ACR–SPR 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 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

Computed tomography (CT) is a radiologic modality that provides clinical information in the detection, differentiation, and demarcation of disease and delineation of anatomy. 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 a National Council on Radiation Protection and Measurements (NCRP) report 184 [2], the radiation exposure from

CT contributes 63% 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 using available technique optimization to achieve adequate diagnostic quality at the lowest achievable dose, without risking nondiagnostic scan quality due to insufficient X-ray flux [7-13]. This practice parameter applies to all CT examinations performed in all settings.

(For pediatric considerations, see section VI.)

II. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

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 engagement in the supervision, interpretation, and reporting of CT examinations in their clinical practice[1]

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) and engagement in the supervision, interpretation, and reporting of CT examinations in their clinical practice.

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 category I CME in the performance and interpretation of CT in the subspecialty where CT reading occurs; and engagement in the supervision, interpretation, and reporting of CT examinations in that subspecialty area.

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 demonstrated on CT, as well as common image artifacts. Additionally, supervising physicians should have appropriate knowledge of alternative imaging methods, including the use of and indications for general radiography, ultrasonography, MRI, nuclear medicine, and angiography.
   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 [14,15].
   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 interpreting CT examinations should be able to 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 appropriate use of CT, acceptable quality, and accuracy of interpretation.

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 [16].

[1] Completion of an accredited radiology residency will be presumed to be satisfactory experience for the reporting and interpreting requirement.

II. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

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 (CCPM), the American Board of Science in Nuclear Medicine (ABSNM), or the American Board of Medical Physics (ABMP).

A Qualified Medical Physicist should meet the ACR Practice Parameter for Continuing Medical Education (CME). [16].

The appropriate subfield of medical physics for CT is Diagnostic Medical Physics (previous medical physics certification categories including Radiological Physics, Diagnostic Radiological Physics, and Diagnostic Imaging Physics are also acceptable). (ACR Resolution 17, adopted in 1996 – revised in 2008, 2012, 2022, Resolution 41f)

II. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

C. Non-Physician Radiology Provider (NPRP)

NPRPs are all Non-Physician Providers (eg, RRA, RPA, RA, PA, NP, ...) who assist with or participate in portions of the practice of a radiologist-led team (Radiologists = diagnostic, interventional, neurointerventional radiologists, radiation oncologists, and nuclear medicine physicians). The term "NPRP" does not include radiology, CT, US, NM MRI technologists, or radiation therapists who have specific training for radiology related tasks (eg, acquisition of images, operation of imaging and therapeutic equipment) that are not typically performed by radiologists.

The term 'radiologist-led team' is defined as a team supervised by a radiologist (ie, diagnostic, interventional, neurointerventional radiologist, radiation oncologist, and nuclear medicine physician) and consists of additional healthcare providers including RRAs, PAs, NPs, and other personnel critical to the provision of the highest quality of healthcare to patients. (ACR Resolution 8, adopted 2020).

II. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

D. Radiologic Technologist

The technologist should have the responsibility for patient, preparation, positioning, comfort 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 policy[3] and with existing operating procedures at the imaging facility. The technologist must also perform required 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), NMTCB (CT) registered, or have an unrestricted state license with documented training and experience in CT.

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

III. SPECIFICATIONS OF THE EXAMINATION

The written or electronic request for 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 – revised in 2016, Resolution 12-b)

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, (5) kVp and mA/mAs**,** and (6) CTDIvol and DLP.

IV. DOCUMENTATION

Reporting should be in accordance with the ACR Practice Parameter for Communication of Diagnostic Imaging Findings [17].

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 included in the patient's medical record regardless of where the study is performed. If contrast material, including, but not limited to, intravascular, intrathecal, or intra-articular agents, is administered during the examination, the brand name, route of administration, and administered dose of the contrast material should be recorded. The organization should document the CTDIvol and DLP on every study produced during a diagnostic CT examination. These dose metrics must be examination specific, summarized by series or anatomic area, and documented in a retrievable format.

See the ACR–SPR Practice Parameter for the Use of Intravascular Contrast Media [15].

V. EQUIPMENT SPECIFICATIONS

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

Equipment performance monitoring should be in accordance with the ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Computed Tomography (CT) Equipment [18].

VI. 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).

VI. RADIATION SAFETY IN IMAGING

A. 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 CTDIvol 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.
7. Pediatric CT may require different examination preparation and performance than in adults. Preparation includes ensuring appropriate NPO status if moderate sedation or general anesthesia is potentially necessary.
8. For pediatric CT scan performance, single-phase scanning is the standard rather than the exception. Only the necessary scan coverage should be obtained, and scan parameters—including beam collimation, tube current, gantry cycle time, pitch, and peak kilovoltage—should be adjusted for the size of the child, the region scanned, and the clinical indications

VI. RADIATION SAFETY IN IMAGING

B. Safety 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 while maintaining 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 radiation dose metric review 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, intradisc, intra-articular, or intrathecal contrast is administered [14,15]. A physician should be available on-site whenever intravenous sedation is administered [25].

Appropriate emergency equipment and medications must be immediately available to treat adverse reactions associated with administered medications [25]. 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 for all patients, but this is particularly important for pediatric patients undergoing CT. Radiation doses should be determined periodically based on a reasonable sample of examinations. Scanning parameters should be optimized to obtain diagnostic image quality while adhering to the as low as reasonably achievable (ALARA) principle. The scan area should be restricted according to the clinical indication, with areas not involved in the clinical problem excluded from the scan. The scanning parameters, including kVp and exposure time product (mAs), should be changed according to body size, regions of interest, and clinical indication. This can be achieved by using weight-based or cross-sectional size tables or by using automatic exposure control (see www.imagegently.org). In addition, mAs should be further reduced if noncontrast scans are performed only to evaluate calcifications or for cases in which only gross bony relationships are being evaluated. Noise-reducing reconstruction technique (eg, iterative reconstruction), if available, can be used to improve image quality and decrease dose.

For further information, see the ACR–ASER–SCBT-MR–SPR Practice Parameter for the Performance of Pediatric Computed Tomography (CT) [26]. Guidelines concerning effective pediatric technical factors are published in the radiological literature [19,27-37]. 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.

For the pregnant or potentially pregnant patient, see the ACR–SPR Practice Parameter for Imaging Pregnant or Potentially Pregnant Patients with Ionizing Radiation [38].

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).

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*Practice parameters and technical standards are published annually with an effective date of October 1 in the year in which amended, revised or approved by the ACR Council. For practice parameters and technical standards published before 1999, the effective date was January 1 following the year in which the practice parameter or technical standard was amended, revised, or approved by the ACR Council.

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