Agency for Healthcare Research and Quality
Advancing Excellence in Health Care

NATIONAL GUIDELINE CLEARINGHOUSE

General

Guideline Title

ACR Appropriateness Criteria® intensive care unit patients.

Bibliographic Source(s)

Suh RD, Genshaft SJ, Kirsch J, Kanne JP, Chung JH, Donnelly EF, Ginsburg ME, Heitkamp DE, Henry TS, Kazerooni EA, Ketai LH, McComb BL, Ravenel JG, Saleh AG, Shah RD, Steiner RM, Mohammed TL, Expert Panel on Thoracic Imaging. ACR Appropriateness CriteriaÂ® intensive care unit patients [online publication]. Reston (VA): American College of Radiology (ACR); 2014. 7 p. [29 references]

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Amorosa JK, Bramwit MP, Mohammed TL, Reddy GP, Brown K, Dyer DS, Ginsburg ME, Heitkamp DE, Jeudy J, Kirsch J, MacMahon H, Ravenel JG, Saleh AG, Shah RD, Expert Panel on Thoracic Imaging. ACR Appropriateness Criteria® routine chest radiographs in ICU patients. [online publication]. Reston (VA): American College of Radiology (ACR); 2011. 6 p. [20 references]

This guideline meets NGC's 2013 (revised) inclusion criteria.

Recommendations

Major Recommendations

ACR Appropriateness Criteria®

Clinical Condition: Intensive Care Unit Patients

Variant 1: Admission or transfer to ICU.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest portable	7		☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 2: Stable patient. No change in clinical status.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest portable	3		☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 3: Patient with clinical worsening.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest portable	9		☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 4: Post-insertion of tube or catheter.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest portable	9		☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Variant 5: Post-chest tube removal.

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest portable	5	Data are largely based on studies of patients following cardiothoracic surgery. This may not be generalizable to all indications for chest tube removal.	☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Summary of Literature Review

Introduction/Background

Portable chest radiographs can be categorized as one of the following:

1. Daily or routine chest radiographs for patient monitoring.
2. Chest radiographs obtained after specific procedures.
3. Chest radiographs documenting the presence or course of disease

This narrative concerns daily routine chest radiographs in the intensive care unit (ICU) and chest radiographs following insertion of endotracheal, nasogastric (orogastric), and chest tubes, placement of pulmonary artery and central venous catheters (CVCs), and chest tube removal.

Discussion of Imaging Modalities by Variant

Variants 1, 2, and 3: Routine Versus Clinically Indicated Chest Radiographs

There has been long-standing controversy regarding the role of routine portable chest radiographs in critically ill patients in the ICU, especially in the mechanically ventilated patient. Traditionally, routine daily chest radiographs have been performed for these patients, largely based on data from the 1980s, which showed a high incidence of new or unexpected findings.

More recent data suggest that this solidly entrenched philosophy in ICU management of patients is of low yield in the absence of a clear indication, such as new device placement or clinical change. One study performed a meta-analysis of eight trials comprising 7,078 ICU patients, half of whom received daily chest radiographs and the other half of whom received chest radiographs for specific clinical indication. The study examined primary endpoints such as hospital or ICU mortality, length of mechanical ventilation, hospital stay, or adverse event rate. Eliminating routine daily chest radiographs did not affect mortality, length of stay in the hospital or ICU, or ventilator days.

Another study performed a large multicenter prospective trial with a cluster-randomized, crossover design, to assess the efficiency and effectiveness of routine daily versus clinically indicated chest radiographs for mechanically ventilated patients in the ICU. In the first period, 11 ICUs were randomly allocated to use daily chest radiographs and 10 ICUs to use an indication-driven strategy. A total of 424 patients had 4,607 routine chest radiographs, and 425 patients had 3,148 indication-driven chest radiographs, which represents a statistically significant 32% reduction in use of chest radiographs without sacrificing quality of care or safety. Other researchers have likewise found decreased resource utilization in ICUs employing an indication-driven chest radiograph ordering pattern.

Another research group concluded from a cohort observational study that the timing of portable chest radiographs needs to be included in the overall management guidelines based on clinical evaluations.

Several studies evaluated the clinical utility of routine daily versus nonroutine clinically indicated chest radiographs. A large study prospectively evaluated the clinical value of 2,457 routine chest radiographs in a combined surgical/medical intensive care unit (MICU). In this study, 5.8% of daily routine chest radiographs showed new or unexpected findings; but only 2.2% warranted a change in therapy. No difference was found between the medical and surgical patients. A randomized control study of MICU patients prospectively divided them into those who received daily routine chest radiographs and those who only received clinically indicated chest radiographs. The study found a greater percentage of radiographs with significant findings (requiring intervention) in the indication-driven group (26.5%) than in the routine group (13.3%). Significant interventions included diuresis, antibiotic administration, or invasive procedures. Patients in the indication-driven group also received significantly fewer radiographs than those in the routine group (4.4 versus 6.8). There was no significant difference in outcome between the groups in length of intubation, ICU stay, hospital stay, or mortality. Another prospective randomized study showed similar findings of increased diagnostic yield of indication-driven versus routine chest radiographs. A group of authors also reported a relatively high rate of actionable findings when the clinical indication of a radiograph is acute hypoxia, with 24.3% of radiographs showing major changes and 20.3% of radiographs showing minor changes.

Another prospective observational study analyzed 1,780 routine chest radiographs in 559 hospital ICU admissions. It concluded that the diagnostic and therapeutic value of routine chest radiograph is low, and the authors recommended abandoning routine chest radiographs in the ICU.

Another study reported the lowest rate of significant abnormal chest radiograph findings at 3% of all chest radiographs in 18% of the MICU patients. They still recommended daily routine studies on all critically ill patients. In another study, a high yield was found in MICU patients who had acute cardiopulmonary disease, but the yield was very low in patients with stable cardiac disease (usually myocardial infarction) and in ICU patients who had extrathoracic disease only.

For cardiothoracic ICU patients, two prospective nonrandomized studies showed a low incidence of significant findings on routine radiographs (4.5% in both studies) and consequently a minimal impact on patient management. The results support the recommendation to obtain chest radiographs in cardiothoracic ICU for clinical findings but not for routine follow-up. The role of chest radiographs for evaluation of intra-aortic balloon pumps and ventricular-assist devices has not been specifically addressed in the literature.

Recommendation

Routine daily radiographs are indicated for patients admitted to the ICU. In stable patients admitted for cardiac monitoring, or in stable patients admitted for extrathoracic disease only, an initial ICU admission radiograph is recommended; follow-up radiographs should be obtained only for specific clinical indications including clinical worsening and tube or line insertion.

Variant 4: Post-insertion of Tube or Catheter

Endotracheal Tubes

There are nine studies described in the literature since 1980 that evaluate the significance of the chest radiograph in assessing endotracheal tube placement following insertion. In five studies, between 12% and 15% of patients had malpositioned endotracheal tubes, many of which required repositioning. Two studies found 28% and 46% of tubes malpositioned upon insertion, and the single dissenting paper found 2% malpositioned. Two studies compared radiographs with physical examination. In both studies, physical examination predicted malpositioned tubes in 3% of patients, whereas the radiographs showed malpositioning in 14% of patients in one study and 28% in the other. One group of researchers found that the vast majority of malpositioned tubes were discovered in the first 3 days.

Recommendation

Very few malpositioned tubes are detected by physical examination. Radiographs immediately postintubation are indicated to insure proper positioning.

Central Venous Catheters

Eight studies were reviewed regarding CVCs. The majority came to the same conclusion: chest radiographs following catheter insertion are useful, with approximately 10% of the chest radiographs demonstrating malpositioned catheters. Pneumothoraces were present in only a small percentage of patients. One study separated jugular and subclavian catheters. Complications were twice as common with subclavian catheters (17% versus 8%), although unsuspected complications were infrequent.

Recommendation

A chest radiograph after insertion of a CVC is recommended to demonstrate proper placement and detect any complications. Beyond the initial insertion, follow-up chest radiographs have a low yield for revealing complications. Follow-up chest radiographs are suggested only when complications are suspected clinically.

Swan-Ganz Catheters

Previously mentioned studies incorporated the position and potential complications of Swan-Ganz catheter placements shown on chest radiographs obtained immediately postprocedure. The majority of complications, which occur in approximately 10% of catheter insertions, are minor and require catheter repositioning. The pneumothorax rate was approximately 2%.

Recommendation

Chest radiographs are suggested after catheter insertion. Once pneumothorax has been excluded and proper positioning has been assured, follow-up radiographs are not required except for specific clinical indications.

Nasogastric Tubes

There are no large prospective studies that consider the utility of obtaining a chest radiograph immediately after the insertion of a nasogastric suction tube or a small-bore feeding tube. Chest radiographs revealed important tube malpositioning in 1% of cases. Clearly, a patient with a functioning nasogastric tube that has already been documented to be in satisfactory position needs no imaging unless a clinical problem arises.

Recommendation

Based on limited evidence, small-bore feeding tubes may, in a small but significant number of patients, be inadvertently placed in the bronchi or lungs. This error is not always detected clinically and may lead to injection of feeding material into the lung or tube penetration of the pleura, with subsequent pneumothorax. A chest radiograph is warranted after initial nasogastric tube insertion and before the first feeding. Beyond the initial chest radiograph, follow-up chest radiographs are not required for managing stable tubes.

Chest Tube Insertion

Few studies have been performed to evaluate the efficacy of the initial chest radiograph after the insertion of a chest tube. The three available studies show that approximately 10% of tubes are malpositioned. Many of the radiographic abnormalities detected are minor and do not result in changes of tube positions.

Recommendation

After insertion of a chest tube, a chest radiograph is recommended to show the position of the tube, any success in drainage, and possible complications from insertion. Beyond this point, evaluation of tube position and function is warranted based on management of the pleural space and clinical indications.

Variant 5: Post-chest Tube Removal

A group of authors performed a meta-analysis of studies evaluating the utility of standard chest radiographs following chest tube removal. A total of 6 prospective observational and retrospective cohort studies evaluating routine and indication-directed chest radiographs following chest tube removal were reviewed. These studies found a low rate of complications, most notably pneumothorax, following chest tube removal, the majority of which were predicted clinically and with a low rate of tube re-insertion of between 0.25% and 4%.

Recommendation

A routine chest radiograph is not recommended following chest tube removal, unless indicated by clinical presentation.

Summary of Recommendations

- Placement of endotracheal or nasogastric (orogastric) tubes, Swan-Ganz catheters, CVC, or any other life support item is an indication for a chest radiograph.
- Change in the clinical condition of the patient is an indication for a chest radiograph.
- Routine daily chest radiograph in the ICU is not indicated.

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."		

Clinical Algorithm(s)

Algorithms were not developed from criteria guidelines.

Scope

Disease/Condition(s)

Critical illnesses in the intensive care unit (ICU)

Guideline Category

Evaluation

Clinical Specialty

Cardiology

Critical Care

Internal Medicine

Pulmonary Medicine

Radiology

Thoracic Surgery

Intended Users

Health Plans

Hospitals

Managed Care Organizations

Physicians

Utilization Management

Guideline Objective(s)

To evaluate the appropriateness of routine portable chest radiographs in the intensive care unit (ICU) following insertion of endotracheal, nasogastric (orogastric), and chest tubes, placement of pulmonary artery and central venous catheters (CVC), and chest tube removal

Note: Portable chest radiographs can be categorized as one of the following:

- Daily or routine chest radiographs for patient monitoring
- Chest radiographs obtained after specific procedures
- Chest radiographs documenting the presence or course of disease

Target Population

Critically ill patients in the intensive care unit (ICU) requiring routine chest radiographs

Interventions and Practices Considered

1. X-ray, chest, portable
    - Admission or transfer to intensive care unit (ICU)
    - Stable patient
    - Patient with clinical worsening
    - Post-insertion of tube or catheter
    - Post-chest tube removal

Major Outcomes Considered

Utility of routine chest radiograph in detecting significant abnormalities affecting patient management

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Literature Search Summary

Of the 20 citations in the original bibliography, 20 were retained in the final document.

A new literature search was conducted in July 2013 to identify additional evidence published since the *ACR Appropriateness Criteria® Intensive Care Unit Patients* topic was finalized. Using the search strategy described in the literature search companion (see the "Availability of Companion Documents" field), 103 articles were found. Six articles were added to the bibliography. Ninety-seven articles were not used due to either poor study design, the articles were not relevant or generalizable to the topic, the results were unclear, misinterpreted, or biased, or the articles were already cited in the original bibliography.

The author added 3 citations from bibliographies, Web sites, or books that were not found in the new literature search.

See also the American College of Radiology (ACR) Appropriateness Criteria® literature search process document (see the "Availability of Companion Documents" field) for further information.

Number of Source Documents

Of the 20 citations in the original bibliography, 20 were retained in the final document. The new literature search conducted in July 2013 identified 6 articles that were added to the bibliography. The author added 3 citations from bibliographies, Web sites, or books that were not found in the new literature search.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Study Quality Category Definitions

Category 1 - The study is well-designed and accounts for common biases.

Category 2 - The study is moderately well-designed and accounts for most common biases.

Category 3 - There are important study design limitations.

Category 4 - The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:

a. The study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description).
b. The study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence.
c. The study is an expert opinion or consensus document.

Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

The topic author assesses the literature then drafts or revises the narrative summarizing the evidence found in the literature. American College of Radiology (ACR) staff drafts an evidence table based on the analysis of the selected literature. These tables rate the study quality for each article included in the narrative.

The expert panel reviews the narrative, evidence table and the supporting literature for each of the topic-variant combinations and assigns an

appropriateness rating for each procedure listed in the variant table(s). Each individual panel member assigns a rating based on his/her interpretation of the available evidence.

More information about the evidence table development process can be found in the ACR Appropriateness Criteria® Evidence Table Development documents (see the "Availability of Companion Documents" field).

Methods Used to Formulate the Recommendations

Expert Consensus (Delphi)

Description of Methods Used to Formulate the Recommendations

Rating Appropriateness

The American College of Radiology (ACR) Appropriateness Criteria (AC) methodology is based on the RAND Appropriateness Method. The appropriateness ratings for each of the procedures or treatments included in the AC topics are determined using a modified Delphi method. A series of surveys are conducted to elicit each panelist's expert interpretation of the evidence, based on the available data, regarding the appropriateness of an imaging or therapeutic procedure for a specific clinical scenario. The expert panel members review the evidence presented and assess the risks or harms of doing the procedure balanced with the benefits of performing the procedure. The direct or indirect costs of a procedure are not considered as a risk or harm when determining appropriateness. When the evidence for a specific topic and variant is uncertain or incomplete, expert opinion may supplement the available evidence or may be the sole source for assessing the appropriateness.

The appropriateness is represented on an ordinal scale that uses integers from 1 to 9 grouped into three categories: 1, 2, or 3 are in the category "usually not appropriate" where the harms of doing the procedure outweigh the benefits; and 7, 8, or 9 are in the category "usually appropriate" where the benefits of doing a procedure outweigh the harms or risks. The middle category, designated "may be appropriate", is represented by 4, 5, or 6 on the scale. The middle category is when the risks and benefits are equivocal or unclear, the dispersion of the individual ratings from the group median rating is too large (i.e., disagreement), the evidence is contradictory or unclear, or there are special circumstances or subpopulations which could influence the risks or benefits that are embedded in the variant.

The ratings assigned by each panel member are presented in a table displaying the frequency distribution of the ratings without identifying which members provided any particular rating. To determine the panel's recommendation, the rating category that contains the median group rating without disagreement is selected. This may be determined after either the first or second rating round. If there is disagreement after the second rating round, the recommendation is "May be appropriate."

This modified Delphi method enables each panelist to articulate his or her individual interpretations of the evidence or expert opinion without excessive influence from fellow panelists in a simple, standardized and economical process. For additional information on the ratings process see the Rating Round Information document on the ACR Web site.

Additional methodology documents, including a more detailed explanation of the complete topic development process and all ACR AC topics can be found on the ACR Web site (see also the "Availability of Companion Documents" field).

Rating Scheme for the Strength of the Recommendations

Not applicable

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Internal Peer Review

Description of Method of Guideline Validation

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The recommendations are based on analysis of the current literature and expert panel consensus.

Summary of Evidence

Of the 29 references cited in the *ACR Appropriateness Criteria® Intensive Care Unit Patients* document, all of them are categorized as diagnostic references including 5 good quality studies and 12 quality studies that may have design limitations. There are 12 references that may not be useful as primary evidence.

While there are references that report on studies with design limitations, 5 good quality studies provide good evidence.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Appropriate use of routine chest radiographs for patient monitoring and evaluation after specific procedures in the intensive care unit (ICU)

Potential Harms

Relative Radiation Level

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. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document (see the "Availability of Companion Documents" field).

Qualifying Statements

Qualifying Statements

The American College of Radiology (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 U.S. Food and Drug Administration (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.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

Suh RD, Genshaft SJ, Kirsch J, Kanne JP, Chung JH, Donnelly EF, Ginsburg ME, Heitkamp DE, Henry TS, Kazerooni EA, Ketai LH, McComb BL, Ravenel JG, Saleh AG, Shah RD, Steiner RM, Mohammed TL, Expert Panel on Thoracic Imaging. ACR Appropriateness CriteriaÂ® intensive care unit patients [online publication]. Reston (VA): American College of Radiology (ACR); 2014. 7 p. [29 references]

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

1995 (revised 2014)

Guideline Developer(s)

American College of Radiology - Medical Specialty Society

Source(s) of Funding

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

Guideline Committee

Committee on Appropriateness Criteria, Expert Panel on Thoracic Imaging

Composition of Group That Authored the Guideline

Panel Members: Robert D. Suh, MD (*Principal Author*); Scott J. Genshaft, MD (*Research Author*); Jacobo Kirsch, MD (*Panel Vice-chair*); Jeffrey P. Kanne, MD (*Panel Vice-chair*); Jonathan H. Chung, MD; Edwin F. Donnelly, MD, PhD; Mark E. Ginsburg, MD; Darel E. Heitkamp, MD; Travis S. Henry, MD; Ella A. Kazerooni, MD; Loren H. Ketai, MD; Barbara L. McComb, MD; James G. Ravenel, MD; Anthony G. Saleh, MD; Rakesh D. Shah, MD; Robert M. Steiner, MD; Tan-Lucien H. Mohammed, MD (*Panel Chair*)

Financial Disclosures/Conflicts of Interest

Not stated

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Amorosa JK, Bramwit MP, Mohammed TL, Reddy GP, Brown K, Dyer DS, Ginsburg ME, Heitkamp DE, Jeudy J, Kirsch J, MacMahon H, Ravenel JG, Saleh AG, Shah RD, Expert Panel on Thoracic Imaging. ACR Appropriateness Criteria® routine chest radiographs in ICU patients. [online publication]. Reston (VA): American College of Radiology (ACR); 2011. 6 p. [20 references]

This guideline meets NGC's 2013 (revised) inclusion criteria.

Guideline Availability

Electronic copies: Available from the American College of Radiology (ACR) Web site.

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

Availability of Companion Documents

The following are available:

- ACR Appropriateness Criteria®. Overview. Reston (VA): American College of Radiology; 2015 Feb. 3 p. Electronic copies: Available from the American College of Radiology (ACR) Web site.
- ACR Appropriateness Criteria®. Literature search process. Reston (VA): American College of Radiology; 2015 Feb. 1 p. Electronic copies: Available from the ACR Web site.
- ACR Appropriateness Criteria®. Evidence table development – diagnostic studies. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available from the ACR Web site.
- ACR Appropriateness Criteria®. Radiation dose assessment introduction. Reston (VA): American College of Radiology; 2015 Feb. 3 p. Electronic copies: Available from the ACR Web site.
- ACR Appropriateness Criteria® intensive care unit patients. Evidence table. Reston (VA): American College of Radiology; 2014. 11 p. Electronic copies: Available from the ACR Web site.
- ACR Appropriateness Criteria® intensive care unit patients. Literature search. Reston (VA): American College of Radiology; 2014. 1 p. Electronic copies: Available from the ACR Web site.

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI Institute on May 10, 2007. This summary was updated by ECRI Institute on June 1, 2010. This summary was updated by ECRI Institute on February 29, 2012. This summary was updated by ECRI Institute on April 16, 2015.

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