

American College of Radiology ACR Appropriateness Criteria®

Clinical Condition: Acute Respiratory Illness

Variant 1: Greater than 40 years old.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	8		Min
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 2: Dementia, any age.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	8		Min
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 3: Less than 40 years old, negative physical exam, and no other signs, symptoms, or risk factors.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	4		Min
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 4: Less than 40 years old, positive physical exam, or other risk factors.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	8		Min
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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Clinical Condition: Acute Respiratory Illness

Variant 5: Complicated pneumonia.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9		Min
CT chest	8	If pneumonia is not resolving or intervention is contemplated.	Med
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 6: Suspected SARS.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9		Min
CT chest	9	If chest radiograph is normal or equivocal.	Med
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 7: Suspected Anthrax.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9		Min
CT chest	8	If lungs or mediastinum are abnormal on chest radiograph and anthrax is suspected.	Med
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 8: Febrile, neutropenic.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9		Min
CT chest	8	If chest radiograph is normal or equivocal.	Med
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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Clinical Condition: Acute Respiratory Illness

Variant 9: Acute asthma uncomplicated.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	4		Min
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 10: Acute asthma, suspected pneumonia, pneumothorax.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9		Min
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 11: Acute exacerbation of COPD, “uncomplicated” (no history of CAD or CHF, no leukocytosis, bandemia, fever, or chest pain).

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	7		Min
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 12: Acute exacerbation of COPD with one or more of the following: leukocytosis, bandemia, pain, history of CAD or CHF.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9		Min
<u>Rating Scale:</u> 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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ACUTE RESPIRATORY ILLNESS

Expert Panel on Thoracic Imaging:
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Summary of Literature Review

Acute respiratory illness (ARI) is defined as one or more of the following: cough, sputum, chest pain, dyspnea, (with or without fever). The work-up 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 x-rays.

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 with symptoms of ARI, a negative physical examination, no hemoptysis, and age <40 years had acute significant radiographic findings, whereas patients either over 40, with hemoptysis, or with a positive physical examination had a much higher incidence of chest x-ray abnormalities. Heckerling, in a study of 464 patients with ARI, Heckerling also found a low incidence (3%) of pneumonia in patients with negative physical examinations [2]. 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. Conversely, Butcher et al [3] 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 x-ray detected abnormality). Patients with substance abuse have an increased risk of acute respiratory illness due to two mechanisms: respiratory pump failure and pulmonary pathology [4]. 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.

Jochelson et al [5] found a low incidence (4%) of pneumonia in febrile, but otherwise asymptomatic, neutropenic patients with a normal physical examination. Heussel et al [6] evaluated the utility of thin-section CT in a group of febrile neutropenic patients with normal or nonspecific chest radiographs. There were 146 episodes in 87 patients. Among the 14% with nonspecific chest radiographs, CT suggested pneumonia in all. Forty-eight percent had a normal chest radiograph, but CT findings of pneumonia. Of these, a specific pathogen was identified in 43%. Both chest radiographs and CT's were normal in 38%. The CT changed patient's therapy in 18%.

According to American Thoracic Society guidelines, posterioranterior (PA) (and lateral when possible) chest radiography should be obtained whenever pneumonia is suspected in adults [7]. Findings on chest radiography are one of several parameters used to determine: 1) which patients should be hospitalized (greater than one lobe involvement, cavitation, rapid progression, presence of pleural effusion); and 2) which patients should be classified as severe (bilateral or multilobar involvement $\geq 50\%$ progression within 48 hours) [7]. CT may play a role in the management of severe pneumonia. It can serve as a guide to pleural drainage or localize an appropriate site for biopsy [8]. 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 intensive care unit admission [7].

The need for chest roentgenography in adult patients with acute asthma is controversial. Petheram et al [9] found clinically important (ie, patient management affected) radiographic findings in 9% of their patients and concluded that chest radiography is indicated. However, Findley and Sahn [10] observed that 99% of their patients either had normal chest radiographic exams or showed only slightly prominent markings or hyperinflation. Heckerling [2] reported that patients with acute asthma rarely have pneumonia. Findley and Sahn [10] recommended chest x-rays only when pneumonia or pneumothorax are suspected. White et al [11] found significant chest radiographic abnormalities in 34% of adults whose asthma exacerbation warranted admission to the hospital.

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Sherman et al [12] 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 x-rays were abnormal in 14% but resulted in significant change in management in only 4.5%. They concluded that the chest x-ray is indicated only if the worsening dyspnea is accompanied by leukocytosis, bandemia, chest pain, or edema or by a history of coronary artery disease or congestive heart failure (CHF).

Emerging infections and biological warfare agents have come to recent attention as causes of acute respiratory illness. Severe acute respiratory syndrome (SARS) emerged in China in late 2002. The etiologic agent is a novel coronavirus (SARS-CoV) that appears to have originated in Himalayan palm civets and crossed the species barrier. In February 2003 the Program for Monitoring Emerging Diseases identified this novel presentation of pneumonia which because of air travel, rapidly spread across continents to involve patients in at least 27 countries. Despite its very recent emergence, there is already literature supporting the utility of chest radiography in patients with known or suspected SARS. Wong et al [13] and Paul et al [14] described the chest radiographic findings of SARS during the Hong Kong and Toronto epidemics. Chest radiographs were abnormal in 78%-80% of patients at presentation. The most common chest radiographic finding was a unifocal opacity with a peripheral and basilar predominance. Multifocal or diffuse opacities could be present initially or develop as the disease progressed. Patients whose disease progressed were generally older, had more comorbidities, and had a higher fatality rate. Cavitation, pleural effusion, and lymphadenopathy were not features of SARS.

Thin section chest CT findings of SARS have been described by Wong et al [15], Chan et al [16] and Paul et al [14]. The most common findings are ground glass opacities and crazy paving. More extensive findings include focal or multifocal consolidation. Chan et al [16] described pleural effusions and pneumomediastinum developing in 26% of patients scanned during the course of their illness. Wong et al [15] describes a major role for CT in patients who have a high clinical suspicion for SARS and a normal chest radiograph. In their series, all 17 patients in that category had CT findings of SARS.

Anthrax is endemic in the soil of Texas, Oklahoma, and the Mississippi Valley. During the 20th century a number of countries developed weapon-grade anthrax to be used as a biological warfare agent [17]. Much of modern medical experience with it arises from a Soviet military accident in 1979 in which 42 people died of anthrax, and from cases of anthrax that developed in the U.S. in 2001

as a result of biological warfare. Anthrax comes in three forms: cutaneous, gastrointestinal, and inhalational. Ninety-five percent of anthrax is cutaneous, but the inhalational form is the most deadly. Inhalation of anthrax spores leads to hemorrhagic lymphadenitis and mediastinitis, sometimes accompanied by necrotizing pneumonia. The chest radiographic findings [17,18] include widened mediastinum and hila, often accompanied by pleural effusions and parenchymal opacities. Earls et al [18] described the CT findings in two patients who survived inhalational anthrax. The CT characteristics were very suggestive of the diagnosis and included hyperattenuating hilar and mediastinal lymphadenopathy and hemorrhagic pleural effusion. Less specific findings included mediastinal edema, peribronchial thickening, and pleural effusion.

Based on these studies, the chest x-ray seems warranted in ARI when one or more of the following are present: age >40; dementia; a positive physical examination; hemoptysis; associated abnormalities (leukocytosis, hypoxemia); or other risk factors, including coronary artery disease, congestive heart failure, or drug-induced acute respiratory failure. X-ray also seems warranted for any adult patient with clinical suspicion of pneumonia. It appears that in patients with ARI, who are <40 years of age, chest radiography is not routinely indicated unless there are other abnormalities, a positive physical exam, or other risk factors. It also appears that chest radiographic examination 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, bandemia, 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. In patients with a normal chest radiograph and a high clinical suspicion of SARS, CT can be helpful in making the diagnosis.

References

1. Benacerraf BR, McLoud TC, Rhea JT, et al. Contribution of chest radiography in outpatients with acute complaints: a prospective study. *Radiology* 1981; 138(2):293-299.
2. Heckerling PS. The need for chest roentgenograms in adults with acute respiratory illness: clinical predictors. *Arch Intern Med* 1986; 146(7):1321-1324.
3. Butcher BL, Nichol KL, Parenti CM. High yield of chest radiography in walk-in clinic patients with chest symptoms. *J Gen Intern Med* 1993; 8(3):115-119.
4. Wilson KC, Saukkonen JJ. Acute respiratory failure from abused substances. *J Intensive Care Med* 2004; 19(4):183-193.
5. Jochelson MS, Altschuler J, Stomper PC. The yield of chest radiography in febrile neutropenic patients. *Ann Intern Med* 1986; 105(5):708-709.
6. Heussel CP, Kauczor HU, Heussel G, et al. Early detection of pneumonia in febrile neutropenic patients: use of thin-section CT. *AJR* 1997; 169(5):1347-1353.

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7. Niederman MS, Bass JB Jr, Campbell GD. Guidelines for the initial management of adults with community-acquired pneumonia: diagnosis, assessment of severity, and initial antimicrobial therapy. American Thoracic Society. Medical Section of the American Lung Association. *Am Rev Respir Dis* 1993; 148(5):1418-1426.
8. Baber CE, Hedlund LW, Oddson TA, Putman CE. Differentiating empyemas and peripheral pulmonary abscesses. The value of computed tomography. *Radiology* 1980; 135(3):755-758.
9. Petheram IS, Kerr IH, Collins JV. Value of chest radiographs in severe acute asthma. *Clin Radiol* 1981; 32(3):281-282.
10. Findley LJ, Sahn SA. The value of chest roentgenograms in acute asthma in adults. *Chest* 1981; 80(5):535-536.
11. White CS, Cole RP, Lubetsky HW, Austin JH. Acute asthma. Admission chest radiography in hospitalized adult patients. *Chest* 1991; 100(1):14-16
12. Sherman S, Skoney JA, Ravikrishnan KP. Routine chest radiographs in exacerbations of chronic obstructive pulmonary disease. Diagnostic value. *Arch Intern Med* 1989; 149(11):2493-2496.
13. Wong KT, Antonio GE, Hui DS, et al. Severe acute respiratory syndrome: radiographic appearance and pattern of progression in 138 patients. *Radiology* 2003; 228(2):401-406.
14. Paul NS, Roberts H, Butany J, et al. Radiologic pattern of disease in patients with severe acute respiratory syndrome: the Toronto experience. *Radiographics* 2004; 24(2):553-563.
15. Wong KT, Antonio GE, Hui DS, et al. Thin-section CT of severe acute respiratory syndrome: evaluation of 73 patients exposed to or with the disease. *Radiology* 2003; 228(2):395-400.
16. Chan MS, Chan IY, Fung KH, et al. High-resolution CT findings in patients with severe acute respiratory syndrome: a pattern based approach. *AJR* 2004; 182(1):49-56.
17. Shafazand S, Doyle R, Ruoss S, et al. Inhalational anthrax: epidemiology, diagnosis and management. *Chest* 1999; 116(5):1369-1376.
18. Earls JP, Cerva D Jr, Berman E, et al. Inhalational anthrax after bioterrorism exposure: spectrum of imaging findings in two surviving patients. *Radiology* 2002; 222(2):305-312.

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