The American College of Radiology, with more than 30,000 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.

Revised 2011 (Resolution 4)*

ACR TECHNICAL STANDARD FOR DIAGNOSTIC MEDICAL PHYSICS PERFORMANCE MONITORING OF RADIOGRAPHIC AND FLUOROSCOPIC EQUIPMENT

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. 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 physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the guidelines, 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 the guidelines 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 the guidelines. However, a practitioner who employs an approach substantially different from these guidelines 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 these guidelines 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 these guidelines 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 technical standard was revised by the American College of Radiology (ACR) with assistance from the American Association of Physicists in Medicine (AAPM).

The performance of all radiographic and fluoroscopic equipment must be evaluated upon installation and monitored at least annually by a Qualified Medical Physicist to ensure that the equipment is functioning properly and that patients are not exposed to unnecessary doses of radiation. Additional or more frequent monitoring may be necessary after repairs that might change the radiation exposure to patients or personnel or the imaging performance of the equipment. Although it is not possible to consider all possible variations of equipment performance to be monitored, adherence to this technical standard will assist in maximizing image quality and in reducing patient radiation doses.

II. GOAL

The goals are to produce the highest quality diagnostic image at the lowest reasonable radiation dose consistent with the clinical use of the equipment and the information requirement of the examination and to establish and maintain performance standards.

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

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 (ACR) 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 subfields 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 Guideline for Continuing Medical Education (CME). (ACR Resolution 17, 1996 – revised in 2012, Resolution 42)

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

Understanding of the relationship between image quality and patient radiation dose is essential for proper monitoring of equipment performance. The medical physicist must be familiar with the principles of imaging physics and radiation protection; the current guidelines of the National Council on Radiation Protection and Measurements (NCRP); federal and local laws and regulations pertaining to the performance of the equipment being tested; the function, clinical uses, and performance specifications of the imaging equipment; and calibration processes and limitations of the instruments used for testing performance.

The medical physicist may be assisted by other properly trained individuals in obtaining test data for performance monitoring. These individuals must be properly trained and approved by the medical physicist in the techniques of performing the tests, the function and limitations of the imaging equipment and test instruments, the reasons for the tests, and the importance of the test results. The tests will be performed by or under the general supervision of the medical physicist, who is responsible for and must review, interpret, and approve all data and provide a signed report.

IV. PERFORMANCE CHARACTERISTICS TO BE MONITORED

A. Performance Evaluation

The performance of each radiographic and fluoroscopic unit must be evaluated at least annually. This evaluation should include, but not be limited to, the following tests (as applicable):
1. Integrity of unit assembly.
2. Collimation and radiation beam alignment.
3. Fluoroscopic system resolution.
6. Image artifacts.
7. Fluoroscopic phantom image quality.
8. kVp accuracy and reproducibility.
9. Linearity of exposure versus mA or mAs.
10. Exposure reproducibility.
11. Timer accuracy.
12. Beam quality assessment (half-value layer).
15. Equipment radiation safety functions.
16. Patient dose monitoring system calibration
17. Video and digital monitor performance.
18. Digital image receptor performance.

For further information on computed radiography [CR] and digital radiography [DR] systems please see the ACR–AAPM–SIIM Practice Guideline for Digital Radiography [1].

B. Quality Control Program

A continuous quality control (QC) program must be implemented for all radiographic and fluoroscopic units. The program should be established with the assistance of the medical physicist. The medical physicist should identify the person responsible for performing the tests and may choose to modify the frequency of testing based on the system’s usage and performance. The QC program should include, but not be limited to, the following tests (as applicable):

1. Appropriateness of technique factors.
2. Visual equipment checklists.
3. Phantom images.
4. Repeat analysis.
5. Viewboxes, image monitors, and viewing conditions.
7. Darkroom and screen cleanliness.
8. Processor quality control.
10. Analysis of fixer retention.
11. Darkroom fog.
12. Screen-film contact.
13. CR and DR system performance.

C. Acceptance Testing

Initial performance testing of imaging equipment must be performed upon installation and before clinical use. This testing must be more comprehensive than periodic performance and must be consistent with current acceptance testing practices. Electrical safety of the equipment must also be tested by appropriate personnel prior to its initial clinical use.
D. Written Survey Reports and Follow-Up Procedures

The medical physicist must provide a written report of the findings of acceptance testing and performance evaluation to the responsible physician(s), if appropriate, and to the professional(s) in charge of obtaining or providing necessary service to the equipment. If appropriate, the medical physicist should initiate the required service. Written reports must be provided in a timely manner consistent with the importance of any adverse findings.

If use of the equipment would pose imminent danger to patients or staff, the medical physicist must take immediate action to prevent its use.

V. 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/p1531interim_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 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).

Patient radiation dose must be estimated for radiographic and fluoroscopic equipment at least annually. Tables of patient radiation exposure for representative examinations must be prepared and supplied to the facility. These tables must be prepared using measured radiation output data and imaging techniques provided by the facility. These results must be compared with appropriate guidelines or recommendations when they are available [2-3]. The medical physicist should assist facilities in understanding and developing policies and procedures to evaluate risks to patients, personnel, and physicians from studies and interventions requiring prolonged radiation exposure [3-13].
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REFERENCES


*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 parameters or technical standard was amended, revised, or approved by the ACR Council.

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