Cardiac Catheterization

Cardiology Services

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Cardiac Catheterization

Guideline

NOTICE: Individuals at intermediate to high risk, with stable chest pain and no known coronary artery disease (CAD) are recommended to use computed tomography coronary angiography (CCTA) in CAD diagnosis, risk stratification and treatment planning, per the 2021AHA/ACC/ASE/ CHEST/SAEM/ SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain as a grade 1A recommendation. [12]

Left Heart Catheterization

A left heart catheterization (coronary angiography) may be indicated when the medical record demonstrates **ANY** of the following: [1] [12] [21]

- **ANY** of the following:
  - Cardiogenic shock due to suspected acute coronary syndrome [18] [20]
  - Cardiomyopathy to determine need for further intervention or treatment after non-invasive diagnostic evaluation [27]
  - Congenital heart disease to guide surgery or treatment [7]
  - Non-ST elevation acute coronary syndrome (NSTE-ACS) [20]
  - Non-sustained (30 seconds or less) polymorphic ventricular tachycardia of unclear etiology after initial evaluation
  - Preoperative non-cardiac high-risk surgery and prior non-invasive imaging with intermediate or high-risk CAD results
  - Pre- or post-operative transplant evaluation
  - Sudden cardiac arrest (SCA), unexplained, recovered (to confirm absence or presence of ischemic heart disease and guide decisions or myocardial revascularization) [6]
  - Sustained monomorphic ventricular tachycardia (30 seconds or more)
  - Valvular heart disease (eg, aortic stenosis, mitral regurgitation) [8] [9]
  - Ventricular fibrillation [14]
- Documented chest pain or angina and **ANY** of the following:
  - Evaluation of prior revascularization (CABG or PCI)
  - Intermediate to high risk for coronary heart disease (CAD) and **ALL** of the following:

- Contraindication to CCTA
- Prior stress imaging (stress cardiovascular magnetic resonance imaging (CMR), stress echocardiography, stress positron emission tomography (PET) or stress single photon emission computed tomography (SPECT) documentation supports **EITHER** of the following:
  - Inconclusive results
  - Moderate to severe ischemia and documentation of persistent symptoms

- Prior CCTA results demonstrate stable ischemic heart disease or CAD with an obstruction of greater than or equal to 50% and **ANY** of the following:
  - High risk CAD (defined as left main greater than or equal to 50%, frequent or unstable angina or 3-vessel disease (70% or greater stenosis)
  - Prior FFR-CT results are 0.8 or less

Right Heart Catheterization

A right heart catheterization may be appropriate when the medical record demonstrates **ALL** of the following: [10] [27]

- Pre-procedural evaluation that includes a transthoracic echocardiogram (TTE)
- **ANY** of the following:
  - Cardiogenic shock [18]
  - Cardiomyopathy, restrictive [1]
  - Congenital heart disease [28]
  - Heart failure [14]
  - Hemodynamic monitoring (following complicated myocardial infarction, heart failure exacerbation, shock or following surgical procedure to guide treatment) [3]
  - Intracardiac shunts, diagnosis and localization [28]
  - Partial anomalous pulmonary venous connection to further define hemodynamics [7]
  - Patent ductus arteriosus (PDA) [7]
  - Pericardial constriction or tamponade [22] [26] [28]
  - Pre- or post-operative transplant evaluation [25] [28]
  - Prior myocardial infarction with **ANY** of the following: [18]
    - Acute right ventricular failure

- Left ventricular failure of suspected ischemic etiology [18]

- Pulmonary hypertension (to establish diagnosis or treatment planning) [29]
- Valvular heart disease when there is a discordance between physical examination and non-invasive testing to determine optimal treatment [8] [9]

Combined Left and Right Heart Catheterization

A combined left and right heart catheterization may be appropriate when the medical record demonstrates **BOTH** of the following:

- Left heart catheterization indications are met.
- Right heart catheterization indications are met.

LCD 33557
See also, **LCD 33557**: Cardiac Catheterization and Coronary Angiography at https://www.cms.gov/medicare-coverage-database/search.aspx *if applicable to individual's healthplan membership*.

LCD 33959
See also, **LCD L33959**: Cardiac Catheterization and Coronary Angiography https://www.cms.gov/medicare-coverage-database/search.aspx *if applicable to individual's healthplan membership*.

Contraindications to Cardiac Catheterization

Left Heart Catheterization Contraindications

A left heart catheterization may be contraindicated when the medical record demonstrates **ANY** of the following: [27]

- Left ventricular (LV) thrombus is suspected.
- Mechanical prosthetic aortic valve(s) present

Left Heart Catheterization Relative Contraindications

Relative contraindications for a left heart catheterization include **ANY** of the following: [20] [27]

- Active Infection that is untreated. [25]
- Bleeding that is active.
- Coagulopathy that is severe.
- Decompensated heart failure and pulmonary edema that prevents lying down during procedure.
- Hypertension that is uncontrolled.
- Peripheral vascular disease that is severe.
- Pregnancy
- Reaction to contrast media (anaphylaxis, nephrotoxicity) [25]
- Renal dysfunction that is moderate to severe.
- Thrombocytopenia that is severe.

Right Heart Catheterization Contraindications

A right heart catheterization may be contraindicated when the medical record demonstrates **ANY** of the following: [27]

- Endocarditis that is right-sided
- Intracardiac tumor is present.
- Mechanical prosthetic tricuspid or pulmonic valve is present.
- Thrombus is present.

Right Heart Catheterization Relative Contraindications

Relative contraindications for a right heart catheterization include **ANY** of the following: [27]

- Bleeding that is active.
- Coagulopathy that is severe.
- Infection that is active.
- Left bundle branch block is present.
- Thrombocytopenia that is severe.

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Procedure Codes

Table 1. Cardiac Catheterization Associated Procedure Codes

CODE	DESCRIPTION
93451	Right heart catheterization including measurement(s) of oxygen saturation and cardiac output, when performed
93452	Left heart catheterization including intraprocedural injection(s) for left ventriculography, imaging supervision and interpretation, when performed

CODE	DESCRIPTION
93453	Combined right and left heart catheterization including intraprocedural injection(s) for left ventriculography, imaging supervision and interpretation, when performed
93454	Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural injection(s) for coronary angiography, imaging supervision and interpretation;
93455	Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural injection(s) for coronary angiography, imaging supervision and interpretation; with catheter placement(s) in bypass graft(s) (internal mammary, free arterial, venous grafts) including intraprocedural injection(s) for bypass graft angiography
93456	Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural injection(s) for coronary angiography, imaging supervision and interpretation; with right heart catheterization
93457	Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural injection(s) for coronary angiography, imaging supervision and interpretation; with catheter placement(s) in bypass graft(s) (internal mammary, free arterial, venous grafts) including intraprocedural injection(s) for bypass graft angiography and right heart catheterization
93458	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
93459	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, catheter placement(s) in bypass graft(s) (internal mammary, free arterial, venous grafts) with bypass graft angiography
93460	Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural injection(s) for coronary angiography, imaging supervision and interpretation; with right and left heart catheterization including intraprocedural injection(s) for left ventriculography, when performed
93461	Catheter placement in coronary artery(s) for coronary angiography, including intraprocedural injection(s) for coronary angiography, imaging supervision and interpretation; with right and left heart catheterization including intraprocedural injection(s) for left ventriculography, when performed, catheter placement(s) in bypass graft(s) (internal mammary, free arterial, venous grafts) with bypass graft angiography
93593	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
93594	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
93595	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
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); normal native connections
93597	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

Definitions/Key Terms

Acute Coronary Syndrome (ACS) A sudden, severe event in which the obstruction of a coronary artery interferes with blood flow to the heart muscle encompassing acute ischemic heart disease (eg, angina, myocardial infarction). ACS is diagnosed on the basis of rapidly accelerating symptoms of myocardial ischemia coupled with objective evidence of acute ischemia from the electrocardiogram and/or elevated circulating markers of myocardial injury.
Angina Pectoris is the medical term for chest pain or discomfort due to coronary heart disease. It occurs when the heart muscle doesn't get as much blood as it needs. This may happen because one or more of the heart's arteries is narrowed or blocked, also called ischemia.

- Atypical chest pain or discomfort that lacks the characteristics of typical angina and is described as sharp or stabbing, or burning brought on by deep breathing or coughing, or movement of arms or torso, and lasting for seconds. The term non-cardiac should be used if heart disease is not suspected.
- Microvascular angina is a type of angina or chest pain that may be a symptom of coronary microvascular disease (MVD). Coronary MVD is a heart disease that affects the heart's smallest coronary artery blood vessels. Spasms within the walls of these very small arterial blood vessels cause reduced blood flow to the heart muscle leading to a type of chest pain referred to as microvascular angina. Angina that occurs in coronary MVD may differ from the typical angina that occurs in heart disease in that the chest pain usually lasts longer than 10 minutes, and it can last longer than 30 minutes.
- Prinzmetal angina may also be referred to as variant angina, Prinzmetal's variant angina or angina inversa. Prinzmetal's angina almost always occurs when a person is at rest, usually between midnight and early morning. These attacks can be very painful. The pain from variant angina is caused by a spasm in the coronary arteries (which supply blood to the heart muscle). The coronary arteries can spasm as a result of any of the following: exposure to cold weather, stress, medicines that tighten or narrow blood vessels, smoking or cocaine use. [1]
- Typical angina, also known as stable angina or angina pectoris, is defined as: 1) substernal/retrosternal chest pain, pressure, tightness or squeezing, described as dull, heavy, or crushing, and /or radiating to the mid-sternal or anterior chest; 2) provoked by exertion or emotional stress and 3) relieved by rest and/or nitroglycerin.
- Unstable angina is defined as angina that is of new onset, occurring at rest or with minimal exertion, and worsening from a previously stable pattern of pain occurrence in terms of frequency or duration of attacks, resistance to previously effective medications, or provocation with decreasing levels of exertion or stress.

[1]American Heart Association, "Heart Topics." [Online]: Available: www.heart.org

ASCVD Risk Estimator Plus

ASCVD (arterial sclerotic cardiovascular disease) Risk Estimator Plus by the American College of Cardiology is a tool to estimate an individual's 10 year ASCVD risk. The optimal recommended use is to establish a reference point, evaluate the impact of interventions, monitor risk over time, and use to engage health care discussions and care planning.

The information required to estimate ASCVD risk includes age, sex, race, total cholesterol, HDL cholesterol, systolic blood pressure, blood pressure lowering medication use, diabetes status and smoking status. The ASCVD Risk Estimator Plus is available online at http:// http://tools.acc.org/ASCVD-Risk-Estimator/.

The ASCVD measures are:

- Low-risk is less than 5%
- Borderline risk is 5% to 7.4%
- Intermediate risk is 7.5% to 19.9%
- High risk is 20% or more

Cardiac catheterization is a procedure in which a thin, flexible tube (catheter) is guided through a blood vessel to the heart to diagnose or treat certain heart conditions, such as clogged arteries or irregular heartbeats. Cardiac catheterization gathers important information about the heart muscle, heart valves and blood vessels in the heart.

Cardiac tamponade is mechanical compression of the heart by large amounts of fluid or blood within the pericardial space that limits the normal range of motion and function of the heart.

Cardiogenic shock (CS) is a serious and life-threatening condition that occurs when the heart is unable to pump enough blood to the body's vital organs and is commonly triggered by heart attack or heart failure.

Cardiomyopathy is a disease of the heart muscle that makes it harder for the heart to pump blood to the rest of the body. Cardiomyopathy can lead to heart failure. The main types of cardio-myopathy include dilated, hypertrophic and restrictive cardiomyopathy.

Congenital Heart Disease (CHD) is a term for a variety of birth defects that affect heart anatomy and function. Congenital is defined as present since birth. CHD occurs when the heart, or blood vessels near the heart, do not develop normally. Common heart defects include: atrial septal defect, coarctation of the aorta, d-transposition of the great arteries, Ebstein's anomoly, patent ductus arteriosus, tetralogy of fallot, total anomalous pulmonary venous connection and ventricular septal defect.

Coronary computed tomography angiography (CCTA) is a non-invasive test that uses a computed tomography (CT) scanner to obtain a 3-dimensional image of the heart including blood vessels that supply the heart muscle (coronary arteries). During the CCTA, contrast dye is injected in the vein so that the coronary arteries can be seen. CCTA provides images which allow for the identification of narrowing or blockages of the coronary arteries caused by plaque. CCTA also

allows for accurate visualization of the 3-dimensional heart structure. CCTA can also be used to evaluate the valves of the heart. [2]

Electrocardiogram (ECG or EKG) is a test that measures and records the electrical activity of the heart. The ECG tracing is divided into the P wave, PR interval, QRS complex, QT interval, ST segment, T wave and U wave. An ECG is useful in establishing many cardiac diagnoses.

Endocarditis is inflammation of the inside lining of the heart chambers and heart valves (endocardium). It is caused by a bacterial or rarely, a fungal infection.

Examples of clinical decision pathways and protocols used to categorize patients into low, intermediate, and high-risk when presenting with acute chest pain and suspected acute coronary syndrome include:

ADAPT Protocol is an accelerated diagnostic protocol to assess chest pain using troponins using a 2-hour accelerated diagnostic protocol to assess chest pain for risk of cardiac event. The ADAPT protocol tool may be found at: https://www.mdcalc.com/adapt-protocol-cardiac-event-risk

Emergency Department Assessment of Chest Pain Score (EDACS) is a diagnostic tool used to identify chest pain with low risk of major adverse cardiac event (MACE). The EDACS tool may be found at: https://www.mdcalc.com/emergency-department-assessment-chest-pain-score-edacs

European Society of Cardiology Rapid Rule-In and Rule-Out Algorithm for Myocardial Infarction Due to the use of high-sensitivity cardiac troponin (hs-cTn) assay test, the time intervals for troponin assessment intervals can be shortened. It is recommended to use the 0 hour/1 hour algorithm (best option, blood draw at 0 hour and 1 hour) or the 0 hour/2 hour algorithm (second best option, blood draw at 0 hour and 2 hours) with suspected acute coronary syndrome. Low risk threshold - inital hs-cTn is "very low" and symptom onset was greater than 3 hours or inital hs-cTn is "low" and 1 or 2 hour is "low". Intermediate risk - initial hs-cTn is between "low" and "high" and/or 1 or 2 hour hs-cTn is between low and high thresholds. High risk - initial hs-cTn is "high" or 1 or 2 hours hs-cTn is high. [3,4]

Global Registry of Acute Coronary Events (GRACE) risk score is a tool used to estimate probability of mortality within 6 months of hospital discharge with acute coronary syndrome. The GRACE tool may be found at: https://www.mdcalc.com/grace-acs-risk-mortality-calculator

HEART Score is a tool used to define risk when presenting to the emergency department with chest pain. The score identifies low, intermediate and high risk for short-term adverse outcome resulting from acute coronary syndrome (ACS). HEART (History, Electrocardiogram, Age, Risk

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[2]Society of Cardiovascular Computed Tomography, "What is CCTA?" [Online]: Available: www.scct.org

[3]Gulati, M., Levy, P.D., et al. 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain: Executive Summary. A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Journal of the American College of Cardiology, 78(22), 2021

[4]Collet, JP, Thiele, H., et al. 2020 2020 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation. European Society of Cardiology. European Heart Journal 42, 1289-367, 2021

factors, Troponin) is a 0 to 10-point scoring system. Scores are categorized as low (0 to 3), intermediate (4 to 6), and high risk (7 to 10) to inform and assist in clinical decision making.

No Objective Testing Rule (NOTR) is a clinical decision tool used to identify low probability of acute coronary syndrome (ACS) and without the need for objective cardiac testing for coronary artery disease (CAD).

Thrombolysis in Myocardial Infarction (TIMI) risk score for unstable angina (UA) and non ST-elevation MI (NSTEMI) estimates mortality for unstable angina and non-ST elevation MI. TIMI score less than 2 is low risk, 2-4 intermediate, and 5-7 high risk. TIMI risk tool may be found at: https://www.ncbi.nlm.nih.gov/books/NBK556069/

Fractional flow reserve (FFR) is a ratio of the maximal myocardial blood flow in the presence of a stenosis to the theoretical normal maximal flow in the same distribution. FFR is calculated by using the distal coronary pressure of the stenosis divided by the aortic pressure during maximal hyperemia.

Guideline-Directed Medical Therapy (GDMT) refers to the optimal course of treatment for each stage of a chronic cardiac condition (eg, angina, heart failure), including those at high risk of disease progression, but without structural heart disease or symptoms. The goal is titration of medications to maximally tolerated doses.

Heart failure (HF) (also known as **Congestive Heart Failure [CHF]**) is a condition that develops when the heart doesn't pump enough blood for the body's needs. This happens if the heart cannot fill with enough blood or is too weak to pump properly. Decompensated heart failure is sudden worsening (exacerbation) heart failure symptoms (eg, difficulty breathing (dyspnea), leg or feet swelling, and fatigue). This is when the heart can no longer continue to compensate for its full function.

Invasive coronary angiography (ICA) is done as part of a procedure known as a heart (cardiac) catheterization. ICA is a procedure that uses contrast material and x-rays for imaging of the arteries of the heart. It can define the presence and severity of a luminal obstruction of an epicardial coronary artery, including its location, length, and diameter, as well as coronary blood flow. [5]

Ischemic Heart Disease is a term given to heart problems caused by narrowed heart arteries. When arteries are narrowed, less blood and oxygen reaches the heart muscle, increasing the risk of myocardial infarction. This is also called coronary artery disease and coronary heart disease.

Myocardial Infarction, also called a heart attack, occurs when the blood flow that brings oxygen to the heart muscle is severely reduced or cut off completely. The coronary arteries that supply the heart muscle with blood flow can become narrowed from a buildup of fat, cholesterol and other substances that together are called plaque. This process is known as atherosclerosis. When plaque within a heart artery breaks, a blood clot forms around the plaque and can block the blood

[5]Gulati, M., Levey, P.D., et al. 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR Guideline for the Evaluation of Chest Pain. Journal of the American College of Cardiology, 78(22), 2021.

flow through the artery to the heart muscle. Ischemia results when there is an inadequate blood supply to the heart muscle. When damage or death of part of the heart muscle occurs as a result of ischemia, it is called myocardial infarction (MI). [6]

Partial Anomalous Pulmonary Venous Connection (PAPVC), also known as partial anomalous pulmonary venous return (PAPVR), is a congenital heart defect in which some of the pulmonary veins inappropriately drain into the pulmonary circulation and can cause right heart failure if left untreated.

Patent Ductus Arteriosus (PDA), is a heart birth defect that occurs when the normal channel between the pulmonary artery and the aorta in the fetus does not close at birth. The blood vessel connecting the pulmonary artery and the aorta (ductus arteriosus) fails to close as it usually does shortly after birth.[7]

Pre-Test Probability is a validated measure of the probability that an individual with chest pain has coronary artery disease (CAD). The test results are useful for making decisions on the appropriate diagnostic testing and planning based on an individual's characteristics. Characteristics measured include: age, sex, type of chest pain, comorbidities, smoking history and Coronary Calcium Scale (if available). The Diamond and Forrester model and the Duke clinical score are two examples of pre-test probability scoring tools often recommended to estimate the pretest probability of CAD when presenting with stable chest pain. Pretest probability tools may be found at https://qxmd.com/calculate/calculator_287/pre-test-probability-of-cad-cad-consortium.

Pulmonary hypertension is increased pressure in the pulmonary circulation that results in thickening and narrowing of the pulmonary arteries. Pulmonary hypertension can be either primary, the cause being idiopathic (cause unknown) or it can be secondary which occurs as a result of an identified medical condition.

Thrombus is a blood clot that forms on the wall of a blood vessel or in the heart when blood platelets, proteins and cells stick together. A thrombus may block the flow of blood.

Valvular Heart Disease is when any valve in the heart has damage or is diseased. The normal heart has four chambers (right and left atria, and right and left ventricles) and four valves. The mitral valve, also called the bicuspid valve, allows blood to flow from the left atrium to the left ventricle. The tricuspid valve allows blood to flow from the right atrium to the right ventricle. The aortic valve allows blood to flow from the left ventricle to the aorta. The pulmonary valve allows blood to flow from the right ventricle to the pulmonary artery. The valves open and close to control or regulate the blood flowing into the heart and then away from the heart.

Diseased valves can become "leaky" where they don't completely close, this is called **regurgitation**. When the opening of the valve is narrowed and stiff and the valve is not able to open fully when blood is trying to pass through, this is called **stenosis**.

[6]American Heart Association (AHA), "Health Topics." [Online]. Available: www.heart.org

[7]Merck & CO., Inc., "Patent Ductus Arteriosus". [Online]. Available: www.merckmanuals.com

When heart valves are diseased, the heart can't effectively pump blood throughout the body and has to work harder to pump, either while the blood is leaking back into the chamber or against a narrowed opening. This can lead to heart failure, sudden cardiac arrest and death.

Ventricular Fibrillation (VF) also called V-fib, is a serious cardiac rhythm disorder in which disordered electrical activity causes the heart's lower chambers (ventricles) to quiver or fibrillate, instead of contracting (or beating) normally. This prohibits the heart from pumping blood, causing collapse and cardiac arrest. This type of arrhythmia is a life-threatening medical emergency.

Ventricular Tachycardia (VT) is a rhythm disorder caused by abnormal electrical signals in the lower ventricles of the heart.

- **Non-sustained ventricular tachycardia (NSVT)** is defined as 3 or more consecutive beats originating from the ventricle, lasting less than 30 seconds, at a rate more than 100 beats per minute.
- **Sustained ventricular tachycardia (SVT)** is defined as a regular wide QRS complex (more than 120 ms) tachycardia at a rate more than 100 beats per minute and lasting more than 30 seconds.
- **Monomorphic ventricular tachycardia** ventricular tachycardia with stable QRS morphology
- **Polymorphic ventricular tachycardia** ventricular rhythm, rate greater than 100 beats/minute with varying QRS pattern that will either terminate spontaneously (causing syncope if it lasts more than a few seconds) or will deteriorate to ventricular fibrillation, causing cardiac arrest

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Purpose

The purpose of the HealthHelp's clinical guidelines is to assist healthcare professionals in selecting the medical service that may be appropriate and supported by evidence to safely improve outcomes. Medical information is constantly evolving, and HealthHelp reserves the right to review and update these clinical guidelines periodically. HealthHelp reserves the right to include in these guidelines the clinical indications as appropriate for the organization's program objectives. Therefore the guidelines are not a list of all the clinical indications for a stated procedure, and associated Procedure Code Tables may not represent all codes available for that state procedure or that are managed by a specific client-organization.

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These clinical guidelines neither preempt clinical judgment of trained professionals nor advise anyone on how to practice medicine. Healthcare professionals using these clinical guidelines are responsible for all clinical decisions based on their assessment. All Clinical Reviewers are instructed to apply clinical indications based on individual patient assessment and documentation, within the scope of their clinical license.

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