercise Testing
 - Exercise test does not imply stress imaging
- Stress Imaging
 - Includes-MPI, stress echo, stress MRI
 - PET stress may be included as per **Cardiac PET (CD-6)**
- Circumstances where CMR, CCT, TEE, and/or Cardiac Catheterization may be Superior to TTE
 - Assessment of RV size and function in repaired Tetralogy of Fallot (TOF), systemic right ventricles, and other conditions associated with right ventricular (RV) volume and pressure overload
 - Identification of anomalous pulmonary venous connections
 - Serial assessment of thoracic aortic aneurysms, especially when the dilation might extend beyond the echocardiographic windows
 - Accurate assessment of pulmonary artery (PA) pressure and pulmonary vascular resistance
 - Assessment for re-coarctation of the aorta
 - Sinus venosus defects
 - Vascular rings
 - Evaluation of coronary anomalies
 - Quantification of valvular regurgitation

Coding (CD-11.1.3)

Modality	
Echocardiogram	
Transthoracic echocardiogram (TTE)	CPT®
TTE for congenital cardiac anomalies; complete	93303
TTE for congenital cardiac anomalies; limited study	93304
TTE (2D) m-mode recording, complete, with spectral and color flow doppler echocardiography	93306
TTE (2D) with or without m-mode recording; complete	93307
TTE (2D) with or without m-mode recording; limited study	93308
Transesophageal echocardiogram (TEE)	
TEE (2D) including probe placement, imaging, interpretation, and report	93312
TEE for congenital cardiac anomalies; including probe placement, imaging, interpretation, and report	93315
MRI	
cardiac (CMR)	CPT®
Cardiac MRI for morphology and function without contrast	75557
Cardiac MRI for morphology and function without and with contrast	75561
MRI Chest	
MRI Chest without contrast	71550
MRI Chest with contrast	71551

Modality	
MRI Chest with & without contrast	71552
MRI Angiography (MRA) MRA Chest	
MRA Chest (excluding myocardium) with or without contrast	71555
CT	
Cardiac (CCT)	CPT®
CT, Heart, with contrast material, for evaluation of cardiac structure and morphology	75572
CT, Heart, with contrast material, for evaluation of cardiac structure and morphology in the setting of congenital heart disease	75573
CT Angiography-cardiac (CCTA)	CPT®
CTA Heart, coronary arteries and bypass grafts (when present), with contrast, including 3D image post-processing	75574
CT-Chest	CPT®
CT Thorax without contrast	71250
CT Thorax with contrast	71260
CT Thorax without & with contrast	71270
CT Angiography-Chest (CTA Chest)	CPT®
CTA Chest without and with contrast	71275
Stress Imaging (echo, MRI, MPI)	
Stress echo	CPT®

Modality	
Echocardiography (TTE), (2D), with or without m-mode, during rest and cardiovascular stress, with interpretation and report	93350
Echocardiography (TTE), (2D), m-mode, during rest and cardiovascular stress test using treadmill, bicycle exercise and/or pharmacologically induced stress, with interpretation	93351
Stress MRI	CPT®
Cardiac MRI for morphology and function without contrast, with stress imaging	75559
Cardiac MRI for morphology and function without and with contrast, with stress imaging	75563
Myocardial perfusion imaging (MPI)	CPT®
MPI, tomographic (SPECT) including attenuation correction, qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); single study, at rest or stress (exercise or pharmacologic)	78451
MPI, tomographic (SPECT) (including attenuation correction, qualitative or quantitative wall motion, ejection fraction by first pass or gated technique, additional quantification, when performed); multiple studies, at rest and/or stress (exercise or pharmacologic) and/or redistribution and/or rest reinjection	78452
Pulmonary perfusion imaging	CPT®
Pulmonary perfusion imaging (e.g., particulate)	78580
Pulmonary ventilation (e.g., aerosol or gas) and perfusion imaging	78582
Quantitative differential pulmonary perfusion, including imaging when performed	78597

Modality	
Quantitative differential pulmonary perfusion and ventilation (e.g., aerosol or gas), including imaging when performed	78598

Congenital Heart Disease Imaging Indications

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

Aortopathies with CHD

- Dilated aortic arches are not uncommon with several congenital heart diseases and postoperative procedures including- Aortic stenosis, Ross repair, Tetralogy of Fallot, Transposition of the great arteries (TGA), Pulmonary atresia, hypoplastic left heart syndrome (HLHS), Truncus Arteriosis, single ventricle.

ASD-Atrial septal defects (CD-11.2.1)

CD.CHD.0011.2.1.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE
 - CMR, CCT (CPT® 75573), and/or TEE are indicated when TTE is suboptimal and either:
 - ASD is suspected
 - To evaluate pulmonary venous connections in known ASD
 - MRA Chest or CTA Chest are when TTE shows pulmonary venous anomalies
 - If normal, repeat pulmonary vein imaging is not required
- Diagnostic cath is indicated when there is either:
 - Evidence of pulmonary hypertension
 - Unanswered questions on CMR/CCT for venous drainage
- Stress imaging and coronary artery imaging is based on **Stress Testing with Imaging – Indications (CD-1.4)**

Consideration of surgery

- Transesophageal echocardiogram (TEE) is recommended to guide percutaneous ASD closure

Post-procedure imaging

- TTE is indicated post ASD device placement:
 - 1 week (if Amplatzer)
 - 1 month
 - 6 months (evaluate for erosion)
 - 12 months
 - then every 1-2 years
- Due to low-risk of erosion in PFO devices- PFO device closure requires follow-up at 6-12 months. No additional evaluation unless PFO not closed see **Frequency of Echocardiography Testing (CD-2.3) PFO closure, TIPS, Cardiac device therapy, LVAD**

Surveillance imaging ASD -surgically closed or without surgical interventions

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
TTE	36	24	12	12

Anomalous Pulmonary Venous Connections (CD-11.2.2)

CD.CHD.0011.2.2.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

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

Consideration of surgery

- Echo, CMR, CT, per cardiology request
- Diagnostic heart catheterization if unanswered questions on other imaging is needed for surgical management

Surveillance imaging anomalous pulmonary venous connections

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
Echo (TTE)	36	24	12	12

Ventricular Septal Defect (VSD) (CD-11.2.3)

CD.CHD.0011.2.3.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE
 - CMR or CCT can be performed if questions are unanswered on echo
 - Catheterization at time of diagnosis for hemodynamics if pulmonary hypertension (PH) or shunt size is a question

Consideration of surgery

- TTE
 - CMR or CCT can be performed if questions are unanswered on echo
 - Catheterization at time of diagnosis for hemodynamics if pulmonary hypertension (PH) or shunt size is a question

Surveillance imaging VSD

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
Echo (TTE)	36	24	12	12

Atrioventricular Septal Defect (AV Canal, AVSD, endocardial cushion defect) (CD-11.2.4)

CD.CHD.0011.2.4.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE
 - CMR or CT Cardiac at time of diagnosis if there are unanswered questions on echo
 - Cardiac cath at time of diagnosis when CMR and TTE leave questions unanswered that affect individual management
- Stress imaging per **Stress Testing with Imaging – Indications (CD-1.4)**

Consideration of surgery

- TTE
 - CMR or CT Cardiac if there are unanswered questions on TTE and information is needed for surgical management
 - Cardiac cath if CMR and TTE leave questions unanswered that affect surgical management

Surveillance imaging -AVSD

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
Echo (TTE)	24	24	12	12

Patent Ductus Arteriosus (PDA) (CD-11.2.5)

CD.CHD.0011.2.5.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE
 - MR Chest or CT Chest if there are questions left unanswered by echo
 - Cardiac Cath for hemodynamics (if planned device closure, diagnostic cardiac cath is not indicated as it is included in the procedure code)
- Stress imaging per **Stress Testing with Imaging – Indications (CD-1.4)**

Consideration of surgery

- TTE
- MR Chest or CT Chest if there are unanswered questions on echo and information is needed for surgical management

Surveillance imaging PDA

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
Echo (TTE)	36	24	12	12

Cor Triatriatum (CD-11.2.6)

CD.CHD.0011.2.6.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE
 - CMR and/or MRA Chest or CT Cardiac and/or CTA Chest indicated as baseline, with clinical changes, and prior to surgery
 - Diagnostic cath may be approved if additional information is required for medical management

Consideration of surgery

- TTE
- CMR and/or MRA Chest or CT Cardiac and/or CTA Chest

Surveillance imaging

- Stress imaging per Stress Testing with Imaging – Indications (CD-1.4)

Congenital Mitral Stenosis (CD-11.2.7)

CD.CHD.0011.2.7.A
v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE

Consideration of surgery

- TTE

Surveillance imaging congenital mitral stenosis

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
Echo (TTE)	24	24	12	12

Subaortic Stenosis (SAS) (CD-11.2.8)

CD.CHD.0011.2.8.A

v1.0.2025

This section relates to subaortic stenosis caused by a discrete membrane or tunnel-like obstruction.

Imaging at baseline and for cardiac clinical changes

- Echo (TTE) (CPT® 93303 or 93304 or 93306 or 93308)
- Stress echo (CPT® 93350 or 93351) or SPECT MPI (CPT® 78452) or Stress MRI (CPT® 75559 or 75563)
 - Once at the time of diagnosis
 - New or changed signs or symptoms of ischemia
 - Changes in cardiac function
 - Any signs or symptoms allowed in **Stress Testing with Imaging – Indications (CD-1.4)**

Consideration of surgery

- Echo (TTE) (CPT® 93303 or 93304 or 93306 or 93308)
- Stress echo (CPT® 93350 or 93351) or SPECT MPI (CPT® 78452) or Stress MRI (CPT® 75559 or 75563)

Surveillance imaging SAS

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
Echo (TTE)	24	24	12	12
Stress imaging		24	24	12

Congenital Valvular Aortic Stenosis (CD-11.2.9)

CD.CHD.0011.2.9.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE
- TEE may be required if TTE limited or equivocal
- MRA Chest or CTA Chest if one of the following:
 - Suspicion of Coarctation based on exam and echocardiogram
 - Proximal ascending aorta not well visualized on TTE

Consideration of surgery

- TTE
- TEE may be required if TTE limited or equivocal

Surveillance imaging congenital valvular aortic stenosis

Modality	Physiological stage / intervals for routine imaging				
	Stage (valvular AS)	Progressive (stage B) Mild Vmax 2.0-2.9 m/s	Progressive (stage B) Moderate Vmax 3.0-3.9 m/s	Severe (stage C) ≥4.0 m/s	Aortic root dilation >4.5 cm
echo (TTE)		3 years	1 years	6 months	12 months
MRA Chest or CTA					if ascending allowed yearly

Degree of aortic stenosis (AS) severity			
	Mild AS	Moderate AS	Severe AS
Vmax (m/s) ^a maximum Doppler velocity	2.0-2.9	3.0-3.9	≥4.0

Degree of aortic stenosis (AS) severity			
	Mild AS	Moderate AS	Severe AS
Mean gradient (mmHg)^a	<30	30-49	≥50
AVA (cm²) aortic valve area	>1.5	1.0-1.5	<1.0
AVAi (cm²/m² BSA) indexed aortic valve area	≥1.0	0.6-0.9	<0.6
^a At normal transvalvular flow, BSA= body surface area			

Adapted from: ESC Guidelines for the management of grown-up congenital heart disease (new version 2010): The Task Force on the Management of Grown-up Congenital Heart Disease of the European Society of Cardiology (ESC).

Aortic disease in Turner Syndrome (CD-11.2.10)

CD.CHD.0011.2.10.A

v1.0.2025

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

Imaging at baseline and for cardiac clinical changes

- TTE
- MRA Chest or CTA Chest to rule out mid ascending aortic aneurysm if mid aorta was not seen on echocardiogram

Consideration of surgery

- TTE
- MRA Chest or CTA Chest if mid aorta was not seen on echocardiogram

Surveillance imaging aortic disease in Turner Syndrome

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

Supravalvular Aortic Stenosis (CD-11.3.1)

CD.CHD.0011.3.1.A

v1.0.2025

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

Imaging at baseline and for cardiac clinical changes

- TTE
- MRA Chest or CTA Chest
- Cardiac MRI or CTA Cardiac to assess coronary ostia
- New cardiac symptoms-any of the following:
 - CT Cardiac or cardiac MR
 - CTA Chest or MRA Chest
 - Stress imaging as per **Stress Testing with Imaging – Indications (CD-1.4)**

Consideration of surgery

- Cardiac cath for any individuals pre-cardiac intervention for coronary arteries

Surveillance imaging - Supravalvular AS

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
TTE	24	24	12	12
CMR or CCT	36	36	36	36

Coarctation of the Aorta (CD-11.3.2)

CD.CHD.0011.3.2.A

v1.0.2025

Coarctation is suspected based on clinical findings:

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

Imaging at baseline and for cardiac clinical changes

- TTE
 - No further imaging is required if echocardiogram (TTE), blood pressure, and exam rule out Coarctation.
 - If echo and exam are equivocal or positive one of the following is indicated:
 - CTA Chest
 - MRA Chest
 - Individuals with Coarctation of the aorta do not require intra-cardiac MRI unless issue cannot be resolved on echocardiogram.
 - Screening for intracranial aneurysm by MRA (70544, 70545, 70546) or CTA (70496) of head is allowed
- ETT for diagnosis of exercise induced hypertension does not require imaging
- Cardiac MRI not required unless issues unresolved by echo for intracardiac anatomy
- Diagnostic cath can be approved prior to stenting of the coarctation
- Stress imaging, TEE, Cardiac MRI or CT, Coronary imaging not routine

Symptomatic

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

Consideration of surgery

- TTE
- MRA Chest or CTA Chest is TTE is equivocal or positive
- Diagnostic cath can be approved prior to stenting of the coarctation

Surveillance imaging Coarctation of the Aorta

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
TTE	24	24	12	12
MRA Chest or CTA Chest	36	36	12	12

Valvular Pulmonary Stenosis (CD-11.3.3)

CD.CHD.0011.3.3.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE
- For issues affecting management not well visualized on TTE
 - Cardiac MRI or CT Cardiac
 - MRA Chest or CTA Chest

Consideration of surgery

- TTE
- Cardiac MRI or CT Cardiac and/or MRA Chest or CTA Chest for issues affecting surgical management not well visualized on TTE

Valvular PS imaging and testing

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

Surveillance imaging Valvular PS

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
TTE	36	24	12	12

Isolated Pulmonary regurgitation after PS repair-Echo and CMR at same interval as TOF

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
TTE	24	12	12	12
CMR	36	24	12	12

Branch and Peripheral pulmonary stenosis (CD-11.3.4)

CD.CHD.0011.3.4.A

v1.0.2025

Overview

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

Imaging at baseline and for cardiac clinical changes

- TTE
- MRA Chest or CTA Chest
- Cath may be considered if other advanced imaging is not adequate for management
- VQ scan or MRA Chest for differential blood flow

Consideration of surgery

- TTE
- MRA Chest or CTA Chest
- Cath is indicated when other advanced imaging does not provide necessary information for surgical management

Surveillance imaging branch and peripheral pulmonary stenosis

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
TTE	24	24	12	12
Cardiac MRI or CT Cardiac	36	36	24	24

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
MRA Chest or CTA Chest	36	36	24	24

Double chambered RV (CD-11.3.5)

CD.CHD.0011.3.5.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE

Consideration of surgery

- TTE

Surveillance imaging double chambered right ventricle (RV)

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
Echo (TTE)	24	24	12	12

Ebstein Anomaly (CD-11.3.6)

CD.CHD.0011.3.6.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE
- TEE if TTE is not adequate
- Cardiac MRI or CT Cardiac

Consideration of surgery

- TEE
- Cardiac MRI or CT Cardiac

Surveillance imaging Ebstein Anomaly

Modality	Physiological stage / intervals for routine imaging (months)			
	A	B	C	D
Physiological stage				
Echo (TTE)	12	12	12	12
Cardiac MRI or CT Cardiac	60	36	24	12

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

CD.CHD.0011.3.7.A

v1.0.2025

Includes TOF with pulmonary atresia, VSD PA

Imaging at baseline and for cardiac clinical changes

Baseline

- TTE
- Cardiac MR or CTA Cardiac
- MRA Chest or CTA Chest
- Cardiac catheterization if other advanced imaging leaves unanswered questions

New or worsening symptoms

- Repeat baseline advanced imaging
 - New or worsening symptoms
 - New EKG changes
- Stress imaging (stress echo, stress MRI, or MPI) allowed for typical chest pain, even if intermediate pretest probability at atypical symptoms in individuals with known or undefined coronary artery (CA) anatomy or CA pathology
- VQ scan or MRA chest for left/right perfusion abnormality

Prior to cardiac intervention or surgery

- Repeat baseline imaging (Echo/MR/CT)
- Cath prior to surgery or intervention
 - If planned Catheter Pulmonary Valve replacement, procedure includes diagnostic cath and hemodynamics and diagnostic cath is not billed separately

Surveillance imaging Tetralogy of Fallot (TOF)

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
TTE	24	12	12	12

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
Cardiac MRI or CCTA	36	24	12	12
CTA Chest or MRA	36	24	12	12

Right Ventricle-to-Pulmonary Artery Conduit (CD-11.3.8)

CD.CHD.0011.3.8.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE
- Cardiac MRI or CTA Cardiac
- MRA Chest or CTA Chest
- Cath allowed for new symptoms or with new imaging findings as needed for management
- Stress imaging (stress echo, stress MRI or MPI) as requested for cardiac symptoms

Consideration of surgery - Surgical repair for many lesions such as TOF/ Truncus /Pulmonary atresia

- TTE
- Cardiac MRI or CTA Cardiac
- MRA Chest or CTA Chest

Surveillance imaging Right Ventricle-to-Pulmonary Artery Conduit

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
TTE	12	12	12	12
CMR or CCTA	36	36	12	12
MRA Chest or CTA Chest	36	36	12	12

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

CD.CHD.0011.3.9.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE
- Cardiac MRI or CCTA
- MRA Chest or CTA

In addition to repeat imaging with the above baseline studies, the following studies are indicated as follows:

- Stress imaging as requested for symptoms or signs of ischemia
- V/Q scan for left to right PA perfusion or MRA Chest
- Symptomatic individuals should be offered stress physiological imaging and repeat anatomic imaging considered if symptoms are suggestive of coronary ischemia (regardless of diamond forester pretest probability category)
- Cath right and left heart when above advanced imaging does not explain clinical issues

Consideration of surgery

- TTE
- Cardiac MRI or CCTA
- MRA Chest or CTA

Surveillance imaging TGA

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
TTE	12	12	12	12
CMR or CCTA	36	24	12	12
MRA Chest or CTA Chest	36	24	12	12

Congenitally corrected TGA (CD-11.3.10)

CD.CHD.0011.3.10.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE
- CMR and MRA Chest
- Repeat CMR and/or Echo for changes in clinical status

Consideration of surgery

- TTE
- CMR and MRA Chest

Surveillance imaging congenitally corrected TGA

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
Echo (TTE)	12	12	12	12
CMR or CCTA	36	36	12	12
CTA Chest or MRA Chest	36	36	12	12

Fontan Palliation of Single Ventricle Physiology (CD-11.3.11)

CD.CHD.0011.3.11.A

v1.0.2025

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

Imaging at baseline and for cardiac clinical changes

- TTE
- CMR or CCTA for issues that are equivocal on TTE (can be done annually vs. based on below chart for individuals who have prior issues that were equivocal on echo, and the data is required for management)
- Cardiac catheterization prior to surgical interventions
- Echo/CMR or CCTA/MRA Chest or CTA Chest/cath with any new signs or symptoms
- V/Q scan or MRA for lung perfusion left vs. right

Consideration of surgery

- Cardiac catheterization prior to surgical interventions

Surveillance imaging Fontan Palliation of Single Ventricle Physiology

Modality	Physiological stage / intervals for routine imaging (months)			
	A	B	C	D
Echo (TTE)	12	12	12	12
CMR or CT Cardiac	36	24	24	24
CTA Chest or MRA	36	24	24	24
Cardiac catheterization	120 (10 years)	120 (10 years)	120 (10 years)	120 (10 years)

Severe Pulmonary Artery Hypertension (PH) and Eisenmenger Syndrome (CD-11.3.12)

CD.CHD.0011.3.12.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE
 - Initial diagnosis
 - With new signs or symptoms
- Cardiac cath
 - Echo (TTE) results suggest PH
 - New signs or symptoms with PH

Consideration of surgery

- TTE
- Cardiac cath if TTE suggests PH

Surveillance imaging Severe Pulmonary artery hypertension (PHT) and Eisenmenger syndrome

Modality	Physiological stage / intervals for routine imaging (months)			
Physiological stage	A	B	C	D
TTE			6	6
CMR or CCT			As needed	As needed
MRA Chest or CTA Chest			As needed	As needed
Cath			As needed	As needed

Coronary artery anomalies (CD-11.3.13)

CD.CHD.0011.3.13.A

v1.0.2025

Imaging at baseline and for cardiac clinical changes

- TTE
 - At baseline
 - Any signs or symptoms
- Coronary CT or CMR or Cath for initial evaluation
- Coronary artery from wrong sinus-baseline stress imaging regardless of symptoms
- Stress imaging for any cardiac signs or symptoms
- For Kawasaki GL regarding echo, Stress imaging, coronary imaging, see pediatric GL **Kawasaki Disease (PEDCD-6)**

Consideration of surgery

- TTE
- Coronary CT or CMR or Cath

Evidence Discussion (CD-11)

Adult Congenital Heart Disease Imaging

- Management of Adult Congenital heart (ACHD) disease involves a multimodal imaging approach. Multimodal imaging helps account for patient-specific considerations, strengths and weaknesses of each modality, institutional resources, and available expertise. Approaches to limit and monitor radiation exposure are recommended during imaging of individuals with ACHD, and studies that do not involve ionization radiation should be prioritized whenever appropriate.
- Echocardiogram, MRI, CT, Cath, and nuclear stress testing all have strengths and weaknesses, including varying radiation levels, temporal resolution, spatial resolution, and ability to image blood flow. Advantages of the various modalities are as follows: MRI has the ability to image the right ventricle in 3 dimensions; Echocardiograms include high temporal resolution and availability, and the ability to measure pressures with catheterizations; Cardiac CTs have the ability to rapidly acquire 3D imaging; and nuclear imaging allows the ability to measure myocardial perfusion concerns.

References (CD-11)

v1.0.2025

1. Mcelhinney DB, Quartermain MD, Kenny D, Alboliras E, Amin Z. Relative Risk Factors for Cardiac Erosion Following Transcatheter Closure of Atrial Septal Defects. *Circulation*. 2016;133(18):1738-1746. doi:10.1161/circulationaha.115.019987.
2. Center for Devices and Radiological Health. 2018 Meeting Materials of the Circulatory System Devices Panel. U.S. Food and Drug Administration. <https://www.fda.gov/advisory-committees/circulatory-system-devices-panel/2018-meeting-materials-circulatory-system-devices-panel>. Published December 3, 2018.
3. Doherty JU, Kort S, Mehran R, Schoenhagen P, Soman P. ACC/AATS/AHA/ASE/ASNC/HRS/SCAI/SCCT/SCMR/STS 2019 Appropriate Use Criteria for Multimodality Imaging in the Assessment of Cardiac Structure and Function in Nonvalvular Heart Disease. *J Nucl Cardiol*. 2019;26(4):1392-1413. doi:10.1007/s12350-019-01751-7.
4. Stout KK, Daniels CJ, Aboulhosn JA, et al. 2018 AHA/ACC Guideline for the Management of Adults with Congenital Heart Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation*. 2019;139(14). doi:10.1161/cir.0000000000000603
5. Silvestry FE, Cohen MS, Armsby LB, et al. Guidelines for the Echocardiographic Assessment of Atrial Septal Defect and Patent Foramen Ovale: From the American Society of Echocardiography and Society for Cardiac Angiography and Interventions. *J Am Soc Echocardiogr*. 2015;28(8):910-958. doi:10.1016/j.echo.2015.05.015.
6. El#Said HG, Bratincsak A, Foerster SR, et al. Safety of Percutaneous Patent Ductus Arteriosus Closure: An Unselected Multicenter Population Experience. *Journal of the American Heart Association*. 2013;2(6). doi:10.1161/jaha.113.000424.
7. Franklin RCG, Béland MJ, Colan SD, et al. Nomenclature for congenital and paediatric cardiac disease: the International Paediatric and Congenital Cardiac Code (IPCCC) and the Eleventh Iteration of the International Classification of Diseases (ICD-11). *Cardiology in the Young*. 2017;27(10):1872-1938. doi:10.1017/s1047951117002244.
8. Whelton PK, Carey RM, Aronow WS, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Hypertension*. 2018;71(6). doi:10.1161/hyp.000000000000065.
9. Shen W-K, Sheldon RS, Benditt DG, et al. 2017 ACC/AHA/HRS Guideline for the Evaluation and Management of Patients with Syncope: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. *Circulation*. 2017;136(5). doi:10.1161/cir.0000000000000499.
10. Page RL, Joglar JA, Caldwell MA, et al. 2015 ACC/AHA/HRS Guideline for the Management of Adult Patients with Supraventricular Tachycardia. *Circulation*. 2016;133(14). doi:10.1161/cir.0000000000000311.
11. Chaikof EL, Dalman RL, Eskandari MK, et al. The Society for Vascular Surgery practice guidelines on the care of patients with an abdominal aortic aneurysm. *Journal of Vascular Surgery*. 2018;67(1). doi:10.1016/j.jvs.2017.10.044.
12. AMPLATZER PFO Occluder: PFO Closure Device. Abbott Cardiovascular. <https://www.cardiovascular.abbott/us/en/hcp/products/structural-heart/amplatzer-pfo.html>.
13. Madhkour R, Wahl A, Praz F, Meier B. Amplatzer patent foramen ovale occluder: safety and efficacy. *Expert Review of Medical Devices*. 2019;16(3):173-182. doi:10.1080/17434440.2019.1581060.
14. Drummond A. AMPLATZER Patent Foramen Ovale (PFO) Occluder: FDA Review of P120021 Office of Device Evaluation Center for Devices and Radiological Health (CDRH) Food and Drug Administration May 24, 2016. <https://www.fda.gov/media/98643/download>.
15. Updates to Instructions for Use (IFU) concerning Erosion with the Amplatzer Atrial Septal Occluder (ASO). Last updated on 06 Jul 2014. <https://www.hsa.gov.sg/content/hsa/>
16. Amsterdam EA, Wenger NK, Brindis RG, et al. 2014 AHA/ACC Guideline for the Management of Patients with Non–ST-Elevation Acute Coronary Syndromes. *Circulation*. 2014;130(25)doi:10.1161/cir.0000000000000134.

17. Priori SG, Wilde AA, Horie M, et al. Executive summary: HRS/EHRA/APHRS expert consensus statement on the diagnosis and management of patients with inherited primary arrhythmia syndromes. *EP Europace*. 2013;15(10):1389-1406. doi:10.1093/europace/eut272.
18. Daniels CJ, Bradley EA, Landzberg MJ, et al. Fontan-Associated Liver Disease. *J Am Coll Cardiol*. 2017;70(25):3173-3194. doi:10.1016/j.jacc.2017.10.045.
19. Collado FMS, Poulin MF, Murphy JJ, Jneid H, Kavinsky CJ. Patent Foramen Ovale Closure for Stroke Prevention and Other Disorders. *Journal of the American Heart Association*. 2018;7(12). doi:10.1161/jaha.117.007146.
20. Khairy P, Hare GFV, Balaji S, et al. PACES/HRS Expert Consensus Statement on the Recognition and Management of Arrhythmias in Adult Congenital Heart Disease. *Canadian Journal of Cardiology*. 2014;30(10). doi:10.1016/j.cjca.2014.09.002.
21. Kusumoto FM, Schoenfeld MH, Barrett C, et al. 2018 ACC/AHA/HRS Guideline on the Evaluation and Management of Patients with Bradycardia and Cardiac Conduction Delay. *J Am Coll Cardiol*. 2018. doi:10.1016/j.jacc.2018.10.044.
22. Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery. *J Am Coll Cardiol*. 2014;64(22). doi:10.1016/j.jacc.2014.07.944.
23. Galiè N, Humbert M, Vachiery J-L, et al. 2015 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension. *European Respiratory Journal*. 2015;46(4):903-975. doi:10.1183/13993003.01032-2015.
24. Otto CM, Kumbhani DJ, Alexander KP, et al. 2017 ACC Expert Consensus Decision Pathway for Transcatheter Aortic Valve Replacement in the Management of Adults with Aortic Stenosis. *J Am Coll Cardiol*. 2017;69(10):1313-1346. doi:10.1016/j.jacc.2016.12.006.
25. O'gara PT, Kushner FG, Ascheim DD, et al. 2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction. *J Am Coll Cardiol*. 2013;61(4). doi:10.1016/j.jacc.2012.11.019.
26. Stout KK, Daniels CJ, Aboulhosn JA, et al. 2018 AHA/ACC Guideline for the Management of Adults with Congenital Heart Disease. *J Am Coll Cardiol*. 2018;73(12). doi:10.1016/j.jacc.2018.08.1029.
27. Elkayam U, Goland S, Pieper PG, Silversides CK. High-Risk Cardiac Disease in Pregnancy. *J Am Coll Cardiol*. 2016;68(4):396-410. doi:10.1016/j.jacc.2016.05.048.
28. Sachdeva R, Valente AM, Armstrong AK, et al. ACC/AHA/ASE/HRS/ISACHD/SCAI/SCCT/SCMR/SOPE 2020 Appropriate Use Criteria for Multimodality Imaging During the Follow-Up Care of Patients with Congenital Heart Disease. *J Am Coll Cardiol*. 2020;75(6):657-703. doi:10.1016/j.jacc.2019.10.002.
29. Rychik J, Atz AM, Celermajer DS, et al. Evaluation and Management of the Child and Adult With Fontan Circulation: A Scientific Statement From the American Heart Association [published online ahead of print, 2019 Jul 1]. *Circulation*. 2019; doi:10.1161/CIR.0000000000000696.

Maternal Imaging in Cardiovascular Disease

Guideline	Page
Diagnostic Cardiovascular Imaging Pre-Pregnancy to Post-Partum (CD-15.1).....	176
Maternal imaging in cardiovascular disease (CD-15.2).....	179
Maternal Imaging in Individuals with Aortopathy (CD-15.3).....	181
Imaging in Pregnancy with Congenital Heart Disease (CHD) (CD-15.4).....	185
References (CD-15).....	189

Diagnostic Cardiovascular Imaging Pre-Pregnancy to Post-Partum (CD-15.1)

CD.MI.0015.1.A

v1.0.2025

Maternal imaging in cardiovascular disease

Ultrasound and magnetic resonance are the preferred imaging modalities to minimize radiation exposure in pregnancy. When imaging using ionizing radiation is necessary, radiation exposure should follow the ALARA principle (As Low As Reasonably Achievable). Shared decision making regarding diagnostic testing should occur in consultation with the individual, cardiologist, and obstetrical team when weighing the risk of fetal exposure to radiation against the need to diagnose or plan treatment for serious illness.

Peripartum Red Flag Signs and Symptoms

Imaging as requested, as listed within **Imaging Modalities in Maternal Imaging** (Echocardiogram, Exercise stress echo, Coronary angiography, Cardiac MRI), is indicated for peripartum individuals for any of the following **red flag** signs or symptoms:

- Chest pain
- Dyspnea
- Orthopnea
- Cough
- Lower extremity edema when there is a concern for heart disease
- Tachycardia
- Unheralded syncope
- Headache
- Acute visual changes
- New onset hypotension
- Hypertension

Imaging Modalities in Maternal Imaging

Transthoracic echocardiography (TTE)

- TTE (CPT® 93306) is the primary cardiac imaging modality in pregnancy. Baseline and surveillance echocardiography is indicated for several conditions as noted in **Maternal imaging in cardiovascular disease (CD-15.2)** Table 1.
- A repeat echocardiogram is indicated when there are new or worsening cardiovascular signs or symptoms, as described in **Peripartum Red Flags, Transthoracic Echocardiography (TTE)– Indications/initial evaluation (CD-2.2)** and **Frequency of Echocardiography Testing (CD-2.3)**, during and after pregnancy.

Exercise Stress Echo

- Exercise stress echo (CPT® 93350, 93351) is indicated pre-conception to assist with risk stratification in individuals with a documented history of **any** of the following:
 - Current left ventricular dysfunction
 - Previous history of left ventricular dysfunction
 - Valvular heart disease of any severity
 - There is a concern for myocardial reserve
- See Stress echocardiogram in **Stress Testing with Imaging – Indications (CD-1.4)** and **Stress echo–indications other than ruling out CAD (CD-2.7)**
- See **Hypertrophic Cardiomyopathy (CD-14)**

Coronary Angiography

- Fetal risk from ionizing radiation is highest before 20 weeks gestational age. When coronary angiography is medically necessary, the ALARA principle should be followed. Invasive management of acute coronary syndrome is associated with lower in-hospital mortality and should be considered. See **Diagnostic Heart Catheterization**

Cardiac MRI

- Cardiac MRI (CPT® 75557) is utilized in pregnant individuals to measure aortic dimensions, wall motion and ventricular function when the echocardiogram is non-diagnostic. Gadolinium-based contrast agents are not necessary in aortic imaging or most other indications in pregnancy. See **Cardiac MRI**.

Background and Supporting Information

- Cardiovascular disease (CVD) in pregnancy has become increasingly prevalent in recent years.
- The increase in plasma volume during pregnancy requires significant physiological adaptation.

- Maternal mortality has increased in the last two decades with CVD accounting for 33% of all deaths.
- Invasive management of myocardial infarction (MI) is associated with lower in-hospital mortality.
- Research has underrepresented females of childbearing age leading to significant deficits in our knowledge of cardiovascular care of these individuals.
- Cardiac Imaging using ionizing radiation
 - Multiple imaging modalities expose the pregnant individual and fetus to ionizing radiation.
 - This exposure causes concern for an elevated risk of childhood cancer.
 - Shared decision-making should be employed when weighing the fetal exposure to radiation against the need to diagnose serious illness

Maternal imaging in cardiovascular disease (CD-15.2)

CD.MI.0015.2.A

v1.0.2025

Table 1: Suggested frequency of echo monitoring during pregnancy

Cardiovascular disease	Monitoring frequency
Hypertensive disorders of pregnancy (BP \geq 130/90)	<ul style="list-style-type: none"> An echocardiogram (TTE) (CPT® 93303, 93304, 93306, 93307, 93308) is indicated once during pregnancy in all hypertensive disorders of pregnancy. A repeat TTE is indicated when there are new or worsening cardiovascular signs or symptoms
Valvular disorders/ Native and Prosthetic	<ul style="list-style-type: none"> One TTE is indicated during the first trimester (weeks 1-12 of pregnancy) for individuals with known or suspected valvular heart disease. A repeat TTE is indicated when there are new or worsening cardiovascular signs or symptoms
Severe Aortic stenosis (AS)	<ul style="list-style-type: none"> A repeat TTE is indicated every 1-2 months or when there are new or worsening cardiovascular signs or symptoms
Mitral stenosis (MS)	<ul style="list-style-type: none"> TTE is indicated each trimester (12 weeks) and prior to delivery in individuals with mild MS. TTE is indicated every 1–2 months in individuals with moderate to severe MS. A repeat TTE is indicated when there are new or worsening cardiovascular signs or symptoms
Dilated cardiomyopathy	<ul style="list-style-type: none"> TTE is indicated during each trimester (12 weeks) A repeat TTE is indicated when there are new or worsening cardiovascular signs or symptoms
Hypertrophic cardiomyopathy	<ul style="list-style-type: none"> TTE is indicated in asymptomatic individuals each trimester TTE is indicated in symptomatic individuals every 1-2 months. A repeat TTE is indicated when there are new or worsening cardiovascular signs or symptoms

Cardiovascular disease	Monitoring frequency
Peripartum cardiomyopathy	<p>TTE is indicated in individuals with signs and symptoms of heart failure.</p> <ul style="list-style-type: none"> • A repeat TTE is indicated when there are new or worsening cardiovascular signs or symptoms • TTE is indicated in subsequent pregnancies: <ul style="list-style-type: none"> ◦ At the time of the first prenatal visit ◦ At the end of the first and second trimesters ◦ One month prior to delivery ◦ After delivery prior to discharge ◦ One month postpartum ◦ At any time when there are worsening signs or symptoms of heart failure • Cabergoline
Pulmonary hypertension	<ul style="list-style-type: none"> • TTE is indicated in individuals with signs and symptoms of pulmonary hypertension • A repeat TTE is indicated at the discretion of the health care provider.

Maternal Imaging in Individuals with Aortopathy (CD-15.3)

CD.MI.0015.3.A

v1.0.2025

Pre-pregnancy imaging

Individuals at risk for aortic aneurysms (**Table 15-3-1**) should be evaluated with echocardiogram (TTE) **and** Computed Tomography (CT)/ Magnetic Resonance Imaging (MRI) of the Chest/Abdomen/Pelvis (**Table 15-3-2**) within 1 year prior to conception to evaluate for aortic valve disease and aortic dimensions.

Table 15-3-1

Individuals at risk for aortic aneurysm, aortic dissection, limb-threatening ischemia
Bicuspid Aortic Valve
Turner Syndrome
Coarctation of the Aorta
Marfan Syndrome
Type IV Ehlers-Danlos
Loeys-Dietz
Familial Thoracic Aortic Disease and Aortic Dissection (defined as first-degree relative with history of aortic dissection or thoracic aortic aneurysm or two second-degree relatives with history of aortic dissection or thoracic aortic aneurysm)

Table 15-3-2

Imaging for Aortic conditions	CPT®
CT Chest and/or Abdomen and/or Pelvis	71260
	74177
	74160
	72193

Imaging for Aortic conditions	CPT®
CTA Chest and/or Abdomen and/or Pelvis	71275 74175 72191 74174
MRA Chest and/or Abdomen and/or Pelvis	71555 74185 72198
Transthoracic Echocardiogram (TTE)	93303 93304 93306 93307 93308
Transesophageal Echocardiogram (TEE)	93312 93313 93314 93315 93316 93317
Doppler echocardiography- is indicated as add-on codes for TEE	+93320 +93321 +93325

Surveillance imaging during pregnancy and postpartum

Follow-up imaging with Echocardiogram (TTE) and CTA/MRA. TEE can be substituted if TTE is equivocal.

Suggested Frequency of Aortic Imaging during pregnancy and postpartum in individuals known to be high-risk for aortic aneurysm

Table 15-3-3

Condition	WHO Class	Imaging frequency	Postpartum (up to 42 days after birth)
Turner Syndrome	<ul style="list-style-type: none"> II-III: Aortic root <20mm/m² with associated risk factors or <25 mm/m without associated risk factors 	<ul style="list-style-type: none"> Once during pregnancy if normal aortic dimension, or every two months if repaired coarctation 	<ul style="list-style-type: none"> Once during the postpartum period
	<ul style="list-style-type: none"> IV: Aortic root ≥20mm/m² with associated risk factors or ≥25 mm/m without associated risk factors 	<ul style="list-style-type: none"> Every 6 weeks if aorta diameter dilated >30mm 	<ul style="list-style-type: none"> Once during the postpartum period
	<ul style="list-style-type: none"> Any patient with Turner who has severe coarctation 	<ul style="list-style-type: none"> At discretion of provider 	<ul style="list-style-type: none"> Once during the postpartum period
Marfan Syndrome	<ul style="list-style-type: none"> III: Aortic root <45mm, mod-severe Aortic Insufficiency 	<ul style="list-style-type: none"> Every trimester if <40mm 	<ul style="list-style-type: none"> Once during the postpartum period
	<ul style="list-style-type: none"> IV: Aortic root ≥45mm, history of dissection 	<ul style="list-style-type: none"> Every 6 weeks if aorta is ≥40mm 	<ul style="list-style-type: none"> Once during the postpartum period
Vascular Ehlers-Danlos	<ul style="list-style-type: none"> Type IV 	<ul style="list-style-type: none"> Every 6 weeks 	<ul style="list-style-type: none"> Once during the postpartum period
Loeys-Dietz	<ul style="list-style-type: none"> III: Aortic diameter <40mm 	<ul style="list-style-type: none"> Every 6 weeks 	<ul style="list-style-type: none"> Once during the postpartum period
	<ul style="list-style-type: none"> IV: Aortic diameter ≥40mm 	<ul style="list-style-type: none"> Every 6 weeks 	<ul style="list-style-type: none"> Once during the postpartum period

Condition	WHO Class	Imaging frequency	Postpartum (up to 42 days after birth)
Familial thoracic aortic aneurysms and dissections	• III: Aortic diameter <40mm	• Every trimester if <40mm aortic diameter	• Once during the postpartum period
	• IV: Aortic diameter ≥40mm	• Every 6 weeks if ≥40mm aortic diameter	• Once during the postpartum period

Background and Supporting Information

First-degree relative (sibling, parent, child).

Second-degree relative (aunt/uncles, grandparent, niece, nephew, cousin, or half-sibling of an individual)

Imaging in Pregnancy with Congenital Heart Disease (CHD) (CD-15.4)

CD.MI.0015.4.A

v1.0.2025

Pre-pregnancy imaging based on the World Health Organization (WHO) chart for imaging in pregnancy with CHD

Imaging modality and indication	CPT®
Echo (TTE) when planning pregnancy	93306
TEE if TTE equivocal	93312
CMR (cardiac MRI) can be performed prior to pregnancy in those lesions where CMR would be routinely performed at some later date	75557
CTA or MRA of chest if known aortic disease, Pulmonary artery disease, anomalous pulmonary veins, anomalous systemic veins. (also see peripartum aortopathy table.)	71275, 71555
Echo with new signs or symptoms	93303, 93304, 93306, 93308
Postpartum imaging per provider requested frequency	imaging as noted above
Stress imaging pre/during pregnancy when known coronary artery anomaly, pulmonary hypertension, LVOT obstruction, cardiac dysfunction, single ventricle	93350, 93351, 93320, 93325
WHO II, III, IV, can have echo/MR/CT/stress imaging prior to pregnancy	imaging as noted above

- Congenital heart disease imaging in pregnancy
 - Echocardiogram (TTE) when planning pregnancy
 - TEE if TTE equivocal
 - CMR can be performed prior to planning pregnancy in those lesions where CMR would be routinely performed at some later date

- CTA Chest or MRA Chest of arch if known disease with aortic involvement or if known dilation
- Repeat echocardiogram and MR (can be without gad) can be performed based on the WHO classification II, III, IV, or other risk factors
- Severe complex CHD TTE (93306)
 - Every 2-4 weeks for major physiological changes
 - As often as needed for any of the following:
 - Pulmonary hypertension
 - Changes in function
 - To guide delivery after 24 weeks
- Echo can be performed if new signs or symptoms during pregnancy
- Postpartum first year can have more frequent imaging
- Stress imaging pre/during pregnancy for individuals with known coronary artery anomaly, pulmonary hypertension, LVOT obstruction, cardiac dysfunction, single ventricle.
- WHO II, III, IV, can have echo/MR/CT/stress imaging prior to pregnancy
- WHO I- one echocardiogram during pregnancy
- WHO II- one echocardiogram per trimester during pregnancy
- WHO II/III- echocardiogram every 2 months during pregnancy
- WHO III/IV- echocardiogram monthly during pregnancy
 - Individuals may require more (even weekly) if treatment decision, delivery is considered.
- Syndromes that allow cardiac imaging at the time of diagnosis if not previously done. This list is not exhaustive
 - DiGeorge/velocardiofacial (22q11.2)
 - Down syndrome (trisomy 21)
 - Holt Oram (TBX5)
 - Klinefelter syndrome (47 XXY)
 - Noonan (PTPN11, KRAS, SOS1 RAF1, NRAS, BRAF, MAP2K1)
 - Turner (45X)
 - Williams (7q11.23 deletion)
 - Any syndrome associated with congenital heart disease.
- Echocardiogram at time of Diagnosis (either genetic testing or clinical features)
- CMR or CCTA if arch involved in disease.
- See **Maternal Imaging in Cardiovascular Disease (CD-15)**

Surveillance Imaging

Surveillance imaging after baseline studies.

TTE frequency after initial imaging, (Individuals who also have aortopathy can have Chest MRA in addition to echo at same frequency.) Individuals with known poor/ inadequate imaging on echo, can have CMR in lieu of echocardiogram.

The World Health Organization modified classification of maternal cardiovascular risk

The World Health Organization established a modified classification of maternal cardiovascular risk used as a tool to evaluate risk status for pregnant individuals with various cardiovascular conditions. See **Pregnancy-Maternal Imaging (CD-11.4)**

Class	Risk	Sample Lesions
WHO Class I	No detectable increased risk of maternal mortality and no or mild increase in morbidity.	<ul style="list-style-type: none"> Mild Pulmonary stenosis Small PDA Mild MVP Successfully repaired simple lesions (ASD, VSD, PDA, anomalous pulmonary venous drainage) Isolated PACs or PVCs
WHO Class II	Small increased risk of maternal mortality or moderate increase in morbidity.	<ul style="list-style-type: none"> Un-operated ASD or VSD Repaired TOF (uncomplicated) Most arrhythmias
WHO Class II-III	Intermediate increased risk of maternal mortality or moderate to severe increase in morbidity.	<ul style="list-style-type: none"> Mild left ventricular impairment Hypertrophic cardiomyopathy Native or tissue valvular heart disease not considered WHO I or IV Aorta <45 mm in aortic disease associated with bicuspid aortic valve Repaired coarctation

Class	Risk	Sample Lesions
WHO Class III	<p>Significantly increased risk of maternal mortality or severe morbidity.</p> <ul style="list-style-type: none"> Expert counseling required. If pregnancy is decided upon, intensive specialist cardiac and obstetric monitoring needed throughout pregnancy, childbirth and the postpartum period. 	<ul style="list-style-type: none"> Mechanical valve Systemic right ventricle Fontan circulation Unrepaired cyanotic heart disease Other complex congenital heart disease
WHO Class IV	<p>Extremely high-risk of maternal mortality or severe morbidity.</p> <ul style="list-style-type: none"> Pregnancy contraindicated. If pregnancy occurs, termination should be discussed. If pregnancy continues, care as for WHO class III. 	<ul style="list-style-type: none"> Pulmonary arterial hypertension from any cause Severe systemic ventricular dysfunction (LVEF <30%, NYHA functional class III-IV) Severe mitral stenosis; severe symptomatic aortic stenosis Aortic dilation ≥ 50 mm in aortic disease associated with bicuspid aortic valve Native severe coarctation of the aorta

References (CD-15)

v1.0.2025

1. Park K, Bairey Merz CN, Bello NA, et al. Management of Women With Acquired Cardiovascular Disease From Pre-Conception Through Pregnancy and Postpartum: JACC Focus Seminar 3/5. *J Am Coll Cardiol*. 2021;77(14):1799-1812. doi:10.1016/j.jacc.2021.01.057.
2. Lindley KJ, Bairey Merz CN, Asgar AW, et al. Management of Women With Congenital or Inherited Cardiovascular Disease From Pre-Conception Through Pregnancy and Postpartum: JACC Focus Seminar 2/5. *J Am Coll Cardiol*. 2021;77(14):1778-1798. doi:10.1016/j.jacc.2021.02.026.
3. O'Kelly AC, Sharma G, Vaught AJ, Zakaria S. The Use of Echocardiography and Advanced Cardiac Ultrasonography During Pregnancy. *Curr Treat Options Cardiovasc Med*. 2019;21(11):71. Published 2019 Nov 21. doi:10.1007/s11936-019-0785-5.
4. Bello NA, Bairey Merz CN, Brown H, et al. Diagnostic Cardiovascular Imaging and Therapeutic Strategies in Pregnancy: JACC Focus Seminar 4/5. *J Am Coll Cardiol*. 2021;77(14):1813-1822. doi:10.1016/j.jacc.2021.01.056.
5. Hemnes AR, Kiely DG, Cockrill BA, et al. Statement on pregnancy in pulmonary hypertension from the Pulmonary Vascular Research Institute. *Pulm Circ*. 2015;5(3):435-465. doi:10.1086/682230.
6. Steiner JM, Lokken E, Bayley E, et al. Cardiac and Pregnancy Outcomes of Pregnant Patients With Congenital Heart Disease According to Risk Classification System. *Am J Cardiol*. 2021;161:95-101. doi:10.1016/j.amjcard.2021.08.037.
7. Canobbio MM, Warnes CA, Aboulhosn J, et al. Management of Pregnancy in Patients With Complex Congenital Heart Disease: A Scientific Statement for Healthcare Professionals From the American Heart Association. *Circulation*. 2017;135(8):e50-e87. doi:10.1161/CIR.0000000000000458.

Condition Specific Imaging

Guideline	Page
Cardiotoxic Agent-Related Cardiac Dysfunction (CD-12).....	191
References (CD-12).....	195
Cardiac Sarcoidosis (CD-3.9).....	196
References (CD-3.9).....	198
Cardiac Trauma Imaging (CD-10.1).....	199
References (CD-10).....	200
Congestive Heart Failure (CD-9).....	201
References (CD-9).....	205
Cardiac Surgery Imaging (CD-13).....	206
References (CD-13).....	211
Pulmonary Hypertension (PH) (CD-8.1).....	213
References (CD-8).....	219
Pulmonary Vein Imaging – Indications (CD-8.2).....	221
References (CD-8).....	222
Hypertrophic Cardiomyopathy (HCM) (CD-14).....	224
References (CD-14).....	227

Cardiotoxic Agent-Related Cardiac Dysfunction (CD-12)

CD.CS.0012.A

v1.0.2025

Cardiotoxic agent/Cancer Therapeutics-Related Cardiac Dysfunction (CD-12.1)

Transthoracic Echocardiogram (TTE)

Transthoracic Echocardiogram (TTE) is indicated to determine Left Ventricular (LV) function in individuals on cardiotoxic chemotherapeutic drugs

- 3D echocardiography CPT® 93319 is indicated in addition to the primary TTE and is the preferred echocardiography modality for the assessment of left ventricular ejection fraction (LVEF) and cardiac volumes. See **3D Echocardiography (CD 2.9)**
- Myocardial strain imaging (CPT® 93356) to obtain a Global Longitudinal Strain (GLS) is indicated as an important adjunct in screening for CTRCD. See **Myocardial Strain Imaging (CD 12.2)**

Multimodality imaging

- Guidelines support using echocardiography rather than MUGA for the determination of LVEF and/or wall motion EXCEPT in one of the circumstances described previously in **MUGA Study – Cardiac Indications (CD-3.4)**. (see **Background and supporting Information** below).
- CT coronary calcium scoring (CPT® 75571) is indicated every 5 years to screen for radiation induced coronary artery disease, unless previous coronary calcium score is >0 in cancer survivors who have received chest radiation therapy.
- Cardiac MRI (CMR) is indicated in the evaluation of CTRCD for the following:
 - TTE is not diagnostic
 - Tissue characterization for cardiomyopathy or myocarditis, particularly when Immune Checkpoint Inhibitor Myocarditis is being questioned.
 - See also **Cardiac MRI and MRA Chest – Indications (CD 5.2)**.

Frequency of CTRCD screening

- Baseline
 - All patients can have a baseline TTE prior to initiation of cardiotoxic agents
- During treatment with cardiotoxic agents

- The frequency of monitoring depends on the agent administered and the patient's baseline cardiovascular toxicity risk. (See **Background and Supporting Information** below)
- Post treatment with cardiotoxic agents surveillance
 - One TTE is indicated 3 to 12 months after completion of therapy
- Adult cancer survivors
 - Long term surveillance TTE is indicated every 5 years, except in those with low risk
 - Additional surveillance TTE, at 1 and 3 years after cancer therapy completion is indicated in those deemed to be high risk for CTRCD
- Adult survivors of childhood and adolescent cancer
 - Surveillance TTE is indicated every 2 years for survivors with indeterminate risk due to unknown cancer therapy history
 - Surveillance TTE is indicated every 2 years for high risk survivors, defined as a history of any of the following:
 - Radiation dose ≥ 30 Gy
 - Anthracycline dose of < 100 mg/m² and radiation dose ≥ 15 Gy
 - Anthracycline dose ≥ 250 mg/m²
 - Surveillance TTE is indicated every 5 years for moderate risk survivors, defined as a history of any of the following:
 - Radiation dose ≥ 15 to < 30 Gy
 - Anthracycline dose of < 250 mg/m² and radiation dose < 15 Gy
 - No screening is indicated in low risk survivors, defined as a history of any of the following:
 - Anthracycline dose of > 0 to < 100 mg/m²
 - Radiation dose > 0 to < 15 Gy
- TTE is indicated for cancer survivors with a history of chest radiotherapy or anthracycline exposure who are pregnant or planning to become pregnant as follows:
 - Baseline exam
 - 12 weeks of pregnancy if missed the baseline TTE or in high risk survivors
 - 20 weeks of pregnancy for high risk survivors
 - TTE can be repeated for any cardiac symptoms at any other time as needed during or immediately following pregnancy
- Adults who received anthracyclines in childhood see **Cardiotoxicity and Echocardiography (PEDONC-19.2)**

Background and Supporting Information

- High value screening protocol to detect CTRCD using TTE (CPT® 93306 or 93308) is contingent upon careful baseline cardiotoxicity risk assessment and stratification into low, moderate and high risk. Currently, there is no universally accepted risk score, documentation of risk by the provider is sufficient to guide screening strategy.
- Advantages of Echocardiography in comparison to MUGA in individuals on cardiotoxic chemotherapy:
 - No ionizing radiation
 - No IV access required when echo contrast is not used
 - Allows view of the pericardium to look for effusion
 - Allows estimate of pulmonary pressure
 - May allow visualization of a clot or tumor in the Inferior Vena Cava (IVC) and/or the right heart

Myocardial Strain Imaging (CD-12.2)

- Myocardial strain imaging (CPT® 93356) in addition to the primary echocardiogram in individuals receiving therapy with cardiotoxic agents for ANY of the following:
 - Initial evaluation-prior to treatment with EITHER:
 - Medications that could result in cardiotoxicity/heart failure
 - Radiation that could result in cardiotoxicity/heart failure
 - Re-evaluation of an individual previously or currently undergoing therapy as per echocardiogram parameters. See **Cardiotoxic agent/Cancer Therapeutics-Related Cardiac Dysfunction (CD-12.1)**
 - Re-evaluation of an individual undergoing therapy with worsening symptoms

Mavacamten for Obstructive Hypertrophic Cardiomyopathy (HCM) (CD-12.3)

Echocardiogram (CPT® 93306) is indicated for individuals treated with mavacamten for class II-III obstructive HCM as follows:

Initiation of treatment

- Baseline-at the beginning of treatment
- 4 weeks after treatment initiation
- 8 weeks after treatment initiation
- 12 weeks after treatment initiation
- Then every 12 weeks while on mavacamten

Changes in treatment

- 4 weeks after any interruption of treatment (any missed dose)
- After any dosage change (including restart of treatment):
 - 4 weeks after dosage change
 - 12 weeks after dosage change
- After initiating a weak CYP2C19 inhibitor (e.g., omeprazole) or moderate CYP3A4 inhibitor (e.g., ciprofloxacin):
 - 4 weeks after start of medication
 - 12 weeks after start of medication
- At any time regardless of timing of prior echo when there are new cardiac signs or symptoms, or worsening of clinical status

See also **Hypertrophic Cardiomyopathy (HCM) (CD-14)**

Background and Supporting Information

Hypertrophic Cardiomyopathy (HCM) is a clinical diagnosis, established by imaging with 2D echocardiography or cardiovascular magnetic resonance (CMR) showing a maximal end-diastolic wall thickness of ≥ 15 mm anywhere in the left ventricle, in the absence of another cause of hypertrophy in adults. More limited hypertrophy (13–14 mm) can be diagnostic, particularly when present in family members of a patient with HCM or in conjunction with a positive genetic test, and/or associated with typical dynamic outflow obstruction, or distinctly abnormal ECG patterns.

References (CD-12)

CD.CS.0012.A

v1.0.2025

1. Hendel RC, Berman DS, Carli MFD, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 Appropriate Use Criteria for Cardiac Radionuclide Imaging. *Circulation*. 2009;119(22). doi:10.1161/circulationaha.109.192519.
2. Genentech: Herceptin® (trastuzumab) - Information for Healthcare Providers. Genentech: Herceptin® (trastuzumab) - Information for Healthcare Providers. <https://www.gene.com/medical-professionals/medicines/herceptin>.
3. Virizuela JA, García AM, Peñas RDL, et al. SEOM clinical guidelines on cardiovascular toxicity (2018). *Clinical and Translational Oncology*. 2019;21(1):94-105. doi:10.1007/s12094-018-02017-3.
4. Friedman DL, Hudson MM. Health Link: Heart Health. Long-Term Follow-Up Guidelines for Survivors of Childhood, Adolescent, and Young Adult Cancers. <http://www.survivorshipguidelines.org/>. Published October 2018.
5. Marian AJ, Braunwald E. Hypertrophic Cardiomyopathy: Genetics, Pathogenesis, Clinical Manifestations, Diagnosis, and Therapy. *Circ Res*. 2017;121(7):749-770. doi:10.1161/CIRCRESAHA.117.311059.
6. CAMZYOS. Highlights of Prescribing Information. Bristol Myers Squibb. April 2022. https://packageinserts.bms.com/pi/pi_camzyos.pdf.
7. Lopez-Mattei J, et al. Cardiac computed tomographic imaging in cardio-oncology: An expert consensus document of the Society of Cardiovascular Computed Tomography (SCCT). Endorsed by the International Cardio-Oncology Society (ICOS). *J Cardiovasc Comput Tomogr*. 2023 Jan-Feb;17(1):66-83.
8. Ehrhardt MJ, Leerink JM, et al. Systematic review and updated recommendations for cardiomyopathy surveillance for survivors of childhood, adolescent, and young adult cancer from the International Late Effects of Childhood Cancer Guideline Harmonization Group. *Lancet Oncol*. 2023 Mar;24(3):e108-e120.
9. Lyon AR, Wilhelm M, Zamorano JL. et al. 2022 ESC Guidelines on cardio-oncology developed in collaboration with the European Hematology Association (EHA), the European Society for Therapeutic Radiology and Oncology (ESTRO) and the International Cardio-Oncology Society (IC-OS). *Eur Heart J*. 2022 Nov 1;43(41):4229-4361.

Cardiac Sarcoidosis (CD-3.9)

CD.CS.0003.9.A

v1.0.2025

Cardiac Sarcoidosis (CD-3.9)

Suspected cardiac sarcoidosis (see Background and Supporting Information)

- MRI imaging of the heart with gadolinium (CPT® 75561). Initial imaging for identification of suspected cardiac sarcoid should be cardiac MRI with late gadolinium enhancement (LGE) protocol unless there is a contraindication to MRI imaging (non-MRI safe pacemaker, renal failure). Absence of LGE is a strong negative predictor for low rates of cardiac morbidity and mortality from cardiac sarcoid and further testing is not usually indicated.
- PET – Metabolic imaging with F-18 FDG for diagnosis if there is a contraindication to MRI and cardiac sarcoid is suspected. Requires PET with F-18 FDG metabolic study combined with a PET perfusion study (CPT® 78432 or CPT® 78433) **OR** PET metabolic study (CPT® 78459 or CPT® 78429) and SPECT perfusion image (CPT® 78451).
 - For equivocal MRI
 - To confirm diagnosis if suggested by MRI

Monitoring of treatment of established cardiac sarcoidosis

- PET - Cardiac PET metabolic is indicated to monitor therapy in cardiac sarcoidosis. Requires PET with F-18 FDG metabolic study combined with a PET perfusion study (CPT® 78432 or CPT® 78433) **OR** PET metabolic study (CPT® 78459 or CPT® 78429) and SPECT perfusion image (CPT® 78451).
 - Prior to treatment of cardiac sarcoid
 - PET (heart FDG metabolic with perfusion study as above) can be repeated at 3-6 month intervals if there is active disease or to make therapeutic decisions.

Background and Supporting Information

- Cardiac imaging is reasonable to detect cardiac sarcoid in the following:
 - Any patient with extra cardiac sarcoid even if no cardiac symptoms
 - Echo with basal thinning of the intraventricular septum, depressed EF <50 or regional wall motion abnormality not associated with CAD
 - Young patients with unexplained ventricular tachycardia, especially monomorphic VT

- Patients with unexplained cardiomyopathy or heart failure (i.e., CAD has been ruled out)
- Patients with unexplained arrhythmia especially advanced AV block or VT
- Full body PET/CT (CPT® 78815) is not indicated for the diagnosis or monitoring response to therapy of cardiac sarcoid. It may be considered to assist in diagnosis and/or treatment options in some instances of pulmonary sarcoid. See **Sarcoid (CH-15.1)** in the Chest Imaging Guidelines

References (CD-3.9)

CD.CS.0003.9.A

v1.0.2025

1. Birnie DH, Sauer WH, Bogun F, et al. HRS expert consensus statement on the diagnosis and management of arrhythmias associated with cardiac sarcoidosis. *Heart Rhythm*. 2014;11(7):1305-1323. doi:10.1016/j.hrthm.2014.03.043.
2. Blankstein R, Waller AH. Evaluation of Known or Suspected Cardiac Sarcoidosis. *Circ Cardiovasc Imaging*. 2016;9(3):e000867. doi:10.1161/CIRCIMAGING.113.000867.
3. Bravo PE, Singh A, Di Carli MF, Blankstein R. Advanced cardiovascular imaging for the evaluation of cardiac sarcoidosis. *J Nucl Cardiol*. 2019;26(1):188-199. doi:10.1007/s12350-018-01488-9.
4. Kim SJ, Pak K, Kim K. Diagnostic performance of F-18 FDG PET for detection of cardiac sarcoidosis; A systematic review and meta-analysis. *J Nucl Cardiol*. 2020;27(6):2103-2115. doi:10.1007/s12350-018-01582-y.
5. Manabe O, Oyama-Manabe N, Aikawa T, et al. Advances in Diagnostic Imaging for Cardiac Sarcoidosis. *J Clin Med*. 2021;10(24):5808. doi:10.3390/jcm10245808.
6. Ramirez R, Trivieri M, Fayad ZA, et al. Advanced Imaging in Cardiac Sarcoidosis. *J Nucl Med*. 2019;60(7):892-898. doi:10.2967/jnumed.119.228130
7. Writing group; Document reading group; EACVI Reviewers: This document was reviewed by members of the EACVI Scientific Documents Committee for 2014–2016 and 2016–2018. A joint procedural position statement on imaging in cardiac sarcoidosis: from the Cardiovascular and Inflammation & Infection Committees of the European Association of Nuclear Medicine, the European Association of Cardiovascular Imaging, and the American Society of Nuclear Cardiology. *Eur Heart J Cardiovasc Imaging*. 2017;18(10):1073-1089. doi:10.1093/ehjci/jex146.
8. Terasaki F, Azuma A, Anzai T, et al. JCS 2016 Guideline on Diagnosis and Treatment of Cardiac Sarcoidosis - Digest Version. *Circ J*. 2019;83(11):2329-2388. doi:10.1253/circj.CJ-19-0508.
9. Trivieri MG, Spagnolo P, Birnie D, et al. Challenges in Cardiac and Pulmonary Sarcoidosis: JACC State-of-the-Art Review. *J Am Coll Cardiol*. 2020;76(16):1878-1901. doi:10.1016/j.jacc.2020.08.042.
10. Ungprasert P, Carmona EM, Utz JP, et al. Epidemiology of Sarcoidosis 1946-2013: A Population-Based Study. *Mayo Clin Proc*. 2016;91(2):183-188. doi:10.1016/j.mayocp.2015.10.024.

Cardiac Trauma Imaging (CD-10.1)

CD.CS.0010.1.A

v1.0.2025

Cardiac Trauma Imaging (CD-10.1)

- One of the following can be used to evaluate cardiac or aortic trauma:
 - Echocardiogram (TTE, TEE)
 - Cardiac MRI Cardiac (CPT® 75557 or CPT® 75561, and CPT® 75565)
 - Cardiac CT Cardiac (CPT® 75572)
 - CCTA (CPT® 75574)
 - Chest CTA Chest (CPT® 71275)
 - Chest CT Chest (CPT® 71260, CPT® 71270)

References (CD-10)

CD.CS.0010.1.A

v1.0.2025

1. Conn A. Chest trauma. In: Trauma: A Comprehensive Emergency Medicine Approach. New York, NY: Cambridge University Press; 2011:190-212.
2. Stojanovska J, Hurwitz Koweek LM, Chung JH, et al. ACR Appropriateness Criteria® Blunt Chest Trauma-Suspected Cardiac Injury. Revised 2020. Am Coll Radiol (ACR). Available at <https://acsearch.acr.org/docs/3082590/Narrative/>.

Congestive Heart Failure (CD-9)

CD.CS.0009.A

v1.0.2025

CHF – Imaging (CD-9.1)

- Congestive heart failure (CHF), including post-cardiac transplant failure:
 - Echocardiogram is the first study after the clinical evaluation for suspected CHF.
 - MUGA, cardiac MRI or cardiac CT may be indicated if the ECHO is limited or does not completely answer the question.
 - Stress test to assess for CAD may be indicated. Follow stress testing guideline: **Stress Testing with Imaging – Indications (CD-1.4)**
- Arteriovenous fistula with “high output” heart failure:
 - CT Chest with contrast (CPT® 71260) and/or CT Abdomen and/or CT Pelvis with contrast (CPT® 74160 or CPT® 72193 or CPT® 74177) **OR**
 - CTA Chest (CPT® 71275) and/or CTA Abdomen and/or CTA Pelvis (CPT® 74175 or CPT® 72191 or CPT® 74174) **OR**
 - MRI Chest and/or MRI Abdomen and/or MRI Pelvis without and with contrast (CPT® 71552 and/or CPT® 74183 and/or CPT® 72197) **OR**
 - MRA Chest and/or MRA Abdomen and/or MRA Pelvis (CPT® 71555 and/or CPT® 74185 and/or CPT® 72198)
- Right-sided congestive heart failure can be a manifestation of pulmonary hypertension or serious lung disease.
 - CT Chest (CPT® 71260) or CTA Chest (CPT® 71275) to evaluate for recurrent pulmonary embolism

Evidence Discussion

- Congestive heart failure is a complex clinical syndrome with signs and symptoms that are a result of structural and/or functional impairment of ventricular ejection or filling which results in objective evidence of pulmonary or systemic congestion.
- Identification of the etiology of the cardiac dysfunction is crucial in the diagnosis of heart failure (HF) to determine subsequent management.
- Evaluation of HF usually entails multiple different diagnostic tools incorporating tools such as echocardiogram, stress testing, genetic testing, nuclear imaging, CT/ MRI imaging, endomyocardial biopsy and cardiac catheterization.
- Treatment of heart failure (HF) is targeted towards treating the underlying cause, improving the function and structure of the heart, reducing mortality and morbidity. This not only includes medications but may also entail the use of

cardiac resynchronization devices, monitoring devices, ventricular assist devices, cardiothoracic surgery and heart transplant.

Myocardial Sympathetic Innervation Imaging in Heart Failure (CD-3.6)

- Nuclear imaging using I-123-meta-iodobenzylguanidine (I-123-mIBG) in an attempt to image increased myocardial sympathetic activity is considered to be experimental and investigational.
- The AMA has established the following set of Category III codes to report these studies:
 - CPT® 0331T Myocardial sympathetic innervation imaging, planar qualitative and quantitative assessment
 - CPT® 0332T Myocardial sympathetic innervation imaging, planar qualitative and quantitative assessment; with tomographic SPECT.

Background and Supporting Information

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

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

Evidence Discussion

I-123-meta-iodobenzylguanidine (MIBG) imaging of the sympathetic nerve activity of the heart has been proposed and approved for the identification of patients with heart failure. However, its clinical utility has not found widespread acceptance and its clinical usefulness remains in question. There are no societal guidelines for its routine use. The guidelines contain many other imaging platforms such as echocardiography, magnetic resonance imaging, perfusion and metabolic imaging that have proven superior for the diagnosis and management of patients with heart failure.

Left ventricular assist devices (LVAD) (CD-9.4)

Left ventricular assist devices (LVAD) are implantable devices used in individuals with advanced heart failure refractory to medical therapy as a bridge to transplantation or as a destination therapy.

Pre-LVAD implant

The following imaging studies are indicated for preoperative evaluation prior to planned LVAD implant:

- TTE (CPT® 93306)
- 3D rendering for echocardiography (CPT® 76376 or CPT® 76377)
- Cardiac MRI (CPT® 75557 or CPT® 75561) and CMR velocity flow mapping (CPT® 75565)
- CT Chest (CPT® 71250 or CPT® 71260) or CTA Chest (CPT® 71275) or MRI Chest (CPT® 71552) or MRA Chest (CPT® 71555)
- CTA Abdomen and pelvis (CPT® 74174) or MRA abdomen and pelvis (CPT® 74185 and CPT® 72198)
- CT coronary angiography (CPT® 75574) in individuals post-coronary artery bypass grafting to assess the location and course of the bypass grafts to guide the surgical approach
- Transesophageal echocardiography (CPT® 93312, 93320, 93325)
- Right heart catheterization (CPT® 93451) or Right and left heart catheterization (CPT 93453)

Post LVAD implant

TTE (CPT® 93306) is indicated as follows:

- Post-implant at the following intervals:
 - 2 weeks
 - One month
 - Three months
 - Six months
 - Twelve months
 - Every 6 months thereafter

CT

- CTA Chest (CPT® 71275) or CT Chest with contrast (CPT® 71260) is indicated for evaluation of LVAD malfunction
- CT Chest without contrast (CPT® 71250) or CT Chest with contrast (CPT® 71260) indicated for the evaluation of LVAD-related infections

FDG PET/CT for LVAD driveline infection (CPT® 78815 or CPT® 78429)

- Early infection detection for LVAD drivelines is desirable, since once the infection extends to the cannula and pump pocket, eradication becomes difficult. CT findings are nonspecific and metal device artifacts of the driveline itself affects sensitivity.
- FDG PET/CT can be approved for suspected LVAD infection if other studies and examination remain inconclusive.

- See **FDG PET/CT for Infections (CD-6.5)**

Right heart catheterization (RHC)

- RHC (CPT® 93451) or Right and Left heart catheterization (CPT® 93453) as needed for hemodynamic assessment to guide changes to therapy

References (CD-9)

CD.CS.0009.A

v1.0.2025

1. Yancy CW, Jessup M, Bozkurt B, et al. 2013 ACCF/AHA Guideline for the Management of Heart Failure: Executive Summary: A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2013;128(16):1810-1852. doi:10.1161/cir.0b013e31829e8807.
2. Yancy CW, Jessup M, Bozkurt B, et al. 2016 ACC/AHA/HFSA Focused Update on New Pharmacological Therapy for Heart Failure: An Update of the 2013 ACCF/AHA Guideline for the Management of Heart Failure. *Journal of Cardiac Failure*. 2016;22(9):659-669. doi:10.1016/j.cardfail.2016.07.001.
3. Ponikowski P, Voors AA, Anker SD, et al. 2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. *European Heart Journal*. 2016;37(27):2129-2200. doi:10.1093/eurheartj/ehw128.
4. Nakata T, Nakajima K, Yamashina S, et al. A Pooled Analysis of Multicenter Cohort Studies of 123I-mIBG Imaging of Sympathetic Innervation for Assessment of Long-Term Prognosis in Heart Failure. *JACC: Cardiovascular Imaging*. 2013;6(7):772-784. doi:10.1016/j.jcmg.2013.02.007.
5. Stainback RF, Estep JD, Agler DA, et al. Echocardiography in the Management of Patients with Left Ventricular Assist Devices: Recommendations from the American Society of Echocardiography. *Journal of the American Society of Echocardiography*. 2015;28(8):853-909. doi:10.1016/j.echo.2015.05.008.
6. Slaughter MS, Pagani FD, Rogers JG, et al. Clinical management of continuous-flow left ventricular assist devices in advanced heart failure. *The Journal of Heart and Lung Transplantation*. 2010;29(4). doi:10.1016/j.healun.2010.01.011.
7. Kirklin JK, Pagani FD, Goldstein DJ, et al. American Association for Thoracic Surgery/International Society for Heart and Lung Transplantation guidelines on selected topics in mechanical circulatory support. *J Thorac Cardiovasc Surg*. 2020;159(3):865-896. doi:10.1016/j.jtcvs.2019.12.021.
8. Saeed D, Feldman D, Banayosy AE, et al. The 2023 International Society for Heart and Lung Transplantation Guidelines for Mechanical Circulatory Support: A 10- Year Update. *J Heart Lung Transplant*. 2023;42(7):e1-e222. doi:10.1016/j.healun.2022.12.004.
9. Pergola V, Cameli M, Dandel M, Soliman-Aboumarie H. Editorial: Multimodality imaging of left ventricular assist devices: applications in advanced heart failure. *Front Cardiovasc Med*. 2023;10:1277563. Published 2023 Sep 28. doi:10.3389/fcvm.2023.1277563.
10. Masarone D, Houston B, Falco L, et al. How to Select Patients for Left Ventricular Assist Devices? A Guide for Clinical Practice. *J Clin Med*. 2023;12(16):5216. Published 2023 Aug 10. doi:10.3390/jcm12165216.
11. Tamaki N, Manabe O. Current status and perspectives of nuclear cardiology. *Ann Nucl Med*. 2024 Jan;38(1):20-30. doi: 10.1007/s12149-023-01878-1.
12. Saraste A, Stähle M, Roivainen A, Knuuti J. Molecular Imaging of Heart Failure: An Update and Future Trends. *Semin Nucl Med*. 2024 Apr 11:S0001-2998(24)00028-X. doi: 10.1053/j.semnuclmed.2024.03.005.
13. Doherty JU, Kort S, Mehran R, et al. ACC/AATS/AHA/ASE/ASNC/HRS/SCAI/SCCT/SCMR/STS 2019 appropriate use criteria for multimodality imaging in the assessment of cardiac structure and function in nonvalvular heart disease: A report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and the Society of Thoracic Surgeons. *J Thorac Cardiovasc Surg*. 2019 Apr;157(4):e153-e182. doi: 10.1016/j.jtcvs.2018.12.061.

Cardiac Surgery Imaging (CD-13)

CD.CS.0013.A

v1.0.2025

Pre-Surgical Cardiac Testing – General Information (CD-13.1)

- It is important to differentiate requests for preoperative CT imaging before cardiac surgery according to type of procedure planned:
 - Primary cardiac operation—individuals who have not had prior heart surgery
 - Redo procedures—individuals who have had a prior procedure (it is important to determine the type of procedure as this may impact which modality is most appropriate for the pre-operative assessment)
 - Minimally invasive procedures, such as minimally invasive aortic valve operations, minimally invasive or robotic mitral operations, TAVR, MitraClip™ or other percutaneous valve procedures (such as valve in valve aortic or mitral, percutaneous tricuspid and TMVR which will be increasing in the future)
- In re-operative cardiac surgery, the benefit of preoperative CT is to assess for aortic calcifications, to evaluate the anatomic relationships in the mediastinum, such as the location of the various cardiac chambers and great vessels and proximity to the sternum, and to assess for the location of prior bypass grafts. Information can then be used to change the operative strategy including non-midline approach, peripheral vascular exposure, and alternative cannulation sites and for establishing cardiopulmonary bypass before re-sternotomy. These techniques can result in decreased incidence of intraoperative injury to heart, great vessels and prior bypass grafts and lower rates of postoperative stroke. IV contrast is necessary with these studies to delineate the anatomic structures. However, in individuals with renal insufficiency, the provider might choose to forgo the contrast if does not want to contrast load the individual prior to placing them on the heart-lung machine.
- Aortic atherosclerosis is recognized as the single most important determinant of postoperative stroke. There is evidence to support that preoperative CT is associated with lower postoperative stroke rates and mortality after primary cardiac surgery.
 - CT Chest without contrast (CPT® 71250) can be performed pre-operatively to allow the surgeon to:
 - Visualize the extent and location of aortic atherosclerosis
 - Change the operative strategy such as those problematic areas are avoided

Primary Cardiac Surgery – No Previous Cardiac Surgery (CD-13.2)

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

Re-operative cardiac surgery (CD-13.3)

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

Minimally Invasive or Robotic Cardiac Surgery (CD-13.4)

- CTA Chest CPT® 71275 (or CT Chest with contrast CPT® 71260) and CTA Abdomen and Pelvis CPT® 74174 (or CT Abdomen and Pelvis with contrast CPT® 74177) are indicated for pre-operative assessment of suitability for the approach and for procedural planning of arterial and venous cannulation and cardiopulmonary bypass for individuals being considered for minimally invasive or robotic cardiac surgical procedures including the following:
 - Valve repair or replacement
 - Coronary artery bypass graft surgery
 - Aortic root or ascending aorta repair
 - Resection of intracardiac tumor, or thrombus or vegetation
 - Open lead extraction
 - Atrial septal defect repair

Transcatheter Valve Interventions (CD-13.5)

Transcatheter Mitral Valve Repair (mitral valve clip)

- The following imaging may be used to determine if an individual is eligible for the procedure:
 - Transthoracic echo (TTE) (CPT® 93306) with or without 3D rendering
 - Transesophageal echo with or without 3D rendering
 - Heart catheterization, including right heart cath if requested
- CTA/CTV of Chest, Abdomen, and Pelvis is not indicated prior to planned transcatheter mitral or tricuspid valve repair.
- Post-procedure transthoracic echo (TTE) can be performed at the following intervals:
 - One month
 - Six months
 - One year
 - Then annually

Transcatheter Tricuspid Valve Replacement

Pre-procedure imaging

- The following imaging studies are indicated to determine eligibility and for procedure planning Pre- Transcatheter Tricuspid Valve Replacement (TTVR):
 - Cardiac CT CPT® 75572
 - CTV Chest CPT® 71275
 - CTV Abdomen and pelvis CPT® 74174

Post-procedure follow up

- TTE (CPT® 93306) is indicated post-procedure at the following intervals:
 - 1 month
 - 6 months
 - 1 year
 - Then annually

Background and Supporting Information

Transcatheter Mitral Valve Repair (mitral valve clip)

Percutaneous treatment of mitral regurgitation can be accomplished using venous access to apply a clip device (e.g., MitraClip™ currently FDA approved) to provide edge-to-edge mitral leaflet coaptation, approximating opposing sections of the anterior and posterior mitral valve leaflets. FDA approved indications include treatment for individuals with symptomatic, moderate to severe or severe primary

mitral regurgitation whose surgical risks are prohibitive, as well as symptomatic moderate to severe or severe secondary mitral regurgitation who have failed optimal medical therapy. This therapy should include, if indicated, cardiac resynchronization therapy.

Transcatheter Tricuspid Valve Replacement

Transcatheter Tricuspid Valve Replacement device (EVOQUE) is currently FDA-approved. In individuals being considered for transcatheter tricuspid or mitral valve replacement, Cardiac CT CPT® 75572 provides detailed imaging of the valve annulus including measurement of valve annulus to guide selection of the appropriate sized valve. CTV Chest CPT® 71275 and CTV Abdomen and pelvis CPT® 74174 provide imaging of the iliac veins and inferior vena cava to exclude stenosis or significant tortuosity and aid in determining eligibility and procedure planning.

Transcatheter aortic valve replacement (TAVR)

Pre-TAVR imaging

Pre-aortic valve replacement

- Once the decision has been made for aortic valve replacement, the following may be used to determine if an individual is a candidate for TAVR:
 - CTA Chest (CPT® 71275), Abdomen and Pelvis (combination code CPT® 74174) are indicated, and
 - CT Cardiac (CPT® 75572) is indicated to measure the aortic annulus or
 - Coronary CTA (CCTA CPT® 75574) is indicated to both measure the aortic annulus and assess the coronary arteries in lieu of heart catheterization
- A repeat diagnostic left heart catheterization is **not** medically necessary when the individual is undergoing a transcatheter aortic valve replacement (TAVR).

Transfemoral access not feasible

Alternative imaging can be obtained to evaluate vascular access for TAVR in individuals for whom it is documented either via the office note or prior imaging that transfemoral access would not be feasible due to **any** of the following exclusion criteria:

- Small vessels
- Highly calcified vessels
- Stenosed or occluded vessels
- Prior aortoiliac vascular intervention

Imaging is indicated based on the documented intended access site (transaxillary or transcarotid) and should be of the involved body areas. The following studies are indicated based on the documented planned access site:

- CTA of the Head (CPT® 70496) and/or Neck (CPT® 70498) for transcarotid access

- CTA of the Chest (CPT® 71275) and/or Upper extremity (CPT® 73206) for transaxillary access

Post-TAVR imaging

CT Cardiac (CPT® 75572) is indicated:

- If any of the post-TAVR TTEs are indeterminate or raises a concern about any of the following:
 - Valve thrombosis
 - Infective endocarditis
 - Structural degeneration
- When a Valve in Valve implantation or surgical re-do AVR is being contemplated
- Routine CT surveillance or follow up for incidental Hypoattenuated Leaflet Thickening (HALT) with or without restricted leaflet motion, also referred to as Hypoattenuation Affecting Motion (HAM) is NOT recommended

Evidence Discussion (CD-4.6 - CD-4.8)

The ability of the cardiac CT technology to provide a tomographic view of the cardiovascular system has resulted in its ubiquitous adoption in the pre-procedure planning for almost all cardiac structural interventions. Specifically, cardiac CT circumvents the image window limitation of echocardiography, it allows high definition visualization of the posterior structures and facilitates pre-procedural planning for pulmonary vein isolation, coronary sinus pacer leads insertion and left atrial appendage occlusion device implantation, among other trans-catheter structural interventions.

The success of a Trans-catheter Aortic Valve Replacement (TAVR) procedure is contingent upon a meticulous pre-TAVR planning imaging study where cardiac CT allows accurate annulus sizing, coronary heights measurement, and calcification distribution evaluation, in addition to access site planning. Post-operatively, clinically suspected complications such as thrombus formation, infective endocarditis or structural degeneration can be confirmed on a cardiac CT; a routine surveillance strategy, however, is not supported because of unclear or even potentially harmful outcome of treating incidental findings.

In non-interventional settings, cardiac CT provides an alternative to cardiac MRI when structural information cannot be adequately obtained by an echocardiography. Most notably, the evaluation of a cardiac mass, extent of pericardial disease, complex congenital heart disease and cardiomyopathy, can be performed by a cardiac CT when cardiac MRI is not available or contraindicated.

References (CD-13)

CD.CS.0013.A

v1.0.2025

1. Cantinotti M. The importance and ways of exploring the entire chest before and after cardiac surgery: Chest radiography, lung ultrasonography, and computed tomography. *The Journal of Thoracic and Cardiovascular Surgery*. 2018;155(5):2041-2042. doi:10.1016/j.jtcvs.2018.01.032.
2. Merlo A, Chen K, Deo S, Markowitz A. Does routine preoperative computed tomography imaging provide clinical utility in patients undergoing primary cardiac surgery? *Interactive Cardiovascular and Thoracic Surgery*. 2017;25(4):659-662. doi:10.1093/icvts/ivx098.
3. Erthal F, Inacio JR, Hazra S, Chan V, Chow BJW. Cardiac Computed Tomography Before and After Cardiac Surgery. *J Thorac Imaging*. 2018 May;33(3):156-167. doi:10.1097/RTI.0000000000000295.
4. Moodley S, Schoenhagen P, Gillinov AM, et al. Preoperative multidetector computed tomography angiography for planning of minimally invasive robotic mitral valve surgery impact on decision making. *J Thorac Cardiovasc Surg*. 2013 Aug;146(2):262-8. doi:10.1016/j.jtcvs.2012.06.052.
5. den Harder AM, de Heer LM, Meijer RC, et al. Effect of computed tomography before cardiac surgery on surgical strategy, mortality and stroke. *Eur J Radiol*. 2016 Apr;85(4):744-50. doi:10.1016/j.ejrad.2016.01.003.
6. Dass C, Simpson SA, Steiner RM, Guy TS. Preprocedural Computed Tomography Evaluation for Minimally Invasive Mitral Valve Surgery. *Journal of Thoracic Imaging*. 2015;30(6):386-396. doi:10.1097/rti.0000000000000170.
7. Adler Y, Fisman EZ, Shemesh J, et al. Spiral computed tomography evidence of close correlation between coronary and thoracic aorta calcifications. *Atherosclerosis*. 2004 Sep;176(1):133-8. doi: 10.1016/j.atherosclerosis.2004.03.027.
8. van der Linden J, Hadjiniakolaou L, Bergman P, et al. Postoperative stroke in cardiac surgery is related to the location and extent of atherosclerotic disease in the ascending aorta. *J Am Coll Cardiol*. 2001 Jul;38(1):131-5. doi:10.1016/s0735-1097(01)01328-6.
9. Lapar DJ, Ailawadi G, Irvine JN Jr, et al. Preoperative computed tomography is associated with lower risk of perioperative stroke in reoperative cardiac surgery. *Interact Cardiovasc Thorac Surg*. 2011 Jun;12(6):919-23. doi:10.1510/icvts.2010.265165.
10. Nishi H, Mitsuno M, Tanaka H, Ryomoto M, Fukui S, Miyamoto Y. Who needs preoperative routine chest computed tomography for prevention of stroke in cardiac surgery? *Interact Cardiovasc Thorac Surg*. 2010 Jul;11(1):30-3. doi:10.1510/icvts.2009.231761.
11. Akhtar NJ, Markowitz AH, Gilkeson RC. Multidetector computed tomography in the preoperative assessment of cardiac surgery patients. *Radiol Clin North Am*. 2010 Jan;48(1):117-39. doi:10.1016/j.rcl.2009.09.002.
12. Khan NU, Yonan N. Does preoperative computed tomography reduce the risks associated with re-do cardiac surgery? *Interact Cardiovasc Thorac Surg*. 2009 Jul;9(1):119-23. doi:10.1510/icvts.2008.189506.
13. Bergman P, Linden JVD, Forsberg K, Öhman M. Preoperative Computed Tomography or Intraoperative Epiaortic Ultrasound for the Diagnosis of Atherosclerosis of the Ascending Aorta? *The Heart Surgery Forum*. 2004;7(3). doi:10.1532/hfs98.20033009.
14. Lee R, Matsutani N, Polimenakos AC, et al. Preoperative noncontrast chest computed tomography identifies potential aortic emboli. *Ann Thorac Surg*. 2007 Jul;84(1):38-41; discussion 42.
15. Nishi H, Mitsuno M, Ryomoto M, Miyamoto Y. Comprehensive approach for clamping severely calcified ascending aorta using computed tomography. *Interactive Cardiovascular and Thoracic Surgery*. 2010;10(1):18-20. doi:10.1510/icvts.2009.216242.
16. Aviram G, Sharony R, Kramer A, et al. Modification of Surgical Planning Based on Cardiac Multidetector Computed Tomography in Reoperative Heart Surgery. *The Annals of Thoracic Surgery*. 2005;79(2):589-595. doi:10.1016/j.athoracsur.2004.07.012.
17. Harder AMD, Heer LMD, Maurovich-Horvat P, et al. Ultra low-dose chest CT with iterative reconstructions as an alternative to conventional chest x-ray prior to heart surgery (CRICKET study): Rationale and design of a multicenter randomized trial. *Journal of Cardiovascular Computed Tomography*. 2016;10(3):242-245. doi:10.1016/j.jcct.2016.01.016.

18. O'gara PT, Grayburn PA, Badhwar V, et al. 2017 ACC Expert Consensus Decision Pathway on the Management of Mitral Regurgitation. *J Am Coll Cardiol*. 2017;70(19):2421-2449. doi:10.1016/j.jacc.2017.09.019.
19. Doherty JU, Kort S, Mehran R, Schoenhagen P, Soman P. ACC/AATS/AHA/ASE/ASNC/HRS/SCAI/SCCT/SCMR/STS 2017 appropriate use criteria for multimodality imaging in valvular heart disease: a report of the American College of Cardiology Appropriate Use Criteria Task Force, American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and Society of Thoracic Surgeons. *J Am Coll Cardiol* 2017;70:1647–72. doi:10.1007/s12350-017-1070-1.
20. Nishi H, Mitsuno M, Tanaka H, Ryomoto M, Fukui S, Miyamoto Y. Who needs preoperative routine chest computed tomography for prevention of stroke in cardiac surgery? *Interactive Cardiovascular and Thoracic Surgery*. 2010;11(1):30-33. doi:10.1510/icvts.2009.231761.
21. Ramchandani M, Al Jabbari O, Abu Saleh WK, Ramlawi B. Cannulation Strategies and Pitfalls in Minimally Invasive Cardiac Surgery. *Methodist Debaquey Cardiovasc J*. 2016 Jan-Mar;12(1):10-3. doi: 0.14797/mdcj-12-1-10.
22. Langer NB, Argenziano M. Minimally Invasive Cardiovascular Surgery: Incisions and Approaches. *Methodist Debaquey Cardiovasc J*. 2016 Jan-Mar;12(1):4-9. doi: 10.14797/mdcj-12-1-4.
23. Ilcheva L, Risteski P, Tudorache I, et al. Beyond Conventional Operations: Embracing the Era of Contemporary Minimally Invasive Cardiac Surgery. *J Clin Med*. 2023 Nov 21;12(23):7210. doi: 10.3390/jcm12237210.
24. El-Sayed Ahmad A, Salamate S, Bakhtiyar F. Lessons learned from 10 years of experience with minimally invasive cardiac surgery. *Front Cardiovasc Med*. 2023 Jan 9;9:1053572. doi: 0.3389/fcvm.2022.1053572.
25. Edwards EVOQUE Tricuspid Valve Replacement System FDA Approval <https://www.fda.gov/medical-devices/recently-approved-devices/edwards-evoque-tricuspid-valve-replacement-system-p230013>
26. Barreiro-Pérez M, González-Ferreiro R, Caneiro-Queija B, et al. Transcatheter Tricuspid Valve Replacement: Illustrative Case Reports and Review of State-of-Art. *J Clin Med*. 2023 Feb 9;12(4):1371. doi: 10.3390/jcm12041371.
27. Kodali S, Hahn RT, George I, et al.; TRISCEND Investigators. Transfemoral Tricuspid Valve Replacement in Patients With Tricuspid Regurgitation: TRISCEND Study 30-Day Results. *JACC Cardiovasc Interv*. 2022 Mar 14;15(5):471-480. doi: 10.1016/j.jcin.2022.01.016.
28. Kodali S, Hahn RT, Makkar R, et al. Transfemoral tricuspid valve replacement and one-year outcomes: the TRISCEND study. *Eur Heart J*. 2023 Dec 7;44(46):4862-4873. doi: 10.1093/eurheartj/ehad667.
29. Webb JG, Chuang AM, Meier D, et al. Transcatheter Tricuspid Valve Replacement With the EVOQUE System: 1-Year Outcomes of a Multicenter, First-in-Human Experience. *JACC Cardiovasc Interv*. 2022 Mar 14;15(5):481-491. doi: 10.1016/j.jcin.2022.01.280.
30. Oh NA, Kampaktsis PN, Gallo M, Guariento A, Weixler V, Staffa SJ, Avgerinos DV, Colli A, Doulamis IP. An updated meta-analysis of MitraClip versus surgery for mitral regurgitation. *Ann Cardiothorac Surg*. 2021 Jan;10(1):1-14. doi: 10.21037/acs-2020-mv-24.
31. McKellar SH, Harkness J, Reid BB, Sekaran NK, May HT, Whisenant BK. Residual or recurrent mitral regurgitation predicts mortality following transcatheter edge-to-edge mitral valve repair. *JTCVS Open*. 2023 Oct 31;16:191-206. doi: 10.1016/j.xjon.2023.10.019.

Pulmonary Hypertension (PH) (CD-8.1)

CD.CS.0008.1.A

v1.0.2025

Pulmonary Hypertension - Imaging indications

Transthoracic echocardiogram (TTE) (CPT® 93306) should be performed initially as it can help determine the probability of pulmonary hypertension.

Screening

A screening echocardiogram (TTE) for PH is indicated in individuals with documented history of **any** of the following:

- Individuals preoperatively for planned liver transplant.
- Individuals evaluated for transjugular portosystemic shunt
- Portal Hypertension
- Liver disease with signs and symptoms of PH
- Bronchopulmonary dysplasia

Annual screening echo (TTE) is indicated in individuals with a documented history of any of the following:

- Systemic sclerosis (SSc)
- Individuals with PH mutations (e.g., BMPR2)
- First-degree relatives of individuals with PH
- Connective tissue disorder with symptoms consistent with PH
- Individuals with TR velocity ≥ 2.8 m/s, with no other findings on additional testing
- Individuals being treated with medications associated with PH
- Individuals who have a concern documented for PH and had a negative echocardiogram but still show signs or symptoms of PH

Follow-up testing is not indicated in individuals with TR velocity < 2.8 m/s and no other signs, symptoms, or risk factors of PH

Initial imaging

Transthoracic echocardiogram (TTE) (CPT® 93306) is indicated for symptoms and signs of pulmonary hypertension (PH) including **any** of the following:

- Notes documenting clinical concern for pulmonary hypertension
- EKG findings concerning for PH such as **any** of the following:
 - Right ventricular hypertrophy (RVH)

- Right axis deviation
- Right atrial enlargement
- Right ventricular hypertrophy or pulmonary artery dilation on other images
- History of pulmonary embolism with persistent or new onset DOE, or exercise limitation
- Suspected PH in individuals with lung disease
- DOE in individuals with connective tissue disorder, HIV, portal hypertension, SSc.
- Symptoms of PH (**any** of the following):
 - Breathlessness
 - SOB
 - Decreased exercise tolerance
 - Fatigue and rapid exhaustion
 - Palpitations
 - Dyspnea on bending forward
 - Hemoptysis
 - Exercise induced abdominal distention and nausea
 - Weight gain due to fluid retention
 - Syncope during or shortly after physical activity
 - Exertional chest pain

Stress Echo (CPT® 93350 or 93351) is indicated for **any** of the following:

- To assess for treatment in the setting of concomitant valvular disease
- As indicated by **Stress Testing with Imaging - Indications (CD-1.4)** or **Stress Echo-Indications Other than Ruling out CAD (CD-2.7)**
- There is documented concern for chronic thrombo-embolic pulmonary hypertension

Cardiac MRI (CPT® 75557) is indicated when there is documentation of **any** of the following:

- TTE is equivocal or unclear (e.g., for RV function) and the information is needed for management
- MRI and TTE may both be required for individuals who need RV pressure and function assessed, and prior RV function cannot be assessed by echocardiogram
- MRI can replace TTE when the issue that makes the imaging by echo unclear is likely to be seen in future echocardiograms

Other advanced imaging is indicated after TTE for the following:

- High-resolution CT Chest (CPT® 71250) is indicated in the setting of hypoxemia to rule out restrictive lung disorders such as pulmonary fibrosis
- CTA Chest (CPT® 71275) or MRA Chest (CPT® 71555) is indicated to evaluate for suspected acute and/or chronic pulmonary embolism

- V/Q scan (CPT® 78580-Pulmonary Perfusion Imaging or CPT® 78582- Pulmonary Ventilation (e.g., Aerosol or Gas) and Perfusion Imaging) is indicated to evaluate for any of the following:
 - Suspected acute pulmonary embolism
 - To evaluate for chronic thromboembolic pulmonary hypertension at 3 to 6 months post pulmonary embolism if both of the following apply:
 - Persistent or new onset dyspnea on exertion or exercise limitation
 - Evidence of pulmonary hypertension on follow up echo
 - To evaluate for chronic thromboembolic pulmonary hypertension in individuals with pulmonary hypertension of uncertain etiology
- SPECT imaging (CPT® 78803) or SPECT/CT imaging (CPT® 78830) can be added to V/Q scan if requested
- Transesophageal (TEE) contrast echocardiography or other imaging techniques (e.g.,CT angiography, cardiac MRI) may be indicated, in addition to 2D Doppler and contrast examinations, to identify CHD to detect or exclude **any** of the following:
 - Sinus venosus
 - Atrial septal defects
 - Patent ductus arteriosus
 - Anomalous pulmonary venous connections

Indications for initial Catheterization

Right heart catheterization (RHC) is indicated for **any** of the following:

- Echo findings
 - TR velocity ≥ 3.4 m/second
 - TR velocity ≥ 2.9 m/second and presence of other PH signs on echo or other testing, or risk factors or associated indications
- Individuals with SSc where breathlessness remains unexplained (RHC is recommended despite normal echocardiogram).
- Individuals with connective tissue disorder who have symptoms or concerns for PH with a negative or equivocal echocardiogram.
- When recommended to determine if shunt closure is recommended due to congenital heart disease
- RHC if **moderate** to **severe** PH on echocardiogram (See **Background and Supporting Information** for definitions of mild, moderate and severe PH)
- RHC is indicated prior to starting PH medical therapy.
- Individuals with **low**-risk profile (based on an evidence based PAH Risk Score Calculator such as REVEAL 2.0, ESC/ERS & Compera 2.0) only need cath if indicated for another reason or equivocal studies.(See **Background and Supporting Information** for additional information about PH risk profile)
- RHC allowed when LHC indicated for separate indication.

- RHC preoperative for surgical intervention treating the cause of PH (MV, TV, AV, PV).
- Eisenmenger syndrome – RHC is indicated when requested by provider.

Left heart catheterization (LHC) or Right and left heart catheterization as per the following guidelines:

- **Evaluation of Conditions Other than Coronary Artery Disease (CD-7.7)**
- **Diagnostic Left Heart Catheterization (LHC) (CD-7.3)**

Repeat Testing

Follow-up echocardiogram (TTE) on patients with PH

- Every 6 months for surveillance of stable individuals with moderate or severe pulmonary hypertension (pulmonary artery systolic pressure ≥ 50 mm Hg)
- Prior to planned intubation (e.g., for elective surgery)
- Prior to planned pregnancy
- During pregnancy as often as requested by provider
- Anytime, without regard for the number or timing of previous ECHO studies to evaluate either:
 - Change in therapy
 - Change in clinical findings or symptoms
- Echocardiogram at baseline then every 3 months with therapy changes in stable patients

Pulmonary embolism (PE)

- TTE is indicated 3 to 6 months post pulmonary embolism if **any** of the following apply:
 - Persistent or new onset dyspnea on exertion, or exercise limitation
 - Pulmonary hypertension or right ventricular dysfunction on initial echo at PE diagnosis
 - History of recurrent pulmonary embolism

RHC is indicated for known PH as follows:

- At baseline
- Then every 6 months
- Anytime for clinical changes or with treatment changes

Other related sections

- **Frequency of Echocardiography Testing (CD-2.3)** in the Cardiac Imaging Guidelines
- **Right Heart Catheterization (RHC) (CD-7.4)** in the Cardiac Imaging Guidelines
- **Pulmonary hypertension (PHT) and Eisenmenger syndrome (CD-11.3.12)** in the Cardiac Imaging Guidelines

- **Congenital Heart Disease Modality Considerations (PEDCD-2.3)** in the Pediatric Cardiac Imaging Guidelines
- **Pediatric Pulmonary Hypertension - General (PEDCD-7)** in the Pediatric Cardiac Imaging Guidelines
- Pulmonary Embolism (PE) (CH-25) in the Chest Imaging Guidelines

Background and Supporting Information

Pulmonary hypertension (PH) is a complex, chronic disease with multiple etiologies, that requires extensive evaluation, including ECG (right ventricular hypertrophy with/without strain, right atrial dilatation); chest x-ray; arterial blood gas, pulmonary function testing, CT angiography based on the etiology.

PH can be subdivided into the following five groups based on the underlying cause:

- Pulmonary arterial hypertension (PAH)
- PH due to left heart disease
- PH due to lung disease
- Chronic thromboembolic PH (CTEPH)
- PH with unclear and/or multifactorial mechanisms

Probability of PH is assessed at initial evaluation:

- High probability:
 - TR velocity ≥ 3.4 m/s
 - TR velocity between 2.9 to 3.4 m/s and **one** of the following:
 - Right ventricle or pulmonary artery enlargement
 - Interventricular septum flattening
 - Right ventricular systolic dysfunction
- Intermediate probability:
 - TR velocity between 2.9 to 3.4 m/s in the absence of other signs of PH
- Low probability:
 - TR velocity < 2.8 m/s

Peak TR velocity ≥ 2.8 m/s may suggest PH; however, the presence or absence of PH cannot be reliably determined by TR velocity alone

In addition to the tricuspid regurgitation velocity, other findings on echo can increase the probability of PH, examples of these findings include:

- Abnormal tricuspid annular plane systolic excursion (TAPSE)
- Abnormal RV fractional area change (RV-FAC)
- Abnormal RV free-wall strain
- Abnormal tricuspid annulus velocity (S' wave) derived from tissue Doppler imaging
- Abnormal RV ejection fraction (RVEF) derived from 3D echocardiography

MRI can be a useful test especially with respect to RV function

Right heart cath is the gold standard for diagnosing PH

See **Severe Pulmonary Artery Hypertension (PH) and Eisenmenger Syndrome (CD-11.3.12)** for additional information regarding Eisenmenger Syndrome

References (CD-8)

CD.CS.0008.1.A

v1.0.2025

1. Abman SH, Hansmann G, Archer SL, et al. Pediatric Pulmonary Hypertension: Guidelines From the American Heart Association and American Thoracic Society [published correction appears in *Circulation*. 2016 Jan 26;133(4):e368]. *Circulation*. 2015;132(21):2037-2099. doi:10.1161/CIR.0000000000000329.
2. Alabed S, Shahin Y, Garg P, et al. Cardiac-MRI Predicts Clinical Worsening and Mortality in Pulmonary Arterial Hypertension: A Systematic Review and Meta-Analysis [published correction appears in *JACC Cardiovasc Imaging*. 2021 Apr;14(4):884]. *JACC Cardiovasc Imaging*. 2021;14(5):931-942. doi:10.1016/j.jcmg.2020.08.013.
3. Alabed S, Uthoff J, Zhou S, et al. Machine learning cardiac-MRI features predict mortality in newly diagnosed pulmonary arterial hypertension. *European Heart Journal - Digital Health*. 2022;3(2):265-275. doi:10.1093/ehjdh/ztac022.
4. Bossone E, Dellegrottaglie S, Patel S, et al. Multimodality imaging in pulmonary hypertension. *Can J Cardiol*. 2015;31(4):440-459. doi:10.1016/j.cjca.2015.02.012.
5. Broncano J, Bhalla S, Gutierrez FR, et al. Cardiac MRI in Pulmonary Hypertension: From Magnet to Bedside. *Radiographics*. 2020;40(4):982-1002. doi:10.1148/rg.2020190179.
6. Dong Y, Pan Z, Wang D, et al. Prognostic Value of Cardiac Magnetic Resonance-Derived Right Ventricular Remodeling Parameters in Pulmonary Hypertension: A Systematic Review and Meta-Analysis. *Circ Cardiovasc Imaging*. 2020;13(7):e010568. doi:10.1161/CIRCIMAGING.120.010568.
7. Expert Panel on Thoracic Imaging, Sirajuddin A, Mirmomen SM, et al. ACR Appropriateness Criteria[®] Suspected Pulmonary Hypertension: 2022 Update. *J Am Coll Radiol*. 2022;19(11S):S502-S512. doi:10.1016/j.jacr.2022.09.018.
8. Goh ZM, Balasubramanian N, Alabed S, et al. Right ventricular remodelling in pulmonary arterial hypertension predicts treatment response. *Heart*. 2022;108(17):1392-1400. Published 2022 Aug 11. doi:10.1136/heartjnl-2021-320733.
9. Hulten EA, Bradley AJ. Cardiac Magnetic Resonance Evaluation of Pulmonary Arterial Hypertension: Transforming From Supplementary to Primary Imaging Modality? *JACC Cardiovasc Imaging*. 2021;14(5):943-946. doi:10.1016/j.jcmg.2020.11.022.
10. Humbert M, Kovacs G, Hoeper MM, et al. 2022 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension. *Eur Heart J*. 2022;43(38):3618-3731. doi:10.1093/eurheartj/ehac237.
11. Kaemmerer H, Apitz C, Brockmeier K, et al. Pulmonary hypertension in adults with congenital heart disease: Updated recommendations from the Cologne Consensus Conference 2018. *Int J Cardiol*. 2018;272S:79-88. doi:10.1016/j.ijcard.2018.08.078.
12. Lewis MJ, Van Dissel A, Kochav J, et al. Cardiac MRI predictors of adverse outcomes in adults with a systemic right ventricle. *ESC Heart Fail*. 2022;9(2):834-841. doi:10.1002/ehf2.13745.
13. Mazurek A, Dziuk M, Witkowska-Patena E, Piszczek S, Gizewska A. The Utility of Hybrid SPECT/CT Lung Perfusion Scintigraphy in Pulmonary Embolism Diagnosis. *Respiration*. 2015;90(5):393-401. doi:10.1159/000439543.
14. McLaughlin VV, Archer SL, Badesch DB, et al. ACCF/AHA 2009 expert consensus document on pulmonary hypertension a report of the American College of Cardiology Foundation Task Force on Expert Consensus Documents and the American Heart Association developed in collaboration with the American College of Chest Physicians; American Thoracic Society, Inc.; and the Pulmonary Hypertension Association. *J Am Coll Cardiol*. 2009;53(17):1573-1619. doi:10.1016/j.jacc.2009.01.004.
15. Moledina S, Pandya B, Bartsota M, et al. Prognostic significance of cardiac magnetic resonance imaging in children with pulmonary hypertension. *Circ Cardiovasc Imaging*. 2013;6(3):407-414. doi:10.1161/CIRCIMAGING.112.000082.
16. Ostfeld E, Kjellström B. The Conundrum of Right Ventricular Remodeling and Outcome in Pulmonary Hypertension. *Circ Cardiovasc Imaging*. 2020;13(7):e011208. doi:10.1161/CIRCIMAGING.120.011208.

17. Reddy YNV, Carter RE, Obokata M, Redfield MM, Borlaug BA. A Simple, Evidence-Based Approach to Help Guide Diagnosis of Heart Failure with Preserved Ejection Fraction. *Circulation*. 2018;138(9):861-870. doi:10.1161/CIRCULATIONAHA.118.034646.
18. Remy-Jardin M, Ryerson CJ, Schiebler ML, et al. Imaging of Pulmonary Hypertension in Adults: A Position Paper from the Fleischner Society. *Radiology*. 2021;298(3):531-549. doi:10.1148/radiol.2020203108.
19. Runser LA, Gauer R, Houser A. Syncope: Evaluation and Differential Diagnosis. *AAFP Home*. <https://www.aafp.org/afp/2017/0301/p303.html>. Published March 1, 2017.
20. Sato T, Ambale-Venkatesh B, Zimmerman SL, et al. Right ventricular function as assessed by cardiac magnetic resonance imaging-derived strain parameters compared to high-fidelity micromanometer catheter measurements. *Pulm Circ*. 2021;11(4):20458940211032529. Published 2021 Sep 24. doi:10.1177/20458940211032529.
21. Thenappan T, Ormiston ML, Ryan JJ, Archer SL. Pulmonary arterial hypertension: pathogenesis and clinical management. *BMJ*. 2018;360:j5492. Published 2018 Mar 14. doi:10.1136/bmj.j5492.
22. van der Bruggen CE, Handoko ML, Bogaard HJ, et al. The Value of Hemodynamic Measurements or Cardiac MRI in the Follow-up of Patients with Idiopathic Pulmonary Arterial Hypertension. *Chest*. 2021;159(4):1575-1585. doi:10.1016/j.chest.2020.10.077.
23. van Wolferen SA, Marcus JT, Boonstra A, et al. Prognostic value of right ventricular mass, volume, and function in idiopathic pulmonary arterial hypertension. *Eur Heart J*. 2007;28(10):1250-1257. doi:10.1093/eurheartj/ehl477.
24. Xue L, Yang Y, Sun B, Liu B, Zeng Q, Xiong C. Mildly Elevated Pulmonary Arterial Pressure Is Associated with a High Risk of Progression to Pulmonary Hypertension and Increased Mortality: A Systematic Review and Meta-Analysis. *J Am Heart Assoc*. 2021;10(7):e018374.
25. Yaghi S, Novikov A, Trandafirescu T. Clinical update on pulmonary hypertension. *J Investig Med*. 2020;68(4):821-827. doi:10.1136/jim-2020-001291.
26. Chemla D, Castelain V, Hervé P, Lecarpentier Y, Brimiouille S. Haemodynamic evaluation of pulmonary hypertension. *Eur Respir J*. 2002;20(5):1314-1331. doi:10.1183/09031936.02.00068002.
27. Boucly A, Weatherald J, Salvale L, et al. External validation of a refined four-stratum risk assessment score from the French pulmonary hypertension registry. *Eur Respir J* 2022; 59:2102419 [DOI: 10.1183/13993003.02419-2021].

Pulmonary Vein Imaging – Indications (CD-8.2)

CD.CS.0008.2.A

v1.0.2025

Indications

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

Background and Supporting Information

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

References (CD-8)

CD.CS.0008.2.A

v1.0.2025

1. Abman SH, Hansmann G, Archer SL, et al. Pediatric Pulmonary Hypertension: Guidelines From the American Heart Association and American Thoracic Society [published correction appears in *Circulation*. 2016 Jan 26;133(4):e368]. *Circulation*. 2015;132(21):2037-2099. doi:10.1161/CIR.0000000000000329.
2. Alabed S, Shahin Y, Garg P, et al. Cardiac-MRI Predicts Clinical Worsening and Mortality in Pulmonary Arterial Hypertension: A Systematic Review and Meta-Analysis [published correction appears in *JACC Cardiovasc Imaging*. 2021 Apr;14(4):884]. *JACC Cardiovasc Imaging*. 2021;14(5):931-942. doi:10.1016/j.jcmg.2020.08.013.
3. Alabed S, Uthoff J, Zhou S, et al. Machine learning cardiac-MRI features predict mortality in newly diagnosed pulmonary arterial hypertension. *European Heart Journal - Digital Health*. 2022;3(2):265-275. doi:10.1093/ehjdh/ztac022.
4. Bossone E, Dellegrottaglie S, Patel S, et al. Multimodality imaging in pulmonary hypertension. *Can J Cardiol*. 2015;31(4):440-459. doi:10.1016/j.cjca.2015.02.012.
5. Broncano J, Bhalla S, Gutierrez FR, et al. Cardiac MRI in Pulmonary Hypertension: From Magnet to Bedside. *Radiographics*. 2020;40(4):982-1002. doi:10.1148/rg.2020190179.
6. Dong Y, Pan Z, Wang D, et al. Prognostic Value of Cardiac Magnetic Resonance-Derived Right Ventricular Remodeling Parameters in Pulmonary Hypertension: A Systematic Review and Meta-Analysis. *Circ Cardiovasc Imaging*. 2020;13(7):e010568. doi:10.1161/CIRCIMAGING.120.010568.
7. Expert Panel on Thoracic Imaging, Sirajuddin A, Mirmomen SM, et al. ACR Appropriateness Criteria[®] Suspected Pulmonary Hypertension: 2022 Update. *J Am Coll Radiol*. 2022;19(11S):S502-S512. doi:10.1016/j.jacr.2022.09.018.
8. Goh ZM, Balasubramanian N, Alabed S, et al. Right ventricular remodelling in pulmonary arterial hypertension predicts treatment response. *Heart*. 2022;108(17):1392-1400. Published 2022 Aug 11. doi:10.1136/heartjnl-2021-320733.
9. Hulten EA, Bradley AJ. Cardiac Magnetic Resonance Evaluation of Pulmonary Arterial Hypertension: Transforming From Supplementary to Primary Imaging Modality? *JACC Cardiovasc Imaging*. 2021;14(5):943-946. doi:10.1016/j.jcmg.2020.11.022.
10. Humbert M, Kovacs G, Hoeper MM, et al. 2022 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension. *Eur Heart J*. 2022;43(38):3618-3731. doi:10.1093/eurheartj/ehac237.
11. Kaemmerer H, Apitz C, Brockmeier K, et al. Pulmonary hypertension in adults with congenital heart disease: Updated recommendations from the Cologne Consensus Conference 2018. *Int J Cardiol*. 2018;272S:79-88. doi:10.1016/j.ijcard.2018.08.078.
12. Lewis MJ, Van Dissel A, Kochav J, et al. Cardiac MRI predictors of adverse outcomes in adults with a systemic right ventricle. *ESC Heart Fail*. 2022;9(2):834-841. doi:10.1002/ehf2.13745.
13. Mazurek A, Dziuk M, Witkowska-Patena E, Piszczek S, Gizewska A. The Utility of Hybrid SPECT/CT Lung Perfusion Scintigraphy in Pulmonary Embolism Diagnosis. *Respiration*. 2015;90(5):393-401. doi:10.1159/000439543.
14. McLaughlin VV, Archer SL, Badesch DB, et al. ACCF/AHA 2009 expert consensus document on pulmonary hypertension a report of the American College of Cardiology Foundation Task Force on Expert Consensus Documents and the American Heart Association developed in collaboration with the American College of Chest Physicians; American Thoracic Society, Inc.; and the Pulmonary Hypertension Association. *J Am Coll Cardiol*. 2009;53(17):1573-1619. doi:10.1016/j.jacc.2009.01.004.
15. Moledina S, Pandya B, Bartsota M, et al. Prognostic significance of cardiac magnetic resonance imaging in children with pulmonary hypertension. *Circ Cardiovasc Imaging*. 2013;6(3):407-414. doi:10.1161/CIRCIMAGING.112.000082.
16. Ostenfeld E, Kjellström B. The Conundrum of Right Ventricular Remodeling and Outcome in Pulmonary Hypertension. *Circ Cardiovasc Imaging*. 2020;13(7):e011208. doi:10.1161/CIRCIMAGING.120.011208.

17. Reddy YNV, Carter RE, Obokata M, Redfield MM, Borlaug BA. A Simple, Evidence-Based Approach to Help Guide Diagnosis of Heart Failure with Preserved Ejection Fraction. *Circulation*. 2018;138(9):861-870. doi:10.1161/CIRCULATIONAHA.118.034646.
18. Remy-Jardin M, Ryerson CJ, Schiebler ML, et al. Imaging of Pulmonary Hypertension in Adults: A Position Paper from the Fleischner Society. *Radiology*. 2021;298(3):531-549. doi:10.1148/radiol.2020203108.
19. Runser LA, Gauer R, Houser A. Syncope: Evaluation and Differential Diagnosis. *AAFP Home*. <https://www.aafp.org/afp/2017/0301/p303.html>. Published March 1, 2017.
20. Sato T, Ambale-Venkatesh B, Zimmerman SL, et al. Right ventricular function as assessed by cardiac magnetic resonance imaging-derived strain parameters compared to high-fidelity micromanometer catheter measurements. *Pulm Circ*. 2021;11(4):20458940211032529. Published 2021 Sep 24. doi:10.1177/20458940211032529.
21. Thenappan T, Ormiston ML, Ryan JJ, Archer SL. Pulmonary arterial hypertension: pathogenesis and clinical management. *BMJ*. 2018;360:j5492. Published 2018 Mar 14. doi:10.1136/bmj.j5492.
22. van der Bruggen CE, Handoko ML, Bogaard HJ, et al. The Value of Hemodynamic Measurements or Cardiac MRI in the Follow-up of Patients with Idiopathic Pulmonary Arterial Hypertension. *Chest*. 2021;159(4):1575-1585. doi:10.1016/j.chest.2020.10.077.
23. van Wolferen SA, Marcus JT, Boonstra A, et al. Prognostic value of right ventricular mass, volume, and function in idiopathic pulmonary arterial hypertension. *Eur Heart J*. 2007;28(10):1250-1257. doi:10.1093/eurheartj/ehl477.
24. Xue L, Yang Y, Sun B, Liu B, Zeng Q, Xiong C. Mildly Elevated Pulmonary Arterial Pressure Is Associated with a High Risk of Progression to Pulmonary Hypertension and Increased Mortality: A Systematic Review and Meta-Analysis. *J Am Heart Assoc*. 2021;10(7):e018374.
25. Yaghi S, Novikov A, Trandafirescu T. Clinical update on pulmonary hypertension. *J Investig Med*. 2020;68(4):821-827. doi:10.1136/jim-2020-001291.
26. Chemla D, Castelain V, Hervé P, Lecarpentier Y, Brimiouille S. Haemodynamic evaluation of pulmonary hypertension. *Eur Respir J*. 2002;20(5):1314-1331. doi:10.1183/09031936.02.00068002.
27. Boucly A, Weatherald J, Salvale L, et al. External validation of a refined four-stratum risk assessment score from the French pulmonary hypertension registry. *Eur Respir J* 2022; 59:2102419 [DOI: 10.1183/13993003.02419-2021].

Hypertrophic Cardiomyopathy (HCM) (CD-14)

CD.CS.0014.A

v1.0.2025

HCM Imaging Indications

Hypertrophic Cardiomyopathy (HCM) is a clinical diagnosis, established by imaging with 2D echocardiography or cardiovascular magnetic resonance (CMR) showing a maximal end-diastolic wall thickness of ≥ 15 mm anywhere in the left ventricle, in the absence of another cause of hypertrophy in adults. More limited hypertrophy (13–14 mm) can be diagnostic, particularly when present in family members of a patient with HCM or in conjunction with a positive genetic test, and/or associated with typical dynamic outflow obstruction, or distinctly abnormal ECG patterns.

Screening

- Screening for inherited hypertrophic cardiomyopathy see Transthoracic Echocardiography (TTE - Indications (CD-2.2) and Frequency of Echocardiography Testing (CD-2.3)

Initial imaging, new or changed symptoms

Transthoracic echocardiography (TTE)

- TTE is indicated for the initial evaluation of a genotype positive individual with inherited hypertrophic cardiomyopathy

Transesophageal echocardiography (TEE) (CPT® 93312, 93320, 93325)

- TEE is indicated for the evaluation of individuals with hypertrophic cardiomyopathy if TTE is inconclusive for **any** of the following:
 - Mitral regurgitation secondary to structural abnormalities of the mitral valve
 - Subaortic membrane or aortic valve stenosis
 - Pre-procedure planning for surgical myectomy or alcohol septal ablation

Stress echocardiogram

- Exercise stress echo (CPT® 93351 or 93350) is indicated for the detection and quantification of dynamic left ventricular outflow tract obstruction in symptomatic individuals with HCM who do **not** have a resting or provokable outflow tract gradient ≥ 50 mm Hg on TTE.
- Stress echo can be repeated when there is documentation of **any** of the following:

- In 1 to 2 years if the resting or provokable outflow tract gradient is < 30 mm Hg on prior stress echo
- Worsening symptoms
- There has been a therapeutic change (i.e., change in medication, surgical procedure performed).

CCTA (CPT® 75574)

- Initial imaging study in individuals with hypertrophic cardiomyopathy and stable anginal symptoms.
 - Chest discomfort is common in individuals with hypertrophic cardiomyopathy. The incidence of false positive myocardial perfusion imaging abnormalities is higher in these individuals, whereas the incidence of severe coronary artery stenosis is low.

Cardiac MRI (CMR)

- Cardiac MRI (CPT® 75557 or CPT® 75561) for assessment of global ventricular function, myocardial composition and mass if a specific clinical question is left unanswered by a recent echocardiogram and results will affect patient management.

Left heart catheterization with coronary arteriography

- Left heart catheterization with coronary arteriography (CPT® 93458 or CPT® 93454) is indicated to rule out coronary artery disease prior to planned surgical myectomy for hypertrophic cardiomyopathy

Surveillance imaging

- TTE is indicated every year when there is no change in clinical status or treatment

Monitoring treatment

Repeat TTE (CPT® 93306) is indicated in individuals with Obstructive Hypertrophic Cardiomyopathy (HCM) for the following:

Mavacamten for obstructive hypertrophic cardiomyopathy**Initiation of treatment**

- Baseline-at the beginning of treatment
- 4 weeks after treatment initiation
- 8 weeks after treatment initiation
- 12 weeks after treatment initiation
- Then every 12 weeks while on mavacamten

Changes in treatment

- 4 weeks after any interruption of treatment (any missed dose)
- After any dosage change (including restart of treatment):
 - 4 weeks after dosage change

- 12 weeks after dosage change
- After initiating a weak CYP2C19 inhibitor (e.g., omeprazole) or moderate CYP3A4 inhibitor (e.g., ciprofloxacin):
 - 4 weeks after start of medication
 - 12 weeks after start of medication
- At any time regardless of timing of prior echo when there are new cardiac signs or symptoms, or worsening of clinical status

Post- Septal Reduction Therapy (SRT)

TTE is indicated within 3 to 6 months after SRT (surgical myectomy or alcohol septal ablation) to evaluate the procedural results in individuals with hypertrophic cardiomyopathy

References (CD-14)

CD.CS.0014.A

v1.0.2025

1. Arbelo E, Protonotarios A, Gimeno JR, et al. 2023 ESC Guidelines for the management of cardiomyopathies. *Eur Heart J*. 2023;44(37):3503-3626. doi:10.1093/eurheartj/ehad194.
2. Ommen, Steve R et al. 2020 AHA/ACC Guideline for the Diagnosis and Treatment of Patients With Hypertrophic Cardiomyopathy: Executive Summary: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation*. 2020 Dec 22;142(25):e533-e557.
3. Nagueh SF, Phelan D, et al. Recommendations for Multimodality Cardiovascular Imaging of Patients with Hypertrophic Cardiomyopathy: An Update from the American Society of Echocardiography, in Collaboration with the American Society of Nuclear Cardiology, the Society for Cardiovascular Magnetic Resonance, and the Society of Cardiovascular Computed Tomography. *J Am Soc Echocardiogr*. 2022 Jun;35(6):533-569.
4. Ommen SR, Ho CY, Asif IM, et al. 2024 AHA/ACC/AMSSM/HRS/PACES/SCMR Guideline for the Management of Hypertrophic Cardiomyopathy: A Report of the American Heart Association/American College of Cardiology Joint Committee on Clinical Practice Guidelines. *Circulation*. 2024 May 8. doi: 10.1161/CIR.000000000000125.