

The Complete

**ICAMRL STANDARDS FOR
ACCREDITATION IN MAGNETIC
RESONANCE IMAGING**

Part I and II

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PART I

ORGANIZATION

Introduction: A magnetic resonance laboratory (i.e.: imaging center, department) is a unit under the overall direction of a Clinical MR Director. When more than one technical staff member is employed, a Technical Director is appointed and is responsible for direct supervision of the technical staff members and the daily operations of the laboratory.

In addition to all standards listed below, the Laboratory, the Medical Director and the Technical Director must comply at all times with all federal, state and local laws and regulations, including but not limited to laws relating to licensed scope of practice, facility operations, and billing requirements.

SECTION 1

Supervision and Personnel

STANDARD – Clinical MR Director

1.1 The Clinical MR Director must be a licensed physician and certified by an American Board of Medical Specialties (ABMS) recognized board in a relevant specialty.

1.1.1 Clinical Director Required Training and Experience:

The Clinical MR Director must demonstrate an appropriate level of training and experience by meeting **ONE OR MORE** of the following:

A) Established Practice – A physician who has worked in a magnetic resonance laboratory for at least five years, has acquired 150 hours of Category I CME relevant to MR to include courses specifically designed to provide knowledge of the techniques, safety, limitations, accuracy and methods of interpretation and clinical applications specific to the anatomic area and has interpreted a minimum of 1,000 magnetic resonance examinations.

OR

B) Formal Training Program – Completion of a residency or fellowship that includes appropriate didactic and clinical magnetic resonance laboratory experience as an integral part of the program and a minimum of 300 cases specific to the anatomic area:

- Body – 300 cases
- Cardiovascular – 300 cases
- Musculoskeletal – 300 cases
- Neurological – 300 cases

The formal training experience is to be documented by a letter from the director of the training program verifying the areas of MR expertise and the extent of the training experience.

OR

C) Informal Training

Didactic

Appropriate background for proper qualifications to interpret magnetic resonance laboratory studies can be achieved through accredited postgraduate continuing medical education (CME). A minimum of 150 hours of AMA Category I CME credits must be acquired within a three (3) year period. These hours must be met with courses specifically designed to provide knowledge of the techniques, safety, limitations, accuracy and methods of interpretation of magnetic resonance examinations and clinical applications specific to the anatomic area. Documentation of the CME courses, with a listing of the content, must be submitted.

Practical Experience

In addition to the formal didactic education outlined above, the individual must acquire a minimum of six (6) months of supervised practical experience observing or participating in MR imaging procedures, preferably in an accredited laboratory. The practical experience must include all areas of MR for which the laboratory is applying. This experience is to be documented with a letter from the Clinical MR Director of the laboratory where the practical experience was obtained.

For those examinations the Clinical MR Director will interpret, experience in interpreting the following minimum number of MRI or MRA studies, while under supervision, must be documented:

- Body – 300 cases
- Cardiovascular – 300 cases
- Musculoskeletal – 300 cases
- Neurological – 300 cases

1.1.2 Clinical MR Director Responsibilities:

- A) The Clinical MR Director is responsible for all clinical MR services provided and for the determination of the quality of imaging provided related to the MR services.
- B) The Clinical MR Director may supervise the entire operation of the laboratory or may delegate specific operations to laboratory staff members.
- C) The Clinical MR Director selects and approves medical staff members and supervises their work.
- D) The Clinical MR Director is responsible for assuring compliance of the medical and technical staff to the Standards outlined within this document.

1.1.3 Continuing Medical Education (CME) Requirements:

The Clinical MR Director must show evidence of maintaining current knowledge by participation in CME courses that are relevant to magnetic resonance imaging. To be relevant, the course content must address the principles, instrumentation, techniques and/or interpretation of magnetic resonance imaging specific to the anatomic area. A minimum of 15 hours of AMA Category I CME is required every three years. Correlation conferences or other internal meetings are not to be counted as part of this requirement. Documentation of accumulated continuing medical education must be kept on file and available for audit.

Note: If the Clinical MR Director has completed formal training as specified under 1.1.1(B) in the last three years, the CME requirement will be considered fulfilled.

STANDARD – Medical Staff

1.2 Medical Staff must be a licensed physician and certified by an American Board of Medical Specialties (ABMS) recognized board in a relevant specialty.

1.2.1 Medical Staff Required Training and Experience:

The medical staff must demonstrate an appropriate level of training and experience by meeting **ONE OR MORE** of the following:

- A) Established Practice – A physician who has worked in a magnetic resonance laboratory for at least three (3) years, has acquired 150 hours of Category I CME relevant to MR to include courses specifically designed to provide knowledge of the techniques, safety, limitations, accuracy and methods of interpretation and clinical applications specific to the anatomic area and has interpreted a minimum of 500 magnetic resonance laboratory examinations.

OR

- B) Formal Training Program – Completion of a residency or fellowship that includes appropriate didactic and clinical magnetic resonance laboratory experience as an integral part of the program and interpreted a minimum of 150 cases specific to the anatomic area:
- Body – 150 cases
 - Cardiovascular – 150 cases
 - Musculoskeletal – 150 cases
 - Neurological – 150 cases

The formal training experience is to be documented by a letter from the director of the training program verifying the areas of MR expertise and the extent of the training experience.

OR

- C) Informal Training

Didactic

Appropriate background for proper qualifications to interpret magnetic resonance laboratory studies can be achieved through accredited postgraduate continuing medical education (CME). A minimum of 150 hours of AMA Category I CME credits must be acquired within a three year (3) period. These hours must be met with courses specifically designed to provide knowledge of the techniques, safety, limitations, accuracy and methods of interpretation of magnetic resonance examinations and clinical applications specific to the anatomic area. Documentation of the CME courses, with a listing of the content, must be submitted.

Practical Experience

In addition to the formal didactic education outlined above, the individual must acquire a minimum of six (6) months of supervised practical experience observing or participating in MR imaging procedures, preferably in an accredited laboratory. The practical experience must include all areas of MR for which the laboratory is applying. This experience is to be documented with a letter from the Clinical MR Director of the laboratory where the practical experience was obtained.

For those examinations the medical staff member will interpret, experience in interpreting the following minimum number of MRI or MRA studies, while under supervision, must be documented:

- Body – 150 cases
- Cardiovascular – 150 cases
- Musculoskeletal – 150 cases
- Neurological – 150 cases

1.2.2 Medical Staff Reports to the Clinical MR Director.

1.2.3 Responsibilities: The medical staff interprets and/or performs clinical MR studies in accordance with privileges approved by the Clinical MR Director.

1.2.4 Continuing Medical Education (CME) Requirements:

The medical staff must show evidence of maintaining current knowledge by participation in CME courses that are relevant to magnetic resonance imaging. To be relevant, the course content must address the principles, instrumentation, techniques and/or interpretation of magnetic resonance imaging specific to the anatomic area. A minimum of 15 hours of AMA Category I CME is required every three years. Correlation conferences or other internal meetings are not to be counted as part of this requirement. Documentation of accumulated continuing medical education must be kept on file and available for audit.

Note: If the medical staff member has completed formal training as specified under 1.2.1(B) in the past three years, the CME requirement will be considered fulfilled.

STANDARD – Technical Director

1.3 A qualified Technical Director (i.e.: supervisor, chief technologist, manager, etc.) is designated for the laboratory.

1.3.1 Technical Director Required Training and Experience:

The Technical Director must have appropriate training, technical certification and documented experience in the field of magnetic resonance imaging.

The Technical Director must meet **ONE** of the following criteria:

A) American Registry of Radiologic Technologists (ARRT) or the Canadian Association of Medical Radiation Technologists (CAMRT) certification in magnetic resonance imaging (RT (MR)).

OR

B) An appropriate credential in another medical imaging field (i.e.: CNMT, RDMS, RT) **AND** One year of full-time equivalent experience as an MR technologist performing a minimum of 100 examinations.

OR

C) For personnel operating scanners capable of performing only peripheral joint imaging, **ALL** of the following criteria must be met:

1. Medical practitioner state license or state certification acceptable to ICAMRL (i.e.: MA, basic operator, LMRT, RE, ARMRIT®)
2. Certificate from MR manufacturer documenting a minimum of 56 hours of uninterrupted (but not necessarily contiguous) training. No more than 16 of the 56 hours may be acquired through self study that includes successful completion of a written examination. The manufacturers training on the device should include:
 - a. MR Safety
 - b. basic anatomy
 - c. basic MR physics
 - d. slice orientation
 - e. sequence and protocol development
3. Three (3) months clinical experience performing examinations.
4. Performance of at least 150 MR examinations.

1.3.2 Technical Director Responsibilities

The Technical Director reports directly to either the laboratory administrator or the Clinical MR Director.

Responsibilities include, but are not limited to, and may be delegated to other staff:

- A) All laboratory duties delegated by the laboratory administrator and/or Clinical MR Director.
- B) Supervision of the technical and ancillary staff. If the laboratory has multiple sites, the Technical Director must provide a minimum of one full day per month at each site supervising the technical and ancillary staff.

- C) The delegation, when warranted, of specific responsibilities to the technical staff and/or the ancillary staff.
- D) Daily technical operation of the MR laboratory (i.e.: staff scheduling, patient scheduling, record-keeping, etc.)
- E) Operation and maintenance of MR imaging equipment.
- F) The compliance of the technical and ancillary staff to the Standards outlined within this document.
- G) Working with the Clinical MR Director, medical staff and technical staff to ensure quality patient care.
- H) Technical training.

1.3.3 Continuing Education (CE) Requirements:

- A) The Technical Director must document at least 15 hours of Category I AMA or RCEEM approved MR related continuing education over a period of three (3) years.
- B) Yearly accumulated continuing education must be kept on file and available to ICAMRL when requested.

Comment: If the Technical Director has successfully acquired an appropriate MR credential within the past three (3) years, the CE requirement will be considered fulfilled.

STANDARD – Technical Staff

1.4 The technical staff must have appropriate training, technical certification and/or documented experience in the field of magnetic resonance imaging.

1.4.1 Technical Staff Required Training and Experience:

All members of the technical staff must meet **ONE OR MORE** of the following criteria:

- A) American Registry of Radiologic Technologists (ARRT) or the Canadian Association of Medical Radiation Technologists (CAMRT) certification in magnetic resonance imaging (RT (MR)).

OR

B) Successful completion of a magnetic resonance training program, which includes verified didactic and supervised clinical experience in magnetic resonance imaging. These programs should be accredited by the Joint Review Committee on Education in Radiologic Technology (JRCERT) or accredited by the Canadian Medical Association Committee on Conjoint Accreditation (CMA-CCA).

OR

C) Completion of 12 months full time (35 hours/week) post graduate clinical magnetic resonance imaging experience plus **ONE** of the following:

1. An appropriate credential in another medical imaging field (i.e.: CNMT, RDMS, RT).
2. Certification by the American Registry of Magnetic Resonance Imaging Technologists (ARMRIT®).
3. Completion of a formal two year program or equivalent in another medical imaging profession. Such as B.
4. Completion of a bachelor's degree in another medical imaging specialty.

OR

D) For personnel operating scanners capable of performing only peripheral joint imaging, **ALL** of the following criteria must be met:

1. Medical practitioner state license or state certification acceptable to ICAMRL (i.e.: MA, basic operator, LMRT, RE).
2. Certificate from MR manufacturer documenting a minimum of 56 hours of uninterrupted (but not necessarily contiguous) training. No more than 16 of the 56 hours may be acquired through self study that includes successful completion of a written examination. The manufacturers training on the device should include:
 - a. MR Safety
 - b. basic anatomy
 - c. basic MR physics
 - d. slice orientation
 - e. sequence and protocol development
3. Three (3) months clinical experience performing examinations.
4. Performance of at least 150 MR examinations.

OR

E) For personnel operating a magnetic resonance imaging scanner for a minimum of five years full time, without meeting any of the above required training and experience criteria (A, B, C or D), the following must be provided:

1. A letter from the current medical director and technical director verifying the training, experience and competency for the last five years specific to the testing area for which they are applying.
2. If less than five years at the current position, a letter from all previous medical and technical directors for the last five years verifying training, experience and competency specific to the testing area for which they are applying.

1.4.2 Technical Staff Responsibilities:

- A) Reports to the Technical Director.
- B) Assumes the responsibilities specified by the Technical Director and, in general, is responsible for the performance of clinical examinations and other tasks assigned.

1.4.3 Continue Education (CE) Requirements

- A) The technical staff must document at least 15 hours of Category I AMA or RCEEM approved MR related continuing education over a period of three (3) years.
- B) Yearly accumulated continuing education must be kept on file and available to ICAMRL when requested.

Comment: If the technical staff member has successfully acquired an appropriate MR credential within the past three (3) years, the CE requirement will be considered fulfilled.

SECTION 2

Support Services

STANDARD – Support Services

2.1 Ancillary personnel (i.e.: clerical, nursing, transport, etc.), if necessary for safe and efficient patient care, shall be provided.

2.1.1 Clerical and Administrative Support:

Clerical and administrative support is sufficient to ensure efficient operation and record keeping.

2.1.2 Supervision:

The Clinical MR Director must ensure that support services are appropriate and in the best interest of patient care. The Clinical MR Director may supervise the entire operation of the laboratory or may delegate specific operations to qualified laboratory staff members and the Technical Director.

SECTION 3

Physical Facilities

STANDARD – Examination Areas

3.1 Examinations must be performed in a setting providing reasonable patient comfort and privacy.

- 3.1.1** The space required by a magnetic resonance system varies depending on the magnetic field strength and size of the system.
- 3.1.2** The patient screening area and any other public passageways or areas should be placed beyond the magnetic fringe field (5.0 Gauss).
- 3.1.3** Warning signs must be posted, as appropriate, to ensure that unauthorized personnel are not entering the magnet area.

STANDARD – Interpretation Space

3.2 Adequate space, apart from patient care areas, must be provided for the interpretation of examination results and preparation of reports.

STANDARD – Storage Space

3.3 Adequate designated space must be provided for the convenient storage of supplies, records and reports.

SECTION 4

Examination Interpretation, Reports and Records

STANDARD – Examination

4.1 Magnetic resonance examinations are interpreted and reported by the Clinical MR Director or by a member of the medical staff of the magnetic resonance laboratory.

Comment: The report represents the final interpretation of the magnetic resonance examination and is part of the patient’s legal medical record. As such, the report must be in the form of a document that is retrievable and/or reproducible for review by health care personnel. In general, the report must contain sufficient information so that any health care professional has access to adequate information regarding the indications for the examination, the type of examination performed and the results of the diagnostic study.

- 4.1.1** All reporting must be standardized in the laboratory. All physicians interpreting magnetic resonance examinations in the laboratory must agree on a standardized report format.
- 4.1.2** All of the MR examination images must be reviewed by the interpreting member of the medical staff (or the Clinical MR Director).
- 4.1.3** Identification of the technologist performing the magnetic resonance examination should be documented.
- 4.1.4** Final interpretations must be verified and, either manually or electronically, signed by the Clinical MR Director or a member of the medical staff of the laboratory.
- 4.1.5** A permanent record of the interpretation must be made and retained in accordance with applicable standards for medical records.
- 4.1.6** The report must accurately reflect the content and results of the study.
- 4.1.7** The contents of the report must include, but are not limited to:
 - 4.1.7.1** The date of the examination.
 - 4.1.7.2** The clinical indications leading to the performance of the examination.
 - 4.1.7.3** An adequate description of the test performed. The description must include the name of the examination and the pulse sequences used in the examination.

- 4.1.7.4 An overview of the results of the examination including pertinent positive and negative findings. Where appropriate, this must include localization and quantification of abnormal findings.
 - 4.1.7.5 The reasons for limited examinations.
 - 4.1.7.6 A summary of the test findings.
 - 4.1.7.7 Comparison with previous related studies, where available.
 - 4.1.7.8 Signature and/or electronic verification.
 - 4.1.7.9 Date of signature and/or verification.
 - 4.1.7.10 The amount and type of contrast used in the examination.
- 4.1.8** If preliminary reports are issued, their preliminary nature must be clearly indicated. Verified final reports must be provided within a reasonable interval after posting of preliminary results. A mechanism for communicating any significant changes must be defined for those situations in which the final interpretation differs substantially from the preliminary report.
- 4.1.9** A mechanism must be defined whereby the results of examinations which demonstrate urgent or life-threatening findings are communicated to the appropriate health care professionals immediately.
- 4.1.10** The physician's final interpretation must be available within two (2) working days of the examination date and the final, verified, signed report sent to the referring physician within four (4) working days, unless awaiting additional clinical information.

Comment: An interpretation can be in the form of paper, digital storage or voice system. The final, verified, signed report must be available in a timely fashion, generally within four (4) working days.

STANDARD – Records

4.2 Provisions exist for the generation and retention of examination records of all studies performed which will permit evaluation of annual procedure volumes.

- 4.2.1** Essential portions of all examinations must be documented and retained on appropriate media. This may include hard copy (printed, photographic and/or digital media) cine images and graphics, and, if applicable, printed documentation of measurements.
- 4.2.2** All examination recordings including images and a signed, dated final report, as outlined in Sections 4.1 and 4.2, must be maintained in an accessible fashion for a minimum of the applicable legal time requirements for medical record-keeping.

SECTION 5

Safety and Patient Confidentiality

STANDARD – Safety

- 5.1 Written policies and procedures must exist to ensure patient and personnel safety. Safety policies shall be written, enforced, reviewed and documented annually by the Clinical MR Director. These guidelines should take into consideration screening procedures for patients and other individuals that enter the MR environment and include considerations for potential hazards (i.e.: from magnetic field interactions, heating and induced electrical currents) posed by implanted objects and materials within patients or individuals in the MR environment. Additionally, a policy must exist to control access to the MR environment to prevent unscreened patients or individuals (with contraindicated implants, devices or objects) from entering the MR environment.**
- 5.1.1** A mechanism must be in place to identify those patients/staff members/visitors at high risk for untoward effects or complications from entering the magnetic resonance environment (e.g.: individuals or patients with cardiac pacemakers, implantable cardioverter defibrillators and certain ferromagnetic implants).
 - 5.1.2** A method for continuous visual, verbal and/or physiologic monitoring of the patient during the examination must be present.
 - 5.1.3** A procedure must exist for identification of a patient or individual (i.e.: visitor, staff member) who suffers untoward effects or complications from the MR examination or exposure to the MR environment and a permanent record of such must be maintained.
 - 5.1.4** Procedures and policies must exist to control the spread of infectious diseases and blood borne pathogens to patients and personnel. The policy should include equipment cleaning, hand washing, glove use and universal precautions that are implemented in the laboratory.
 - 5.1.5** Appropriate (i.e.: MR safe and MR compatible) equipment, supplies and licensed and/or qualified and trained personnel (i.e. BLS or ACLS certified) must be available to manage medical emergencies and handle critically ill or high-risk patients.
 - 5.1.6** The administration of contrast agents, medication and/or sedation must be performed by licensed or qualified trained personnel, under the direct supervision of a licensed physician or in compliance with federal, state or local laws.

5.1.7 The laboratory must meet the standards set forth by the Occupational Safety and Health Administration (OSHA) and by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), where applicable.

5.2 Written policies and procedures exist to ensure safety within the MR environment.

5.2.1 It is mandatory that all individuals who may potentially enter the magnetic resonance environment be aware of the appropriate safeguards necessary with regard to the force of the magnet on ferromagnetic objects (i.e.: oxygen tanks, tools, etc.) A written policy must be established and used by the magnetic resonance laboratory.

5.2.2 If gradient noise is produced by the MR system, protective ear devices must be available to every patient and all other individuals present in the scan room during the procedure.

5.2.3 To avoid radio frequency burns caused by the combination of electrical and magnetic fields, proper patient setup is necessary when utilizing electrical conductors such as RF coils, ECG leads, monitoring equipment, etc.

5.2.4 In the event of a MR procedure-related emergency (e.g.: respiratory arrest, cardiac arrest, severe agent reaction, quench, etc.), there must be a written policy for patient management that includes rapid recognition, response and handling of the emergency situation. Notably, in the event of a quench, the patient must be removed from the scan room as quickly as possible to avoid risks such as asphyxiation, frostbite and ruptured eardrums. For other emergencies, proper MR safe and compatible equipment and supplies (e.g.: defibrillator, oxygen tank, suction, monitoring device, etc.) must be used, as needed.

5.2.5 MR safety policies in a cardiovascular laboratory must include a detailed description of graded protocols and/or infusion protocols used; timing of assessing symptoms, heart rate, blood pressure and electrocardiographic tracings; exercise testing end points; pharmaceutical injection criteria; post stress monitoring and treatment of common adverse effects.

5.2.6 MR safety policies must address possible contraindications to MR procedures that include the presence of electrical, mechanical or magnetically-activated devices including cardiac pacemakers, implantable cardioverter defibrillators, certain neurostimulators, certain cochlear implants and other similar devices that may malfunction or have altered operation under conditions used for MR procedures.

- 5.2.7** MR safety policies must address possible contraindications to MR procedures that include implants made from ferromagnetic or electrically conductive materials such as certain aneurysm clips, certain stents, certain ocular implants, certain otologic implants, certain cardiovascular catheters and other similar devices that may be moved, dislodged or heat excessively during the MR procedures.
- 5.2.8** MR safety procedures must address possible contraindications that include Nephrogenic Systemic Fibrosis (NSF) and contrast material sensitivity, if used, and allergies to medications. Patient management must address these possible contraindications prior to the MR procedure and they should be listed on the screening questionnaire. Documentation of contrast reaction should include contrast type, amount, lot number, and should be communicated to the manufacturer.
- 5.2.9** A written policy must be established to educate, train and screen all MR laboratory staff members and personnel that may be required to enter the MR environment.

STANDARD - Patient Confidentiality

- 5.3** All laboratory personnel must ascribe to professional principles of patient confidentiality as legally required by federal, state, local or institutional policy or regulation.

SECTION 6 Instrumentation

STANDARD - Instrumentation Requirements

- 6.1** An FDA approved magnetic resonance imaging device must be available for MR imaging.
- 6.2** The MR equipment specifications and performance must meet all state, federal and local requirements.

The requirements may include maximum rate of change of magnetic field strength (dB/dt), specifications of maximum static magnetic field strength, maximum auditory noise levels and maximum radiofrequency power deposition (specific absorption rate).

SECTION 7

Quality Assurance

STANDARD – Quality Assurance (QA)

Quality assurance procedures must be designed to provide a standard of measurement for system and laboratory performance and the documentation of any variance thereof. A Quality Assurance Committee should be appointed as an oversight to these procedures.

7.1 There must be a quality assurance program in the MR laboratory.

- 7.1.1** The Quality Assurance Committee should, at minimum, consist of the Technical Director, Clinical MR Director, service engineer and/or site-appointed medical physicist or qualified expert.
- 7.1.2** Quality control tests, standards, thresholds, timelines and results should be reviewed and discussed on a regular basis by the Quality Assurance Committee.
- 7.1.3** Quality control tests should be performed according to the manufacturer's performance standards by the MR technologist, service engineer, medical physicist, or qualified expert.
- 7.1.4** Quality assurance documentation (policies, reports, records, etc.) must be maintained at the MR laboratory and made available to all personnel.

7.2 The quality assurance program must consist of MR system installation acceptance testing and major upgrade acceptance testing.

- 7.2.1** Acceptance testing must be performed as part of the system installation process and after major upgrades, prior to patient clinical use.
- 7.2.2** The manufacturer's representative, service engineer, or the MR site-appointed medical physicist, or qualified expert should perform the acceptance testing.
- 7.2.3** The system parameters should be compared to the manufacturer's system specifications or industry standards, and reviewed by the Quality Assurance Committee. Acceptance testing should include, but is not limited to:
 - 7.2.3.1** Signal- to- noise ratio (SNR) evaluation for all coils present in laboratory
 - 7.2.3.2** Gradient and RF calibration
 - 7.2.3.3** Magnetic field homogeneity

- 7.2.3.4 Image quality
- 7.2.3.5 Slice thickness
- 7.2.3.6 Slice accuracy
- 7.2.3.7 Spatial resolution
- 7.2.3.8 Artifact assessment
- 7.2.3.9 Monitor/Processor QC

7.2.4 A written report of the acceptance tests must be maintained at the MR laboratory. The report must include the QC tests performed, the results as compared to manufacturer's or industry guidelines, recommendations to the lab (if any) and must be signed and dated by the person performing the tests. The tests performed must also be archived on the system or a separate device for future reference.

7.3 Routine (daily and periodic) QC tests are to be conducted according to performance measurements as outlined by the manufacturer. The daily quality control assessments should consist of, but are not limited to:

7.3.1 Signal-to-noise ratio (SNR)

7.3.2 Artifact assessment

7.3.3 Proper function of audible and visual patient safety equipment

7.3.4 Image uniformity

7.3.5 Center frequency (CF) tests.

7.3.5.1 The SNR and CF tests must be acquired using the manufacturer's suggested testing phantom. These may be done simultaneously and performed and recorded by the MR technologist.

7.3.5.2 Deviations from established thresholds must be documented and corrective action taken where appropriate.

7.4 Periodic preventive maintenance (PM) service is recommended for each MR scanner at the laboratory.

7.4.1 A manufacturer's service engineer and/or the MR site's representative, who has been properly trained to maintain the equipment, must perform the preventive maintenance.

7.4.1.1 The PM quality control assessment should include, but is not limited to:

7.4.1.2 Signal to noise (SNR) ratio

- 7.4.1.3 Magnetic field homogeneity
- 7.4.1.4 RF of calibration for all coils
- 7.4.1.5 Spatial resolution tests
- 7.4.1.6 Artifact assessment

7.4.2 General equipment inspection (e.g.: RF coil cables, RF shielding, scan table manipulation, etc.) should also be included in the PM.

7.4.3 A complete report of PM, quality control tests and service records must be maintained at the MR laboratory. The reports must be signed and dated by the person(s) performing the tests.

7.5 Ancillary equipment used in the MR procedures must be a part of the quality assurance program.

7.5.1 The Quality Assurance Committee should determine the appropriate personnel and timeline for the QA evaluation of ancillary MR equipment. This includes monitoring equipment, injectors, cameras/processors, workstations, PACS, etc.

7.5.2 A complete service record for all ancillary MR equipment must be maintained at the MR laboratory. The reports must be signed and dated by the person(s) performing the tests.

SECTION 8

Multiple Sites and Mobile Services

STANDARD – Multiple Sites

8.1 When testing is performed at more than one physical facility, the laboratory may be eligible to apply for a single accreditation as a multiple site laboratory if the following criteria are met:

- 8.1.1** All technologists performing any MR procedures at any of the sites must be included in the application for accreditation.
- 8.1.2** All physicians interpreting any MR procedures at any of the sites must be included in the application for accreditation in the Organization section.
- 8.1.3** All sites must have the same Medical Director and Technical Director.
- 8.1.4** All physicians and technologists must participate together in quality assurance and education programs, including in-house conferences.
- 8.1.5** All sites utilize similar protocols.
- 8.1.6** Technical and interpretive quality assessment, as outlined in Part II, Section 4, must be evaluated for all MR testing sites.

STANDARD – Mobile Service

8.2 A mobile service is comprised of one or more units (technologists and equipment) that provide MR testing services at one or more locations if all the following criteria are met:

- 8.2.1** All magnetic resonance procedures that are performed at the mobile locations must be interpreted by the physicians included in the application for accreditation.
- 8.2.2** All technologists performing any magnetic resonance procedures at the mobile locations must be included in the application for accreditation.
- 8.2.3** The entire mobile service must share the same Medical Director and Technical Director.
- 8.2.4** All physicians and technologists must participate together in quality assurance and education programs, including in-house conferences.
- 8.2.5** The entire mobile service must utilize similar protocols.

PART II

MAGNETIC RESONANCE TESTING

SECTION 1

Indications

STANDARD – Indications

1.1 MR testing is performed for appropriate indications.

Comment: Accepted indications will vary depending on clinical considerations that are provided by the referring healthcare provider and can only be assessed at the time of the examination. Appropriate indications include evaluation of patients with suspected pathology.

1.2 Indications for performance of a comprehensive or limited examination must be included.

1.2.1 *Body Imaging*

MR body imaging includes examinations of the chest, neck, abdomen, pelvis, breast and vascular structures and is a technological challenge due to physiological motion artifacts. However, since the emergence of fast scan and motion compensation techniques, MR examinations of the body have become more practical. The ability to acquire scan data during a breath hold has greatly improved spatial resolution of structures in areas previously degraded by motion artifacts. In addition, the ability of MR to demonstrate anatomy and pathology in multiple planes, and the improved conspicuity provided by chemical shift imaging, has made MR an important tool for imaging of body structures. In many instances, MR has become the imaging method of choice for demonstrating organ function and morphology, and the detection, differentiation and staging of benign and malignant lesions.

1.2.2 *Cardiovascular Imaging*

Cardiovascular MRI involves imaging of the heart and central vascular system using single-planar and multi-planar acquisitions. Included in disorders of the heart are disorders of the myocardium, heart chambers, valves, coronary blood vessels, blood pathways and the pericardium. Included in disorders of the central vascular system are abnormalities of the aorta (ascending, arch, thoracic descending, abdominal descending and the iliac bifurcation), the pulmonary vasculature and the thoracic venous system.

1.2.3 *Musculoskeletal Imaging*

MRI is a valuable tool in the visualization, detection and staging of a wide range of musculoskeletal disorders. These include degenerative, infectious, neoplastic and traumatic evaluation of articular structures, non-articular soft tissues, bones and bone marrow.

1.2.4 *Neurological Imaging*

Neurological MRI involves imaging of the brain and spine using both 2D and 3D acquisitions and neurophysiological techniques. Included in disorders of the brain are conditions of the skull base, intra and extra cranial vasculature, the cranial nerves as well as other structures. Included in disorders of the spine are conditions involving the cervical, thoracic lumbar and sacral regions.

1.3 Verification of the indication: A process must be in place in the laboratory for obtaining and recording the indication. Before a study is performed, the indication must be verified and any additional information needed to direct the examination must be obtained.

SECTION 2

Techniques

STANDARD – Techniques

2.1 Examination performance should include proper technique (e.g. pulse sequences, coil selection, and positioning).

2.1.1 Elements of study performance include, but are not limited to:

2.1.1.1 Proper coil selection and patient positioning.

2.1.1.2 Appropriate protocol selection based on the clinical indication and patient history.

2.1.1.3 Optimization of pulse sequence(s) and equipment settings that are necessary to achieve a diagnostic study and answer the clinical indication.

2.1.1.4 Utilization of appropriate software, workstations, techniques, and measurements to aid in the diagnosis.

2.2 A protocol that defines the components of the standard examination must be in place and should be modified to answer the clinical indication.

2.3 The laboratory must have a complete, written description of each protocol that is being utilized for each MR examination and the protocol(s) should include:

2.3.1 The indication for the study.

2.3.2 Anatomical region(s) to be imaged.

2.3.3 Utilization of the correct scanner for the given indication.

2.3.4 Clear criteria for deviating from protocols.

2.3.5 Adherence to established practice guidelines.

2.3.6 All orientations/views that will be displayed.

2.3.7 Scanner settings or acquisition parameters to include:

2.3.7.1 Pulse sequence parameters:

2.3.7.1.1 Name of pulse sequence

2.3.7.1.2 TR/TE

2.3.7.1.3 FA

- 2.3.7.1.4 Matrix
- 2.3.7.1.5 FOV
- 2.3.7.1.6 Slice thickness
- 2.3.7.1.7 Interval or slice gap

2.3.8 Filming instructions to include window level and contrast settings, views, format, and magnification.

2.3.9 Indication for IV contrast to include: type of contrast, amount, injection rate and scan delay protocol.

2.3.10 Other medications used including dose and route of administration.

2.3.11 Instruction on data archiving and transmission of images including what files are to be stored/transmitted.

SECTION 3

Procedure Volumes

STANDARD – Procedure Volumes

3.1 The annual procedure volume must be sufficient to maintain proficiency in examination performance and interpretation:

Comment: In general, a laboratory should perform a minimum of 300 magnetic resonance examinations annually. In some settings, laboratories may perform quality examinations with lower volumes.

SECTION 4

Technical and Interpretive Quality Assessment

STANDARD – Technical/Administrative Quality Assessment

4.1 Under the supervision of the Technical Director and the Clinical MR Director, the laboratory must have a defined quality assessment program that evaluates the ongoing technical and administrative quality of the imaging procedures performed in the laboratory:

4.1.1 This program should have predefined indicators of quality and predefined thresholds that indicate the need for corrective action. The laboratory should maintain reports of quality assessment evaluations and corrective actions taken.

4.1.1.1 Technical indicators may include, but are not limited to: adverse effects, poor quality of examinations, poor reproducibility of computer processing, etc.

4.1.1.2 Administrative indicators may include, but are not limited to: backlog for scheduled examinations, late reporting, and long patient waiting times.

4.1.2 Thresholds are determined for each indicator.

4.1.3 Corrective actions should be taken to improve the operation of the laboratory.

4.2 Appropriate Use Criteria (AUC)

4.2.1 As part of the ongoing quality improvement program, facilities providing magnetic resonance imaging should incorporate the measurement of the appropriate use of this diagnostic imaging examination based on criteria published and/or endorsed by professional medical organization(s).

4.2.2 Overall results should be documented. The percentage of appropriate, inappropriate and uncertain indications for testing should be measured.

4.2.3 A program for education and reporting should be developed and may include but is not limited to:

4.2.3.1 Patterns of adherence to AUC.

4.2.3.2 Baseline rates of adherence.

- 4.2.3.3 **Goals for improvement of adherence to appropriate use criteria.**
- 4.2.3.4 **Measurement of improvement rate.**
- 4.2.3.5 **Confidential comparison reports on patterns of adherence in aggregate by ordering physician, ordering practice, and interpreting practice.**

STANDARD – Interpretive Quality Assessment

4.3 Under the supervision of the Clinical MR Director, the laboratory must have a defined quality assessment program that evaluates the ongoing quality of the interpretation of the MR examinations.

This program should have predefined indicators of quality and predefined thresholds that indicate the need for corrective action. The Clinical MR Director should maintain reports, as necessary, of quality assessment evaluations and document, if applicable, corrective measures taken.

- 4.3.1 A quality assessment program may consist of, but not be limited to:
 - 4.3.1.1 Correlation of interpretation of studies with patient outcome, such as results of surgery, biopsy, autopsy, etc.
 - 4.3.1.2 Reproducibility of interpretation with previous interpretation, or with interpretation of the same study by other qualified interpreting physicians.