CLINICAL GUIDELINES

Pediatric Chest Imaging Guidelines

Version 1.0.2023

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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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Procedure Codes Associated with Chest Imaging

MRI	CPT®
MRI Chest without contrast	71550
MRI Chest with contrast (rarely used)	71551
MRI Chest without and with contrast	71552
Unlisted MRI procedure (for radiation planning or surgical software)	76498
MRA	**CPT®**
MRA Chest (non-cardiac)	71555
CT	**CPT®**
CT Chest without contrast	71250
CT Chest with contrast	71260
CT Chest without and with contrast (rarely used)	71270
CT Guidance for Placement of Radiation Therapy Fields	77014
Unlisted CT procedure (for radiation planning or surgical software)	76497
CTA	**CPT®**
CTA Chest (non-coronary)	71275
Nuclear Medicine	**CPT®**
PET Imaging; limited area (this code not used in pediatrics)	78811
PET Imaging: skull base to mid-thigh (this code not used in pediatrics)	78812
PET Imaging: whole body (this code not used in pediatrics)	78813
PET with concurrently acquired CT; limited area (this code rarely used in pediatrics)	78814
PET with concurrently acquired CT; skull base to mid-thigh	78815
PET with concurrently acquired CT; whole body	78816
Pulmonary Ventilation (e.g., Aerosol or Gas) Imaging	78579
Pulmonary Perfusion Imaging	78580
Pulmonary Ventilation (e.g., Aerosol or Gas) and Perfusion Imaging	78582
Quantitative Differential Pulmonary Perfusion, Including Imaging When Performed	78597
Quantitative Differential Pulmonary Perfusion and Ventilation (e.g., Aerosol or Gas), Including Imaging When Performed	78598
Ultrasound	**CPT®**
Ultrasound, chest (includes mediastinum, chest wall, and upper back)	76604
Ultrasound, axilla	76882
Ultrasound, breast; *unilateral*, including axilla when performed; complete	76641
Ultrasound, breast; *unilateral*, including axilla when performed; limited	76642

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General Guidelines (PEDCH-1)

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General Guidelines (PEDCH-1.0)

- A pertinent clinical evaluation since the onset or change in symptoms, including a detailed history, physical examination, and appropriate laboratory, and basic imaging such as plain radiography or ultrasound should be performed prior to considering advanced imaging (CT, MRI, Nuclear Medicine), unless the individual is undergoing guideline-supported scheduled imaging evaluation. A meaningful technological contact (telehealth visit, telephone call, electronic mail or messaging) since the onset or change in symptoms can serve as a pertinent clinical evaluation.
- Unless otherwise stated in a specific guideline section, the use of advanced imaging to screen asymptomatic individuals for disorders involving the chest is not supported. Advanced imaging of the chest is only supported in individuals who have documented active clinical signs or symptoms of disease involving the chest.
- Unless otherwise stated in a specific guideline section, repeat imaging studies of the chest are not necessary unless there is evidence for progression of disease, new onset of disease, and/or documentation of how repeat imaging will affect individual management or treatment decisions.

Pediatric Chest Imaging Age Considerations (PEDCH-1.1)

- Many conditions affecting the chest in the pediatric population are different diagnoses than those occurring in the adult population. For those diseases which occur in both pediatric and adult populations, differences may exist in management due to individual age, comorbidities, and differences in disease natural history between children and adults.
- Individuals who are 18 years old or younger[20] should be imaged according to the Pediatric Chest Imaging Guidelines if discussed. Any conditions not specifically discussed in the Pediatric Chest Imaging Guidelines should be imaged according to the General Chest Imaging Guidelines. Individuals who are >18 years old should be imaged according to the General Chest Imaging Guidelines, except where directed otherwise by a specific guideline section.

Pediatric Chest Imaging Modality General Considerations (PEDCH-1.3)

- MRI
  - MRI Chest is generally performed without and with contrast (CPT® 71552) unless the individual has a documented contraindication to gadolinium or otherwise stated in a specific guideline section.
  - Due to the length of time required for MRI acquisition and the need to minimize individual movement, anesthesia is usually required for almost all infants (except neonate) and young children (age <7 years), as well as older children with delays in development or maturity. This anesthesia may be administered via oral or intravenous routes. In this individual population, MRI sessions should be planned with a goal of minimizing anesthesia exposure by adhering to the following considerations:

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- MRI procedures can be performed without and/or with contrast use as supported by these condition-based guidelines. If intravenous access will already be present for anesthesia administration and there is no contraindication for using contrast, imaging without and with contrast may be appropriate if requested. By doing so, the requesting provider may avoid repetitive anesthesia administration to perform an MRI with contrast if the initial study without contrast is inconclusive.
  - Recent evidence-based literature demonstrates the potential for gadolinium deposition in various organs including the brain, after the use of MRI contrast.
  - The U.S. Food and Drug Administration (FDA) has noted that there is currently no evidence to suggest that gadolinium retention in the brain is harmful and restricting gadolinium-based contrast agents (GBCAs) use is not warranted at this time. It has been recommended that GBCA use should be limited to circumstances in which additional information provided by the contrast agent is necessary and the necessity of repetitive MRIs with GBCAs should be assessed.
- If multiple body areas are supported by eviCore guidelines for the clinical condition being evaluated, MRI of all necessary body areas should be obtained concurrently.
- The presence of surgical hardware or implanted devices may preclude MRI.
- The selection of best examination may require coordination between the provider and the imaging service.

- CT
  - CT Chest is generally performed either with contrast (CPT® 71260) or without contrast (CPT® 71250).
    - There are no generally accepted pediatric indications for CT Chest without and with contrast (CPT® 71270).
  - CT should not be used to replace MRI in an attempt to avoid sedation unless listed as a recommended study in a specific guideline section.
  - The selection of best examination may require coordination between the provider and the imaging service.
- Ultrasound
  - Ultrasound chest (CPT® 76604) or axilla (CPT® 76882) is indicated as an initial study for evaluating adenopathy, palpable chest wall lesions, pleural effusion or thickening, patency of thoracic vasculature, and diaphragm motion abnormalities.
  - For those individuals who do require advanced imaging, ultrasound can be very beneficial in selecting the proper modality, body area, image sequences, and contrast level that will provide the most definitive information for the individual.

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- Nuclear Medicine
  - Nuclear medicine studies other than PET/CT are rarely used in evaluation of the pediatric chest.
  - Pulmonary Ventilation-Perfusion Imaging (CPT® 78582) has been replaced by CTA Chest (CPT® 71275) or CT Chest with contrast (CPT® 71260), but are appropriate for evaluation of suspected pulmonary embolism if CT is unavailable.
    - See **Pulmonary Embolism (PE) (CH-25.1)** in the Chest Imaging Guidelines.
  - Pulmonary Perfusion Imaging (CPT® 78580) are generally not appropriate in lieu of CPT® 78582 for initial evaluation of suspected pulmonary embolism, but is appropriate for follow up of an equivocal or positive recent ventilation-perfusion lung scan (CPT® 78582) to evaluate for interval change.
  - Pulmonary Ventilation Imaging (CPT® 78579) are not appropriate in lieu of CPT® 78582 for evaluation of suspected pulmonary embolism, but is appropriate for additional evaluation of an abnormal perfusion-only scan (CPT® 78580).
  - Pulmonary split crystal function study (CPT® 78597 or CPT® 78598), also known as Quantitative Differential Pulmonary Perfusion, is indicated for preoperative planning of segmental, lobar, or lung resection.
  - Quantitative Differential Pulmonary Perfusion Lung Scan (CPT® 78597 or CPT® 78598), can be performed for post lung transplant individuals to detect regional perfusion abnormalities.
  - Radiopharmaceutical nuclear medicine imaging of an inflammatory process (CPT® 78800, CPT® 78801, CPT® 78802, or CPT® 78803) is rarely performed, but is indicated for evaluation of sarcoidosis or toxicity from drug toxicity (cyclophosphamide, busulfan, bleomycin, amiodarone, or nitrofurantoin).
- 3D Rendering
  - 3D Rendering indications in pediatric chest imaging are identical to those in the general imaging guidelines. See **3D Rendering (Preface-4.1)** in the Preface Imaging Guidelines.

The guidelines listed in this section for certain specific indications are not intended to be all-inclusive; clinical judgment remains paramount and variance from these guidelines may be appropriate and warranted for specific clinical situations.

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Lymphadenopathy (PEDCH-2)

Lymphadenopathy (PEDCH-2.1)

- Axillary lymphadenopathy imaging indications in pediatric individuals are identical to those for adult individuals. See **Axillary Lymphadenopathy (and Mass) (CH-2.2)** in the Chest Imaging Guidelines.
- Supraclavicular adenopathy in pediatric individuals is almost always pathologic, and advanced imaging is indicated prior to excisional biopsy. Fine needle aspiration, while common in adults prior to advanced imaging, is inappropriate for evaluating lymphadenopathy in pediatric individuals. ANY of the following studies are appropriate for evaluation of supraclavicular adenopathy in children:
  - CT Chest with contrast (CPT® 71260).
  - MRI Chest without and with contrast (CPT® 71552).
  - Ultrasound chest (CPT® 76604).
- If malignancy is suspected, see the appropriate imaging guidelines as below:
  - Lymphoma: **Pediatric Lymphomas (PEDONC-5)** in the Pediatric Oncology Imaging Guidelines.
  - Soft tissue sarcoma: **Pediatric Soft Tissue Sarcomas (PEDONC-8)** in the Pediatric Oncology Imaging Guidelines.
  - Neuroblastoma: **Neuroblastoma (PEDONC-6)** in the Pediatric Oncology Imaging Guidelines.

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Mediastinal Mass (PEDCH-3)

Mediastinal Mass (PEDCH-3.1)

The causes of mediastinal masses in children are generally different than those in adults, and the imaging considerations are different. Up to half of all pediatric mediastinal masses are malignant.[7]

- Chest x-ray is indicated as an initial study for all individuals with suspected mediastinal mass.
- CT Chest with contrast (CPT® 71260) is indicated for any pediatric individual with a mediastinal mass identified on Chest x-ray.
  - Masses can be very large and anterior masses frequently cause compression of the trachea and/or mediastinal blood vessels.
- MRI Chest without and with contrast (CPT® 71552) is indicated for any pediatric individual with:
  - A posterior (paravertebral) mediastinal mass on CT Chest that invades the spinal canal.
  - CT findings are inconclusive regarding specific anatomy.
  - MRI should not be used for individuals with large anterior mediastinal masses if anesthesia is necessary to complete the study.
- PET/CT (CPT® 78815) is indicated prior to biopsy in pediatric individuals if lymphoma is known or strongly suspected or there is evidence of tracheal compression on CT imaging. See **Pediatric Lymphoma (PEDONC-5)** in the Pediatric Oncology Imaging Guidelines
- MIBG (CPT® 78800, CPT® 78802, CPT® 78803, or CPT® 78804) is indicated and is supported prior to biopsy in pediatric individuals if neuroblastoma is known or strongly suspected. See **Neuroblastoma (PEDONC-6)** in the Pediatric Oncology Imaging Guidelines
- Ultrasound chest (CPT® 76604) is appropriate in children younger than 5 years old to distinguish prominent but otherwise normal thymus from true mediastinal mass.
- A single repeat CT Chest with contrast (CPT® 71260) is appropriate to confirm stability and avoid biopsy for individuals with NONE of the following features:
  - Anterior mediastinal mass.
  - Enlarged lymph nodes anywhere in the imaging field.
  - Lymphopenia.
  - Pleural effusion.

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Hemoptysis (PEDCH-4)

Hemoptysis – Imaging (PEDCH-4.1)

- True hemoptysis is rare in pediatric individuals, and a detailed history, physical examination, and appropriate laboratory studies should be performed prior to considering advanced imaging.
  - Aspirated blood from epistaxis or emesis frequently presents as hemoptysis, and history and physical examination will aid in this assessment.
- Chest x-ray is indicated as an initial study for stable individuals.
  - Advanced imaging is not indicated for individuals with epistaxis and a normal chest radiograph and no personal or family history of underlying lung disease or bleeding disorder.
  - CT Chest with contrast (CPT® 71260) is indicated for all other pediatric individuals with hemoptysis.
    - CT Chest without contrast (CPT® 71250) for individuals with a documented allergy to CT contrast or significant renal dysfunction.
- MRI is not indicated in the evaluation of pediatric hemoptysis.

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Cystic Fibrosis and Bronchiectasis (PEDCH-5)

Cystic Fibrosis (PEDCH-5.1)	**14**
Bronchiectasis Not Associated with Cystic Fibrosis (PEDCH-5.2)	**14**

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Cystic Fibrosis (PEDCH-5.1)

- Chest x-ray is the primary study for initial evaluation of acute clinical symptoms in individuals with cystic fibrosis.
- CT Chest without contrast (CPT® 71250) or with contrast (CPT® 71260) is indicated for the following (without initial Chest x-ray):
  - Hemoptysis.
  - Pneumonia worsening despite antibiotic therapy.
  - Pleural effusion or empyema.
  - Suspected fungal pneumonia.
  - Monitoring treatment changes on bronchiectasis.
  - Expiratory CT for evaluating small airways disease.
  - Pre- and post-lung transplant evaluation.
- Low dose CT Chest without contrast (CPT® 71250) is indicated **every 2 years** for monitoring of bronchiectasis and small airways disease.
- Cystic fibrosis associated liver disease develops in 5-10% of individals with cystic fibrosis. Advanced imaging may be appropriate if concerned for liver disease. See **Liver Disease (PEDAB-16)** in the Pediatric Abdomen Imaging Guidelines.

Bronchiectasis Not Associated with Cystic Fibrosis (PEDCH-5.2)

- Bronchiectasis not associated with cystic fibrosis is rare in pediatric individuals, and imaging indications are identical to those for adult individuals. See **Bronchiectasis (CH-7.1)** in the Chest Imaging Guidelines.

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Bronchiolitis (PEDCH-6)

Bronchiolitis (PEDCH-6.1)

Bronchiolitis is a self-limiting viral infection causing inflammation of the small airways, most common in infants under 12 months of age.

- Chest x-rays are indicated when there is a clinical suspicion of pneumonia or other complications.
- Advanced imaging is not indicated for routine evaluation or monitoring of bronchiolitis, but CT Chest with contrast (CPT® 71260) is appropriate for the following:
  - Pleural effusion or empyema on recent Chest x-ray.
  - Immunocompromised individual with acute pulmonary symptoms.
  - Abnormality on recent Chest x-ray suggesting condition other than bronchiolitis.

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Pneumonia (PEDCH-7)

Pneumonia (PEDCH-7.1)	**17**
Coronavirus Disease 2019 (COVID-19) (PEDCH-7.2)	**17**

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Pneumonia (PEDCH-7.1)

- Pneumonia imaging indications in pediatric individuals are very similar to those for adult individuals. See **Pneumonia (CH-13.1)** in the Chest Imaging Guidelines.
- Pediatric-specific imaging considerations include the following:
  - Chest x-ray and/or Ultrasound chest (CPT® 76604) is indicated when the individual's condition does not respond to standard therapy.
  - CT Chest with contrast (CPT® 71260) for immunocompromised individuals with acute pulmonary symptoms.
  - CT Chest without contrast (CPT® 71250) or with contrast (CPT® 71260) for individuals with recurrent lower respiratory tract infections.
  - Ultrasound chest (CPT® 76604) for evaluation of complicated or recurrent childhood pneumonia.

Coronavirus Disease 2019 (COVID-19) (PEDCH-7.2)

- Pediatric imaging for COVID-19 positive individuals are similar to those for adult individuals. See **Coronavirus Disease 2019 (COVID-19) (CH-13.2)** in the Chest Imaging Guidelines.
- Pediatric-specific imaging considerations include the following:
  - Chest x-ray is the initial imaging test for all pediatric individuals

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Solitary Pulmonary Nodule (PEDCH-8)

Solitary Pulmonary Nodule (PEDCH-8.1)

The Fleischner Society guidelines for solitary pulmonary nodule management do not apply to pediatric individuals. An incidental solitary pulmonary nodule in a child representing a primary lung carcinoma has never been reported in the literature. Similarly, an extrathoracic malignancy presenting with an incidental solitary pulmonary nodule in an otherwise healthy child is very rare.

- CT Chest with contrast (CPT® 71260) as a one-time evaluation for all children with a pulmonary nodule incidentally discovered on other imaging.
- Follow up imaging of incidental solitary pulmonary nodules in asymptomatic healthy children is not necessary.[6]
  - Follow up imaging is indicated for the following:
    - Immunocompromised individuals.
    - Malignancy (see below).
    - Invasive infection.
    - New or worsening pulmonary symptoms.
- Children with a malignant solid tumor who have pulmonary nodules of any size should have imaging according to the guideline section for the specific cancer type. See **Pediatric Oncology Imaging Guidelines** for specific imaging indications.
- This guideline section does not apply to multiple pulmonary nodules, which are imaged according to the underlying disorder in pediatric individuals.

Background and Supporting Information

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.

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Positive PPD or Tuberculosis (PEDCH-9)

Positive PPD or Tuberculosis (PEDCH-9.1)

- Positive PPD and tuberculosis imaging indications in pediatric individuals are similar to those for adult individuals. See **PPD or TB (Mycobacterium tuberculosis and Nontuberculous Mycobacterial Pulmonary Disease (NTM-PD)) (CH-14.1)** in the Chest Imaging Guidelines.
- Pediatric-specific imaging considerations include the following:
  - MRI Spine with and without contrast is appropriate at symptomatic levels in individuals with concern for spinal involvement of tuberculosis.

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Asthma (PEDCH-10)

Asthma (PEDCH-10.1)

- Chest x-ray and/or Ultrasound chest (CPT® 76604) is indicated when the individual's condition does not respond to standard therapy, to identify complications, such as pneumonia or to rule out other causes of respiratory distress.
- Advanced imaging is not indicated for routine evaluation or monitoring of asthma, but CT Chest without (CPT® 71250) or with (CPT® 71260) contrast is appropriate for the following:
  - Pleural effusion or empyema on recent Chest x-ray.
  - Immunocompromised individual with acute pulmonary symptoms.
  - Abnormality on recent Chest x-ray suggesting condition other than asthma, including suspected foreign body.
  - Asthma and poor response to bronchodilators or conventional inhaled corticosteroid therapy in whom associated conditions, such as allergic bronchopulmonary aspergillosis and eosinophilic pneumonia can mimic asthma.

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Pectus Deformities (PEDCH-11)

Pectus Deformities (PEDCH-11.1)

- CT Chest without contrast (CPT® 71250), MRI Chest with and without contrast (CPT® 71552), or MRI Chest without contrast (CPT® 71550) is indicated in individuals with a pectus deformity for:
  - Preoperative planning.
  - Significant cardiac displacement after Chest x-ray and echocardiography (CPT® 93306).
  - Evidence of pulmonary impingement after Chest x-ray and pulmonary function tests (PFTs) if there is increasing shortness of breath. **Note**: It may not be possible to obtain PFTs in children younger than 9 years old.
  - Evaluation of congenital heart disease or Marfan's syndrome when suspected in those individuals with pectus deformities.

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Breast Masses (PEDCH-12)

Breast Masses (PEDCH-12.1)

- See **Pediatric Breast Masses (PEDONC-17)** in the Pediatric Oncology Imaging Guidelines.

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Vascular Malformations (PEDCH-13)

Vascular Ring (PEDCH-13.1)	**24**
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Vascular Ring (PEDCH-13.1)

Vascular rings generally present with either respiratory symptoms (stridor, wheezing, tachypnea, cough) or feeding difficulties (dysphagia, slow feeding, hyperextension of the head while feeding, weight loss, failure to thrive) but can also be discovered incidentally on imaging obtained for other purposes.

- Chest x-ray is the recommended initial study in individuals with respiratory symptoms. A chest x-ray is not needed for individuals diagnosed with a vascular ring on prenatal imaging studies.
- Barium esophagram is the recommended initial study in individuals with feeding difficulties.
- CT Chest with contrast (CPT® 71260), CTA Chest (CPT® 71275) or MRA Chest (CPT® 71555) in individuals with known or suspected vascular ring after prenatal imaging studies, Chest x-ray or barium esophagram.
- Echocardiogram is appropriate to rule out associated congenital heart disease.
  - CPT® 93303, CPT® 93306, CPT® 93320, and CPT® 93325 is appropriate for initial evaluation of individuals with vascular ring and no prior echocardiograms.

Other Vascular Malformations (PEDCH-13.2)

See **Pulmonary Arteriovenous Malformations (PEDCH-14.2)** for Pulmonary AVMs.

See **Vascular Anomalies (PEDPVD-2)** in the Pediatric Peripheral Vascular Disease Imaging Guidelines.

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Congenital Chest Diseases (PEDCH-14)	
Congenital Cystic Lung Diseases (PEDCH-14.1)	26
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Congenital Cystic Lung Diseases (PEDCH-14.1)

- This section includes common congenital cystic lung lesions such as:
  - Bronchogenic cyst
  - Congenital pulmonary airway malformation (congenital cystic adenomatoid malformation)
  - Congenital lobar overinflation
- Cystic Lung disease may be first identified on prenatal ultrasound, or discovered incidentally on Chest x-ray.
- CT Chest with contrast (CPT® 71260) is appropriate when Chest x-ray suggests a cystic lung lesion.
- MRI Chest with and without contrast (CPT® 71552) is appropriate if CT is inconclusive or if requested for pre-operative planning

Pulmonary Arteriovenous Malformations (PEDCH-14.2)

- Pulmonary arteriovenous malformations (PAVMs) are vascular structures that most commonly result from abnormal communication between pulmonary arteries and pulmonary veins.
  - Chest x-ray are indicated as an initial imaging modality for individuals with known AVMs, or individuals presenting with hypoxemia and/or hemoptysis
  - CTA or MRA is appropriate in individuals with known AVM or abnormal Chest x-ray suggesting AVM for treatment planning.

Congenital Diaphragmatic Hernia (PEDCH-14.3)

- Congenital Diaphragmatic hernia (CDH) is a defect in the diaphragm which may allow the abdominal organs to enter the chest cavity, and may lead to compromised pulmonary function or may be associated with congenital heart disease.
  - Over 90% of the hernias occur in the posterolateral diaphragm (Bochdalek hernia) typically on the left side.
  - Most of the rest of the hernias are in the anteromedial diaphragm (Morgagni hernia).
- The vast majority of CDH are diagnosed prenatally (See **Fetal MRI (PV-15.1)** in the Pelvis Imaging Guidelines), or as an inpatient shortly after delivery.
- If there is clinical concern for CDH, Chest x-ray and/or US Chest (CPT® 76604) is indicated as the initial imaging study.
- CT Chest with contrast (CPT® 71260) or MRI Chest with and without contrast (CPT® 71552) is appropriate when Chest x-ray and/or US are inconclusive, or if requested for treatment planning.

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