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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 PRACTICE PARAMETER FOR PERFORMING AND INTERPRETING DIAGNOSTIC COMPUTED TOMOGRAPHY (CT)

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*, 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

Computed tomography (CT) is a radiologic modality that provides clinical information in the detection, differentiation, and demarcation of disease. It is the primary diagnostic modality for a variety of clinical problems and is widely accepted as a supplement to other imaging techniques.

CT is a form of medical imaging that involves the exposure of patients to ionizing radiation [1]. According to National Council on Radiation Protection & Measurements (NCRP) report 160 [2], the radiation exposure from CT contributes to nearly half of all the radiation exposure from medical procedures to the US population. It should be performed only under the supervision of a physician with the necessary training in radiation protection to optimize examination safety [1,3-5]. A Qualified Medical Physicist must be available [6].

CT examinations should be performed only for a valid medical reason and with the minimum exposure that provides the image quality necessary for adequate diagnostic information [7-10]. This practice parameter applies to all CT examinations performed in all settings.

(For pediatric considerations, see section VII.)

II. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

Physicians who supervise and interpret CT examinations should be licensed medical practitioners who have a thorough understanding of the indications for CT as well as a familiarity with the basic physical principles and limitations of the technology of CT imaging. They should be familiar with alternative and complementary imaging and diagnostic procedures and should be capable of correlating the results of these with CT findings. The physicians should have a thorough understanding of CT technology and instrumentation as well as radiation safety. Physicians responsible for CT examinations should be able to demonstrate familiarity with the anatomy, physiology, and pathophysiology of those organs or anatomic areas that are being examined. These physicians should provide evidence of training and the requisite competence to perform CT examinations successfully.

A. Physician

All examinations must be performed under the supervision of and interpreted by a physician who has the following qualifications:

Certification in Radiology, Diagnostic Radiology or Interventional Radiology/Diagnostic Radiology (IR/DR) by the American Board of Radiology, the American Osteopathic Board of Radiology, the Royal College of Physicians and Surgeons of Canada, or the Collège des Médecins du Québec, and involvement with the supervision, interpretation, and reporting of 300 CT examinations in the past 36 months²

or

Completion of a diagnostic radiology residency program approved by the Accreditation Council for Graduate Medical Education (ACGME), the Royal College of Physicians and Surgeons of Canada (RCPSC), the Collège des Médecins du Québec, or the American Osteopathic Association (AOA) to include involvement with the supervision, interpretation, and reporting of 500 CT examinations in the past 36 months.

or

Physicians not board certified in radiology or not trained in a diagnostic radiology residency program who assume these responsibilities for CT imaging exclusively in a specific anatomical area should meet the following criteria: completion of an ACGME approved residency program in the specialty practiced plus 200 hours of Category I CME in the performance and interpretation of CT in the subspecialty where CT

²Completion of an accredited radiology residency in the past 24 months will be presumed to be satisfactory experience for the reporting and interpreting requirement.

reading occurs; and supervision, interpretation, and reporting of 500 cases in that subspecialty area during the past 36 months in a supervised situation.

and

1. The physician should have documented training in the physics of diagnostic radiology. Additionally, the physician must be familiar with the principles of radiation protection, the hazards of radiation, and radiation monitoring requirements and how they apply to both patients and personnel.

and

2. The physician should be thoroughly acquainted with the many morphologic and pathophysiologic manifestations and artifacts demonstrated on CT. Additionally, supervising physicians should have appropriate knowledge of alternative imaging methods, including the use of and indications for general radiography and specialized studies such as angiography, ultrasonography, magnetic resonance imaging, and nuclear medicine studies.

and

3. The physician should be familiar with patient preparation for the examination. The physician must have had training in the recognition and treatment of adverse effects of contrast materials used for these studies. See the ACR Manual on Contrast Media and the ACR–SPR Practice Parameter for the Use of Intravascular Contrast Media [11,12].

and

4. The physician must have the responsibility for reviewing all indications for the examination; specifying the use, dosage, and rate of administration of contrast agents; specifying the imaging technique, including available techniques to reduce radiation dose; interpreting images; generating official interpretations (final reports); and maintaining the quality of the images and the interpretations.

Maintenance of Competence

All physicians performing CT examinations should demonstrate evidence of continuing competence in the interpretation and reporting of those examinations. Competency can be assured on the basis of continuing experience or through monitoring and evaluation that indicates acceptable technical success, accuracy of interpretation, and appropriateness of evaluation.

Continuing Medical Education

The physician's continuing education should be in accordance with the [ACR Practice Parameter for Continuing Medical Education \(CME\)](#) and should include CME in CT as is appropriate to the physician's practice needs [13].

B. Qualified Medical Physicist

A Qualified Medical Physicist is an individual who is competent to practice independently one or more of the subfields in medical physics. The American College of Radiology considers certification, continuing education, and experience in the appropriate subfield(s) to demonstrate that an individual is competent to practice one or more of the subfield(s) in medical physics and to be a Qualified Medical Physicist. The ACR strongly recommends that the individual be certified in the appropriate subfield(s) by the American Board of Radiology (ABR), the Canadian College of Physics in Medicine, or by the American Board of Medical Physics (ABMP).

A Qualified Medical Physicist should meet the [ACR Practice Parameter for Continuing Medical Education \(CME\)](#). (ACR Resolution 17, 1996 – revised in 2012, Resolution 42) [13]

The appropriate subfield of medical physics for computed tomography is Diagnostic Medical Physics. (Previous medical physics certification categories including Radiological Physics, Diagnostic Radiological Physics, and Diagnostic Imaging Physics are also acceptable.)

C. Registered Radiologist Assistant

A registered radiologist assistant is an advanced level radiographer who is certified and registered as a radiologist assistant by the American Registry of Radiologic Technologists (ARRT) after having successfully completed an advanced academic program encompassing an ACR/ASRT (American Society of Radiologic Technologists) radiologist assistant curriculum and a radiologist-directed clinical preceptorship. Under radiologist supervision, the radiologist assistant may perform patient assessment, patient management and selected examinations as delineated in the Joint Policy Statement of the ACR and the ASRT titled “Radiologist Assistant: Roles and Responsibilities” and as allowed by state law. The radiologist assistant transmits to the supervising radiologists those observations that have a bearing on diagnosis. Performance of diagnostic interpretations remains outside the scope of practice of the radiologist assistant. (ACR Resolution 34, adopted in 2006)

D. Radiologic Technologist

The technologist should have the responsibility for patient comfort, preparation and positioning for the CT examination, monitoring the patient during the examination, and obtaining the CT data in a manner prescribed by the supervising physician. If intravenous contrast material is to be administered, qualifications for technologists performing intravenous injections should be in compliance with current ACR policy³ and with existing operating procedures or manuals at the imaging facility. The technologist should also perform regular quality control testing of the CT system under the supervision of a medical physicist.

Technologists performing CT examinations should be certified by the American Registry of Radiologic Technologists (ARRT) or have an unrestricted state license with documented training and experience in CT.

III. SPECIFICATIONS OF THE EXAMINATION

The written or electronic request for a CT examination 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)

Self-referred patients who meet CT screening criteria may not require documentation of signs and symptoms and may not require a referring provider request.

Images must be labeled with the following: (1) patient identification, (2) facility identification, (3) examination date, (4) the side (right or left) of the anatomic site imaged, and (5) kVp and mA/mAs or other suitable radiation dose parameter.

IV. DOCUMENTATION

High-quality patient care requires adequate documentation. There should be a permanent finalized record of the CT examination and its interpretation. Images of all appropriate areas, both normal and abnormal, should be recorded in a suitable archival format. An official interpretation (final report) of the CT findings should be

³See the [ACR–SPR Practice Parameter for the Use of Intravascular Contrast Media](#).

included in the patient's medical record regardless of where the study is performed. If intravascular, intrathecal, or intra-articular contrast material is administered during the examination, the brand name, route of administration, and administered dose of the contrast agent should be recorded and included in the permanent record of the examination, as should injection of any drugs. Retention of the CT examination should be consistent both with clinical need and with relevant legal and local health care facility requirements. The organization documents the radiation CT dose index (CTDI_{vol}, dose length product [DLP], or size-specific dose estimate [SSDE]) on every study produced during a diagnostic CT examination. The radiation dose index must be exam specific, summarized by series or anatomic area, and documented in a retrievable format.

Reporting should be in accordance with the [ACR Practice Parameter for Communication of Diagnostic Imaging Findings](#) [14].

V. EQUIPMENT SPECIFICATIONS

See the various anatomic CT procedure practice parameters or technical standards for definitive equipment specifications.

VI. RADIATION SAFETY IN IMAGING

A. General Policy

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).

Facilities performing CT should be attentive to radiation exposure in the pediatric population and adhere to the principles of patient appropriate, **size-based** protocols, such as those suggested by Image Gently [24].

B. Actions Specifically for CT

1. The supervising radiologist, lead CT technologist, and Qualified Medical Physicist should collaborate to design and review all new or modified protocol settings to ensure that both image quality and radiation dose aspects are appropriate.
2. The facility should establish radiation dose index thresholds during any new CT protocol design.
3. If an estimated radiation dose index is above the applicable threshold for a routine clinical CT examination, steps should be taken to adjust the protocol to fall within established values, if possible.
4. A periodic review process should be instituted for all protocols to ensure that no changes have been applied that may degrade image quality or unreasonably increase radiation dose.
5. Depending on the implementation on a particular scanner, the CT dose index display option should not be disabled. Such information should be viewed during the examination prescription phase.
6. CT staff should maintain CT-specific continuing education that focuses on patient safety.

VII. 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>).

A comprehensive CT quality control program should be documented and maintained at the CT facility. The program should help minimize radiation risk to the patient, facility personnel, and the public and maximize the quality of diagnostic information. CT facility personnel must adhere to radiation safety regulations when inside the scanner room. Overall program responsibility should remain with the physician, but specific program implementation should be supervised by the medical physicist in compliance with local and state regulations as well as manufacturer specifications. The facility should maintain a record of quality control tests, frequency of their performance, description of procedures and a list of individuals or groups performing each test. The parameters of technique, equipment testing, and acceptability of limits for each test should also be maintained, along with sample records for each test. Quantitative dose determination should be conducted periodically, in addition to equipment performance monitoring.

The supervising physician should review all practices and policies at least annually. Policies with respect to contrast and sedation must be administered in accordance with institutional policy as well as state and federal regulations. A physician should be available on-site whenever intravenous, intra-disc, intra-articular, or intrathecal contrast is administered [11,12]. A physician should be available on-site whenever intravenous sedation is administered [15].

Appropriate emergency equipment and medications must be immediately available to treat adverse reactions associated with administered medications [15]. The equipment and medications should be monitored for inventory and drug expiration dates on a regular basis. The equipment, medications, and other emergency support must also be appropriate for the range of ages and sizes in the patient population.

The lowest possible radiation dose consistent with acceptable diagnostic image quality should be used, particularly in pediatric examinations. Radiation doses should be determined periodically based on a reasonable sample of pediatric examinations. For further information see the [ACR–ASER–SCBT–MR–SPR Practice Parameter for the Performance of Pediatric Computed Tomography \(CT\)](#) [16,17]. Technical factors should be appropriate for the size and the age 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 [18-26].

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](#) [27].

Equipment performance monitoring should be in accordance with the [ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Computed Tomography \(CT\) Equipment](#) [28].

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