ACR–SPR–STR PRACTICE PARAMETER FOR THE PERFORMANCE OF PORTABLE (MOBILE UNIT) CHEST RADIOGRAPHY

The American College of Radiology, with more than 40,000 members, is the principal organization of radiologists, radiation oncologists, and clinical medical physicists in the United States. The College is a nonprofit professional society whose primary purposes are to advance the science of radiology, improve radiologic services to the patient, study the socioeconomic aspects of the practice of radiology, and encourage continuing education for radiologists, radiation oncologists, medical physicists, and persons practicing in allied professional fields.

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.

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 care[1]. 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 considering 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 variables such as the condition of the patient, limitations of available resources, or advances in knowledge or technology after publication of this document. However, a practitioner who employs an approach substantially different from the guidance in this document may consider documenting in the patient record information sufficient to explain the approach taken.

The practice of medicine involves the science, and 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 purpose of this document is to assist practitioners in achieving this objective.

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1 *Iowa Medical Society and Iowa Society of Anesthesiologists v. Iowa Board of Nursing, 831 N.W.2d 826 (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).

Portable chest radiography is the examination of choice for the imaging evaluation of cardiopulmonary diseases in patients under certain circumstances, including, but not limited to, the evaluation of critically ill or medically unstable patients, in patients who, because of their clinical condition, cannot be transported for standard radiography, assessment of placement of support devices, assessment for complications (eg, pneumothorax following chest interventions), and in newborns.

(For pediatric considerations, see sections III, IV, V.C, V.E.1, V.E.5, VII. A., and IX.)

The goal of portable chest radiography is to help determine absence of disease or presence and etiology of disorders that involve the thorax. The portable radiograph may be used to follow abnormalities and to evaluate clinical support devices such as endotracheal tubes, chest tubes, vascular catheters, and cardiopulmonary support devices. The addition of postprocessing tools that enhance visualization of these devices and foreign objects can be helpful. Upright portable chest radiographs can also be performed for evaluation for free air in the abdomen.

II. INDICATIONS AND CONTRAINDICATIONS

Portable chest radiography should be performed for diagnostic indications or to answer a clinical question [2].

Indications include, but are not limited to

1. Evaluation of patients with cardiopulmonary signs and/or symptoms following cardiac or thoracic surgery or major trauma, when chest CT has not already been performed, and when PA and lateral examinations cannot be performed
2. Patients with life-support devices
3. Patients who are critically ill or medically unstable
4. Patients who, because of their clinical condition, cannot be transported for standard chest radiography [3-11]
5. Immediate assessment for pneumothorax following an interventional procedure in the chest or abdomen
6. Intraoperative indications, such as verification of line or device placement or assessment for retained foreign bodies

For the pregnant or potentially pregnant patient, see the ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Patients with Ionizing Radiation [12].

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

A. Physician
   See the ACR–AAPM–SIIM–SPR Practice Parameter for Digital Radiography [13].
   Additionally, physicians interpreting pediatric portable chest radiographs should also have had 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 examination.

B. Radiologic Technologist
   See the ACR–AAPM–SIIM–SPR Practice Parameter for Digital Radiography [13].

C. Qualified Medical Physicist

See the ACR–AAPM–SIIM–SPR Practice Parameter for Digital Radiography [13].

IV. SPECIFICATIONS OF THE EXAMINATION

A. Written request for the examination
The written or electronic request for portable 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 – revised in 2016, Resolution 12-b)

B. The technologist should seek permission of and expect assistance from nursing or other personnel to position unstable patients and adjust or remove support apparatus in the radiographic field.

C. In cooperative adults and older pediatric patients, fully upright portable chest radiographs should be performed at a source-image distance (SID) of 40 to 72 inches, with the optimal distance as close as possible to 72 inches. Infants and young children and unresponsive or uncooperative patients may be imaged supine or semi-erect with a 40-inch or greater SID. The patient-to-image receptor distance should be minimized. Young or uncooperative children should be immobilized when necessary to ensure adequate patient positioning and prevent motion artifact resulting in unnecessary repeat exposures. The examination may be modified by the physician or by a qualified technologist under the direction of a physician, as dictated by the clinical circumstances or the condition of the patient.

D. Radiographic exposure should optimally be performed at peak inspiration for most indications. The radiograph should include the lung apices, the costophrenic sulci, the upper airway, and the upper abdomen. On an optimally penetrated chest radiograph, the retrocardiac vasculature and lower thoracic spine should be visible [14].

E. Technical Factors
1. In adults, without a grid, the kilovoltage should be between 70 and 100 kVp to optimize penetration and limit the effects of scattered radiation. When a grid is used, kilovoltage greater than 100 kVp may be employed [1,15-17]. In newborns, infants, and small children, lower kVp should be used to optimize contrast and decrease the radiation dose. Avoid the use of grids in children with less than 10 to 12 cm thickness [18].
2. On an optimally exposed chest radiograph, the lung parenchyma is displayed at a mid-gray level.
3. Exposure times should be as short as feasible to reduce motion artifacts.
4. Exposure parameters (including mAs, kVp, distance, and patient position) should be recorded for each image and may be used to optimize subsequent portable radiographs. Digital radiographs should be in accordance with the ACR–AAPM–SIIM–SPR Practice Parameter for Digital Radiography [13].
5. For all patients, the radiographic beam should be appropriately collimated to limit radiation exposure outside the area of clinical interest. Inadequate collimation in neonatal intensive care units may increase exposure by a factor of 2 [19]. Therefore, inclusion of the abdomen below the costophrenic sulcus level on neonatal chest radiographs is discouraged. If concurrent abdomen radiography is clinically warranted, a separate request including the medical necessity of the examination is required. In that circumstance, the chest and abdomen may be included in a single exposure using appropriate collimation and exposure parameters.

F. The following quality control (QC) procedures should be applied to chest radiography. For more information, please refer to the ACR–AAPM–SIIM–SPR Practice Parameter for Digital Radiography [13].
    1. When the examination is completed, the radiographs should be reviewed by qualified personnel, either a physician or a radiologic technologist [14]. The accuracy of laterality labeling (left or right) should be checked.
    2. Images that are not of diagnostic quality should be repeated as necessary. A repeat-rate program should be part of the QC process.

V. DOCUMENTATION

Reporting should be in accordance with the ACR Practice Parameter for Communication of Diagnostic Imaging Findings [20].

Images should be compared with prior chest examinations and/or other pertinent examinations if available. The date and time of the examination should be included in the official interpretation.

An official interpretation (final report) of the examination should be included in the patient's medical record.

VI. EQUIPMENT SPECIFICATIONS

A. Portable radiographic equipment should have adequate kVp and mA capabilities to produce diagnostic-quality radiographs of most patients (from newborns to full-size adults) at acceptable exposure times (100 ms for adults and 30 ms for newborns and infants). In some instances, diagnostically adequate radiographic images of morbidly obese patients may not be possible. A battery maintenance procedure, if appropriate, should be part of routine maintenance.
B. An inherent problem in portable chest radiography is correctly identifying catheters and devices, as well as foreign objects. The addition of postprocessing tools such as edge enhancement or noise suppression can be helpful. These are generally vendor specific.

VII. RADIATION SAFETY IN IMAGING

Radiologists, medical physicists, non-physician radiology providers**,** 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 who work with ionizing radiation must understand the key principles of occupational and public radiation protection (justification, optimization of protection, application of dose constraints and limits) and the principles of proper management of radiation dose to patients (justification, optimization including the use of dose reference levels). https://www-pub.iaea.org/MTCD/Publications/PDF/PUB1775_web.pdf

Nationally developed guidelines, such as the ACR's Appropriateness Criteria®, should be used to help choose the most appropriate imaging procedures to prevent unnecessary radiation exposure.

Facilities should have and adhere to policies and procedures that require ionizing radiation examination protocols (radiography, fluoroscopy, interventional radiology, CT) to vary according to diagnostic requirements and patient body habitus to optimize the relationship between appropriate radiation dose and adequate image quality. Automated dose reduction technologies available on imaging equipment should be used, except when inappropriate for a specific exam. If such technology is not available, appropriate manual techniques should be used.

Additional information regarding patient radiation safety in imaging is available from the following websites – Image Gently® for children (www.imagegently.org) and Image Wisely® for adults (www.imagewisely.org). 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 periodically measured by a Qualified Medical Physicist in accordance with the applicable ACR Technical Standards. Monitoring or regular review of dose indices from patient imaging should be performed by comparing the facility's dose information with national benchmarks, such as the ACR Dose Index Registry and relevant publications relying on its data, applicable ACR Practice Parameters, 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; 2006, 2009, amended 2013, revised 2023 (Res. 2d).

VIII. 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 Quality Control & Improvement, Safety, Infection Control*, *and Patient Education* on the ACR website (https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Quality-Control-and-Improvement).

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 such parameters as characteristics of the imaging system, organs in the radiation field, etc. Guidelines concerning effective pediatric technical factors are published in the radiological literature.

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Writing Committee – members represent their societies in the initial and final revision of this practice parameter

ACR	SPR	STR
Subba R. Digumarthy, MD, Chair	Sarah M. Desoky, MD	Anu Brixey MD
Justin P. Dodge, MD	Jordan Rapp, MD, MS	Paul Cronin, MD
Dexter Mendoza, MD		Demetrios Raptis, MD
Erica Poletto, MD		

Committee on Practice Parameters – General, Small, Emergency and/or Rural Practices (GSER)

(ACR Committee responsible for sponsoring the draft through the process)

Candice Johnstone, MD, Chair

Lynn Broderick, MD, FACR

Justin P. Dodge, MD

Brian D. Gale, MD, MBA

Rachel Gerson, MD

Carolyn A. Haerr, MD, FACR

Charles E. Johnson, MD

Mallikarjunarao Kasam, PhD

Steven E. Liston, MD, MBA, FACR

Nathan J. Rohling, DO

Samir S. Shah, MD

Derrick Siebert, MD

Michael Straza, MD, PhD

Jennifer L. Tomich, MD

Samir S. Shah, MD

Committee on Practice Parameters – Pediatric Radiology

(ACR Committee responsible for sponsoring the draft through the process)

Terry L. Levin, MD, FACR, Chair

John B. Amodio, MD, FACR

Jesse Berman, MD

Tara M. Catanzano, MB, BCh

Harris L. Cohen, MD, FACR

Kassa Darge, MD, PhD

Dorothy L. Gilbertson-Dahdal, MD

Lauren P. Golding, MD

Jane Sun Kim, MD

Jennifer A Knight, MD

Jessica Kurian, MD

Matthew P. Lungren, MD, MPH

Helen R. Nadel, MD

Erica Poletto, MD

Richard B. Towbin, MD, FACR

Andrew T. Trout, MD

Committee on Practice Parameters – Pediatric Radiology

Safwan S. Halabi, MD

Jason Higgins, DO

Esben S. Vogelius, MD

Committee on Practice Parameters – Thoracic Body Imaging

(ACR Committee responsible for sponsoring the draft through the process)

Lynn Broderick, MD, FACR, Chair

Jonathan H. Chung, MD

Subba R. Digumarthy, MD

Jane P. Ko, MD

David A. Lynch, MB, ChB

Kerry L. Thomas, MD

Andrew B. Rosenkrantz, MD, Chair, Commission on Body Imaging

Robert S. Pyatt, Jr., MD, FACR, Chair, Commission on General, Small, Emergency and/or Rural Practice

Richard A. Barth, MD, FACR, Chair, Commission on Pediatric Radiology

David B. Larson, MD, MBA, Chair, Commission on Quality and Safety

Mary S. Newell, MD, FACR, Chair, Committee on Practice Parameters and Technical Standards

Comments Reconciliation Committee

William Sensakovic, PhD– CSC Chair

Jamaal Benjamin, MD, PhD– CSC Co-Chair

Richard A. Barth, MD, FACR

Anu Brixey MD

Paul Cronin, MD

Timothy A. Crummy, MD, FACR

David B. Larson, MD, MBA

Paul Larson, MD

Terry L. Levin, MD, FACR

Dexter Mendoza, MD

Rebecca Milman, Ph.D

Mary S. Newell, MD, FACR

Comments Reconciliation Committee

Sarah M. Desoky, MD

Justin P. Dodge, MD

Subba R. Digumarthy, MD

Candice Johnstone, MD

Jane Ko, MD

Amy L. Kotsenas, MD, FACR

Erica Poletto, MD

Robert S. Pyatt Jr, MD, FACR

Jordan Rapp, MD, MS

Demetrios Raptis, MD

Andrew B. Rosenkrantz, MD

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