

**Canadian Association of Medical Radiation Technologists**

**COMPETENCY PROFILE**

**MAGNETIC RESONANCE**

**January 2014**

Prepared by the Magnetic Resonance Competency Profile Task Group  
© CANADIAN ASSOCIATION OF MEDICAL RADIATION TECHNOLOGISTS  
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# Entry-Level Competency Profiles for Medical Radiation Technologists

## MAGNETIC RESONANCE IMAGING

### Principles and Definitions

The competency profiles describe the practice requirements of Medical Radiation Technologists (MRTs) at entry-level<sup>1</sup>, in order to provide safe, effective and ethical patient care in a variety of work environments. The profiles will be of value to users both within and outside the profession, however their primary uses are:

- To develop a blueprint for the CAMRT Certification Examinations, and
- To provide a guide for the curriculum of accredited education programs.

The competency profile for each of the four MRT disciplines is distinct, although there is a common framework and some common content.

Each competency profile consists of a listing of competencies, defined as follows:

- *A competency is a practice task that can be performed with entry-level proficiency.*

Entry-level proficiency is characterized as follows:

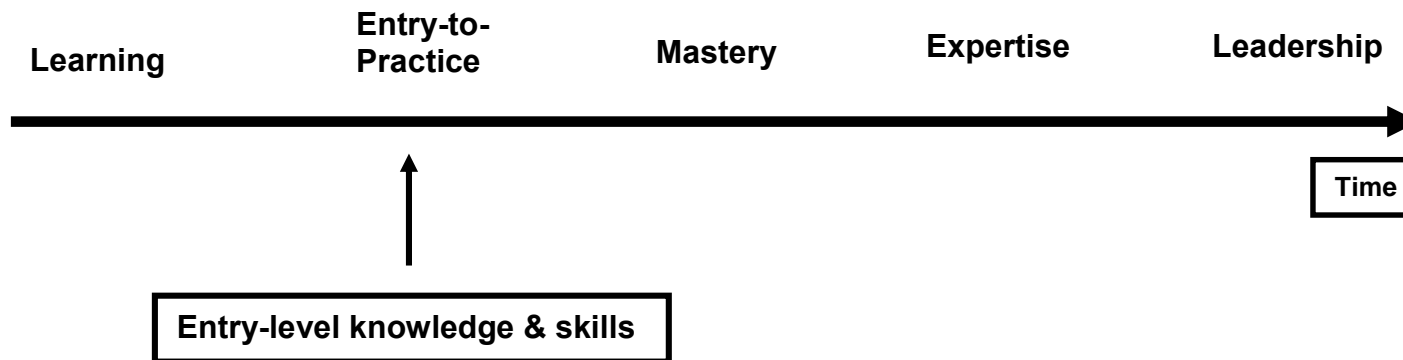
- *When presented with routine situations, the entry-level MRT performs relevant competencies in a manner consistent with generally accepted standards in the profession, independently, and within a reasonable timeframe. The entry-level MRT anticipates what outcomes to expect in a given situation, and responds appropriately, selecting and performing competencies in an informed manner.*
- *The entry-level MRT recognizes unusual, difficult to resolve and complex situations which may be beyond her / his capacity. The entry-level MRT takes appropriate steps to address these situations, which may include consulting with others, seeking supervision or mentorship, reviewing literature or documentation, or referring the situation to a more experienced MRT.*

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<sup>1</sup> *Entry-level* means initial entry into the profession.

The competency profile for each discipline establishes a minimum standard for entry to the profession, and a foundation upon which to build:

- Attainment at entry-to-practice of additional competencies, and higher levels of proficiency, is encouraged.
- Following entry-to-practice, the MRT's competencies and levels of proficiency are expected to develop further, based upon experience and ongoing learning. CAMRT strongly advocates continuing professional development. The figure below illustrates in general terms how workplace performance may evolve over time:



## Structural Framework

The format of the competency profiles is based upon modules, each module representing a general area of practice. Within each module, related competencies are clustered together in sections.

In situations where a given competency applies to a series of similar items (such as a list of equipment, a list of treatment procedures, or a list of pathologies) appendices are used to avoid repetition and to make the profiles more manageable. The items listed in an appendix have no significance other than in the context of the competency or competencies to which they apply.

The general content of the modules, sections and appendices is shown below.

Magnetic Resonance Imaging		Nuclear Medicine Technology		Radiation Therapy		Radiological Technology	
Module A Professional Practice		Module A Professional Practice		Module A Professional Practice		Module A Professional Practice	
A.1	Legal and Ethical Requirements	A.1	Legal and Ethical Requirements	A.1	Legal and Ethical Requirements	A.1	Legal and Ethical Requirements
A.2	Professional Behaviour	A.2	Professional Behaviour	A.2	Professional Behaviour	A.2	Professional Behaviour
A.3	Communication	A.3	Communication	A.3	Communication	A.3	Communication
A.4	Decision Making	A.4	Decision Making	A.4	Decision Making	A.4	Decision Making
A.5	Interprofessional Practice	A.5	Interprofessional Practice	A.5	Interprofessional Practice	A.5	Interprofessional Practice
A.6	Use of Resources	A.6	Use of Resources	A.6	Use of Resources	A.6	Use of Resources
A.7	Quality Assurance	A.7	Quality Assurance	A.7	Quality Assurance	A.7	Quality Assurance
A.8	Research	A.8	Research	A.8	Research	A.8	Research
Module B Patient Management		Module B Patient Management		Module B Patient Management		Module B Patient Management	
B.1	Patient Interactions	B.1	Patient Interactions	B.1	Patient Interactions	B.1	Patient Interactions
B.2	Patient Safety	B.2	Patient Safety	B.2	Patient Safety	B.2	Patient Safety

Magnetic Resonance Imaging		Nuclear Medicine Technology		Radiation Therapy		Radiological Technology	
B.3	Patient Assessment and Care	B.3	Patient Assessment and Care	B.3	Patient Assessment and Care	B.3	Patient Assessment and Care
Module C Health and Safety		Module C Health and Safety		Module C Health and Safety		Module C Health and Safety	
C.1	Infection Control and Materials Handling	C.1	Infection Control and Materials Handling	C.1	Infection Control and Materials Handling	C.1	Infection Control and Materials Handling
C.2	Self-Protection	C.2	Self-Protection	C.2	Self-Protection	C.2	Self-Protection
C.3	MR Screening	C.3	Radiation Safety Practices	C.3	Radiation Safety Practices	C.3	Radiation Safety Practices
C.4	MR Bioeffects	C.4	Radiation Safety Education	C.4	Radiation Safety Education	C.4	Radiation Safety Education
C.5	Emergency Procedures	C.5	Emergency Procedures	C.5	Emergency Procedures	C.5	Emergency Procedures
Module D Operation of Equipment		Module D Operation of Equipment		Module D Operation of Equipment		Module D Operation of Equipment	
D.1	Principles of MRI equipment	D.1	Physics and Instrumentation	D.1	Principles of Radiation Therapy Equipment	D.1	Principles of Radiological Technology Equipment
D.2	Equipment Quality Control	D.2	Equipment Operation	D.2	Equipment Operation	D.2	Image Acquisition and Management
D.3	Image Acquisition	D.3	Equipment Quality Control	D.3	Equipment Quality Control	D.3	Equipment Quality Control
D.4	Image Quality	D.4	Image and Data Quality			D.4	Image Quality
Module E Procedure Management		Module E Procedure Management		Module E Procedure Management		Module E Procedure Management	
E.1	Clinical Principles	E.1	Radiopharmacy and Laboratory Procedures	E.1	Simulation	E.1	Clinical Principles
E.2	Imaging Procedures	E.1.1	Radiopharmacy Storage	E.2	Accessory Devices	E.2	Imaging Procedures
E.3	Pharmaceutical Administration	E.1.2	Radionuclide Generator	E.3	Dosimetry	E.3	Pharmaceutical Administration
		E.1.3	Radiopharmaceutical Preparation	E.4	Treatment		
		E.1.4	Radiopharmaceutical Quality Control	E.4.1	Clinical Principles		
		E.1.5	Radiopharmaceutical Dispensing	E.4.2	Treatment Delivery		

<b>Magnetic Resonance Imaging</b>		<b>Nuclear Medicine Technology</b>		<b>Radiation Therapy</b>		<b>Radiological Technology</b>	
		E.1.6	General Laboratory Procedures	E.5	Patient Care		
		E.2	Clinical Procedures				
		E.2.1	Clinical Principles				
		E.2.2	Diagnostic Procedures				
		E.2.3	Therapeutic Procedures				
		E.2.4	Pharmaceutical Administration				
		E.2.5	ECG Procedures				
<b>Appendix 1 Patient interactions</b>		<b>Appendix 1 Patient interactions</b>		<b>Appendix 1 Patient interactions</b>		<b>Appendix 1 Patient interactions</b>	
<b>Appendix 2 Common Pathologies and Anomalies</b>		<b>Appendix 2 Equipment</b>		<b>Appendix 2 Malignant Tumours</b>		<b>Appendix 2 Imaging Systems</b>	
<b>Appendix 3 Imaging Procedures</b>		<b>Appendix 3 Body Systems and Pathologies</b>		<b>Appendix 3 Non-Malignant and Benign Conditions</b>		<b>Appendix 3 Pathology</b>	
<b>Appendix 4 Pharmaceuticals</b>		<b>Appendix 4 Pharmacologic and Dietary Agents</b>		<b>Appendix 4 Clinical Oncology</b>		<b>Appendix 4 Imaging Procedures</b>	
		<b>Appendix 5 Procedures</b>				<b>Appendix 5 Accessory Equipment</b>	
						<b>Appendix 6 Pharmaceuticals</b>	

## Relationship between the Competency Profiles and Education Programs

Education programs in Medical Radiation Technology are accredited through the Canadian Medical Association (CMA) Conjoint Accreditation Service. CMA accepts the competency profiles that have been approved by the professional association and regulators and requires that accredited programs develop curricula to ensure that their students demonstrate proficiency in all competencies prior to graduation.

The profiles specify an Assessment Environment<sup>2</sup> for each competency, which identifies the educational setting in which students must be assessed for proficiency prior to program graduation. This provides guidance for the program and for accreditation surveys. The following Assessment Environments are used:

Assessment Environment	Definition	Criterion for Student Success
Academic, A	Academic education takes place in a classroom or through guided independent study, and involves cognitive and affective learning that enables students to perform competencies.	Assessment by means of written and / or oral examinations designed to determine performance consistent with the definition of entry-level proficiency.
Simulation, S	Simulation involves cognitive, affective and psychomotor learning in a setting that simulates a practice activity. It may include learning through role-play, or through uses of technology or equipment where a mannequin, model or other object replaces a human patient.	Repeated and reliable performance consistent with the definition of entry-level proficiency.
Clinical, C	Clinical education involves cognitive, affective and psychomotor learning where students work directly with a patient in a setting designed to provide patient care. Students are supervised throughout their clinical education, in a manner that facilitates their development of independent clinical abilities while ensuring that patient care is safe, effective and ethical.	Repeated and reliable performance consistent with the definition of entry-level proficiency, involving a variety of clinical situations.

Learning activities within an education program are commonly structured to move sequentially through these progressively more challenging Assessment Environments<sup>3</sup>. For example patient care skills, which may in the final instance require

<sup>2</sup> Assessment Environments were referred to as Performance Environments in previous versions of the competency profiles.

<sup>3</sup> The order of increasing challenge of Assessment Environments is considered to be Academic<Simulation<Clinical.



demonstration clinically, will have been first introduced in an academic setting, and later practiced in simulation, before finally being assessed in the clinical environment. For simplicity, the competency profiles designate only the most challenging Assessment Environment required for each competency.

Education programs may at their discretion assess student proficiency in a more challenging Assessment Environment than specified by the competency profile.

In the event that a program cannot meet the specified Assessment Environment in a particular competency, the program must provide a rationale for accreditation purposes.

### **Relationship between the Competency Profiles and the CAMRT Certification Examinations**

The CAMRT Certification Examinations are written examinations in a multiple-choice format, intended to assess cognitive and affective learning related to performance of the competencies. Competencies that may be assessed in the Certification Examination are designated Examinable Competencies, and identified as such in the profile.

CAMRT has developed Examination Blueprints which describe how the content of the examinations are derived from the Examinable Competencies. Each Examinable Competency is assigned a Weighting<sup>4</sup>, referred to as *High, Medium or Low*, and derived from frequency-of-use data provided by practitioners. The Weighting guides the structure of the Blueprint and the emphasis for examination items.

In provinces that regulate the practice of MRTs, regulatory authorities (with the exception of Quebec) require CAMRT Certification for registration purposes. However, since the Certification Examinations are national in scope, they do not test provincially-unique requirements.

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<sup>4</sup> Weighting was referred to as Competency Level in previous versions of the competency profiles.

## **Development and Updating of the Competency Profiles**

Re-validation of the competency profiles, including a review of Assessment Environments, Examinable Competencies and Weightings, takes place approximately every five years. In general this involves an initial critical review by an expert committee, followed by consultation with regulators, education programs, practitioners and service department heads / managers.

Due to rapid changes in technology and practice certain portions of the profile may be validated more frequently to ensure that the profiles accurately reflect workplace needs.

Updated profiles are subject to approval by the CAMRT Board of Directors.

### **Additional Notes**

In order to fully understand and utilize the competency profiles, it is important to be aware of the following principles:

1. The competencies in each profile are interdependent, each competency informing and qualifying other competencies. Competencies are not intended to be applied in isolation.
2. The competencies should be considered as an array of abilities which the MRT brings to the workplace. The MRT performs appropriate competencies in a manner consistent with the situation at hand, while complying with organizational directives. The competencies are not intended to be applied in the sequence listed, nor should they be considered a protocol.
3. Performance of a competency requires the application of learning which may involve the cognitive domain (knowledge and thinking skills), the affective domain (attitudes and values) and the psychomotor domain (manual skills).
4. The Assessment Environment assigned to each competency denotes the setting in which proficiency is assessed in education programs<sup>5</sup>. Further orientation or guidance may be required in the workplace.

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<sup>5</sup> In an education program it may not be feasible or desirable to assess the proficiency of every competency in a clinical Assessment Environment.

5. The competency profiles define the key learning outcomes that should be the product of accredited education programs. They do not constitute a complete educational curriculum nor do they define a learning process; these should be developed by appropriately qualified program personnel.
6. The profile is intended to set a meaningful national standard for each discipline without being overly prescriptive. It provides a guide for curriculum development. Curriculum should incorporate the expectations stated in the definition of entry-level proficiency.

<b>Module A Professional Practice</b>		<b>AE</b>	<b>EC wt</b>
<b>A.1</b>	<b>Legal and Ethical Requirements</b>		
A.1.1	Practice within provincial scope of practice.	<b>C</b>	-
A.1.2	Comply with federal and provincial legislation and regulations affecting the practice of medical radiation technology.	<b>C</b>	-
A.1.3	Comply with requirements of provincial regulatory body, including applicable Standards of Practice and sexual abuse prevention guidelines.	<b>A</b>	-
A.1.4	Practice within provincial regulatory or national association code of ethics, as relevant.	<b>C</b>	-
A.1.5	Practice in a manner that recognizes patient's legal rights.	<b>C</b>	<b>H</b>
<b>A.2</b>	<b>Professional Behaviour</b>		
A.2.1	Present a professional appearance and manner.	<b>C</b>	-
A.2.2	Interact respectfully with others.	<b>C</b>	-
A.2.3	Provide care in an unbiased manner.	<b>C</b>	-
A.2.4	Practice within limits of personal knowledge and skills.	<b>C</b>	-
A.2.5	Comply with organizational policies and directives.	<b>C</b>	-
A.2.6	Maintain thorough and complete workplace documentation.	<b>C</b>	-
A.2.7	Respond professionally to changes impacting the practice environment.	<b>A</b>	-
A.2.8	Utilize techniques to manage personal stress in the workplace.	<b>C</b>	-
A.2.9	Utilize basic conflict management techniques.	<b>S</b>	-
A.2.10	Respond professionally to feedback received from others.	<b>C</b>	-
A.2.11	Provide constructive feedback to others.	<b>S</b>	-
A.2.12	Provide information and guidance to students in the medical radiation technology workplace.	<b>A</b>	-
A.2.13	Engage in reflective practice.	<b>C</b>	-
A.2.14	Implement a learning plan to enhance personal knowledge and skills.	<b>C</b>	-
A.2.15	Demonstrate basic knowledge of current and emerging issues in health care relevant to the practice of medical radiation technology.	<b>A</b>	-
A.2.16	Demonstrate basic knowledge of current and emerging practices and technological developments in the field of medical radiation technology.	<b>A</b>	-
<b>A.3</b>	<b>Communication</b>		
A.3.1	Use effective written communication skills.	<b>A</b>	-
A.3.2	Use effective oral communication skills.	<b>C</b>	-
A.3.3	Use effective interpersonal skills.	<b>C</b>	-
A.3.4	Utilize medical terminology in professional communication.	<b>A</b>	-
A.3.5	Explain complex and technical matters related to medical radiation technology to the level of the respondent's understanding.	<b>C</b>	-

<b>A.4</b>	<b>Decision Making</b>	<b>AE</b>	<b>EC wt</b>
A.4.1	Appraise decision options based on best practice evidence, clinical information, resource implications and other contextual factors.	<b>C</b>	-
A.4.2	Use professional judgement to reach decisions.	<b>C</b>	-
A.4.3	Take responsibility for decisions and actions.	<b>C</b>	-
<b>A.5</b>	<b>Interprofessional Practice</b>		
A.5.1	Recognize the roles of health care professionals commonly encountered in the medical radiation technology workplace.	<b>A</b>	-
A.5.2	Contribute productively to teamwork and collaborative processes.	<b>C</b>	-
A.5.3	Contribute knowledge of medical radiation technology in collaborative practice.	<b>C</b>	-
<b>A.6</b>	<b>Use of Resources</b>		
A.6.1	Prioritize workflow to optimize patient care.	<b>S</b>	<b>H</b>
A.6.2	Prioritize workflow to optimize use of resources.	<b>S</b>	-
A.6.3	Monitor inventory of materials and supplies, and respond.	<b>C</b>	-
<b>A.7</b>	<b>Quality Assurance</b>		
A.7.1	Maintain awareness of factors in the clinical environment that may affect delivery of care, and take appropriate action.	<b>C</b>	-
A.7.2	Participate in activities that support a quality assurance program.	<b>A</b>	-
A.7.3	Apply principles of risk management.	<b>A</b>	-
<b>A.8</b>	<b>Research</b>		
A.8.1	Demonstrate basic knowledge of research methodology and ethics.	<b>A</b>	-
A.8.2	Critically appraise professional literature to assess relevance to practice.	<b>A</b>	-
A.8.3	Participate in activities that require application of research methodology.	<b>A</b>	-

<b>Module B Patient Management</b>			
<b>B.1</b>	<b>Patient Interactions</b>	<b>AE</b>	<b>EC wt</b>
B.1.1	Respect the dignity, privacy and autonomy of the patient.	C	-
B.1.2	Maintain professional boundaries.	C	-
B.1.3	Recognize and respond appropriately to cultural, religious and socio-economic variables affecting patient management.	S	-
B.1.4	Adapt interactions to enhance communication with patient and support persons.	C	-
B.1.5	Provide complete information about procedures to patient and support persons, and verify understanding.	C	-
B.1.6	Respond to questions from patient and / or support persons, or direct them to appropriate personnel.	C	-
B.1.7	Ensure ongoing, informed consent to procedures.	C	-
<b>B.2</b>	<b>Patient Safety</b>		
B.2.1	Ensure a safe physical environment.	C	-
B.2.2	Verify patient identity.	C	-
B.2.3	Verify accuracy and completeness of pre-procedure documentation.	C	-
B.2.4	Transport patient safely.	C	-
B.2.5	Transfer patient safely.	C	H
B.2.6	Utilize immobilization devices.	C	H
B.2.7	Ensure proper function of patient's supportive devices and equipment.	C	-
B.2.8	Assess and respond to any changes in patient condition.	C	H
B.2.9	Recognize medical emergencies, and respond.	S	M
B.2.10	Ensure post-procedure transfer of care.	C	-
B.2.11	Verify accuracy and completeness of post-procedure documentation.	C	-
B.2.12	Ensure entry of information to data archiving system.	C	-
<b>B.3</b>	<b>Patient Assessment and Care</b>		
B.3.1	Enhance patient comfort.	C	-
B.3.2	Review clinical history provided, relative to requested procedure, and address discrepancies.	C	-
B.3.3	Obtain information from patient or support person.	C	-
B.3.4	Identify clinically relevant details, and respond.	C	-
B.3.5	Determine patient's pregnancy status and respond.	C	-
B.3.6	Assess patient for contraindications to procedure and respond.	C	H
B.3.7	Perform venipuncture.	C	-
B.3.8	Assist with administration of pharmaceuticals.	C	-
B.3.9	Adapt procedures based upon patient's physical and cognitive condition.	C	H
B.3.10	Provide care for patient's physiological needs.	C	H
B.3.11	Provide patient interventions as listed in Appendix 1.	See App 1	See App 1
B.3.12	Advise patient of necessary post-procedure follow-up.	C	H

<b>Module C Health and Safety</b>			
<b>C.1</b>	<b>Infection Control and Materials Handling</b>	<b>AE</b>	<b>EC wt</b>
C.1.1	Employ routine practices for infection control.	C	H
C.1.2	Employ transmission-based precautions.	C	H
C.1.3	Follow standardized procedures for patients with compromised immunity.	A	H
C.1.4	Use aseptic technique.	C	H
C.1.5	Use sterile technique.	A	M
C.1.6	Follow standardized procedures for handling and disposing of sharps, and contaminated and biohazardous materials.	C	H
<b>C.2</b>	<b>Self-Protection</b>		
C.2.1	Utilize protective equipment.	C	-
C.2.2	Employ proper body mechanics.	C	-
C.2.3	Ensure a safe working environment.	C	-
<b>C.3</b>	<b>MR Screening</b>		
C.3.1	Determine suitability of items for admission into MR environment.	C	H
C.3.2	Determine suitability of objects in / on patient's body for MR environment.	C	H
C.3.3	Screen and educate all persons entering MR environment.	C	H
C.3.4	Verify completion of screening forms.	C	-
<b>C.4</b>	<b>MR Bioeffects</b>		
C.4.1	Provide hearing protection.	C	H
C.4.2	Monitor and respond to potential bio-effects of static magnetic fields.	C	H
C.4.3	Monitor and respond to potential bio-effects of time-varying (gradient) magnetic fields.	C	H
C.4.4	Monitor and respond to potential bio-effects of radiofrequency (RF) field.	C	H
C.4.5	Ensure safe practices in RF coil and equipment cable placement.	C	H
<b>C.5</b>	<b>Emergency Procedures</b>		
C.5.1	Implement procedure for quench.	S	L
C.5.2	Implement procedure for projectile in magnetic field.	S	L
C.5.3	Implement procedure for fire.	S	-

<b>Module D Operation of Equipment</b>			
<b>D.1</b>	<b>Principles of MRI equipment</b>	<b>AE</b>	<b>EC wt</b>
D.1.1	Apply knowledge of magnet systems.	A	H
D.1.2	Apply knowledge of RF coils and systems.	C	H
D.1.3	Apply knowledge of gradient coils and systems.	A	H
D.1.4	Perform shimming.	C	H
D.1.5	Apply knowledge of cooling systems.	A	M
D.1.6	Utilize computer systems.	C	-
D.1.7	Utilize MR ancillary equipment.	C	H
<b>D.2</b>	<b>Equipment Quality Control</b>		
D.2.1	Assess performance of RF coils, and respond.	C	H
D.2.2	Assess cryogen levels, and respond.	C	-
D.2.3	Assess performance of cryogen reclamation system, and respond.	C	-
D.2.4	Assess performance of magnet, and respond.	A	-
D.2.5	Assess performance of ancillary equipment, and respond.	C	-
<b>D.3</b>	<b>Image Acquisition</b>		
D.3.1	Select and optimize pulse sequences.	C	H
D.3.2	Select and optimize imaging parameters.	C	H
D.3.3	Select and optimize imaging options.	C	H
D.3.4	Select appropriate type of data acquisition technique.	C	H
D.3.5	Utilize digital networking and archiving system.	C	-
<b>D.4</b>	<b>Image Quality</b>		
D.4.1	Optimize signal to noise ratio.	C	H
D.4.2	Optimize contrast to noise ratio.	C	H
D.4.3	Optimize spatial resolution.	C	H
D.4.4	Optimize scan time.	C	H
D.4.5	Optimize imaging parameters and options.	C	H
D.4.6	Evaluate tissue weighting, and respond.	C	H
D.4.7	Evaluate image artifacts, and respond.	C	H
D.4.8	Evaluate precessional frequencies utilizing Larmor equation, and respond.	C	M
<b>D.5</b>	<b>Other Imaging Modalities</b>		
D.5.1	Apply knowledge of basic principles of PET / CT.	A	-
D.5.2	Apply knowledge of basic principles of radiological technology.	A	-
D.5.3	Apply knowledge of basic principles of diagnostic ultrasound.	A	-
D.5.4	Apply knowledge of basic principles of Spect / CT.	A	-



<b>Module E Procedure Management</b>			
<b>E.1</b>	<b>Clinical Principles</b>	<b>AE</b>	<b>EC wt</b>
E.1.1	Apply knowledge of anatomy and physiology.	<b>A</b>	-
E.1.2	Differentiate anatomical structures on images.	<b>C</b>	<b>H</b>
E.1.3	Apply knowledge of common pathologies and anomalies listed in Appendix 2.	See App 2	See App 2
E.1.4	Apply knowledge of the effects of pharmaceutical agents (as listed in Appendix 4) as they relate to procedures.	See App 4	See App 4
<b>E.2</b>	<b>Imaging Procedures listed in Appendix 3</b>		
E.2.1	Correlate clinical information, reports and previous imaging studies.	See App 3	See App 3
E.2.2	Select optimal RF coil.	See App 3	See App 3
E.2.3	Prepare and position patient for procedure.	See App 3	See App 3
E.2.4	Determine limit and extent of image coverage.	See App 3	See App 3
E.2.5	Utilize optimal imaging planes.	See App 3	See App 3
E.2.6	Select appropriate imaging parameters and options.	See App 3	See App 3
E.2.7	Recognize signal characteristics consistent with common pathologies and anomalies listed in Appendix 2 related to procedures in Appendix 3.	See App 3	See App 3
E.2.8	Ensure appropriate anatomical coverage.	See App 3	See App 3
E.2.9	Ensure optimal pathological visualization.	See App 3	See App 3
E.2.10	Apply specific absorption rate reduction practices.	See App 3	See App 3
E.2.11	Activate, monitor and manage acquisition	See App 3	See App 3
E.2.12	Assess need for additional sequences.	See App 3	See App 3
E.2.13	Perform post processing and measurements on images.	See App 3	See App 3
E.2.14	Verify accuracy and completeness of acquired data.	See App 3	See App 3
<b>E.3</b>	<b>Pharmaceutical Administration</b>		
E.3.1	Assess for contraindications to contrast media, and respond.	<b>C</b>	<b>H</b>
E.3.2	Prepare contrast media.	<b>C</b>	<b>H</b>
E.3.3	Prepare patient and administer contrast media via appropriate route.	<b>C</b>	<b>H</b>
E.3.4	Utilize power injector.	<b>C</b>	<b>M</b>
E.3.5	Prepare and administer pharmaceutical agents.	<b>C</b>	<b>M</b>
E.3.6	Recognize and respond to adverse reactions.	<b>C</b>	<b>M</b>

## Magnetic Resonance Imaging Appendix 1: Patient Interventions

*This Appendix lists the patient interventions referred to in competency B.3.11*

	Intervention	AE	EC wt
1.1	Assist with administration of oxygen.	C	H
1.2	Assist with suctioning.	S	L
1.3	Administer bedpans and urinals.	C	L
1.4	Monitor vital signs.	S	H
1.5	Perform CPR.	S	L



2.1.17	Hemorrhage	A	L		
2.1.18	Hepatic abscess	A	H		
2.1.19	Hepatic cell carcinoma (HCC)	A	H		
2.1.20	Horseshoe kidney	A	L		
2.1.21	Inflammatory bowel disorders	A	M		
2.1.22	Iron deposition (hemochromatosis)	A	M		
2.1.23	Kidney carcinoma	A	H		
2.1.24	Liver metastases	A	H		
2.1.25	Metastases	A	H		
2.1.26	Nephrogenic systemic fibrosis	A	L		
2.1.27	Pancreatitis	A	M		
2.1.28	Polycystic kidney disease	A	M		
2.1.29	Renal transplant	A	L		
2.1.30	Stenosis	A	L		
2.1.31	Wilms' tumor	A	M		

	4. Head	AE	EC wt		5. Male Pelvis	AE	EC wt		6. Musculoskeletal System	AE	EC wt
2.4.1	Abscess	A	H	2.5.1	Benign prostatic hyperplasia (BPH)	A	H	2.6.1	Abscess	A	L
2.4.2	Acoustic neuroma	A	H	2.5.2	Bladder carcinoma	A	L	2.6.2	Avascular necrosis (AVN)	A	H
2.4.3	Agenesis of the corpus callosum	A	M	2.5.3	Fistula	A	L	2.6.3	Avulsion fractures	A	M
2.4.4	Aging changes / Dementia / Alzheimer's	A	M	2.5.4	Prostate carcinoma	A	H	2.6.4	Bone contusions	A	H
2.4.5	Aneurysm	A	H					2.6.5	Cartilage defects	A	H
2.4.6	Aqueduct Stenosis	A	M					2.6.6	Cysts	A	M
2.4.7	Arterial dissection	A	L					2.6.7	Dislocation	A	L
2.4.8	Arteriovenous malformation (AVM)	A	H					2.6.8	Edema	A	H
2.4.9	Astrocytoma	A	M					2.6.9	Hemangioma	A	M
2.4.10	Cavernous angioma	A	M					2.6.10	Hip dysplasia	A	M
2.4.11	Chiari Malformations	A	H					2.6.11	Labral defects	A	H
2.4.12	Cysts	A	M					2.6.12	Ligament tears	A	H
2.4.13	Dandy-Walker malformation	A	M					2.6.13	Lipoma	A	H
2.4.14	Encephalitis	A	L					2.6.14	Meniscal defects	A	H
2.4.15	Ependymoma	A	M					2.6.15	Metastatic bone lesions	A	H
2.4.16	Glioblastoma multiforme (GBM)	A	H					2.6.16	Morton's nueroma	A	M
2.4.17	Hemangioma	A	L					2.6.17	Osteoarthritis	A	M
2.4.18	Hemorrhage	A	H					2.6.18	Osteomyelitis	A	M

2.4.19	Hydrocephalus	<b>A</b>	<b>H</b>		2.6.19	Pathological fractures	<b>A</b>	<b>M</b>
2.4.20	Ischemia	<b>A</b>	<b>H</b>		2.6.20	Peripheral vascular disease	<b>A</b>	<b>M</b>
2.4.21	Medulloblastoma	<b>A</b>	<b>M</b>		2.6.21	Sarcoma	<b>A</b>	<b>H</b>
2.4.22	Meningioma	<b>A</b>	<b>H</b>		2.6.22	Stress fractures	<b>A</b>	<b>M</b>
2.4.23	Meningitis	<b>A</b>	<b>M</b>		2.6.23	Subluxation	<b>A</b>	<b>L</b>
2.4.24	Mesial temporal sclerosis / epilepsy /seizures	<b>A</b>	<b>H</b>		2.6.24	Tendon tears	<b>A</b>	<b>H</b>
2.4.25	Metastatic tumors	<b>A</b>	<b>H</b>		2.6.25	Tendonitis	<b>A</b>	<b>H</b>
2.4.26	Multiple Sclerosis	<b>A</b>	<b>H</b>					
2.4.27	Neuroblastoma	<b>A</b>	<b>M</b>					
2.4.28	Oligodendroglioma	<b>A</b>	<b>M</b>					
2.4.29	Optic neuritis	<b>A</b>	<b>H</b>					
2.4.30	Pituitary macroadenoma	<b>A</b>	<b>H</b>					
2.4.31	Pituitary microadenoma	<b>A</b>	<b>H</b>					
2.4.32	Retinoblastoma	<b>A</b>	<b>L</b>					
2.4.33	Schwannoma	<b>A</b>	<b>H</b>					
2.4.34	Shearing injuries	<b>A</b>	<b>M</b>					
2.4.35	Stroke / cerebrovascular accident (CVA)	<b>A</b>	<b>H</b>					
2.4.36	Subarachnoid hemorrhage	<b>A</b>	<b>L</b>					

2.4.37	Subdural hematoma	<b>A</b>	<b>M</b>		
2.4.38	Transient ischemic attack (TIA)	<b>A</b>	<b>H</b>		
2.4.39	Trigeminal neuralgia	<b>A</b>	<b>M</b>		
2.4.40	Vascular Stenosis	<b>A</b>	<b>H</b>		
2.4.41	Venous sinus occlusion	<b>A</b>	<b>H</b>		

	7. Neck	AE	EC wt		8. Spine	AE	EC wt		9. Thorax	AE	EC wt
2.7.1	Abscess	A	H	2.8.1	Abscess	A	M	2.9.1	Aneurysm	A	L
2.7.2	Cysts	A	H	2.8.2	Ankylosing spondylitis	A	L	2.9.2	Arterial septal defect (ASD)	A	M
2.7.3	Squamous cell carcinoma	A	H	2.8.3	Arthritis	A	L	2.9.3	Cardiomegaly	A	L
				2.8.4	Bone contusions	A	L	2.9.4	Coarctation	A	H
				2.8.5	Cauda-equina syndrome	A	H	2.9.5	Dissection	A	H
				2.8.6	Cysts	A	L	2.9.6	Ischemic heart disease	A	M
				2.8.7	Degenerative disc disease	A	H	2.9.7	Myocardial infarction	A	M
				2.8.8	Diastematomyelia (split cord)	A	L	2.9.8	Myxoma	A	L
				2.8.9	Discitis	A	M	2.9.9	Situs inversus	A	L
				2.8.10	Dislocation	A	L	2.9.10	Thrombosis	A	M
				2.8.11	Ependymoma	A	M	2.9.11	Valvular insufficiency / regurgitation	A	L
				2.8.12	Free herniated disc fragment (sequestered)	A	H	2.9.12	Ventricular septal defect (VSD)	A	L
				2.8.13	Hemangioma	A	M				
				2.8.14	Hematomas	A	L				
				2.8.15	Hemorrhage	A	L				
				2.8.16	Herniated disc	A	H				
				2.8.17	Meningioma	A	H				
2.8.18	Multiple myeloma	A	L								



	2.8.19	Multiple sclerosis	<b>A</b>	<b>H</b>	
	2.8.20	Neurofibromatosis	<b>A</b>	<b>M</b>	
	2.8.21	Osteomyelitis	<b>A</b>	<b>M</b>	
	2.8.22	Osteophytes	<b>A</b>	<b>M</b>	
	2.8.23	Pathological fractures	<b>A</b>	<b>H</b>	
	2.8.24	Scoliosis	<b>A</b>	<b>H</b>	
	2.8.25	Spina bifida	<b>A</b>	<b>M</b>	
	2.8.26	Spondylolisthesis	<b>A</b>	<b>M</b>	
	2.8.27	Syrinx	<b>A</b>	<b>H</b>	
	2.8.28	Tethered cord	<b>A</b>	<b>H</b>	

### Magnetic Resonance Imaging Appendix 3: Imaging Procedures

*This Appendix lists the imaging procedures referred to by the competencies in section E.2*

	Imaging Procedure		Structure	AE	EC wt
3.1	Musculoskeletal	3.1.1	Temporal mandibular joints	S	L
		3.1.2	Shoulder	C	H
		3.1.3	Upper arm	S	M
		3.1.4	Elbow	S	M
		3.1.5	Forearm	S	L
		3.1.6	Wrist	C	M
		3.1.7	Hand	S	L
		3.1.8	Pelvis	C	H
		3.1.9	Sacro-iliac joint	S	M
		3.1.10	Hip	C	H
		3.1.11	Thigh	S	M
		3.1.12	Knee	C	H
		3.1.13	Calf	S	L
		3.1.14	Ankle	C	H
		3.1.15	Foot	C	M
		3.1.16	Arthrogram	S	M
		3.1.17	Vascular MR angiography (MRA), MR venography (MRV)	C	H
3.2	Head and Neck	3.2.1	Brain	C	H
		3.2.2	Cranial nerves	C	M
		3.2.3	Internal auditory canal	C	H
		3.2.4	Orbits	C	M
		3.2.5	Temporal lobes	C	H
		3.2.6	Pituitary gland	C	H
		3.2.7	Posterior fossa	C	M
		3.2.8	Sinuses	A	L
		3.2.9	Soft tissues neck	S	M
		3.2.10	Pharynx	A	L

		3.2.11	Vascular MRA and MRV	C	H
3.3	Spine	3.3.1	Cervical	C	H
		3.3.2	Thoracic	C	H
		3.3.3	Lumbar	C	H
		3.3.4	Sacral	C	M
		3.3.5	Complete spine	C	H
		3.3.6	Brachial plexus	C	L
		3.3.7	Lumbosacral plexus	A	L
3.4	Thorax	3.4.1	Breast	S	M
		3.4.2	Chest wall	A	L
		3.4.3	Vascular MRA and MRV	S	M
3.5	Abdominal	3.5.1	Adrenal glands	S	L
		3.5.2	Biliary imaging	C	H
		3.5.3	Gastrointestinal tract	S	M
		3.5.4	Kidneys	C	M
		3.5.5	Liver	C	H
		3.5.6	Pancreas	C	H
		3.5.7	Spleen	A	L
		3.5.8	Vascular MRA and MRV	S	M
3.6	Pelvic	3.6.1	Bladder	S	L
		3.6.2	Cervix	C	M
		3.6.3	Ovaries	C	M
		3.6.4	Prostate	C	L
		3.6.5	Rectum	C	M
		3.6.6	Testes	A	L
		3.6.7	Uterus	C	M
		3.6.8	Vascular MRA and MRV	A	L
3.7	Advanced Imaging	3.7.1	Cardiac	A	-
		3.7.2	Diffusion tensor imaging (DTI)	A	-
		3.7.3	Functional MRI (fMRI)	A	-
		3.7.4	Interventional procedures	A	-
		3.7.5	Kinematic MRI (kMRI)	A	-

		3.7.6	Lung imaging (hyperpolarized noble gases)	<b>A</b>	-
		3.7.7	Molecular imaging (MMR)	<b>A</b>	-
		3.7.8	MR guided focused ultrasound treatment (MRgFUS)	<b>A</b>	-
		3.7.9	MR microscopy (MRM)	<b>A</b>	-
		3.7.10	Perfusion imaging	<b>A</b>	-
		3.7.11	Spectroscopy (MRS)	<b>A</b>	-

### **Magnetic Resonance Imaging Appendix 4: Pharmaceuticals**

*This Appendix lists the categories of pharmaceuticals referred to in competency E.1.4*

	<b>Pharmaceutical Category</b>	<b>AE</b>	<b>EC wt</b>
4.1	Anesthetic	<b>A</b>	<b>H</b>
4.2	Antianxiety	<b>A</b>	<b>H</b>
4.3	Antihistamine	<b>A</b>	<b>H</b>
4.4	Antiperistaltic	<b>A</b>	<b>H</b>
4.5	Bronchodilator	<b>A</b>	<b>L</b>
4.6	Contrast agent	<b>A</b>	<b>H</b>
4.7	Organic nitrates	<b>A</b>	<b>L</b>
4.8	Osteoporosis drug therapy	<b>A</b>	<b>L</b>
4.9	Sedative	<b>A</b>	<b>H</b>
4.10	Vasodilator	<b>A</b>	<b>M</b>