



CLINICAL GUIDELINES

Chest Imaging Guidelines

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eviCore healthcare Clinical Decision Support Tool Diagnostic Strategies: This tool addresses common symptoms and symptom complexes. Imaging requests for individuals with atypical symptoms or clinical presentations that are not specifically addressed will require physician review. Consultation with the referring physician, specialist and/or individual's Primary Care Physician (PCP) may provide additional insight.

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Abbreviations for Chest Guidelines

AAA	abdominal aortic aneurysm		
ACE	angiotensin-converting enzyme		
AVM	arteriovenous malformation		
BI-RADS	Breast Imaging Reporting and Database System		
BP	blood pressure	BRCA	tumor suppressor gene
CAD	computer-aided detection	CBC	Complete blood count
COPD	chronic obstructive pulmonary disease		
CT	computed tomography		
CTA	computed tomography angiography		
CTV	computed tomography venography		
DCIS	ductal carcinoma in situ	DVT	deep venous thrombosis
ECG	electrocardiogram	EM	electromagnetic
EMG	electromyogram	FDA	Food and Drug Administration
FDG	fluorodeoxyglucose	FNA	fine needle aspiration
GERD	gastroesophageal reflux disease		
GI	gastrointestinal		
HRCT	high resolution computed tomography		
IPF	idiopathic pulmonary fibrosis		
LCIS	lobular carcinoma in situ		
LFTP	localized fibrous tumor of the pleura		
MRA	magnetic resonance angiography		
MRI	magnetic resonance imaging		
MRV	magnetic resonance venography		
NCV	nerve conduction velocity		
PE	pulmonary embolus		
PEM	positron-emission mammography		
PET	positron emission tomography		
PFT	pulmonary function tests		
PPD	purified protein derivative of tuberculin		
RODEO	Rotating Delivery of Excitation Off-resonance MRI		
SPN	solitary pulmonary nodule		
SVC	superior vena cava		

CH-1: General Guidelines

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CH-1.0: General Guidelines

- A pertinent clinical evaluation is required prior to considering advanced imaging.
 - ◆ A pertinent clinical evaluation should include the following:
 - A detailed history and physical examination
 - Appropriate laboratory studies and basic imaging, such as plain radiography or ultrasound
 - A recent chest x-ray (generally within the last 60 days) that has been over read by a radiologist would be performed in many of these cases prior to considering advanced imaging.^{1,2}
 - Identify and compare with previous chest films to determine presence and stability.
 - ◆ For an established individual a meaningful technological contact (telehealth visit, telephone call, electronic mail or messaging) can serve as a pertinent clinical evaluation.

CH-1.1: General Guidelines – Chest X-Ray

- Chest x-ray can help identify previously unidentified disease and may direct proper advanced imaging for such conditions as:
 - ◆ Pneumothorax, (See **CH-19: Pneumothorax/Hemothorax**)
 - ◆ Pneumomediastinum, (See **CH-19: Pneumothorax/Hemothorax**)
 - ◆ Fractured ribs, (See **CH-22: Chest Wall Mass**)
 - ◆ Acute and chronic infections, (See **CH-13: Pneumonia and Coronavirus Disease 2019 (COVID-19)** and **CH-14: Other Chest Infections**)
 - ◆ Malignancies
- Exceptions to preliminary chest x-ray may include such conditions as:
 - ◆ Supraclavicular lymphadenopathy (See **CH-2.1: Supraclavicular Region**)
 - ◆ Known Bronchiectasis (See **CH-7: Bronchiectasis**)
 - ◆ Suspected Interstitial lung disease (See **CH-11: Interstitial Disease**)
 - ◆ Positive PPD or tuberculosis (See **CH-14: Other Chest Infections**)
 - ◆ Suspected Pulmonary AVM (See **CH-26: Pulmonary Hypertension**)

CH-1.2: General Guidelines – Chest Ultrasound

- Chest ultrasound (CPT® 76604) includes transverse, longitudinal, and oblique images of the chest wall with measurements of chest wall thickness, and also includes imaging of the mediastinum.
 - ◆ Chest ultrasound:
 - CPT® 76604
 - ◆ Breast ultrasound:
 - CPT® 76641: unilateral, complete.
 - CPT® 76642: unilateral, limited.
 - CPT® 76641 and CPT® 76642 should be reported only once per breast, per imaging session
 - ◆ Axillary ultrasound:
 - CPT® 76882 (unilateral); if bilateral, can be reported as CPT® 76882 x 2

CH-1.3: General Guidelines – CT Chest

- Intrathoracic abnormalities found on chest x-ray, fluoroscopy, CT Abdomen, or other imaging modalities may be further evaluated with CT Chest with contrast (CPT® 71260).
- CT Chest without contrast (CPT® 71250) can be used for the following:
 - ◆ Individual has contraindication to contrast
 - ◆ Follow-up of pulmonary nodule(s)
 - ◆ High Resolution CT (HRCT)
 - ◆ Low-dose CT Chest (CPT® 71271) (See **CH-33: Lung Cancer Screening**)
- CT Chest without and with contrast (CPT® 71270) does not add significant diagnostic information above and beyond that provided by CT Chest with contrast, unless a question regarding calcification, most often within a lung nodule, needs to be resolved.¹

CT Chest Coding Notes:

- High resolution CT Chest should be reported only with an appropriate code from the set CPT® 71250-CPT® 71270.
 - ◆ No additional CPT® codes should be reported for the “high resolution” portion of the scan. The “high resolution” involves additional slices which are not separately billable.

CH-1.4: General Guidelines – CTA Chest (CPT® 71275)

- CTA Chest (CPT® 71275) can be considered for suspected Pulmonary Embolism and Thoracic Aortic disease.
 - ◆ CTA prior to minimally invasive or robotic surgery (See **CD-4.8: Transcatheter Aortic Valve Replacement (TAVR)** in the Cardiac Imaging Guidelines).

CH-1.5: General Guidelines – MRI Chest without and with Contrast (CPT® 71552)

- Indications for MRI Chest are infrequent and may relate to concerns about CT contrast such as renal insufficiency or contrast allergy. MRI may be indicated:
 - ◆ Clarification of some equivocal findings on previous imaging studies, which are often in the thymic mediastinal region or determining margin (vascular/soft tissue) involvement with tumor and determined on a case-by-case basis.
 - Certain conditions include:
 - Chest wall mass (See **CH-22: Chest Wall Mass**)
 - Chest muscle tendon injuries (See **MS-11: Muscle/Tendon Unit Injuries/Diseases** in the Musculoskeletal Imaging Guidelines)
 - Brachial plexopathy (See **PN-4: Brachial Plexus** in the Peripheral Nerve Disorders Imaging Guidelines)
 - Thymoma (See **ONC-10.5: Thymoma and Thymic Carcinoma - Suspected/Diagnosis** in the Oncology Imaging Guidelines)

CH-1.6: General Guidelines – Nuclear Medicine

78597	Quantitative differential pulmonary perfusion, including imaging when performed
78598	Quantitative differential pulmonary perfusion and ventilation (e.g., aerosol or gas), including imaging when performed

CH-1.7: Navigational Bronchoscopy

- CPT® 76497 (Unlisted CT procedure) can be considered if:
 - ◆ A CT Chest has been performed within the last 6 weeks and study is needed for navigational bronchoscopy.
- CT Chest without contrast (CPT® 71250) can be considered for:
 - ◆ Previous diagnostic scan was ≥6 weeks ago and study is needed for navigational bronchoscopy

Practice Notes

- Navigational Bronchoscopy: This is a form of guided bronchoscopy. A special sensor inside a bronchoscopy is used to navigate to the desired location within the lung. Computer software generates a virtual bronchial tree which provides a road map to the target lesion. A thin-cut CT Chest with optimized reconstruction parameters is required to generate the virtual map of the lungs. A previous CT Chest may not be usable for navigation if it was not formatted correctly, even if done just a few days prior.

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CH-2: Lymphadenopathy

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CH-2.1: Supraclavicular Region

- Ultrasound (CPT® 76536) is the initial study for palpable or suspected lymphadenopathy.
 - ◆ Allows simultaneous ultrasound-guided core needle biopsy (CPT® 76942)
 - ◆ CT Neck with contrast (CPT® 70491) or CT Chest with contrast (CPT® 71260) if ultrasound is indeterminate
 - See **Neck-1: General** in the Neck Imaging Guidelines

CH-2.2: Axillary Lymphadenopathy (and Mass)

- There is no evidence-based support for advanced imaging of clinically evidenced axillary lymphadenopathy prior to a biopsy.^{2,3} If axillary node biopsy reveals benign findings, advanced imaging is not indicated. If axillary node biopsy reveals findings concerning for malignancy, pathology results will determine the need for further advanced imaging. See **ONC-31.7: Carcinoma of Unknown Primary Site** in the Oncology imaging Guidelines for imaging recommendations for carcinoma found in an axillary lymph node.
- Localized axillary lymphadenopathy should prompt:
 - ◆ Axillary US (CPT® 76882)
 - Initial evaluation of any axillary mass or enlarged node
 - ◆ Ultrasound directed core needle biopsy or surgical excisional biopsy of the most abnormal lymph node if condition persists or malignancy suspected.
 - ◆ Search for adjacent hand or arm injury or infection, and
 - ◆ 3-4 week observation if benign clinical picture, and
 - ◆ Excisional or ultrasound directed core needle biopsy of most abnormal lymph node if condition persists or malignancy suspected.
 - ◆ No advanced imaging indicated.
- Generalized axillary lymphadenopathy should prompt:
 - ◆ Axillary US (CPT® 76882)
 - Initial evaluation of any axillary mass or enlarged node
 - ◆ Ultrasound directed core needle biopsy or surgical excisional biopsy of the most abnormal lymph node if condition persists or malignancy suspected.
 - ◆ Diagnostic work-up, including serological tests, for systemic diseases, and
 - ◆ Excisional biopsy of most abnormal lymph node if uncertainty persists.
 - ◆ See **ONC-27: Non-Hodgkin Lymphomas** in the Oncology Imaging Guidelines.
- Occult Primary Cancer in axillary lymph node(s):
 - ◆ See **ONC-31: Metastatic Cancer, Carcinoma of Unknown Primary Site, and Other Types of Cancer** in the Oncology Imaging Guidelines.

Practice Notes

Adenocarcinoma is the most common histology, with breast cancer seen most often; non-palpable breast cancer and axillary metastases accounts for less than 0.5% of all breast cancers. Carcinomas of the lung, thyroid, stomach, colon, rectum, and pancreas have the potential to spread to axillary lymph nodes, but these metastases are rarely the first manifestations of disease

CH-2.3: Mediastinal Lymphadenopathy

- CT Chest with contrast (CPT® 71260) if mediastinal abnormalities are detected on a chest x-ray (over read by a radiologist) or other non-dedicated advanced chest imaging.
 - ◆ Follow-up CT Chest (CPT® 71260) after 3-6 months if:
 - Enlarged lymph nodes, ≥ 15 mm, are in the mediastinum with no other thoracic abnormalities; and
 - Low risk or no clinical suspicion for malignancy.
 - Thereafter, stability or decreasing size, does not require further advanced imaging.
 - ◆ Further evaluations:
 - Lymph node biopsy (see methods below) should be considered for:
 - Persistent or increasing lymphadenopathy on follow-up CT Chest; or
 - Suspected malignancy.
 - See **ONC-27: Non-Hodgkin Lymphomas** and/or **ONC-28: Hodgkin Lymphoma** in the Oncology Imaging Guidelines for suspicion of Lymphoma
- PET/CT (CPT® 78815) can be considered for enlarged lymph nodes, ≥ 15 mm with no explainable disease or increasing lymph node size on follow-up CT Chest

Practice Notes

- Incidentally detected lymph nodes < 15 mm (in short axis) in individuals with no other findings do not require further evaluation.
- Most benign nodes have smooth and well-defined borders, show uniform and homogeneous attenuation, and demonstrate a central fatty hilum
- Explainable disease such as emphysema, interstitial lung disease, sarcoidosis, cardiac disease.
- Unexplained causes, consider lymphoma, undiagnosed metastatic disease, including testicular carcinoma in young male, and infection.
- Lymphadenopathy from neoplasms as well as from benign sources of inflammation can result in a positive PET scan. Therefore, the use of PET may not be helpful prior to histologic diagnosis.
- Less invasive methods of mediastinal biopsies are CT or ultrasound directed percutaneous biopsy, transbronchial biopsy, transbronchial biopsy using endobronchial ultrasound, and endoscopic ultrasound-guided FNA.
- More invasive and traditional methods are mediastinoscopy or thoracoscopy/thoracotomy.

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CH-3: Cough

CH-3.1: Cough

- Initial evaluation should include a recent chest x-ray after the current episode of cough started or changed.^{1,2}
 - ◆ In addition all medications known to cause coughing (e.g. ACE inhibitors, Sitagliptin) should be discontinued.^{1,2,3}
- CT Chest (either with contrast [CPT® 71260] or without contrast [CPT® 71250]), if the initial chest x-ray is without abnormalities and all medications known to cause coughing have been discontinued, for the following:
 - ◆ Non-Smoker cough after the following sequence for a total 3 week trial and investigation after ALL of the following:⁴
 - Antihistamine and decongestant treatment.^{1,2}
 - Bronchoprovocation challenge (e.g. methacholine challenge, exhaled nitric oxide test) and spirometry should be performed to rule out asthma.¹
 - Empiric trial of corticosteroids.^{1,2}
 - Treatment of gastroesophageal reflux disease (GERD).^{1,2}
 - See **HD-29: Sinusitis** in the Head Imaging Guidelines.
 - ◆ Current or past cigarette smokers with either⁴:
 - New cough lasting greater than 2 weeks.
 - Changed chronic cough in worsening frequency or character
 - See **CH-6: Hemoptysis**.
 - ◆ CT Maxillofacial without contrast (CPT® 70486) or CT Sinus, limited without contrast (CPT® 76380) can be considered in those with suspicion of Upper Airway Cough Syndrome (UACS) secondary to rhinosinus disease.⁴
 - ◆ For any abnormalities present on the initial chest x-ray, advanced chest imaging can be performed according to the relevant Chest Imaging Guidelines section.¹

Practice Notes

- The resolution of cough usually will occur at a median time of 26 days of stopping use of the angiotensin-converting enzyme (ACE) inhibitor drug.² Smoking cessation is “almost always effective” in resolving cough in smoker.²
- Cough after URI (Upper Respiratory Infection) can typically last beyond 2-3 weeks.³

References

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CH-4.0: Non-Cardiac Chest Pain

- See the following guidelines:
 - ◆ **CH-25: Pulmonary Embolism (PE)**
 - ◆ **CD-1: General Guidelines** in the Cardiac Imaging Guidelines
- “Evidence is not conclusive whether Triple-rule-out CT (CAD, PE, and AD) will improve efficiency of patient management” with acute chest pain.¹
- MRI is not supported in the evaluation of chest pain.

CH-4.1: Non-Cardiac Chest Pain – Imaging

- Initial evaluation should include a chest x-ray.^{1,2}
 - ◆ CT Chest with contrast (CPT® 71260) or CTA Chest with contrast (CPT® 71275) if x-ray is abnormal.^{1,2,3}
 - ◆ If x-ray is normal, individual should undergo evaluation of other possible causes of pain prior to advanced imaging (CT Chest with contrast or CTA Chest with contrast) including:^{1,2,3}
 - Cardiac evaluation^{1,2} (See **CD-1: General Guidelines** in the Cardiac Imaging Guidelines)
 - GI any ONE of the following since GERD is the cause in almost 60%:
 - Trial of anti-reflux medication, or pH probe, or esophageal manometry¹ or
 - Barium swallow or endoscopy
 - Pulmonary Function Test (PFT's)^{1,2}
 - ◆ CT Chest with contrast (CPT® 71260) if persistent:
 - The initial chest x-ray reveals no abnormalities; and either
 - Sickle cell disease², or
 - Suspected lung mass in an individual with chest pain, cough, and weight loss.²

CH-4.2: Costochondritis/Other Musculoskeletal Chest Wall Syndrome

- Costochondritis or other suggested musculoskeletal chest wall syndrome does not require advanced imaging (CT or MRI) unless it meets other criteria in these guidelines.
- Costochondritis can be readily diagnosed with palpation tenderness and/or hooking maneuver and imaging is non-specific.³

Practice Notes

Differential diagnosis of non-cardiac nonspecific chest pain includes aortic, pulmonary, gastrointestinal (GI), or musculoskeletal pathologies. Chest x-ray could identify pneumothorax, pneumomediastinum, fractured ribs, acute and chronic infections, and malignancies.¹

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CH-5: Dyspnea/Shortness of Breath

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CH-5.1: Dyspnea/Shortness of Breath

- Initial evaluation should include a recent chest x-ray.^{1, 2}
 - ◆ CT Chest without contrast (CPT® 71250) if x-ray is abnormal.^{1,2}
 - ◆ CT Chest without contrast (CPT® 71250, including HRCT), or CT Chest with contrast (CPT® 71260) if the initial chest x-ray is indeterminate and the following evaluations have been conducted and are indeterminate:²
 - ECG, echocardiogram or stress testing,² and
 - Pulse oximetry and pulmonary function studies (PFT's)²

Practice Notes

Dyspnea is the subjective experience of breathing discomfort.

CH-5.2: Pre-Operative Assessment

- “Split Function Studies” (CPT® 78597-Quantitative Differential Pulmonary Perfusion, Including Imaging When Performed or CPT® 78598-Quantitative Differential Pulmonary Perfusion and Ventilation (e.g., Aerosol or Gas), Including Imaging When Performed) can be considered for pre-operative assessment prior to a planned segmental, lobar or lung removal,^{3,4} as well as for pre-interventional assessment prior to a planned endobronchial valve (e.g. Zephyr valve) placement.
 - ◆ CT Chest (CPT® 71250, CPT® 71260 or CPT® 71270) can also be considered, in addition to a “Split Function Study” or as stand-alone imaging, for pre-interventional procedure assessment prior to a planned endobronchial valve (e.g. Zephyr Valve) placement.
 - ◆ If pulmonary embolus (PE) is suspected, See **CH-25: Pulmonary Embolism (PE)**.

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CH-6: Hemoptysis

CH-6.1: Hemoptysis

- Following a chest x-ray performed after hemoptysis started or worsened the following can be appropriate:
 - ◆ CT Chest with contrast (CPT® 71260) or CTA Chest (CPT® 71275)
- For recurrent hemoptysis, (hemoptysis occurring after medical therapy or embolization), the following can be appropriate:
 - ◆ CTA Chest (CPT® 71275)

NOTE:

- CT Chest without contrast, (CPT® 71250), is only warranted in individuals with poor renal function or life-threatening contrast allergy.
- There is no data to support the use of CT Chest without and with contrast, (CPT® 71270), in the diagnosis of hemoptysis.

Practice Notes

- Chest x-ray has been shown to predict the side and cause of bleeding in up to 82% of individuals and can be abnormal in up to 90% of cases. The most common cause of hemoptysis was acute bronchitis with the second most common cause as respiratory tract neoplasm. Bronchiectasis and tuberculosis were additional common causes

Reference

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CH-7: Bronchiectasis

CH-7.1: Bronchiectasis

- High resolution CT Chest (HRCT) without contrast (CPT® 71250) for ANY of the following:^{4,5}
 - ◆ To confirm suspected diagnosis of bronchiectasis after an initial x-ray.^{1,2}
 - ◆ For known bronchiectasis with worsening symptoms or worsening PFT's.²
 - ◆ For hemoptysis with known or suspected bronchiectasis.³

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CH-8: Bronchitis

CH-8.1: Bronchitis

- Advanced imaging is not needed for bronchitis.^{1,2}
- Chest x-ray to determine if any abnormality is present.

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CH-9: Asbestos Exposure

CH-9.1: Asbestos Exposure

- Chest x-ray as radiographic screening for asbestos exposure.^{1,2}
 - ◆ Stable calcified pleural plaques on chest x-ray do not require advanced imaging of the chest.²
- CT Chest should not be used to screen populations at risk for asbestos-related diseases.²
- High resolution CT Chest (HRCT) (CPT® 71250) for ANY of the following:²
 - ◆ Any change seen on chest x-ray
 - ◆ Progressive respiratory symptoms that may indicate the development or progression of asbestos related interstitial fibrosis

Practice Notes

- Asbestosis and asbestos-related diseases include: pleural effusion, pleural plaques, lung cancer, and malignant mesothelioma. The risk of developing mesothelioma increases with increasing intensity and duration of exposure.

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CH-10: Chronic Obstructive Pulmonary Disease (COPD)

CH-10.1: COPD

- Chest x-ray should be performed initially.
 - ◆ CT Chest without contrast (CPT® 71250) or CT Chest with contrast (CPT® 71260)^{1,2} can be performed if:
 - Emphysema is known or suspected and a pre-operative study for Lung Volume Reduction Surgery (LVRS) is being requested.¹ OR
 - Definitive diagnosis is not yet determined by laboratory studies and chest x-ray and ONE of the following is suspected:
 - Bronchiectasis
 - Sarcoidosis
 - Emphysema
 - Pneumoconiosis
 - Idiopathic pulmonary fibrosis
 - Langerhans cell histiocytosis
 - Hypersensitivity pneumonitis
 - Bronchiolitis obliterans
 - Lipoid pneumonia
 - Drug toxicity
 - Lymphangitic cancer²
 - Alpha-1-Antitrypsin Deficiency
- Lung cancer screening is discussed in the following guideline:
 - ◆ See “Screening Indications” in **CH-33: Lung Cancer Screening**
- Pre-interventional lung procedure assessment prior to a planned endobronchial valve (e.g. Zephyr valve) placement
 - ◆ See **CH-5.2: Pre-Operative Assessment**

Practice Notes

- COPD includes asthmatic bronchitis, chronic bronchitis, and emphysema. COPD is airflow reduction (FEV1/FVC ratio <0.7 or FEV1 <80% predicted) in the presence of respiratory symptoms, such as dyspnea. Advanced chest imaging is not typically indicated in COPD exacerbation, which is an acute change in baseline dyspnea, cough, and/or sputum beyond normal day-to-day variations.²

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CH-11: Interstitial Disease

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CH-11.2: E-cigarette, or Vaping, Product Use–Associated Lung Injury (EVALI)	23

CH-11.1: Interstitial Lung Disease (ILD)

- High resolution CT Chest (HRCT) without contrast (CPT® 71250) is the diagnostic modality of choice to evaluate for:
 - ◆ Interstitial changes identified on other imaging (including chest x-ray) in individuals with pulmonary symptoms and abnormal pulmonary function studies (PFT's) (See **CH-5: Dyspnea/Shortness of Breath**)¹⁻⁶
 - ◆ In individuals with pulmonary symptoms and abnormal pulmonary function studies (PFT's) and normal chest x-ray with high clinical suspicion for ILD, as chest x-ray can be normal in up to 10% of ILD⁸
 - ◆ Initial request to identify interstitial disease with a connective tissue disease diagnosis, or significant exposures including (chest x-ray not required):
 - Rheumatoid arthritis
 - Scleroderma
 - Idiopathic inflammatory myopathies (polymyositis, dermatomyositis, inclusion body myositis)
 - Asbestosis
 - Silicosis
 - Coal miner's lung disease¹⁻⁶
 - ◆ New or worsening pulmonary symptoms or worsening PFT's in any type of interstitial disease, including connective tissue diseases¹⁻⁶
 - ◆ Once a year in individuals with known idiopathic pulmonary fibrosis (IPF) if showing progression or regression of disease will change individual management³

CH-11.2: E-cigarette, or Vaping, Product Use–Associated Lung Injury (EVALI)

- CT Chest with or without contrast (CPT® 71250 or CPT® 71260) if EVALI is suspected.⁷

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CH-12: Section left intentionally blank

CH-13: Pneumonia and Coronavirus Disease 2019 (COVID-19)

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CH-13.2: Coronavirus Disease 2019 (COVID-19)	26

CH-13.1: Pneumonia

- Chest x-ray would be performed initially in all individuals with suspected pneumonia, prior to considering advanced imaging.^{1, 2}
 - ◆ CT Chest without or with contrast (CPT® 71250 or CPT® 71260) if initial or repeat chest x-ray findings reveal:
 - Complication of pneumonia (e.g. abscess, effusion, hypoxemia, respiratory distress, necrotizing pneumonia, pneumothorax).^{1,2}
 - Possible lung mass associated with the infiltrate.²

CH-13.2: Coronavirus Disease 2019 (COVID-19)

- CT Chest without contrast (CPT® 71250), or with contrast (CPT® 71260) may be appropriate in the following clinical situations:
 - ◆ Symptomatic COVID-19 positive individuals with underlying comorbidities (including but not limited to age >65 years, asthma, COPD, cystic fibrosis, cardiovascular disease, malignancy, bronchopulmonary dysplasia, chronic infections, or immunocompromised state).
 - ◆ Moderate to severe symptomatic individuals with evidence of significant pulmonary dysfunction or damage (e.g., hypoxemia, moderate-to-severe dyspnea), suspected of having COVID-19, regardless of COVID-19 test results or when viral testing is not available.
 - Thromboembolic complications including pulmonary embolism, stroke and mesenteric ischemia are recognized complications of COVID-19. See **CH-25.1: Pulmonary Embolism**, **AB-6.1: Mesenteric Ischemia** in the Abdomen Imaging Guidelines, and **HD-21.1: Stroke/TIA** in the Head Imaging Guidelines for appropriate imaging guidance.
 - Other systemic complications are being recognized as medical knowledge about this condition evolves. Requested imaging for possible COVID-19 complications should be managed by the appropriate condition based guidelines.
 - ◆ Repeat imaging may be appropriate in the following clinical circumstances:
 - If there is significant worsening of symptoms in a COVID-19 positive individual and imaging will be used to modify individual management.
 - A recovered COVID-19 positive individual with significant residual functional impairment and/or persistence hypoxemia.
- Current literature does not support preoperative screening with advanced imaging in asymptomatic individuals

Practice Notes

- The role of advanced imaging in the diagnosis and management of COVID-19 is very dynamic in this rapidly evolving condition.
- Findings on both Chest X-ray and CT Chest are non-specific. Chest X-rays may show patchy opacities with lower lung predominance. CT may show peripheral multifocal ground glass opacities with lower lung predominance. However, a significant portion of cases have opacities without a clear or specific distribution.^{3,4,6}
 - ◆ Pediatric individuals may have less pronounced imaging findings than adults.

- Major professional society guidelines to date:
 - ◆ The American College of Radiology (ACR) recommends that CT Chest should not be used for screening or as a first-line test to diagnose COVID-19.³
 - ◆ The Centers for Disease Control and Prevention (CDC) recommends viral testing as the only specific method of diagnosis.⁴
 - ◆ The CDC has stated that symptoms may appear 2-14 days after exposure to the virus. These symptoms may include:⁵
 - Fever or chills
 - Cough
 - Shortness of breath or difficulty breathing
 - Fatigue
 - Muscle or body aches
 - Headache
 - New loss of taste or smell
 - Sore throat
 - Congestion or runny nose
 - Nausea or vomiting
 - Diarrhea
 - ◆ The Fleischner Society consensus statement published on April 7, 2020, recommends against the use of imaging in individuals with suspected COVID-19 who are either asymptomatic or have only mild symptoms without evidence of significant pulmonary dysfunction or damage (e.g., absence of hypoxemia, no or mild dyspnea).⁶
 - ◆ According to The American Society of Transplantation, screening donors is based on methods below. Screening donors encompasses three different methods.⁷
 - Epidemiologic screening for travel and potential exposures
 - Screening for symptoms suggestive of COVID-19
 - Viral testing (Nucleic acid testing of specimens)
 - There is no current indication for screening asymptomatic donors with advanced imaging

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CH-14: Other Chest Infections

CH-14.1: PPD or TB (Mycobacterium tuberculosis and Mycobacterium avium complex (MAC))	30
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CH-14.4: Suspected Sternal Dehiscence	30

CH-14.1: PPD or TB (*Mycobacterium tuberculosis* and *Mycobacterium avium* complex (MAC))

- CT Chest with contrast (CPT® 71260) or CT Chest without contrast (CPT® 71250) with ANY of the following:
 - ◆ Positive PPD skin test or other positive tuberculin skin tests or positive QuantiFERON-TB Gold or suspected active (or reactivated) tuberculosis and a normal or equivocal chest x-ray¹
 - ◆ Suspected complications or progression of tuberculosis (e.g. pleural tuberculosis, empyema, and mediastinitis)²
- If CT Chest is unremarkable, there is insufficient data to support performing subsequent CT Chest unless symptoms develop or chest x-ray shows a new abnormality.
- Follow-up CT Chest with contrast (CPT® 71260) or without contrast (CPT® 71250) with frequency at the discretion of or in consultation with the pulmonary or infectious disease specialist (not to exceed 3 studies in 3 months).
 - ◆ Re-evaluate individuals undergoing active treatment for tuberculosis who had abnormalities seen only on CT Chest.

CH-14.2: Fungal Infections (Suspected or Known)

- CT Chest with contrast (CPT® 71260) or High resolution CT Chest (HRCT) without contrast (CPT® 71250):^{3,4}
 - ◆ Initial diagnosis of any fungal pneumonia or chest infection^{3,4}
 - ◆ Suspected complications or progression of the fungal chest infection (e.g. worsening pneumonitis; pleural effusion, empyema, mediastinitis)
- Follow-up CT Chest with contrast (CPT® 71260) or High resolution CT Chest (HRCT) without contrast (CPT® 71250) with frequency at the discretion of or in consultation with the pulmonary or infectious disease specialist.

CH-14.3: Wegener's Granulomatosis/Granulomatosis with Polyangiitis

- CT Chest without contrast (CPT® 71250)* should be done in all individuals who have pulmonary symptoms and are newly diagnosed or suspected of having Antineutrophil cytoplasmic autoantibody (ANCA)-associated vasculitides (AAV) for a baseline prior to initiating immunosuppressive therapy.^{5,6}
- Selective use of additional imaging is useful in evaluating individuals who are suspected or known to have AAV, including CT Head (sinuses, orbits, mastoids) in individuals with visual or upper respiratory track symptoms or signs, and CT Neck (subglottic region) in individuals with symptoms or signs of subglottic stenosis.⁶

*In most situations, CT scans in individuals with AAV should be performed without an iodinated contrast agent administered.⁶

CH-14.4: Suspected Sternal Dehiscence

- Sternal wound dehiscence is primarily a clinical determination.

- Chest x-ray is performed prior to advanced imaging to identify abnormalities in the sternal wire integrity and/or a midsternal stripe. Other findings include rotated, shifted or ruptured wires.
- CT Chest without contrast (CPT® 71250) can be considered if there is planned debridement and/or repair.

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CH-15: Sarcoid

CH-15.1: Sarcoid

- CT Chest with contrast (CPT® 71260) or without contrast (CPT® 71250) for ANY of the following:¹
 - ◆ Establish or rule out the diagnosis when suspected
 - ◆ Development of worsening symptoms
 - ◆ New symptoms appear after a period of being asymptomatic
 - ◆ Treatment change is being considered in known sarcoid
- If CT is equivocal, definitive diagnosis can only be made by biopsy.^{2,3,4}
- PET/CT should not be used in the standard work-up of all sarcoid individuals. There is currently no evidence to support the use of PET/CT for screening.
- PET/CT (CPT® 78815) can be considered under the following conditions:^{5,6,7}
 - ◆ Help guide biopsy location if:
 - Known lesion on CT Chest is difficult to access, to help identify alternative biopsy location
 - No apparent lung involvement and to identify an extrapulmonary biopsy site
 - ◆ Differentiation of reversible granulomatous disease from irreversible pulmonary fibrosis and will affect treatment options
 - ◆ Help identify treatment failure where either current treatment will be modified or new treatment will be introduced

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CH-16: Solitary Pulmonary Nodule (SPN)

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CH-16.0: Solitary Pulmonary Nodule

- For Lung Cancer Screening (LDCT) including incidental findings from LDCT, See **CH-33: Lung Cancer Screening**.

CH-16.1: Solitary Pulmonary Nodule – Imaging

- CT Chest with contrast (CPT® 71260) or CT Chest without contrast (CPT® 71250) initially for discrete nodule(s) in the following scenarios:^{1,2,3}
 - ◆ Lung nodule(s) seen on an imaging study other than a “dedicated” CT or MRI Chest. Examples of other studies:
 - Chest x-ray
 - CT Abdomen
 - MRI Spine
 - Coronary CTA¹
 - ◆ But NOT in the following which are considered initial dedicated advanced chest imaging:
 - CT Chest without and with contrast (CPT® 71270)
 - CTA Chest without and with contrast (CPT® 71275)
 - MRI Chest without contrast (CPT® 71550)
 - MRI Chest without and with contrast (CPT® 71552)
 - MRA Chest without and with contrast (CPT® 71555)
- Comparisons should include the earliest available study and the more recent previous CT Chest scans to determine if nodule was present and stable.¹ Using largest measurement of multiple lung nodules.¹
 - ◆ Similar-sized pleural nodule(s) is treated as a pulmonary nodule(s)
- The size of the lung or pleural nodule(s) is crucial information for decisions making regarding follow-up. The largest of multiple lung and/or pleural nodules will guide the surveillance interval. (See **CH-16.2: Incidental Pulmonary Nodules Detected on CT Images**, and **CH-17.1: Pleural-Based Nodules and Other Abnormalities**) Yet, multiple nodules may also change this interval. (See **CH-16.2: Incidental Pulmonary Nodules Detected on CT Images**).

Practice Notes

Abnormality examples include: mass, opacity, lesion, density, nodule, and calcification.

CH-16.2: Incidental Pulmonary Nodules Detected on CT Images

Incidentally Detected Solid Pulmonary Nodules Follow-up Recommendations*				
Size				
Nodule Type	<6 mm (<100 mm ³)	6–8 mm	>8 mm	Comments
Single Nodule				
	Follow-up (optional) CT at 12 months. No routine follow-up if stable at 12 months	CT at 6–12 months, then CT at 18–24 months if stable	CT at 3 months, then CT at 6-12 and then at 18-24 months if stable. Consider PET/CT** or biopsy	Certain individuals at high risk with suspicious nodule morphology, upper lobe location, or both may warrant 12-month follow-up
Multiple Nodules				
	Follow-up (optional) CT at 12 months. *No routine follow-up if stable at 12 months	CT at 3–6 months, then at 18–24 months if stable	CT at 3–6 months, then at 18–24 months if stable. Consider PET/CT** or biopsy	Use most suspicious nodule as a guide to management. Follow-up intervals may vary according to size and risk.

Incidentally Detected Sub-Solid Pulmonary Nodules Follow-up Recommendations			
Size			
Nodule Type	<6 mm (<100 mm ³)	≥6 mm (≥100 mm ³)	Comments
Single Ground glass opacity (GGO)	Consider follow-up at 2 and 4 years. If solid component(s) or growth develops, consider resection.	CT at 6–12 months to confirm persistence, then follow-up with CT every 2 years until 5 years	In certain suspicious nodules, <6 mm, consider follow-up at 2 and 4 years. If solid component(s) or growth develops, consider resection.
Single Part-solid	Consider follow-up at 2 and 4 years. If growth develops, consider resection.	CT at 3–6 months to confirm persistence. If unchanged and solid component remains <6 mm, then annual CT should be performed for 5 years. If the solid component has suspicious morphology (i.e., lobulated margins or cystic components), is >8 mm or is growing: Consider PET/CT** or biopsy	In practice, part-solid nodules cannot be defined as such until ≥6 mm. Persistent part-solid nodules with solid components ≥6 mm should be considered highly suspicious.
Multiple Part-Solid	CT at 3–6 months. If stable, consider CT at 2 and 4 years.	CT at 3–6 months. Subsequent management based on the most suspicious nodule(s).	Multiple <6 mm pure ground-glass nodules are usually benign.

(*Following the Fleischner Society Guidelines for high risk which include American College of Chest Physicians intermediate and high risk categories.^{1,2})

**PET/CT consider for ≥ 8 mm lung nodule

If a PET/CT was found to be negative, follow-up with CT at 3 months, 9 months, and 21–24 months, if stable.

If a PET/CT was found to be positive, a biopsy was negative or non-diagnostic, follow-up with CT at 3 months, 12 months, and 24 months, if stable.

CH-16.3: Interval Imaging Outcomes

- No further advanced imaging is necessary if a nodule has been:
 - ◆ Stable for 2 years
 - Nodules(s) stable on chest x-ray
 - Nodule(s) ≥ 6 mm stable on CT Chest¹
 - ◆ Stable for 1 year
 - Nodule(s) < 6 mm¹
 - ◆ At any time, if:
 - Classically benign characteristics by chest x-ray or previous CT (e.g. benign calcification pattern typical for a granuloma or hamartoma)
 - Decreasing or disappearing nodule(s)³
- Lung nodule(s) which increases in size or number should no longer be considered for CT screening or surveillance.^{1,2,3,7}
 - ◆ With an increase in nodule(s) size or number, PET (See **CH-16.4: PET**) as well as tissue sampling or other further diagnostic investigations should be considered.

CH-16.4: PET

- PET/CT (CPT® 78815) for a distinct lung nodule ≥ 8 mm on dedicated advanced chest imaging, as described in **CH-16.1: Solitary Pulmonary Nodule – Imaging**. See **ONC-8.2: Non-Small Cell Lung Cancer – Suspected/Diagnosis** in the Oncology Imaging Guidelines for lung mass ≥ 3.1 cm
 - ◆ If there is a history of malignancy, refer to the appropriate Oncology restaging/recurrence guideline for indications for PET imaging
 - ◆ Pleural nodule, See **CH-17.1: Pleural-Based Nodules and Other Abnormalities**
 - ◆ Serial PET studies are not considered appropriate
 - ◆ PET studies are not appropriate for infiltrate, ground glass opacity, or hilar enlargement

Practice Notes

- A **nodule** is any pulmonary or pleural lesion that is a discrete, spherical opacity 2-30 mm in diameter surrounded by normal lung tissue. A larger nodule is called a mass. Entities that are not nodules, and are considered benign, include non-spherical linear, sheet-like, two-dimensional or scarring opacities.³

- **Malignant** nodule features can include spiculation, abnormal calcification, size greater than 7-10 mm, interval growth, history of a cancer that tends to metastasize to the lung or mediastinum, and/or smoking history.^{1,3}
 - ◆ A nodule that grows at a rate consistent with cancer (doubling time 100 to 400 days) may be sampled for biopsy or resected.¹
 - ◆ Less than 1% of <6 mm lung nodules are malignant.¹
 - ◆ Three percent of all 8 mm lung nodules are malignant.¹
 - ◆ Only one follow-up at 6-12 months is sufficient for 6-8 mm nodules and not all require traditional 2 year follow-up.¹
 - ◆ The larger the solid component of a subsolid nodule, the greater the risk of invasiveness and metastases.¹
 - ◆ Increased risk of primary cancer as the total nodule count increased from 1 to 4 but decreased risk in individuals with 5 or more nodules, most of which likely resulted from prior granulomatous infection.¹
 - ◆ A nodule that does not grow in 6 months has a risk of malignancy at <10%.
- **Benign** features in solid nodules can include benign calcification (80% granuloma, 10% hamartoma), multiple areas of calcification, small size, multiple nodules, negative PET, and stability of size over 2 years.³
- **Ground glass** or subsolid opacities, which can harbor indolent adenocarcinoma with average doubling times of 3–5 years.¹
- **Repeat PET** is discouraged. If the original PET is positive, biopsy may be performed. If the original PET is negative but subsequent CT Chest shows an increase in nodule size, biopsy may be performed.
- **False positive PET** can occur with infection or inflammation; false negatives can occur with small size nodule, ground glass lesions and indolent cancers such as bronchoalveolar or carcinoid.
- **False negative PET** can be seen in individuals with adenocarcinoma in situ, carcinoid tumors, and mucinous adenocarcinomas. High pre-test likelihood of malignancy with negative findings on PET scan only reduces the likelihood of malignancy to 14%; while in an individual with a low pre-test likelihood (20%) of malignancy, a negative PET scan reduces the likelihood of malignancy to 1%.⁶
- Individuals aged 35 years or younger¹
 - ◆ Considered to have an overall low risk for pulmonary malignancy
 - ◆ In this age group, nodules are most likely to be infectious rather than cancer
 - ◆ Management of incidentally-found pulmonary nodules in this group should be individualized

- Pulmonary cyst(s)¹⁰
 - ◆ May represent a rare form of adenocarcinoma, squamous cell carcinoma or small cell carcinoma.
 - ◆ Short-term initial imaging to exclude rapid growth can be considered at 3-6 months
 - ◆ Further imaging can be managed according to the part-solid pathway

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CH-17: Pleural-Based Nodules and Other Abnormalities

CH-17.1: Pleural-Based Nodules and Other Abnormalities

- CT Chest with contrast (CPT® 71260) or CT Chest without contrast (CPT® 71250) (with contrast is preferred for initial evaluation) for pleural nodule(s).¹
 - ◆ Pleural nodule(s) seen on an imaging study other than a “dedicated” CT or MRI Chest.¹
 - ◆ Pleural nodule(s) identified incidentally on any of the following dedicated chest studies can replace CT Chest as the initial dedicated study.¹
 - CT Chest without and with contrast (CPT® 71270)
 - CTA Chest without and with contrast (CPT® 71275)
 - MRI Chest without contrast (CPT® 71550)
 - MRI Chest without and with contrast (CPT® 71552)
 - MRA Chest without and with contrast (CPT® 71555)
 - ◆ After preliminary comparison with any available previous chest films to determine presence and stability.
 - ◆ Using largest measurement of multiple nodule(s). (See **CH-16.1: Solitary Pulmonary Nodule – Imaging**).
 - ◆ Following the Fleischner Society Guidelines for high risk. (See **CH-16.2: Incidental Pulmonary Nodules Detected on CT Images**).¹
- PET/CT (CPT® 78815) can be considered if dedicated CT or MRI Chest identifies a pleural nodule/mass or defined area of pleural thickening that is ≥8 mm when there is a likelihood of malignancy including current or previous malignancy, pleural effusion, bone erosion, chest pain.¹

Practice Notes

- Pleural nodule/mass or thickening without suggestion of malignancy would undergo surveillance or biopsy.

Reference

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CH-18: Pleural Effusion

CH-18.1: Pleural Effusion

- CT Chest with contrast (CPT® 71260) after both:^{1,2}
 - ◆ Chest x-ray including lateral decubitus films; and
 - ◆ Thoracentesis to determine if fluid is exudative or transudative and remove as much as possible (this fluid can obscure the underlying lung parenchyma and possibly a mass).
- Chest ultrasound (CPT® 76604) can be used as an alternative to chest x-ray to evaluate for the presence of fluid within the pleural spaces and guide thoracentesis.

Practice Notes

- Bilateral effusions are more often systemic related transudates (congestive heart failure, renal failure, liver insufficiency, etc.), and advanced imaging is rarely needed. Large unilateral effusions can be malignant. Analysis of fluid may include: cytology, culture, cell count, and biochemical studies.

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CH-19: Pneumothorax/Hemothorax

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CH-19.1: Pneumothorax/Hemothorax

- Chest x-ray initially.
 - ◆ CT Chest with contrast (CPT® 71260) or without contrast (CPT® 71250) if:
 - Diagnosis of a small pneumothorax is in doubt, and the presence of a pneumothorax will affect individual treatment decisions.¹
 - Preoperative study for treatment of pneumothorax.¹
 - Pneumothorax associated with hemothorax.²
 - Suspected complications from hemothorax (e.g. empyema).²
 - Suspected Alpha-1-Antitrypsin Deficiency (even without pneumothorax).³

CH-19.2: Pneumomediastinum; Subcutaneous Emphysema

- Chest x-ray initially.
 - ◆ CT Chest with contrast (CPT® 71260) or without contrast (CPT® 71250) if:
 - Recent vomiting and/or suspected esophageal perforation.^{4,5}
 - Associated pneumopericardium.^{4,5}
 - Associated pneumothorax.^{4,5}
 - Preoperative study for treatment.^{4,5}

Practice Notes

- An expiration chest x-ray can enhance the evaluation of equivocal plain x-ray. There is no data supporting the use of serial CT Chest to follow individuals with a known pneumothorax, pneumomediastinum, or hemothorax who are asymptomatic or have stable symptoms. With the exception of the indications above, advanced imaging of the chest is rarely indicated in the diagnosis or management of pneumothorax, or pneumomediastinum. Inspiratory/expiratory chest x-rays are helpful in defining whether a pneumothorax is present.

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3. Sandhaus R, Turino G, Brantly M, et al. The Diagnosis and Management of Alpha-1 Antitrypsin Deficiency in the Adult. *Chronic Obst Pulm Dis* 2016; 3:668.
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CH-20: Mediastinal Mass

CH-20.1: Mediastinal Mass

- CT Chest with contrast (CPT® 71260) or CT Chest without contrast (CPT® 71250) or MRI Chest without and with contrast (CPT® 71552) or MRI Chest without contrast (CPT® 71550), to evaluate mediastinal abnormalities, may include, but not limited to mediastinal cyst including bronchogenic, thymic, pericardial or esophageal, seen on chest x-ray or other non-dedicated chest imaging.
- MRI Chest without and with contrast (CPT® 71552) or MRI Chest without contrast (CPT® 71550) can be considered for indeterminate mediastinal mass on CT Chest.
 - ◆ Lesions that remain indeterminate on MRI, if biopsy is not performed, surveillance imaging could be performed at 3-12 month intervals over 2 years or more with MRI Chest, depending upon level of clinical concern.
- FDG PET/CT offers limited additional value beyond that of conventional CT in the initial assessment of mediastinal mass(es), with the exception of primary mediastinal lymphoma. See **ONC-27: Non-Hodgkin Lymphomas** or **ONC-28: Hodgkin Lymphoma** in the Oncology Imaging Guidelines. A positive FDG PET/CT has little value for discrimination between benign and malignant lesions.
 - ◆ MRI Chest without and with contrast (CPT® 71552) or MRI Chest without contrast (CPT® 71550) can be considered for indeterminate mediastinal mass on FDG PET/CT
- CT Chest with contrast (CPT® 71260), or CT Chest without contrast (CPT® 71250) or MRI Chest without and with contrast (CPT® 71552), or MRI Chest without contrast (CPT® 71255) for subsequent evaluations if:
 - ◆ New signs or symptoms, or
 - ◆ Preoperative assessment
- For Adenopathy; See **CH-2: Lymphadenopathy**.
- For Goiter; See **NECK-8.1: Thyroid Nodule** in the Neck Imaging Guidelines.
- For Myasthenia Gravis; See **PN-6.1: Neuromuscular Joint Disorders** in the Peripheral Nerve Disorders Imaging Guidelines.

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CH-21: Chest Trauma

CH-21.1: Chest Trauma

- Chest X-ray initially.
 - ◆ CT Chest without contrast (CPT® 71250) or with contrast (CPT® 71260) for the following situations:¹
 - Rib¹ or Sternal² Fracture:
 - With associated complications identified clinically or by other imaging, including pneumothorax, hemothorax, pulmonary contusion, atelectasis, flail chest, cardiovascular injury and/or injuries to solid or hollow abdominal organs.¹
 - Uncomplicated, single fractures, multiple fractures, non-acute fractures, or occult rib fractures are NOT an indication for CT Chest unless malignancy is suspected as the etiology.¹
 - Routine follow-up advanced imaging of rib or sternal fractures is not indicated.¹
- CT Chest without contrast (CPT® 71250) or Tc-99m bone scan whole body (CPT® 78306) for suspected pathological rib fractures, with or without a history of trauma.¹
- Clavicle Fractures:
 - ◆ CT Chest with contrast (CPT® 71260) or CT Chest without contrast (CPT® 71250) or MRI Chest without and with contrast (CPT® 71552) or MRI Chest without contrast (CPT® 71550) for proximal (medial) 1/3 fractures or sternoclavicular dislocations.³
 - ◆ X-ray is adequate for evaluation of middle and distal 1/3 fractures.³
- No advanced imaging of the abdomen or pelvis is indicated when there is chest trauma and no physical examination or laboratory evidence of abdominal and/or pelvic injury.

References

1. ACR Appropriateness Criteria® Rib Fractures: *American College of Radiology (ACR)*; 2018.
2. Clancy K, Velopulos C, Bilaniuk J, et al. Eastern Association for the Surgery of Trauma. Screening for blunt cardiac injury: an Eastern Association for the Surgery of Trauma practice management guideline. *J Trauma Acute Care Surg*. 2012 Nov; 73 (5 Suppl 4): S301-6.
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CH-22: Chest Wall Mass

CH-22.1: Chest Wall Mass

- Chest x-ray is useful in the workup of a soft-tissue mass and is almost always indicated as the initial imaging study.¹
 - ◆ Chest ultrasound (CPT® 76604) may be useful as an initial imaging study in the setting of a suspected superficial or subcutaneous lipoma. This modality may also be valuable in differentiating cystic from solid lesions and has also been used to assess the vascularity of lesions.¹
 - ◆ CT Chest with contrast (CPT® 71260) or CT Chest without contrast (CPT® 71250) or MRI Chest without and with contrast (CPT® 71552) or MRI Chest without contrast (CPT® 71550) unless chest x-ray or ultrasound demonstrate ONE of the following:^{1,2}
 - Obvious lipomas¹ (See **MS-10: Soft Tissue Mass or Lesion of Bone** in the Musculoskeletal Imaging Guidelines).
 - Clearly benign entity¹ (See **MS-10: Soft Tissue Mass or Lesion of Bone** in the Musculoskeletal Imaging Guidelines).

Practice Notes

- Chest x-rays of chest wall masses can detect calcification, ossification, or bone destruction as well as location and size.³

References

1. ACR Appropriateness Criteria® Soft-Tissue Masses. *American College of Radiology (ACR)*; 2017.
2. ACR Appropriateness Criteria® Primary Bone Tumors. *American College of Radiology (ACR)*; 2013.

CH-23: Pectus Excavatum and Pectus Carinatum

CH-23.1: Pectus Excavatum and Carinatum

- CT Chest without contrast (CPT® 71250) or MRI Chest without and with contrast (CPT® 71552) and 3-D reconstruction (CPT® 76377 or CPT® 76376) if:
 - ◆ Candidates for surgical correction.^{1,2}
 - Cosmetic repairs requests without physiological disability or severe deformities may not meet certain payors policies.
 - ◆ Cardiac or pulmonary dysfunction has been identified^{1,2}
 - ECG and echocardiography if cardiac symptoms or evidence of cardiac function abnormalities.
 - Chest x-ray and PFT's if increasing shortness of breath.¹
- Chest measurements derived from CT Chest, such as the Haller Index, are helpful to the thoracic surgeon in pre-operative assessment of chest wall deformities to assess for the appropriateness of operative repair prior to the development of symptomatic pectus deformities.

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CH-24: Pulmonary Arteriovenous Fistula (AVM)

CH-24.1: Pulmonary AVM

- CT Chest with contrast (CPT® 71260), CTA Chest (preferred modality) (CPT® 71275), or MRA Chest (CPT® 71555) for evaluation of:^{1,2,3}
 - ◆ Suspected pulmonary AVM
 - ◆ First degree relatives of an individual with a primary pulmonary AVM
 - ◆ Evaluation of individuals with paradoxical embolus/stroke and no evidence of patent foramen ovale on echocardiogram
 - ◆ Follow-up of treated AVM's at 6 months post embolization and then every 3-5 years⁴
 - ◆ Follow-up of untreated AVM's to be determined by treating physician, but no more than annually. Usually the interval is 3-5 years due to the slow-growth nature of PAVM's⁴
 - ◆ Treated or untreated PAVM's with recurrent symptoms⁴

Practice Notes

- Pulmonary AVMs are abnormal connections between pulmonary arteries and veins, usually found in the lower lobes, that can be either primary or acquired (such as trauma, bronchiectasis). They can be identified in up to 98% of chest x-rays by a peripheral, circumscribed, non-calcified lesion connected by blood vessels to the hilum of the lung. Treatment is often by surgery or embolization of the feeding artery using platinum coils or detachable balloons.

References

1. De Cillis E, Burdi N, Bortone A, et al. Endovascular treatment of pulmonary and cerebral arteriovenous malformations in patients affected by hereditary haemorrhagic telangiectasia. *Current Pharmaceutical Design* 2006; 12 (10):1243-1248.
2. Gossage J and Kanj G. Pulmonary Arteriovenous Malformations a State of the Art Review, *Am. J. Respir. Crit. Care Med.* August 1, 1998 vol. 158 no. 2 643-661.
3. Lee E, Boiselle P, Cleveland R. Multidetector CT evaluation of congenital lung anomalies. *Radiology*, 2008; 247: 632-648.
4. Faughnan ME, et al. "International Guidelines for the Diagnosis and Management of Hereditary Haemorrhagic Telangiectasia." *Journal of Medical Genetics*, vol. 48, no. 2, 23 June 2009, pp. 73–87, doi: 10.1136/jmg.2009.069013.

CH-25: Pulmonary Embolism (PE)

CH-25.1: Pulmonary Embolism

- CT Chest with contrast with PE protocol (CPT® 71260) or CTA Chest (CPT® 71275) if at least one symptom, clinical/laboratory finding or risk factor from each of the lists below are present.
 - ◆ With any ONE of the 3:^{6,7,8}
 - Dyspnea, new onset and otherwise unexplained;
 - Chest Pain, pleuritic;
 - Tachypnea
 - ◆ AND, with any ONE of the 3:^{6,7,8}
 - Abnormal **D-dimer** test;
 - Wells Criteria score* higher than 4 points;
 - One Risk Factor** or Symptom** of new onset demonstrating high clinical probability of PE

RISK FACTORS** ^{6,7,8}	SYMPTOMS ATTRIBUTED TO PE** ^{6,7,8}
Immobilization at least 3 days or surgery in last 4 weeks or recent trauma	Signs or symptoms of DVT
Previous history of DVT or PE	Hemoptysis
Cancer actively treated in last 6 months or receiving palliative treatment	Right heart strain or failure
Recent history of a long airplane flight	Systolic BP <90
Use of estrogen-based contraceptives (birth control pills, the patch, and vaginal ring)/Oral estrogen ¹	Syncope
Advanced age (≥70)	Cough
Congestive heart failure	Heart Rate >100
Obesity (BMI ≥35)	Palpitations
Suspicion or diagnosis of COVID-19	

Well's Criteria for Clinical Probability of PE* ⁶	
Clinical signs/symptoms of DVT (at minimum: leg swelling and pain with palpation of the deep veins)	3
PE is likely or equally likely diagnosis	3
Heart rate >100	1.5
Immobilization at least 3 days or surgery in last 4 weeks	1.5
Previous history of DVT or PE	1.5
Hemoptysis	1
Cancer actively treated in last 6 months or receiving palliative treatment	1
Calculate Probability: Low <2 Moderate 2 to 6 High >6	
Using the above criteria, only 3% of individuals with a low pretest probability had PE versus 63% of those with a high pretest probability.	

- ◆ Non-urgent cases which do not meet above 2-step criteria, should undergo prior to advanced imaging:⁹
 - Chest x-ray (to rule out other causes of acute chest pain).
 - Primary cardiac and pulmonary etiologies should be eliminated.
- ◆ Pregnant women with suspected PE are suggested to proceed with:^{1,9}
 - D-dimer and/or;
 - Doppler studies of the lower extremities;
 - V/Q preferred if Doppler negative; CTA Chest (CPT® 71275) or MRA Chest (CPT® 71555) can be performed if V/Q scanning is not available.
- ◆ Ventilation-perfusion scans, also called V/Q, scans (CPT® 78580-Pulmonary Perfusion Imaging; CPT® 78582-Pulmonary Ventilation (e.g., Aerosol or Gas) and Perfusion Imaging).
 - Is not a replacement for CTA Chest⁹
 - Can be considered in any of the following:
 - Suspected pulmonary embolism if there is a contraindication to CT or CTA Chest (ventilation-perfusion scans CPT® 78582)
 - Suspected pulmonary embolism when a chest x-ray is negative and CTA Chest is not diagnostic (CPT® 78580 or CPT® 78582)
 - Follow-up of an equivocal or positive recent ventilation-perfusion lung scan to evaluate for interval change (CPT® 78580)
- ◆ Follow-up Imaging in Stable or Asymptomatic Individuals with Known PE is not warranted^{2,3,4,10}
- ◆ CT Chest with contrast with PE protocol (CPT® 71260) or CTA Chest (CPT® 71275) for ANY of the following indications:
 - Recurrent signs or symptoms such as dyspnea, or
 - Elevated d-dimer which is persistent or recurrently elevated, or
 - Right heart strain or failure identified by EKG, ECHO or Heart catheterization.

- Pulmonary Artery Hypertension (PAH) - See **CD-8.1: Pulmonary Artery Hypertension (PAH) – Indications** in the Cardiac Imaging Guidelines

Practice Notes

- Pulmonary embolism is found in approximately 10% of all those that present with suspicion of PE. Dyspnea, pleuritic chest pain and tachypnea occur with about 50% incidence with leg swelling or pain just over 50%.
- D-dimer level has a high sensitivity and low specificity for diagnosing PE.
 - ◆ A negative D-dimer in combination with low or moderate PE risk classification has a negative predictive value approaching 100%.
 - ◆ D-dimer can be falsely elevated with recent surgery, injury, malignancy, sepsis, diabetes, pregnancy, or other conditions where fibrin products are likely to be present.
- CT imaging has supplanted V/Q scanning since the latter is difficult to obtain quickly, does not provide a substantial cost savings, and does not diagnose other pulmonary pathology.
- The decision to terminate anticoagulation treatment after previous pulmonary embolism (PE) with absent or stable symptoms is based on clinical evaluation and risk factors.
- Repeat studies do not allow one the ability to distinguish new from residual clot, with luminal diameter and clot character poorly correlated to symptoms and ECHO findings.
- Two thirds of individuals with primary thromboembolism have residual pulmonary artery clot at 6 months and 50% remain at one year.
- Subsequent persistence or elevation of D-dimer is associated with increased risk of recurrent PE. ECHO and Right Heart Catheterization (RHC) can identify those with pulmonary hypertension. Yet, 1/2 of all have persistent or new pulmonary hypertension after primary thromboembolism and only half of this latter group has dyspnea at rest or exercise intolerance.

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CH-26: Pulmonary Hypertension

- See the **Peripheral Vascular Disease Imaging Guidelines**.

CH-27: Subclavian Steal Syndrome

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CH-27.0: Subclavian Steal Syndrome – General

- Occurs from blood flowing up the contralateral vertebral artery to the basilar artery and retrograde down the ipsilateral vertebral artery (reversal of flow) to supply collateral circulation to the arm on the side and past the stenotic or occluded proximal subclavian or innominate artery to perfuse that arm.

CH-27.1: Subclavian Steal Syndrome

- Initial evaluation should include clinical findings satisfying the symptom complex and initial imaging with Carotid duplex study (CPT® 93882).
 - ◆ Satisfying the symptom complex
 - Physical examination findings suggestive of subclavian stenosis include a discrepancy of >15 mmHg in blood pressure readings taken in both upper extremities, delayed or decreased amplified pulses in the affected side, and a bruit in the supraclavicular area on the affected side.
 - Symptoms include vertebral basilar artery insufficiency, vertigo, limb paresis, and paresthesias. Bilateral cortical visual disturbances, ataxia, syncope, and dysarthria occur less frequently.
 - Symptoms of cerebral ischemia may be produced by exercise of the affected arm.
 - ◆ Carotid duplex study (CPT® 93882) is the initial and definitive imaging study
 - Reversal of flow in the ipsilateral vertebral artery.
 - If the carotid duplex is not diagnostic for reversal of flow in the ipsilateral vertebral artery, then neurological symptoms should be evaluated according to the Head guidelines.
- MRA Neck and Chest (CPT® 70548 and CPT® 71555) or CTA Neck and Chest (CPT® 70498 and CPT® 71275) can be performed for diagnosis in individuals with symptoms of vertebrobasilar ischemia if the clinical exam and duplex study are positive, indeterminate, or as preoperative studies if they will substitute for invasive angiography.
- MRA Upper extremity (CPT® 73225) or CTA Upper extremity (CPT® 73206) can be performed in symptomatic individuals if needed to exclude pathology distal to the subclavian artery and if they will substitute for invasive angiography.
- See **HD-21.1: Stroke/TIA** (for vertebrobasilar stroke) in the Head Imaging Guidelines.
- Treatment options include ligation of the ipsilateral vertebral artery, aorta-subclavian artery bypass graft, or subclavian endarterectomy.

Practice Note

- While MRA does not expose the individual to radiation, CTA should be considered the test of choice for subclavian steal syndrome given its superior spatial and temporal resolution.

References

1. Van Brimberge F, Dymarowski S, Budts W, et al. Role of magnetic resonance in the diagnosis of subclavian steal syndrome. J Magn Reson Imaging. 2000; 12 (2): 339.
2. Potter B and Pinto D. Subclavian steal syndrome. Circulation, 2014; 129: 2320-2323.

CH-28: Superior Vena Cava (SVC) Syndrome

CH-28.1: SVC Syndrome

- CT Chest with contrast (CPT® 71260) for the evaluation of suspected SVC syndrome based on the facial cyanosis and upper extremity swelling without anasarca.^{1,2}
- MRV (CPT® 71555) or CTV (CPT® 71275) Chest may be indicated when stenting of the SVC is being considered.^{1,2}

Practice Notes

- SVC syndrome is caused by acute or subacute, intrinsic or extrinsic obstruction of the SVC, most commonly from lung cancer (80-85%) and less often benign (fibrosis, mediastinitis, indwelling devices). Other symptoms include dyspnea, headache and dizziness.

References

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2. Lepper P, Ott S, Hoppe H, et la. Superior vena cava syndrome in thoracic malignancies. *Respir Care*, 2011; 56: 653-666.

CH-29: Thoracic Aorta

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CH-29.0: Thoracic Aorta

- See the **Peripheral Vascular Disease Imaging Guidelines**

CH-29.1: Aortic Dissection

- See the **Peripheral Vascular Disease Imaging Guidelines**

CH-29.2: Thoracic Aortic Aneurysm (TAA)

- See the **Peripheral Vascular Disease Imaging Guidelines**

CH-29.3: Screening Guidelines for Familial Syndromes

- See the **Peripheral Vascular Disease Imaging Guidelines**

CH-29.4: Thoracic Aorta in Individuals with Bicuspid Aortic Valve

- See the **Peripheral Vascular Disease Imaging Guidelines**

CH-29.5: Calcified Ascending Aorta

- See the **Cardiac Imaging Guidelines**

CH-30: Elevated Hemidiaphragm

CH-30.1: Elevated Hemidiaphragm

- CT Chest with contrast (CPT® 71260) and CT Neck with contrast (CPT® 70491) (if requested) with new diaphragmatic paralysis after:^{1,2}
 - ◆ Previous chest x-rays are available and reviewed to determine if the diaphragmatic elevation is a new finding, and/or
 - ◆ Fluoroscopic examination (“sniff test”) to differentiate true paralysis from weakness.
- CT Abdomen with contrast (CPT® 74160) to rule out liver or abdominal process if CT Chest is negative.^{1,2}
- Repeat advanced imaging studies in the absence of new signs or symptoms are not indicated.

Practice Notes

- The right hemidiaphragm sits about 2 cm higher than the left.
- “Eventration” is thin membranous replacement of muscle, usually on the right, as the most common cause of elevation.
- Any injury to the phrenic nerve from neck to diaphragm can lead to paralysis.
- Common phrenic causes are traumatic or surgical injury or malignancy involving the mediastinum.
- Any loss of lung volume or increased abdominal pressure can lead to diaphragm elevation.

References

1. Ko MA, Darling GE. 2009. Acquired paralysis of the diaphragm. *Thorac Surg Clin* 19 (4): 501-510.
2. Qureshi A. 2009. Diaphragm paralysis. *Semin Respir Crit Care Med* 30(3): 315-320.

CH-31: Thoracic Outlet Syndrome (TOS)

CH-31.1: Thoracic Outlet Syndrome

- Chest x-ray should be performed initially in all cases, after the onset of symptoms or if there has been a change in symptoms, since it can identify bony abnormalities or other causes of upper extremity pain.^{1,2}
- Preferred imaging modality in individuals with suspected TOS varies depending upon suspected etiology. More than one type of imaging may be required for diagnosis in complex cases.^{1,2}
- Neurogenic Thoracic Outlet Syndrome:
 - ◆ MRI Chest without contrast or with and without contrast (CPT® 71550 or CPT® 71552) (preferred studies) or CT Chest with Contrast (CPT® 71260)
- Venous Thoracic Outlet Syndrome:
 - ◆ CT Chest with Contrast (CPT® 71260) (preferred study) or MRI Chest with contrast (CPT® 71551) or CTV Chest (CPT® 71275)
- Arterial Thoracic Outlet Syndrome:
 - ◆ CTA Chest (CPT® 71275) (preferred study) or MRA Chest (CPT® 71555) (preferred study) or CT Chest either without or with contrast (CPT® 71250 or CPT® 71260) or MRI Chest with contrast (CPT® 71551)
- CT Chest with contrast (CPT® 71260) or CT Neck with contrast (CPT® 70491) can be used in place of MRI for:
 - ◆ Suspected anomalous ribs or fractures, as bone anatomy is more easily definable with CT.
 - ◆ Postoperative individuals in whom there is a question regarding a remnant first rib.
 - ◆ Dialysis-dependent renal failure, claustrophobia, or implanted device incompatibility.
- See **PN-4: Brachial Plexus** in the Peripheral Nerve Disorders Imaging Guidelines.

Practice Notes

- TOS refers to compression of the subclavian vessels and/or brachial plexus at the thoracic outlet of the chest (the area bounded by the two scalene muscles and the first rib).
- There are 3 types, with neurogenic causes seen in 80%, venous causes (also called effort thrombosis) found in 15% and the remaining 5% being arterial in etiology.
- Since this is such a rare entity and diagnosis is difficult, specialist evaluation by a vascular surgeon or thoracic surgeon is helpful in determining the appropriate imaging pathway.

References

1. Raptis C, Sridhar S, Thompson R, et al. Imaging of the Patient with Thoracic Outlet Syndrome. *RadioGraphics*, 2016; 36: 984-1000.
2. ACR Appropriateness Criteria® imaging in the diagnosis of thoracic outlet syndrome: *American College of Radiology (ACR)*; <https://www.acr.org/-/media/ACR/Files/Appropriateness-Criteria/RadiationDoseAssessmentIntro.pdf>. September 2019.

CH-32: Lung Transplantation

CH-32.1: Pre-Transplant Imaging Studies

- Individuals on the waiting list or being considered for the lung transplant can undergo advanced imaging per that institution's protocol as long as the studies do not exceed the following:
 - ◆ CT Chest with and without contrast (CPT® 71270), CT Chest with contrast (CPT® 71260), or CT Chest without contrast (CPT® 71250)
 - ◆ ECHO
 - ◆ Imaging Stress Test (MPI, SE, MRI) or Heart Catheterization (Right and Left); Heart catheterization can also be done after a positive stress test.
- Other studies that will be considered include V/Q scan, Six Minute Walk Test.
- CT Chest with and without contrast (CPT® 71270), CT Chest with contrast (CPT® 71260), or CT Chest without contrast (CPT® 71250) for initial post-transplant follow-up.
- See **CD-1.6: Transplant Individuals** in the Cardiac Imaging Guidelines.

Reference

1. Ng, Y. L, N. Paul, D. Patsios, and et al. "Imaging of Lung Transplantation: Review." *AJR. American Journal of Roentgenology*. U.S. National Library of Medicine, Mar. 2009. Vol 192, No 3 supplement.

CH-33: Lung Cancer Screening

CH-33.1: U.S. Preventative Services Task Force: Lung Cancer Screening (Commercial and Medicaid)	62
CH-33.2: National Coverage Determination (NCD) for Lung Cancer Screening with Low Dose Computed Tomography (LDCT) (210.14) (Medicare)	63
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CH-33.1: U.S. Preventative Services Task Force: Lung Cancer Screening (Commercial and Medicaid)

- Low-dose CT Chest (CPT® 71271) may be approved for lung cancer screening annually if all of the following criteria are met:

Screening Indications – Commercial and Medicaid	Imaging Study
➤ All criteria below must be met for approval: ◆ Individual has not received a low-dose CT lung screening in less than 12 months; and ◆ Individual has NO health problems that substantially limit life expectancy or the ability or willingness to have curative lung surgery*; and ◆ Individual is between 50 and 80 years of age; and ◆ Individual has at least a 20 pack-year history of cigarette smoking; and ◆ Currently smokes or quit within the past ≤15 years	Low-Dose CT Chest without contrast (CPT® 71271)

*This is based on a range of chest or other organ signs, symptoms or conditions which would question the member's ability to undergo surgical or non-surgical treatment if a lung cancer was discovered. For example, congestive heart failure, advanced cancer from another site or a member with COPD who uses oxygen when ambulating, would be examples of conditions that would "substantially limit life expectancy." Conversely, stable COPD and its symptoms, including cough, shortness of breath would not "substantially limit life expectancy."

CH-33.2: National Coverage Determination (NCD) for Lung Cancer Screening with Low Dose Computed Tomography (LDCT) (210.14) (Medicare)

- Low-dose CT Chest (CPT® 71271) may be approved for lung cancer screening annually if all the following criteria are met:

Screening Indications - Medicare	Imaging Study
➤ All criteria below must be met for approval: ◆ Individual has not received a low-dose CT lung screening in less than 12 months; and ◆ Individual has NO signs or symptoms suggestive of underlying lung cancer*; and ◆ Individual is between 55 and 77 years of age; and ◆ Individual has at least a 30 pack-year history of cigarette smoking; and ◆ Currently smokes or quit within the past ≤15 years ◆ A written order for LDCT lung cancer screening that includes counseling and shared decision making	Low-Dose CT Chest without contrast (CPT® 71271)

The Medicare Decision Memo and NCD 210.14

* Individuals that present with the following symptoms are not eligible for screening, rather, they should be considered symptomatic for lung cancer: unexplained cough, hemoptysis, or unexplained weight loss of more than 15 pounds in the past year.

CH-33.3: Incidental Pulmonary Nodules Detected on Low Dose CT Chest (LDCT) Images

- Any Lung-RADS less than 1 year interval follow-up is coded as Low-Dose CT Chest (CPT® 71250) (Not CPT® 71271 which is ONLY the annual screen)
- For lung nodules, including incidental findings from studies other than screening LDCT, See **CH-16.2: Incidental Pulmonary Nodules Detected on CT Images**

Primary Category/Category Descriptor*	Management
3: Probably benign finding(s) - short term follow-up suggested; includes nodules with a low likelihood of becoming a clinically active cancer	6 month LDCT (CPT® 71250) with a return to annual LDCT screening (CPT® 71271)**, if unchanged.
4A: Suspicious - Findings for which additional diagnostic testing and/or tissue sampling is recommended	PET/CT (CPT® 78815) may be used when there is a ≥8 mm solid component Follow-up with LDCT (CPT® 71250) in 3 months and a return to annual screening (CPT® 71271)**, if stable and there is low suspicion of lung cancer.
4B or 4X: Suspicious - Findings for which additional diagnostic testing and/or tissue sampling is recommended	CT Chest with or without contrast, PET/CT (CPT® 78815) and/or tissue sampling depending on the probability of malignancy and comorbidities. PET/CT (CPT® 78815) may be used when there is a ≥8 mm solid component. If there is low suspicion of lung cancer, follow-up with LDCT (CPT® 71250) in 3 months with another LDCT (CPT® 71250) in 6 months and a return to annual screening (CPT® 71271)**, if stable.

*The full description of the LUNG-RADS categories <https://www.acr.org/-/media/ACR/Files/RADS/Lung-RADS/LungRADSAssessmentCategoriesv1-1.pdf?la=en>

**Annual screening to begin 12 months after the last CT scan

References

1. "Lung Cancer: Screening." Final Recommendation Statement : Screening for Lung Cancer - US Preventive Services Task Force Recommendation Statement. N.p., n.d. JAMA. 2021;325(10):962-970 . U.S. Preventive Services Task Force.
2. CMS Decision Memo for Lung Cancer Screening with Low Dose Computed Tomography (LDCT) (210.14) Effective Date of this Version 2/5/2015.
3. Lung-RADS™ Version 1.1 Assessment Categories Release date: 2019. <https://www.acr.org/-/media/ACR/Files/RADS/Lung-RADS/LungRADSAssessmentCategoriesv1-1.pdf?la=en>