American College of Radiology
ACR Appropriateness Criteria®
Workup of Pleural Effusion or Pleural Disease

Variant: 1   Recent pneumonia with suspected parapneumonic effusion or empyema. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
Radiography chest	Usually Appropriate	☢
CT chest with IV contrast	Usually Appropriate	☢☢☢
US chest	May Be Appropriate (Disagreement)	O
CT chest without IV contrast	May Be Appropriate	☢☢☢
MRI chest without and with IV contrast	Usually Not Appropriate	O
MRI chest without IV contrast	Usually Not Appropriate	O
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA chest with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 2   Recent minor blunt trauma with suspected pleural effusion. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
Radiography chest	Usually Appropriate	☢
CT chest with IV contrast	Usually Appropriate	☢☢☢
US chest	May Be Appropriate (Disagreement)	O
CT chest without IV contrast	May Be Appropriate	☢☢☢
CTA chest with IV contrast	May Be Appropriate (Disagreement)	☢☢☢
Image-guided aspiration chest	Usually Not Appropriate	Varies
MRI chest without and with IV contrast	Usually Not Appropriate	O
MRI chest without IV contrast	Usually Not Appropriate	O
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 3   Dyspnea, cough, or chest pain with suspected pleural effusion, noninfectious. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
Radiography chest	Usually Appropriate	☢
CT chest with IV contrast	Usually Appropriate	☢☢☢
US chest	May Be Appropriate (Disagreement)	O
CT chest without IV contrast	May Be Appropriate	☢☢☢
MRI chest without and with IV contrast	Usually Not Appropriate	O
MRI chest without IV contrast	Usually Not Appropriate	O
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CTA chest with IV contrast	Usually Not Appropriate	☢☢☢

Variant: 4   Pleural effusion incidentally detected on incomplete thoracic imaging study. Next imaging study.

Procedure	Appropriateness Category	Relative Radiation Level
US chest	May Be Appropriate (Disagreement)	O

Radiography chest	May Be Appropriate (Disagreement)	☢
CT chest with IV contrast	May Be Appropriate (Disagreement)	☢☢☢
MRI chest without and with IV contrast	Usually Not Appropriate	O
MRI chest without IV contrast	Usually Not Appropriate	O
CT chest without and with IV contrast	Usually Not Appropriate	☢☢☢
CT chest without IV contrast	Usually Not Appropriate	☢☢☢
CTA chest with IV contrast	Usually Not Appropriate	☢☢☢

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Summary of Literature Review

Introduction/Background

Under normal circumstances, approximately 0.1 to 0.2 mL/kg body weight of pleural fluid resides in the pleural space [1]. Abnormal accumulation of pleural fluid is the most common clinical manifestation of pleural disease [2], typically caused by increased pulmonary capillary pressure, increased pleural membrane permeability, decreased oncotic pressure, or lymphatic obstruction [3]. Pleural effusions are categorized as transudative or exudative [4], with transudative effusions usually reflecting the sequala of a systemic etiology and exudative effusions usually resulting from a process localized to the pleura [5]. Common causes of transudative pleural effusions include congestive heart failure, cirrhosis, and renal failure, whereas exudative effusions are typically due to infection, malignancy, or autoimmune disorders [6], emphasizing the importance of prompt diagnosis to aid in patient management [7]. In general, physical examination findings have a lower positive likelihood ratio for detection of pleural effusions [8], supporting the use of imaging to aid in identification of clinically significant pleural effusions.

When imaging pleural effusions, chest radiographs can typically detect >75 mL on the lateral view and >175 mL on the frontal view [9]. Thoracic ultrasound (US) can detect >20 mL of pleural fluid [10]. Chest CT can detect >10 mL of pleural fluid, and is considered the reference standard for imaging [11].

Special Imaging Considerations

For the purposes of distinguishing between CT and CT angiography (CTA), ACR Appropriateness Criteria topics use the definition in the ACR–NASCI–SIR–SPR Practice Parameter for the Performance and Interpretation of Body Computed Tomography Angiography (CTA) [12]:

   "*CTA uses a thin-section CT acquisition that is timed to coincide with peak arterial and/or venous enhancement, depending on the vascular structures to be analyzed. The resultant volumetric data set is interpreted using primary transverse reconstructions as well as multiplanar reformations and 3-D*

renderings."

All elements are essential: 1) timing, 2) reconstructions/reformats, and 3) 3-D renderings. Standard CTs with contrast also include timing issues and reconstructions/reformats. Only in CTA, however, is 3-D rendering a **required** element. This corresponds to the definitions that the CMS has applied to the Current Procedural Terminology codes.

Initial Imaging Definition

Initial imaging is defined as imaging at the beginning of the care episode for the medical condition defined by the variant. More than one procedure can be considered usually appropriate in the initial imaging evaluation when:

- There are procedures that are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care)

OR

- There are complementary procedures (ie, more than one procedure is ordered as a set or simultaneously wherein each procedure provides unique clinical information to effectively manage the patient's care).

Discussion of Procedures by Variant

Variant 1: Recent pneumonia with suspected parapneumonic effusion or empyema. Initial imaging.

Variant 1: Recent pneumonia with suspected parapneumonic effusion or empyema. Initial imaging.
A. CT Chest With IV Contrast

Current American Association for Thoracic Surgery consensus guidelines recommend CT chest with intravenous (IV) contrast in cases of suspected parapneumonic effusion (class IIa) [13]. A recent meta-analysis reported 5 chest CT findings most commonly associated with the diagnosis of empyema: pleural enhancement (sensitivity 84%, 95% confidence interval [CI], 62%-94%; specificity 83%, 95% CI, 75%-89%), pleural thickening (sensitivity 68%, 95% CI, 56%-77%; specificity 87%, 95% CI, 80%-92%), loculation (sensitivity 52%, 95% CI, 44%-59%; specificity 89%; 95% CI, 82%-94%), extrapleural fat proliferation (sensitivity 53%, 95% CI, 47%-60%; specificity 91%, 95% CI, 82%-96%), and increased attenuation of the extrapleural fat (sensitivity 39%, 95% CI, 32%-48%; specificity 97%, 95% CI, 94%-98%) [14]. Of note, these pooled sensitivities and specificities include CT chest with IV contrast or CT chest without IV contrast. Pleural enhancement has the highest area under curve for the diagnosis of empyema (0.86) and for distinguishing between simple parapneumonic effusion and empyema (0.83) [14]. In a secondary analysis of the Multi-centre Intra-pleural Sepsis Trial (MIST) 2 trial of patients with laboratory proven pleural infection, the combination of parietal pleural enhancement and pleural thickening was seen in 98.7% of patients (95% CI, 92.8%-99.8%) on pleural-phase contrast-enhanced CT [15]. The presence of pleural enhancement with pleural gas/microbubbles [16] or larger pleural effusion size [17] also boosts the accuracy for identifying parapneumonic effusions requiring thoracentesis [16,17]. Parapneumonic effusions <2.5 cm in anteroposterior (AP) dimension can often be managed without thoracentesis [18]. From a technical

perspective, acquiring the CT scan 60 seconds after the IV contrast bolus optimizes visualization of the pleura [19,20].

Variant 1: Recent pneumonia with suspected parapneumonic effusion or empyema. Initial imaging.
B. CT Chest Without and With IV Contrast

There is no relevant literature to support the use of CT chest without and with IV contrast in the initial imaging of recent pneumonia with suspected parapneumonic effusion or empyema.

Variant 1: Recent pneumonia with suspected parapneumonic effusion or empyema. Initial imaging.
C. CT Chest Without IV Contrast

There is no relevant literature to support the use of CT chest without IV contrast in the initial imaging of recent pneumonia with suspected parapneumonic effusion or empyema. If a noncontrast CT is obtained, 4 out of 5 chest CT findings most commonly associated with the diagnosis of empyema in a recent meta-analysis may be ascertained without IV contrast: pleural thickening (sensitivity 68%, 95% CI, 56%-77%; specificity 87%; 95% CI, 80%-92%), loculation (sensitivity 52%, 95% CI, 44%-59%; specificity 89%; 95% CI, 82%-94%), fat thickening (sensitivity 53%, 95% CI, 47%-60%; specificity 91%; 95% CI, 82%-96%), and fat stranding (sensitivity 39%, 95% CI, 32%-48%; specificity 97%; 95% CI, 94%-98%) [14]. Of note, these pooled sensitivities and specificities include CT chest with IV contrast or CT chest without IV contrast. Gas in the pleural space is another specific marker for complicated parapneumonic effusion, with specificities ranging from 81% (95% CI, 73%-87%) to 96% (95% CI, 86%-99%) [16,17]. Parapneumonic effusions <2.5 cm in AP dimension can often be managed without thoracentesis [18].

Variant 1: Recent pneumonia with suspected parapneumonic effusion or empyema. Initial imaging.
D. CTA Chest With IV Contrast

There is no relevant literature to support the use of CTA chest with IV contrast in the initial imaging of recent pneumonia with suspected parapneumonic effusion or empyema. Note that CTA often employs contrast timing that is earlier than 60 seconds and therefore does not allow sufficient time for pleural enhancement.

Variant 1: Recent pneumonia with suspected parapneumonic effusion or empyema. Initial imaging.
E. MRI Chest Without and With IV Contrast

There is no relevant literature to support the use of MRI chest without and with IV contrast in the initial imaging of recent pneumonia with suspected parapneumonic effusion or empyema in adults. In case reports, MRI chest without and with IV contrast has been used as an adjunctive modality for the diagnosis of empyema necessitans [21]. In pediatric patients, limited data suggests MRI is noninferior to CT chest with IV contrast for the diagnosis of empyema [22-24].

Variant 1: Recent pneumonia with suspected parapneumonic effusion or empyema. Initial imaging.
F. MRI Chest Without IV Contrast

There is no relevant literature to support the use of MRI chest without IV contrast in the initial imaging of recent pneumonia with suspected parapneumonic effusion or empyema. In small studies, diffusion weighted imaging [25] and T1 mapping [26] have shown promise in distinguishing exudative from transudative pleural effusions without contrast material.

Variant 1: Recent pneumonia with suspected parapneumonic effusion or empyema. Initial imaging.
G. Radiography Chest

Consensus recommendations endorse chest radiography as the initial imaging modality for patients with recent pneumonia and suspected pleural effusion [27,28]; however, there are limited empiric data to support these recommendations. Posteroanterior (PA) and lateral radiographs have a significantly greater sensitivity for the detection of parapneumonic effusions than single-view AP radiographs. In a retrospective analysis of patients from the Community-Acquired Pneumonia Organization international cohort study, PA and lateral radiographs had a sensitivity of 83.9% versus 67.3% for AP radiographs when using CT as the reference standard [29]. Single-view PA, single lateral view, or single-view AP radiographs have been shown to have statistically equivalent sensitivities for detection of parapneumonic effusions [30], with most missed parapneumonic effusions occurring in patients with coexistent lower lobe consolidation [30]. The specificity of chest radiography for the detection of complicated parapneumonic effusions, defined as those requiring thoracentesis, is modest. For example, in a retrospective study of 66 patients undergoing thoracentesis for parapneumonic effusions, chest radiography had a specificity of 60% for the detection of complicated parapneumonic effusions [31].

Variant 1: Recent pneumonia with suspected parapneumonic effusion or empyema. Initial imaging.
H. US Chest

Identification of a pleural effusion for possible US-guided thoracentesis is currently the primary reason for chest US [32]. Current American Association for Thoracic Surgery consensus guidelines recommend thoracic US for the diagnostic evaluation of pleural space infection (class I), typically occurring in patients with prior imaging documenting the presence of a pleural effusion [13]. US findings of septations [33,34], increased echogenicity of the pleural effusion [31,35], pleural thickening [36], and microbubbles [37] are associated with parapneumonic effusion/empyema. A retrospective study of 66 patients with suspected parapneumonic effusion found that US chest had a significantly higher specificity (90%, 95% CI, 76.3%-97.2%) and a nonsignificant difference in sensitivity (69.2%, 95% CI, 48.2%-87.7%) compared with CT chest for the diagnosis of complicated parapneumonic effusion [31]. A retrospective comparison of US chest and CT chest in pediatric patients found similar accuracy for the detection of parapneumonic effusion [38].

Variant 2: Recent minor blunt trauma with suspected pleural effusion. Initial imaging.

The definition of minor blunt trauma involves isolated minor injury to the chest (eg, abrasions, contusion, or ecchymoses) and/or no more than 2 rib fractures without flail chest [39,40]. For patients with major blunt trauma please refer to the ACR Appropriateness Criteria® topic on "Major Blunt Trauma" [41].

Variant 2: Recent minor blunt trauma with suspected pleural effusion. Initial imaging.
A. CT Chest With IV Contrast

CT chest with IV contrast or CTA chest with IV contrast is regarded as the reference standard for the noninvasive assessment of thoracic injury in patients with chest trauma, regardless of severity, and a clinical indication for imaging [42]. The goal of CT chest with IV contrast is to identify hemothorax and contrast extravasation. The incidence of pleural effusion on chest CT in minor blunt trauma is unknown; however, in a retrospective study of 2,440 multiple trauma patients undergoing whole body CT with IV contrast, 2.2% had an incidental pleural effusion [43]. In a secondary analysis of the prospective observational NEXUS Chest and NEXUS Chest CT studies of

patients with major or minor blunt trauma, 1.8% of patients had a hemothorax on CTA chest with IV contrast [44].

Variant 2: Recent minor blunt trauma with suspected pleural effusion. Initial imaging.
B. CT Chest Without and With IV Contrast

There is no relevant literature to support the use of CT chest without and with IV contrast in the initial imaging of recent minor blunt trauma with suspected pleural effusion.

Variant 2: Recent minor blunt trauma with suspected pleural effusion. Initial imaging.
C. CT Chest Without IV Contrast

In patients with blunt trauma, regardless of severity and suspected pleural effusion, CT chest without IV contrast is generally reserved for patients with renal dysfunction, risk factors for contrast nephropathy, or known contrast allergy [45]. The incidence of pleural effusion on chest CT without IV contrast in minor blunt trauma is unknown. On CT chest without IV contrast, a pleural effusion threshold of ≥15.6 Hounsfield units (HU) (sensitivity 86.8%, specificity 97.4%) and HU ratio of pleural fluid to aortic blood of ≥30% (sensitivity 94.7%, specificity 83.3%) were best able to discriminate hemothorax from pleural effusion after blunt chest trauma [45].

Variant 2: Recent minor blunt trauma with suspected pleural effusion. Initial imaging.
D. CTA Chest With IV Contrast

CTA chest with IV contrast or CT chest with IV contrast is regarded as the reference standard for the noninvasive assessment of thoracic injury in patients with chest trauma and a clinical indication for imaging [42]. The goal of CTA chest with IV contrast is to identify hemothorax and contrast extravasation. The incidence of pleural effusion on chest CT in minor blunt trauma is unknown; however, in a retrospective study of 2,440 multiple trauma patients undergoing whole body CT with IV contrast, 2.2% had an incidental pleural effusion [43]. In a secondary analysis of the prospective observational NEXUS Chest and NEXUS Chest CT studies of patients with major or minor blunt trauma, 1.8% of patients had a hemothorax on CTA chest with IV contrast [44].

Variant 2: Recent minor blunt trauma with suspected pleural effusion. Initial imaging.
E. Image-Guided Aspiration Chest

There is no relevant literature to support the use of image-guided aspiration chest in the initial imaging of recent minor blunt trauma with suspected pleural effusion.

Variant 2: Recent minor blunt trauma with suspected pleural effusion. Initial imaging.
F. MRI Chest Without and With IV Contrast

There is no relevant literature to support the use of MRI chest without and with IV contrast in the initial imaging of recent minor blunt trauma with suspected pleural effusion.

Variant 2: Recent minor blunt trauma with suspected pleural effusion. Initial imaging.
G. MRI Chest Without IV Contrast

There is no relevant literature to support the use of MRI chest without IV contrast in the initial imaging of recent minor blunt trauma with suspected pleural effusion.

Variant 2: Recent minor blunt trauma with suspected pleural effusion. Initial imaging.
H. Radiography Chest

Chest radiography is considered a first-line imaging test for patients with chest trauma and a clinical indication for imaging [46]. In the prospective NEXUS Chest CT trial, blunt trauma patients without an abnormal chest radiograph and 6 clinical criteria could avoid an unnecessary chest CT

(sensitivity 99.2%; 95% CI, 95.4%-100%, specificity 20.8%; 95% CI, 19.2%-22.4%) [47]. A meta-analysis of the pooled sensitivity and specificity of chest radiographs for the detection of hemothorax in patients with chest trauma was 54% (95% CI, 33%-75%) and 99% (95% CI, 94%-100%), respectively, when using chest CT as the reference standard [48]. A study of 24 patients using only PA radiographs found a similar sensitivity of 62.5% and specificity of 100% for the detection of pleural effusions in patients with chest trauma [49]. In 2 prospective series of patients with minor blunt thoracic trauma and an initial normal chest radiograph, 7.4% to 11.8% had a pleural effusion on follow-up radiography within 2 weeks, clinically ascribed as a delayed hemothorax [39,40]. A delayed hemothorax on chest radiographs after minor blunt thoracic trauma was significantly more likely in patients with at least 1 fracture between the third and ninth ribs [50].

Variant 2: Recent minor blunt trauma with suspected pleural effusion. Initial imaging.
I. US Chest

The sensitivity and specificity of chest US for only minor blunt trauma has not been reported. Identification of a hemothorax for possible US-guided thoracentesis is the primary reason for chest US [32]. A recent meta-analysis reported chest US had a 60% sensitivity (95% CI, 31%-86%) and a 98% specificity (95% CI, 94%-99%) for traumatic hemothorax [51].

Variant 3: Dyspnea, cough, or chest pain with suspected pleural effusion, noninfectious. Initial imaging.

Variant 3: Dyspnea, cough, or chest pain with suspected pleural effusion, noninfectious. Initial imaging.
A. CT Chest With IV Contrast

In patients with suspected malignant pleural effusion or suspected unilateral pleural effusion with an increased pretest probability of malignancy, CT chest with IV contrast is recommended [52,53], although this is not limited to patients with dyspnea, cough, or chest pain. Acquiring the CT scan 60 seconds after the contrast bolus improves visualization of pleural abnormalities associated with malignancy [19].

Variant 3: Dyspnea, cough, or chest pain with suspected pleural effusion, noninfectious. Initial imaging.
B. CT Chest Without and With IV Contrast

There is no relevant literature to support the use of CT chest without and with IV contrast in the initial imaging of dyspnea, cough, or chest pain with suspected noninfectious pleural effusion.

Variant 3: Dyspnea, cough, or chest pain with suspected pleural effusion, noninfectious. Initial imaging.
C. CT Chest Without IV Contrast

There is no relevant literature to support the use of CT chest without IV contrast in the initial imaging of dyspnea, cough, or chest pain with suspected noninfectious pleural effusion. Heart failure, liver failure, and renal failure are common noninfectious causes of pleural effusion, and these patients may present with dyspnea, cough, or chest pain and undergo CT chest without IV contrast as part of their diagnostic workup [54,55].

Variant 3: Dyspnea, cough, or chest pain with suspected pleural effusion, noninfectious. Initial imaging.
D. CTA Chest With IV Contrast

In patients with dyspnea, cough, or chest pain and suspected noninfectious pleural effusion, CTA chest with IV contrast is typically performed when there is clinical concern for pulmonary embolism [56] or aortopathy [57]. Pleural effusions in these patients are usually small and not associated with adverse clinical outcomes [57,58].

Variant 3: Dyspnea, cough, or chest pain with suspected pleural effusion, noninfectious. Initial imaging.
E. MRI Chest Without and With IV Contrast

There is no relevant literature to support the use of MRI chest without and with IV contrast in the initial imaging of dyspnea, cough, or chest pain with suspected noninfectious pleural effusion. Incidental pleural effusions have been reported in a minority of patients undergoing MRI with contrast for dyspnea, cough, or chest pain. For example, 6.6% (34/514) of patients had a moderate or large pleural effusion on contrast-enhanced MRA ordered for pulmonary embolism evaluation [59], and 4.3% (17/399) patients had a pleural effusion on stress cardiac MRI for possible acute coronary syndrome [60].

Variant 3: Dyspnea, cough, or chest pain with suspected pleural effusion, noninfectious. Initial imaging.
F. MRI Chest Without IV Contrast

There is no relevant literature to support the use of MRI chest without IV contrast in the initial imaging of dyspnea, cough, or chest pain with suspected noninfectious pleural effusion.

Variant 3: Dyspnea, cough, or chest pain with suspected pleural effusion, noninfectious. Initial imaging.
G. Radiography Chest

Consensus recommendations endorse chest radiography as the initial imaging modality for patients with suspected noninfectious pleural effusion [7,61]; however, there are limited empiric data to support these recommendations.

Variant 3: Dyspnea, cough, or chest pain with suspected pleural effusion, noninfectious. Initial imaging.
H. US Chest

Identification of a pleural effusion for possible US-guided thoracentesis is currently the primary reason for chest US [32]. Chest US is increasingly used as part of the diagnostic pathway for patients in the emergency department [62] and in the intensive care setting [63]. A recent meta-analysis found that chest US had a pooled sensitivity of 91% (95% CI, 83%-96%) and specificity of 92% (95% CI, 82%-97%) using CT as the reference standard for identification of pleural effusion in patients in the intensive care unit [63]. Adding chest US to the conventional diagnostic pathway has been shown to reduce the time to final diagnosis in the emergency department in patients with infectious and noninfectious causes of dyspnea [64].

Variant 4: Pleural effusion incidentally detected on incomplete thoracic imaging study. Next imaging study.

The frequency of an incidental pleural effusion detected on an incomplete thoracic imaging study including neck, spine, and abdomen varies based on the indication and type of imaging modality, in the range of 1% to 5% [65-71]. The clinical significance of these incidental pleural effusions is variable. In a retrospective study of patients undergoing run-off CTA, 4.2% (9/214) had an incidental pleural effusion, leading to the diagnosis of pneumonia in 22% (2/9) and optimization of heart failure therapy in 44% (4/9) [72]. However, in a study of 352 patients undergoing MRA of the

abdomen, pelvis, and lower extremities, 2.9% had an incidental pleural effusion, and no patients required follow-up diagnostic testing or change in therapy.

Variant 4: Pleural effusion incidentally detected on incomplete thoracic imaging study. Next imaging study.
A. CT Chest With IV Contrast

There is no relevant literature to support the use of CT chest with IV contrast as the next imaging study following a pleural effusion incidentally detected on prior abdominal imaging. The recommendation for a follow-up CT chest with IV contrast should be based on clinical assessment (eg, clinical suspicion of malignancy).

Variant 4: Pleural effusion incidentally detected on incomplete thoracic imaging study. Next imaging study.
B. CT Chest Without and With IV Contrast

There is no relevant literature to support the use of CT chest without and with IV contrast as the next imaging study following a pleural effusion incidentally detected on prior abdominal imaging. The recommendation for a follow-up CT chest without and with IV contrast should be based on clinical assessment.

Variant 4: Pleural effusion incidentally detected on incomplete thoracic imaging study. Next imaging study.
C. CT Chest Without IV Contrast

There is no relevant literature to support the use of CT chest without IV contrast as the next imaging study following a pleural effusion incidentally detected on prior abdominal imaging. The recommendation for a follow-up CT chest without IV contrast should be based on clinical assessment (eg, clinical suspicion of malignancy).

Variant 4: Pleural effusion incidentally detected on incomplete thoracic imaging study. Next imaging study.
D. CTA Chest With IV Contrast

There is no relevant literature to support the use of CTA chest with IV contrast as the next imaging study following a pleural effusion incidentally detected on prior abdominal imaging. The recommendation for a follow-up CTA chest with IV contrast should be based on clinical assessment.

Variant 4: Pleural effusion incidentally detected on incomplete thoracic imaging study. Next imaging study.
E. MRI Chest Without and With IV Contrast

There is no relevant literature to support the use of MRI chest without and with IV contrast as the next imaging study following a pleural effusion incidentally detected on prior abdominal imaging. The recommendation for a follow-up MRI chest without and with IV contrast should be based on clinical assessment.

Variant 4: Pleural effusion incidentally detected on incomplete thoracic imaging study. Next imaging study.
F. MRI Chest Without IV Contrast

There is no relevant literature to support the use of MRI chest without IV contrast as the next imaging study following a pleural effusion incidentally detected on prior abdominal imaging. The recommendation for a follow-up MRI chest without IV contrast should be based on clinical

assessment.

Variant 4: Pleural effusion incidentally detected on incomplete thoracic imaging study. Next imaging study.
G. Radiography Chest

There is no relevant literature to support the use of chest radiography as the next imaging study following a pleural effusion incidentally detected on prior abdominal imaging. The recommendation for a follow-up chest radiograph should be based on clinical assessment (eg, clinical suspicion of malignancy).

Variant 4: Pleural effusion incidentally detected on incomplete thoracic imaging study. Next imaging study.
H. US Chest

There is no relevant literature to support the use of US chest as the next imaging study following a pleural effusion incidentally detected on prior abdominal imaging. The recommendation for a follow-up US chest should be based on clinical assessment.

Summary of Recommendations

- **Variant 1**: Radiography chest or CT chest with IV contrast is usually appropriate for the initial imaging for patients with recent pneumonia with suspected parapneumonic effusion or empyema. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care). If CT chest with IV contrast is performed, acquiring the CT scan 60 seconds after the IV contrast bolus optimizes visualization of the pleura. The panel did not agree on recommending US chest for patients with recent pneumonia with suspected parapneumonic effusion or empyema. There is insufficient medical literature to conclude whether or not these patients would benefit from this modality. Imaging in this patient population is controversial but may be appropriate.
- **Variant 2**: Radiography chest or CT chest with IV contrast is usually appropriate for the initial imaging for patients with recent minor blunt trauma with suspected pleural effusion. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care). The panel did not agree on recommending US chest or CTA chest with IV contrast for patients' with recent minor blunt trauma with suspected pleural effusion. There is insufficient medical literature to conclude whether or not these patients would benefit from these modalities. Imaging in this patient population is controversial but may be appropriate.
- **Variant 3**: Radiography chest or CT chest with IV contrast is usually appropriate for the initial imaging for patients with dyspnea, cough, or chest pain with suspected pleural effusion with suspected noninfectious pleural effusion. These procedures are equivalent alternatives (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care). If CT chest with IV contrast is performed, acquiring the CT scan 60 seconds after the IV contrast bolus optimizes visualization of the pleura. The panel did not agree on recommending US chest for patients' with dyspnea, cough, or chest pain with suspected noninfectious pleural effusion. There is insufficient medical literature to conclude whether or not these patients would benefit from this modality. Imaging in this patient population is controversial but may be appropriate.

- **Variant 4**: The panel did not agree on recommending US chest, radiography chest or CT chest with IV contrast for patients' with pleural effusion incidentally detected on incomplete thoracic imaging study. There is insufficient medical literature to conclude whether or not these patients would benefit from these modalities. Imaging in this patient population is controversial but may be appropriate.

Supporting Documents

The evidence table, literature search, and appendix for this topic are available at https://acsearch.acr.org/list. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents, please go to the ACR website at https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria.

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, because of both organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as

compared with those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document.

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies."

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The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

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