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The American College of Radiology will periodically define new practice parameters and technical standards for radiologic practice to help advance the science of radiology and to improve the quality of service to patients throughout the United States. Existing practice parameters and technical standards will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each practice parameter and technical standard, representing a policy statement by the College, has undergone a thorough consensus process in which it has been subjected to extensive review and approval. The practice parameters and technical standards recognize that the safe and effective use of diagnostic and therapeutic radiology requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published practice parameter and technical standard by those entities not providing these services is not authorized.

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ACR–SPR–STR PRACTICE PARAMETER FOR THE PERFORMANCE OF CHEST RADIOGRAPHY

PREAMBLE

This document is an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. Practice Parameters and Technical Standards are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care¹. For these reasons and those set forth below, the American College of Radiology and our collaborating medical specialty societies caution against the use of these documents in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the practitioner in light of all the circumstances presented. Thus, an approach that differs from the guidance in this document, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in this document when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations of available resources, or advances in knowledge or technology subsequent to publication of this document. However, a practitioner who employs an approach substantially different from the guidance in this document is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also the art of dealing with the prevention, diagnosis, alleviation, and treatment of disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. Therefore, it should be recognized that adherence to the guidance in this document will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of this document is to assist practitioners in achieving this objective.

¹ *Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing*, ___ N.W.2d ___ (Iowa 2013) Iowa Supreme Court refuses to find that the *ACR Technical Standard for Management of the Use of Radiation in Fluoroscopic Procedures* (Revised 2008) sets a national standard for who may perform fluoroscopic procedures in light of the standard's stated purpose that ACR standards are educational tools and not intended to establish a legal standard of care. See also, *Stanley v. McCarver*, 63 P.3d 1076 (Ariz. App. 2003) where in a concurring opinion the Court stated that "published standards or guidelines of specialty medical organizations are useful in determining the duty owed or the standard of care applicable in a given situation" even though ACR standards themselves do not establish the standard of care.

I. INTRODUCTION

This practice parameter was revised collaboratively by the American College of Radiology (ACR), the Society for Pediatric Radiology (SPR), and the Society of Thoracic Radiology (STR).

Chest radiography is a proven and useful procedure for evaluating the airways, lungs, pulmonary vessels, mediastinum, heart, pleura, and chest wall. The common and accepted practice consists of posteroanterior (PA) and left lateral radiographic images obtained in the upright position. Under certain clinical circumstances and in certain patient populations (eg, critically ill, postoperative, trauma, and newborn patients), portable chest radiography may be indicated and should be performed in accordance with the [ACR–SPR Practice Parameter for the Performance of Portable \(Mobile Unit\) Chest Radiography](#) [1].

(For pediatric considerations, see section V.D.2.)

II. GOAL

The goals of the chest radiographic examination are to help identify or exclude disease processes that may involve the thorax, determine the etiology of the ailment, and potentially follow its course.

III. INDICATIONS AND CONTRAINDICATIONS

Indications for chest radiography include, but are not limited to:

1. Evaluation of signs and symptoms potentially related to the respiratory, cardiovascular, upper gastrointestinal, and thoracic musculoskeletal systems. The chest radiograph may also help to evaluate disease processes, including systemic and extrathoracic diseases that secondarily involve the chest. Because the lungs and bony thorax are frequent sites of metastases, chest radiography may be useful in staging neoplasms. However, chest radiography should not supplant chest CT (computed tomography) as part of routine restaging or when there is clinical suspicion for disease recurrence or progression.
2. Follow-up of known thoracic disease processes when clinically indicated. Routine chest radiographs are not necessary in children to ensure resolution, such as in uncomplicated pneumonia.
3. Monitoring of patients with life-support devices and patients who have undergone cardiac or thoracic surgery or other interventional procedures. A restricted approach should limit daily chest radiographs in those patients who have not had clinical change or movement in their support devices [2].
4. Compliance with government regulations that may mandate chest radiography. Examples include surveillance PA chest radiographs for active tuberculosis or occupational lung disease or exposures, or other surveillance studies required by public health law.
5. Preoperative radiographic evaluation when cardiac or respiratory symptoms are present when there is a significant potential for thoracic pathology that may influence anesthesia or the surgical result or lead to increased perioperative morbidity or mortality. Routine preoperative chest x-rays are not appropriate [2].

For the pregnant or potentially pregnant patient, see the [ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation](#) [3].

IV. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

A. Physician

See the [ACR–SPR Practice Parameter for General Radiography](#) [4].

Additionally, physicians interpreting pediatric chest radiographs should also have documented formal training in pediatric radiology, including interpretation and formal reporting of pediatric chest radiographs.

Physicians whose residency or fellowship training did not include the above may still be considered qualified to interpret pediatric chest radiographs when the following are documented:

1. The physician has supervised and interpreted chest radiographs for at least 2 years.
2. An official interpretation (final report) was generated for each study.

B. Radiologic Technologist

See the [ACR–SPR Practice Parameter for General Radiography](#) [4].

V. SPECIFICATIONS OF THE EXAMINATION

- A. The written or electronic request for chest radiography should provide sufficient information to demonstrate the medical necessity of the examination and allow for its proper performance and interpretation.

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). Additional information regarding the specific reason for the examination or a provisional diagnosis would be helpful and may at times be needed to allow for the proper performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider. The accompanying clinical information should be provided by a physician or other appropriately licensed health care provider familiar with the patient's clinical problem or question and consistent with the state's scope of practice requirements. (ACR Resolution 35, adopted in 2006)

- B. A standard chest examination should include an erect PA and left lateral projection made during full inspiration. The examination may be modified by the physician or qualified technologist depending on the clinical circumstances.

In some instances, additional views may be clinically useful. Decubitus views can aid in detecting pneumothoraces and establishing mobile versus loculated pleural effusions. Reverse apical lordotic and oblique views help in localizing abnormalities to the lung or bones. Views in expiration or bilateral decubitus views may also be useful in the assessment of air trapping or radiolucent endobronchial foreign bodies in pediatric patients. Expiration views have limited utility in the detection of pneumothorax [5]. Radiograph with nipple markers can be helpful in evaluating nodular opacities in the expected location of the nipple.

At times, as in the case of a pregnant or pediatric patient, a single frontal view may be appropriate. In young pediatric patients who are not able to stand for appropriate positioning, supine or sitting radiographs are routinely performed. Cross-table lateral radiographs may be done with the patient supine and the arms raised above the head, which facilitates proper positioning. In adults unable to stand or known to be at risk for a fall, a sitting anteroposterior (AP) view may be substituted for a PA view. Nipple markers may also be useful in specific instances.

- C. The chest radiograph should include both of the lung apices and the costophrenic sulci. Optimally, the patient should be positioned so that the scapulae and the arms do not overlies the lungs. The vertebral column should be centered between the clavicles. The lower thoracic vertebral bodies and the retrocardiac pulmonary vessels should be appropriately defined. The radiographic beam should be appropriately

collimated to include the structures listed while limiting exposure of the remainder of the patient and should not exceed the geometry of the image receptor.

D. Technical Factors

1. Adults: For a PA chest radiograph, the exposure time should not exceed 40 msec and the incident air kerma should adhere to the [ACR–AAPM Practice Parameter for Diagnostic Reference Levels and Achievable Doses in Medical X-Ray Imaging](#) [6]. A high-kilovoltage technique (120 to 150 kVp) should be employed. An antiscatter technique (eg, grid or air gap) should be used that reduces scatter at least as much as a 10:1 grid (preferably a 12:1 grid). Technique charts should be posted for use by technologists. An optimally exposed radiograph should display the lung parenchyma at a mid-gray level.
2. Newborns, infants, and children: For an AP or PA chest radiograph, the incident air kerma should be in accordance with ACR diagnostic reference levels. For more information, please refer to the ACR–AAPM Practice Parameter for Diagnostic Reference Levels and Achievable Doses in Medical X-Ray Imaging [6]. mean ESE should range from 0.05 to 0.3 mGy per exposure, respectively, for a 1-year-old to adult-sized patient using a 200-speed image receptor. The kVp should be selected to provide adequate contrast while minimizing dose; it should range from as low as 60 for infants to as high as 150 for adult-sized patients.

When using high-kVp techniques on larger patients, an antiscatter technique (eg, grid or air gap) should be selected to reduce scatter equivalent to that of a 10:1 grid (preferably a 12:1 grid). After establishing the correct kVp as a function of patient size, a tube current should be selected that makes the exposure time as short as feasible for fixed radiographic units to minimize patient motion during the exposure. The selected mAs and kVp should produce an image that displays the lung parenchyma at a mid-gray level [7]. Digital radiographs should be in accordance with the ACR–AAPM–SIIM Practice Parameter for Digital Radiography [8].

E. The following quality control (QC) procedures should be applied to chest radiography:

1. When the examination is completed, the images should be reviewed by qualified personnel, either a physician or a radiologic technologist.
2. Images of less than optimal diagnostic quality should be repeated as necessary. A repeat-rate program should be part of the QC process [9].
3. Each film or image should be permanently marked with the facility identification, patient's name, identification number, right or left side, patient position, and the date and time of the radiographic exposure. Labeling the image with the patient's date of birth is strongly recommended.

VI. DOCUMENTATION AND REPORTING

Images should be compared with prior chest examinations and/or other pertinent studies that may be available.

An official interpretation (final report) of the examination should be included in the patient's medical record. Reporting should be in accordance with the [ACR Practice Parameter for Communication of Diagnostic Imaging Findings](#) [10].

VII. EQUIPMENT SPECIFICATIONS

The equipment requirements include a diagnostic radiographic unit with a rotating anode tube and tube filtration sufficient to achieve a half-value layer (HVL) greater than 3 mm of aluminum at 100 kVp. A grid should be used

for adult radiography. At least a 10:1 grid (preferably a 12:1 grid) with a minimum of 103 lines per inch (stationary) or 80 lines per inch (reciprocating) is recommended.

Radiographs shall be exposed only with equipment having a beam-limiting device that provides rectangular collimation.

There should be at least a 72-in source-image distance (SID) to minimize magnification for routine upright projections. A 40-in SID may be used when clinically necessary (eg, supine positioning, infants and young children, immobilized patients, etc).

The nominal source (focal spot) must not exceed 2.0 mm; 0.6 to 1.2 mm is the recommended range. For analog studies, intensifying screens must be used. Any film-screen combination with a speed of at least 200 may be used.

Photostimulable phosphor plates or digital imaging techniques require careful QC to remove scatter and to improve image quality. Usage of a grid is recommended whenever appropriate [8,11-15].

An inherent problem in chest radiography is correctly identifying lung abnormalities that can be masked by or confused with overlying anatomical structures such as ribs or clavicles [16]. New and evolving techniques such as dual energy subtraction, bone suppression imaging, computer aided detection, temporal subtraction, and digital tomosynthesis may be helpful in the detection of subtle lung pathology or changes on serial examinations [17-21].

VIII. RADIATION SAFETY IN IMAGING

Radiologists, medical physicists, registered radiologist assistants, radiologic technologists, and all supervising physicians have a responsibility for safety in the workplace by keeping radiation exposure to staff, and to society as a whole, “as low as reasonably achievable” (ALARA) and to assure that radiation doses to individual patients are appropriate, taking into account the possible risk from radiation exposure and the diagnostic image quality necessary to achieve the clinical objective. All personnel that work with ionizing radiation must understand the key principles of occupational and public radiation protection (justification, optimization of protection and application of dose limits) and the principles of proper management of radiation dose to patients (justification, optimization and the use of dose reference levels)

http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1578_web-57265295.pdf.

Nationally developed guidelines, such as the ACR’s [Appropriateness Criteria](#)[®], should be used to help choose the most appropriate imaging procedures to prevent unwarranted radiation exposure.

Facilities should have and adhere to policies and procedures that require varying ionizing radiation examination protocols (plain radiography, fluoroscopy, interventional radiology, CT) to take into account patient body habitus (such as patient dimensions, weight, or body mass index) to optimize the relationship between minimal radiation dose and adequate image quality. Automated dose reduction technologies available on imaging equipment should be used whenever appropriate. If such technology is not available, appropriate manual techniques should be used.

Additional information regarding patient radiation safety in imaging is available at the Image Gently[®] for children (www.imagegently.org) and Image Wisely[®] for adults (www.imagewisely.org) websites. These advocacy and awareness campaigns provide free educational materials for all stakeholders involved in imaging (patients, technologists, referring providers, medical physicists, and radiologists).

Radiation exposures or other dose indices should be measured and patient radiation dose estimated for representative examinations and types of patients by a Qualified Medical Physicist in accordance with the applicable ACR technical standards. Regular auditing of patient dose indices should be performed by comparing the facility’s dose information with national benchmarks, such as the ACR Dose Index Registry, the NCRP Report No. 172, Reference Levels and Achievable Doses in Medical and Dental Imaging: Recommendations for

the United States or the Conference of Radiation Control Program Director's National Evaluation of X-ray Trends. (ACR Resolution 17 adopted in 2006 – revised in 2009, 2013, Resolution 52).

IX. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education appearing under the heading *Position Statement on QC & Improvement, Safety, Infection Control, and Patient Education* on the ACR website (<http://www.acr.org/guidelines>).

The lowest possible radiation dose consistent with acceptable diagnostic image quality should be used, particularly in pediatric examinations. Pediatric radiation doses should be determined periodically based on a reasonable sample of examinations. Technical factors should be appropriate for the size of the child and should be determined with consideration of parameters such as characteristics of the imaging system, organs in the radiation field, lead shielding, etc. Guidelines concerning effective pediatric technical factors are published in the radiological literature [22].

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