

American College of Radiology ACR Appropriateness Criteria®

Clinical Condition: Acute Respiratory Illness in Immunocompetent Patients

Variant 1: Older than age 40.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	8		⊕
CT chest without IV contrast	4		⊕ ⊕ ⊕
CT chest with IV contrast	3		⊕ ⊕ ⊕
CT chest without and with IV contrast	1		⊕ ⊕ ⊕
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 2: Dementia, any age.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	8		⊕
CT chest without IV contrast	6	In patients without reliable follow-up or with a likelihood of morbidity if disease is not detected initially, a CT may be required in the setting of a negative chest x-ray.	⊕ ⊕ ⊕
CT chest with IV contrast	3		⊕ ⊕ ⊕
CT chest without and with IV contrast	1		⊕ ⊕ ⊕
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 3: Younger than age 40, negative physical examination, and no other signs, symptoms, or risk factors.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	4		⊕
CT chest without IV contrast	1		⊕ ⊕ ⊕
CT chest with IV contrast	1		⊕ ⊕ ⊕
CT chest without and with IV contrast	1		⊕ ⊕ ⊕
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

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Variant 4: Younger than age 40 and positive physical examination or other risk factors.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9		⊕
CT chest without IV contrast	4		⊕ ⊕ ⊕
CT chest with IV contrast	3		⊕ ⊕ ⊕
CT chest without and with IV contrast	1		⊕ ⊕ ⊕
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 5: Complicated pneumonia.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9		⊕
CT chest without IV contrast	8	If pneumonia is not resolving or intervention is contemplated.	⊕ ⊕ ⊕
CT chest with IV contrast	5		⊕ ⊕ ⊕
CT chest without and with IV contrast	2		⊕ ⊕ ⊕
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 6: Acute asthma, uncomplicated.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	4		⊕
CT chest without IV contrast	1		⊕ ⊕ ⊕
CT chest with IV contrast	1		⊕ ⊕ ⊕
CT chest without and with IV contrast	1		⊕ ⊕ ⊕
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 7: Acute asthma and suspected pneumonia or pneumothorax.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9		⊕
CT chest without IV contrast	2		⊕ ⊕ ⊕
CT chest with IV contrast	1		⊕ ⊕ ⊕
CT chest without and with IV contrast	1		⊕ ⊕ ⊕
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

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Variant 8: Acute exacerbation of COPD, “uncomplicated” (no history of coronary artery disease or congestive heart failure, no leukocytosis, fever, or chest pain).

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	4		☼
CT chest without IV contrast	2		☼ ☼ ☼
CT chest with IV contrast	1		☼ ☼ ☼
CT chest without and with IV contrast	1		☼ ☼ ☼
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 9: Acute exacerbation of COPD with one or more of the following: leukocytosis, pain, history of coronary artery disease or congestive heart failure.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9		☼
CT chest without IV contrast	4		☼ ☼ ☼
CT chest with IV contrast	3		☼ ☼ ☼
CT chest without and with IV contrast	1		☼ ☼ ☼
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

ACUTE RESPIRATORY ILLNESS IN IMMUNOCOMPETENT PATIENTS

Expert Panel on Thoracic Imaging: Jacobo Kirsch, MD¹; Tan-Lucien H. Mohammed, MD²; Jeffrey P. Kanne, MD³; Jonathan H. Chung, MD⁴; Edwin F. Donnelly, MD, PhD⁵; Mark E. Ginsburg, MD⁶; Darel E. Heitkamp, MD⁷; Travis S. Henry, MD⁸; Ella A. Kazerooni, MD⁹; Loren H. Ketai, MD¹⁰; Barbara L. McComb, MD¹¹; James G. Ravenel, MD¹²; Anthony G. Saleh, MD¹³; Rakesh D. Shah, MD¹⁴; Robert M. Steiner, MD¹⁵; Robert D. Suh, MD.¹⁶

Summary of Literature Review

Introduction/Background

Acute respiratory illness (ARI) is defined as one or more of the following: cough, sputum production, chest pain, or dyspnea (with or without fever). The workup of a patient with ARI, including the need for chest radiography and computed tomography (CT), depends on many factors, including severity of the illness; age of patient; presence of fever, leukocytosis, or hypoxemia; clinical history; presence of other risk factors; and physical examination. Not all studies concur as to which patients with ARI should have chest radiographs.

Benacerraf et al [1] in a study of 1,102 outpatients with ARI, found patient age, the physical examination, and the presence or absence of hemoptysis to be important factors. Only 4% (7/175) of patients younger than age 40 with symptoms of ARI, a negative physical examination, and no hemoptysis had acute significant radiographic findings, whereas patients either older than age 40 with hemoptysis or with a positive physical examination, such as the presence of wheezing, had a much higher incidence of chest radiograph abnormalities. In a study of 464 patients with ARI, Heckerling [2] also found a low incidence (3%) of pneumonia in patients with negative physical examinations. A notable exception was found for patients with dementia, in whom the incidence of pneumonia was very high regardless of the results of the physical examination. Okimoto et al [3] studied 79 outpatients presenting with clinical suspicion of pneumonia and concluded that radiographs should be ordered only when patients present with fever, cough, sputum production, and coarse crackles on physical examination. Conversely, Butcher et al [4] in a study of 221 patients with ARI found that 77 (35%) had new clinically important findings. Furthermore, the clinical findings did not differ significantly between those with positive radiographic findings and those with negative findings (ie, clinical history and physical examination were poor predictors of radiography-detected abnormalities). Speets et al [5] evaluated 192 patients with a clinical suspicion of pneumonia by general practitioners and found that the probability of pneumonia was changed by chest radiographic results in 53% of patients, with a decrease in probability in 47% and an increase in probability in 6%.

Pneumonia

In a series of 300 patients with acute cough illness, Aagaard et al [6] found that for patients with a high pretest probability of pneumonia, a radiograph was not always obtained in clinical practice; they infer that when the clinical probability of pneumonia exceeds a certain level, a negative radiograph would not alter treatment decisions by clinicians. A series by Basi et al [7] that included 2,706 patients hospitalized with community-acquired pneumonia (CAP) similarly showed that 911 (one-third) of them had radiographs initially interpreted as negative for pneumonia, with minimal change in this interpretation on retrospective review of a random subgroup. The groups with positive and negative radiographs had similar rates of positive sputum cultures and blood cultures. These 2 studies call into question the utility of radiographs in patients with high pretest probability of pneumonia. O'Brien et al [8] developed a prediction rule for the use of chest radiographs in evaluating for CAP and in a 70-patient series, in both the outpatient and emergency setting. They concluded that chest radiographs are unnecessary in patients with normal vital signs and physical examination findings. However, because approximately 5% of cases would be missed, their criteria are only useful for patients with reliable follow-up and

¹Principal Author and Panel Vice-chair, Cleveland Clinic, Weston, Florida. ²Panel Chair, Virginia Mason Medical Center, Seattle, Washington. ³Panel Vice-chair, University of Wisconsin School of Medicine and Public Health, Madison, Wisconsin. ⁴National Jewish Health, Denver, Colorado. ⁵Vanderbilt University Medical Center, Nashville, Tennessee. ⁶Columbia University, New York, New York, Society of Thoracic Surgeons. ⁷Indiana University, Indianapolis, Indiana. ⁸Emory University Hospital, Atlanta, Georgia. ⁹University of Michigan Medical Center, Ann Arbor, Michigan. ¹⁰University of New Mexico, Albuquerque, New Mexico. ¹¹Mayo Clinic, Jacksonville, Florida. ¹²Medical University of South Carolina, Charleston, South Carolina. ¹³New York Methodist Hospital, Brooklyn, New York, The American College of Chest Physicians. ¹⁴North Shore University Hospital, Manhasset, New York. ¹⁵Temple University, Philadelphia, Pennsylvania. ¹⁶Ronald Regan UCLA Medical Center, Los Angeles, California.

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a low likelihood of morbidity if CAP is not detected initially. Hagaman et al [9] showed that 21% of 105 patients hospitalized with a clinical diagnosis of CAP initially had negative chest radiographs, with over one-half of the 9 patients who had subsequent radiographic studies within 48 hours of hospitalization developing opacities.

Patients with substance abuse have an increased risk of ARI due to two potential conditions: respiratory pump failure and pulmonary pathology [10]. Respiratory pump failure generally does not have radiographic manifestations. However pulmonary pathology includes multiple diagnosis with chest radiographic manifestations, including aspiration, pulmonary edema, pneumonia, hemorrhage, and septic emboli.

According to the guidelines of the Infectious Diseases Society of America and the American Thoracic Society, chest radiography should be obtained whenever pneumonia is suspected in adults to establish the diagnosis and to aid in differentiating CAP from other common causes of cough and fever, such as acute bronchitis [11]. Findings on chest radiographs are one of several parameters used to determine: 1) which patients should be hospitalized (presence of pleural effusion); 2) which patients should be classified as having severe pneumonia (multilobar involvement); and 3) which patients may require additional diagnostic testing (cavitation, pleural effusion), including thoracentesis (pleural effusions >5 cm on lateral upright radiograph) [11]. CT may show findings in patients with normal radiographs, but the significance of these findings and therefore the utility of CT in patients with clinically suspected pneumonia and negative radiographs is unclear [11]. Hayden et al [12] found that in 27% of patients (out of 97) presenting to the emergency department with both a chest radiograph study and a CT scan performed in the workup of varied chief complaints, pneumonia was demonstrated on a CT scan in the face of a negative or nondiagnostic chest radiograph study. As in the study by O'Brien mentioned above, they recommend that when the chief complaint is fever, cough or chest pain in patients with serious comorbidities, obtaining a CT scan in the setting of a negative chest radiograph study would seem to be necessary [8,12].

Additionally, CT may play a role in the management of severe pneumonia. It can serve as a guide for pleural drainage or to localize an appropriate site for biopsy [13]. However, its use for potentially differentiating bacterial and nonbacterial pneumonias remains limited [14]. Severe pneumonias bear a strong relationship to etiologic pathogens and have implications for antimicrobial treatment. Patients with severe pneumonia should be considered as candidates for admission to an intensive care unit.

Asthma

The need for chest radiographs in adult patients with acute asthma is controversial. Petheram et al [15] found clinically important (ie, affecting patient management) radiographic findings in 9% of their patients and concluded that chest radiography is indicated. However, Findley and Sahn [16] observed that 99% of their patients either had normal chest radiographic examinations or showed only slightly prominent markings or hyperinflation. Heckerling [2] reported that patients with acute asthma rarely have pneumonia. Findley and Sahn [16] recommended chest radiographs only when pneumonia or pneumothorax is suspected. White et al [17] found significant chest radiographic abnormalities in 34% of adults whose asthma exacerbation warranted admission to the hospital.

Chronic Obstructive Pulmonary Disease

Sherman et al [18] studied the utility of chest radiography in 242 patients with acute exacerbations of chronic obstructive pulmonary disease (COPD) (ie, dyspnea). Of this group, 135 patients (56%) had asthma, and 107 (44%) had emphysema and chronic bronchitis. Chest radiographs were abnormal in 14% but resulted in significant change in management in only 4.5%. They concluded that the chest radiograph is indicated only if the worsening dyspnea is accompanied by leukocytosis, chest pain, or edema or by a history of coronary artery disease or congestive heart failure (CHF).

It is estimated that bacterial infection is a factor in 70%–75% of COPD exacerbations; up to 60% caused by *S. pneumoniae*, *H. influenzae* or *M. catarrhalis*. The latter, a nosocomial respiratory tract pathogen, is the causative agent particularly in older adults. Okada et al [19] reviewed the CT findings of 109 patients with acute *M. catarrhalis* pulmonary infection; the most common were ground-glass opacity followed by bronchial wall thickening, centrilobular nodules, consolidation and bronchiectasis with basal and peripheral predominance.

Summary

- Chest radiography seems warranted in ARI when one or more of the following are present: older than age 40; dementia; a positive physical examination; hemoptysis; associated abnormalities (leukocytosis, hypoxemia); or other risk factors, including coronary artery disease, CHF, or drug-induced acute respiratory failure.

- Chest radiography also seems warranted for any adult patient with clinical suspicion of pneumonia, although some clinicians may choose not to perform radiography if clinical suspicion of respiratory infection is sufficiently high to warrant treatment if a radiograph were to be negative.
- It appears that in patients with ARI who are younger than age 40, chest radiography is not routinely indicated unless there are other abnormalities, a positive physical examination, or other risk factors.
- It also appears that chest radiography is not indicated in most patients with exacerbations of COPD (including asthma) unless there is a suspected complication such as pneumonia or pneumothorax or unless one or more of the following are present: leukocytosis, chest pain, edema, or a history of coronary artery disease or CHF.
- Chest CT may be warranted in complicated cases of severe pneumonia and in febrile neutropenic patients with normal or nonspecific chest radiographic findings.

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, both because of 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 to 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
○	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 (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as “Varies”.

Supporting Documents

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

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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.