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.

Amended 2014 (Resolution 39)*

ACR PRACTICE PARAMETER FOR PERFORMING AND INTERPRETING MAGNETIC RESONANCE IMAGING (MRI)

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 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

Magnetic resonance imaging (MRI) is a multiplanar imaging method based on an interaction between radiofrequency (RF) electromagnetic fields and certain nuclei in the body (usually hydrogen nuclei) after the body has been placed in a strong magnetic field. MRI differentiates between normal and abnormal tissues, providing a sensitive examination to detect disease. This sensitivity is based on the high degree of inherent contrast due to variations in the magnetic relaxation properties of different tissues, both normal and diseased, and the dependence of the MRI signal on these tissue properties.

II. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

A. Physician

A physician must be responsible for all aspects of the study including, but not limited to, reviewing indications for the examination, specifying the pulse sequences to be performed, specifying the use and dosage of contrast agents, interpreting images, generating official interpretations (final reports), and assuring the quality of the images and the interpretations.

Physicians assuming these responsibilities for MR imaging of all anatomical areas (exclusive of cardiac MRI) should meet one of the following criteria:

Certification in Radiology or Diagnostic Radiology 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 MRI examinations within the last 36 months.

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 MRI examinations in the past 36 months.

or

Physicians not board certified in radiology or not trained in a diagnostic radiology residency program who assumes these responsibilities for MR imaging exclusively in a specific anatomical area, excluding cardiac MRI, should meet the following criteria:

Completion of an ACGME approved residency program in the specialty practiced, plus 200 hours of Category I CME in MRI to include, but not limited to: MRI physics, recognition of MRI artifacts, safety, instrumentation, and clinical applications of MRI in the subspecialty area where MRI reading occurs; and supervision, interpretation, and reporting of 500 MRI cases in that specialty area in the past 36 months in a supervised situation. For neurologic MRI, at least 50 of the 500 cases must have been MR angiography (MRA) of the central nervous system.

Specific qualifications for physicians performing cardiac MRI are described in the ACR–NASCI–SPR Practice Parameter for the Performance and Interpretation of Cardiac MRI.

Maintenance of Competence

All physicians performing MRI examinations should demonstrate evidence of continuing competence in the interpretation and reporting of those examinations. If competence is assured primarily on the basis of continuing experience, a minimum of 100 examinations per year is recommended in order to maintain the physician’s skills. Because a physician’s practice or location may preclude this method, continued competency can also be assured.

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3 Board certification and completion of an accredited radiology residency in the past 24 months will be presumed to be satisfactory experience for the reporting and interpreting requirement.
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 MRI as is appropriate to the physician’s practice needs.

B. Medical Physicist / MR Scientist

The personnel qualified to carry out acceptance testing and monitoring of MRI equipment for the purposes of this practice parameter include a medical physicist or an MR scientist.

A Qualified Medical Physicist is an individual who is competent to practice independently one or more 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 in one or more 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).

The Qualified Medical Physicist should meet the ACR Practice Parameter for Continuing Medical Education (CME). (ACR Resolution 17, 1996 – revised in 2012, Resolution 42)

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

A Qualified MR Scientist is an individual who has a graduate degree in a physical science involving nuclear magnetic resonance (NMR) or MRI. These individuals should have 3 years of documented experience in a clinical MR environment.

The medical physicist/MR scientist must be familiar with the principles of MRI safety for patients, personnel, and the public; the Food and Drug Administration’s guidance for MR diagnostic devices; and other regulations pertaining to the performance of the equipment being monitored. The medical physicist/MR scientist must be knowledgeable in the field of nuclear MR physics and familiar with MRI technology, including function, clinical uses, and performance specifications of MRI equipment, as well as calibration processes and limitations of the performance testing hardware, procedures, and algorithms. The medical physicist/MR scientist must have a working understanding of clinical imaging protocols and methods of their optimization. This proficiency must be maintained by participation in continuing education programs of sufficient frequency to ensure familiarity with current concepts, equipment, and procedures.

The medical physicist/MR scientist may be assisted in obtaining test data for performance monitoring by other properly trained individuals. These individuals must be properly trained and approved by the medical physicist/MR scientist in the techniques of performing the tests, the function and limitations of the imaging equipment and test instruments, the reason for the tests, and the importance of the test results. The medical physicist/MR scientist must review and approve all measurements. The MR scientist should meet the ACR Practice Parameter for Continuing Medical Education (CME).

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) [1]

D. Radiology Technologist

The technologist should participate in assuring patient comfort and safety, preparing and positioning the patient for the MRI examination, and obtaining the MRI data in a manner suitable for interpretation by the physician. The technologist should also perform frequent quality control testing in accordance with the MRI manufacturer’s recommendations.

The technologist performing MRI should:

1. Be certified by the American Registry of Radiologic Technologists (ARRT), the American Registry of MRI Technologists (ARMRIT), or the Canadian Association of Medical Radiation Technologists (CAMRT) as an MRI technologist (RTMR).

   or

2. Be certified by the ARRT and/or have appropriate state licensure and have 6 months supervised clinical experience in MRI scanning.

   or

3. Have an associate’s degree in an allied health field or a bachelor’s degree and certification in another clinical imaging field and have 6 months of supervised clinical MRI scanning.

To assure competence, the responsible physician should evaluate any technologist who began performing MRI prior to October 1996 and who does not meet the above criteria.

Any technologist practicing MRI scanning should be licensed in the jurisdiction in which he/she practices, if state licensure exists. To assure competence, all technologists must be evaluated by the supervising physician.

III. TECHNIQUES AND INDICATIONS

The currently accepted techniques and indications for MRI are discussed in various ACR practice parameters that are based on anatomic sites of examination. It is important that each site offering MRI have documented procedures and technical expertise and appropriate equipment to examine each anatomic site. Because the clinical applications of MRI continue to expand, the enumerated techniques and indications in the reference documents may not be all-inclusive.

Each site’s procedures should be reviewed and updated at appropriate intervals. The final judgment regarding appropriateness of a given examination for a particular patient is the responsibility of the ordering physician or other appropriately licensed health care provider and radiologist. The decision to use MRI to scan a particular part of the human body depends on the MRI software and hardware available and the relative cost, efficacy, and availability of alternative imaging methods. The examination should provide images with suitable contrast characteristics, spatial resolution, signal-to-noise ratio, and section geometry appropriate to the specific clinical indications.

IV. POSSIBLE CONTRAINDICATIONS

Possible contraindications include, but are not limited to, the presence of cardiac pacemakers, ferromagnetic intracranial aneurysm clips, certain neurostimulators, certain cochlear implants, and certain other ferromagnetic foreign bodies or electronic devices [2-5]. Possible contraindications should be listed on a screening questionnaire. All patients should be screened for possible contraindications prior to MRI scanning [6-7]. Published test results and/or on-site testing of an identical device or foreign body may be helpful to determine whether a patient with a particular medical device or foreign body may be safely scanned. There is no known
adverse effect of MRI on the fetus. The decision to scan during pregnancy should be made on an individual basis [8].

V. SPECIFICATIONS OF THE EXAMINATION

The examination should be performed within parameters currently approved by the FDA. Examinations that use techniques not approved by the FDA may be considered when they are judged to be medically appropriate.

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

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)

Images should be labeled with the following: a) patient identification, b) facility identification, c) examination date, and d) image orientation indicated by unambiguous polarity symbols (e.g., R, L, A, P, H, F).

VI. DOCUMENTATION

High-quality patient care requires adequate documentation. There should be a permanent record of the MRI examination and its interpretation. Imaging of all appropriate areas, both normal and abnormal, should be recorded in a suitable archival format. If contrast material is administered during the MRI examination, the brand name of the contrast agent and the administered dose should be recorded and included in the permanent record of the MRI examination. An official interpretation (final report) of the MRI findings should be included in the patient’s medical record regardless of where the study is performed. Retention of the MRI examination should be consistent both with clinical need and with relevant legal and local health care facility requirements.

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

VII. SAFETY GUIDELINES

Safety guidelines, practices, and policies must be written, enforced, reviewed, and documented at least annually by the supervising physician. These guidelines should take into consideration potential magnetic field interactions for ferromagnetic objects in the MRI environment [9]. They should also consider potential patient hazards (e.g., from magnetic field interactions, tissue heating, and induced electrical currents) and potential hazards posed by implanted objects and materials within the patient as well as other individuals in the MR environment [4-5].

A screening program should be implemented to assure appropriate and safe use of MR contrast material and to reduce the risk of nephrogenic systemic fibrosis (NSF) [10-11]. For further information on ACR screening recommendations see the ACR Manual on Contrast Media [12] and the ACR Guidance Document on MR Safe Practices [8]. Peer-reviewed literature pertaining to MR safety should be reviewed on a regular basis.

In pregnancy, gadolinium-based contrast agents (GBCAs) cross the placental barrier, enter the fetal circulation, and pass via the kidneys into the amniotic fluid. Although no definite adverse effects of GBCA administration on the human fetus have been documented, the potential bioeffects of fetal GBCA exposure are not well understood.
GBCA administration should therefore be avoided during pregnancy unless no suitable alternative imaging is possible and the benefits of contrast administration outweigh the potential risk to the fetus. (See the ACR–SPR Practice Parameter for the Safe and Optimal Performance of Fetal MRI).

When GBCAs are administered to nursing women, a small amount of the contrast agent is excreted in the breast milk. It is unlikely that the minute amount of GBCA absorbed by a nursing infant’s gastrointestinal tract will be harmful. If there is concern on the part of the referring physician, radiologist, or patient, the nursing mother can be advised to discard her breast milk for 24 hours after GBCA administration.

When contrast and/or sedation are necessary, they must be administered in accordance with institutional policy and state and federal law by a qualified practitioner with training in cardiopulmonary resuscitation [13]. (See the ACR–SPR Practice Parameter for the Use of Intravascular Contrast Media and the ACR–SIR Practice Parameter for Sedation/Analgesia.)

Appropriate emergency equipment and medications must be immediately available to treat adverse reactions associated with administered medications. 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.

VIII. EQUIPMENT SPECIFICATIONS

The MRI equipment specifications and performance must meet all state and federal requirements. The requirements include, but are not limited to, specifications of maximum static magnetic field strength, maximum rate of change of magnetic field strength (dB/dt), maximum radiofrequency power deposition (specific absorption rate), and maximum acoustic noise levels.

IX. QUALITY CONTROL PROGRAM

A documented quality control program must be maintained at the MR site. Quality control testing should be conducted by the technologist and/or service engineer with review at least annually by the supervising physician and/or a medical physicist/MR scientist [14-16].

X. 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).

Equipment performance monitoring should be in accordance with the ACR–AAPM Technical Standard for Diagnostic Medical Physics Performance Monitoring of Magnetic Resonance Imaging (MRI) Equipment.

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

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