

UNITED COUNCIL  
FOR  
NEUROLOGIC  
SUBSPECIALTIES

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# UCNS Neuroimaging Milestones

For definitions and instructions to complete milestones, please visit the [ACGME website](#).

**~DRAFT 6~**

- UCNS Common Milestones for Interpersonal & Communication Skills, Practice-based Learning and Improvement, Professionalism, and Systems-based Practice, adopted from the ACGME Clinical Neurophysiology milestones
- Template for subspecialty-specific milestones for Patient Care and Medical Knowledge

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**Neuroimaging Milestones Task Force**

Representing the Neuroimaging Subspecialty as appointed by the American Society of Neuroimaging:

Jerome Graber, MD, MPH, Alvord Brain Tumor Center at University of Washington Medicine

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1. Systems thinking, including cost- and risk-effective practice – Systems-based Practice				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>Identifies and describes the roles of other team members.</li> <li>Identifies obvious or critical causes of error.</li> </ul>	<ul style="list-style-type: none"> <li>Minimizes unnecessary diagnostic and therapeutic tests.</li> <li>Advocates for cost-conscious utilization of resources.</li> <li>Reports system errors that contribute to patient safety.</li> </ul>	<ul style="list-style-type: none"> <li>Practices cost-effective patient care.</li> <li>Advocates for safe patient care and optimal patient care systems.</li> <li>Participates in quality assurance or improvement activities to improve patient safety.</li> </ul>	<ul style="list-style-type: none"> <li>Leads quality assurance or improvement activities.</li> <li>Initiates care delivery models to mitigate barriers to cost-effective and high-quality care.</li> </ul>	<ul style="list-style-type: none"> <li>Mentors others in quality improvement activities.</li> <li>Mentors others in developing care delivery models.</li> </ul>
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2. Self-directed learning – Practice-based Learning and Improvement				
<ul style="list-style-type: none"> <li>● Identify strengths, deficiencies, and limits in one’s knowledge and expertise</li> <li>● Set learning and improvement goals</li> <li>● Identify and perform appropriate learning activities</li> </ul>				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>● Engages in self-reflection when asked to do so.</li> <li>● Responsive to feedback when offered.</li> </ul>	<ul style="list-style-type: none"> <li>● Welcomes unsolicited feedback.</li> <li>● Engages in self-reflection routinely.</li> <li>● Receptive to feedback from multiple sources.</li> </ul>	<ul style="list-style-type: none"> <li>● Recognizes sub-optimal performance as an opportunity for self-improvement.</li> <li>● Consistently incorporates feedback in learning plan.</li> </ul>	<ul style="list-style-type: none"> <li>● Demonstrates proficiency in reconciling disparate or conflicting feedback.</li> <li>● Continuously self-reflects and incorporates self-improvement opportunities to maximize practice improvement.</li> <li>● Seeks 360-degree feedback.</li> </ul>	<ul style="list-style-type: none"> <li>● Mentors others on self-reflection.</li> <li>● Mentors others on the process of self-improvement.</li> <li>● Provides constructive feedback to others in a non-judgmental manner.</li> </ul>
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3. Practice-Based Learning and Improvement 1: Evidence-Based and Informed Practice				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>● Demonstrates how to access and use available evidence to determine the best imaging examination for a routine patient/diagnosis.</li> </ul>	<ul style="list-style-type: none"> <li>● Articulates clinical questions and elicits patient preferences and values in order to guide evidence-based imaging.</li> <li>● <i>Elicits findings listed as standards in authoritative guidelines.</i></li> </ul>	<ul style="list-style-type: none"> <li>● Locates and applies the best available evidence, integrated with patient preferences and values, to the <i>diagnostic exploration</i> of complex patients.</li> <li>● <i>Adheres to common terminology and key imaging elements deemed meaningful in authoritative guidelines.</i></li> </ul>	<ul style="list-style-type: none"> <li>● Critically appraises conflicting evidence to guide care <i>and</i> diagnostic <i>imaging investigations</i>, tailored to the individual patient <i>and stage in the disease process</i>.</li> <li>● <i>Constantly reports beyond the common data elements as per authoritative guidelines.</i></li> </ul>	<ul style="list-style-type: none"> <li>● Coaches others to critically appraise and apply evidence for complex patients; and/or participates in the development of evidence-based <i>neurological care and neuroimaging guidelines</i>.</li> <li>● <i>Develops new avenues for precision neuroimaging and tailoring of neurological care.</i></li> </ul>
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4. Compassion, integrity, accountability, and respect for self and others – Professionalism				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>● Demonstrates compassion, sensitivity and responsiveness to patients and families.</li> <li>● Demonstrates non-discriminatory behavior in all interactions including diverse and vulnerable populations.</li> <li>● Consistently demonstrates professional behavior, including, boundaries, dress, and timeliness in all activities.</li> </ul>	<ul style="list-style-type: none"> <li>● Demonstrates appropriate steps to address impairment in self.</li> <li>● Demonstrates compassionate practice of medicine, even in context of disagreement with patient beliefs.</li> <li>● Incorporates patients' socio-cultural needs and beliefs into patient care.</li> <li>● Advocates for quality patient care.</li> </ul>	<ul style="list-style-type: none"> <li>● Advocates to reduce healthcare disparities.</li> <li>● Demonstrates appropriate steps to address impairment in colleagues.</li> <li>● Committed to managing conflicts of interest with sponsors and/or for-profit industries.</li> </ul>	<ul style="list-style-type: none"> <li>● Mentors others in the compassionate practice of medicine, even in context of disagreement with patient beliefs.</li> <li>● Mentors others in sensitivity and responsiveness to diverse and vulnerable populations.</li> </ul>	<ul style="list-style-type: none"> <li>● Engages in scholarly activity regarding professionalism in the subspecialty.</li> <li>● Advocates for quality patient care at a regional or national level.</li> <li>● Advocates to reduce healthcare disparities at a regional or national level.</li> </ul>
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5. Knowledge about, respect for, and adherence to the ethical principles relevant to the practice of medicine, remembering in particular that responsiveness to patients that supersedes self-interest is an essential aspect of medical practice – Professionalism				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>• Demonstrates ability to discuss common ethical principles and identify ethical issues in practice.</li> </ul>	<ul style="list-style-type: none"> <li>• Consistently displays responsiveness to patients that supersedes self-interest.</li> </ul>	<ul style="list-style-type: none"> <li>• Analyzes and manages ethical issues in straightforward clinical situations.</li> </ul>	<ul style="list-style-type: none"> <li>• Analyzes and manages ethical issues in complex clinical situations <i>and resource allocation</i>.</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrates leadership and mentorship in applying ethical principles.</li> <li>• Active participant on hospital ethics committee.</li> </ul>
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6. Relationship development, teamwork, and managing conflict – Interpersonal and Communication Skills				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>● Develops a therapeutic relationship with patients in uncomplicated situations.</li> <li>● Actively participates in team-based care.</li> </ul>	<ul style="list-style-type: none"> <li>● Manages simple patient/ family related conflicts.</li> <li>● Engages patients in shared decision making.</li> <li>● Consistently demonstrates respect for all team members <i>in all capacities</i>.</li> </ul>	<ul style="list-style-type: none"> <li>● Manages conflict in complex situations.</li> <li>● Uses easy-to-understand language in all phases of communication (avoids “medicalese” and considers the health literacy of the recipient).</li> <li>● Consistently demonstrates respect for healthcare providers from other departments.</li> </ul>	<ul style="list-style-type: none"> <li>● Manages conflict across specialties and systems of care.</li> <li>● Leads team-based patient care activities.</li> </ul>	<ul style="list-style-type: none"> <li>● Engages in scholarly activity regarding teamwork and conflict management.</li> <li>● Is proficient in crucial conversations.</li> </ul>
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7. Demonstrates communication skills which result in effective information exchange and collaboration with patients, their families and other healthcare professionals – Interpersonal and Communication Skills				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>• Completes documentation in a timely fashion.</li> <li>• Describes how to communicate respectfully with persons of different socioeconomic and cultural backgrounds.</li> <li>• Follows through on patient communications.</li> <li>• Forwards notes to appropriate providers.</li> </ul>	<ul style="list-style-type: none"> <li>• Educates patients about their diseases and management including risks and benefits of treatment options.</li> <li>• Effectively communicates the results of a neurologic study in a timely manner.</li> <li>• Effectively communicates with other healthcare professionals.</li> </ul>	<ul style="list-style-type: none"> <li>• Effectively gathers information from collateral sources when necessary.</li> <li>• Demonstrates synthesis, formulation, and <i>clinical appropriateness</i> in documentation.</li> <li>• Demonstrates effective non-verbal communication skills.</li> <li>• <i>Communicates clinically relevant guidelines.</i></li> <li>• <i>Identifies common findings adhering to authoritative guidelines standards in neurosciences.</i></li> <li>• <i>Engages in communication with persons of different socioeconomic and cultural backgrounds.</i></li> </ul>	<ul style="list-style-type: none"> <li>• Mentors colleagues in timely, accurate and efficient documentation.</li> <li>• <i>Systematically reports clinically meaningful elements, in adherence to standard expectations for subspecialized clinical teams.</i></li> <li>• Models cross-cultural communication and establishes therapeutic relationships with persons of diverse socioeconomic and cultural backgrounds.</li> <li>• <i>Recommends subsequent neuroimaging studies if additional investigation is warranted.</i></li> </ul>	<ul style="list-style-type: none"> <li>• Consistently receives highest tenth percentile patient/family feedback on communication skills on standardized validated assessments.</li> <li>• Develops patient education materials related to the subspecialty.</li> <li>• Engages in scholarly activity regarding interpersonal communication in the subspecialty.</li> <li>• <i>Recommends additional investigation across disciplines, including those outside of neuroimaging if investigation is warranted.</i></li> </ul>
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8. Research and other scholarly activity				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"><li>• Reads subspecialty-scientific literature.</li></ul>	<ul style="list-style-type: none"><li>• Critically evaluates and presents results of published research in the subspecialty at journal club or in a similar setting.</li></ul>	<ul style="list-style-type: none"><li>• Writes a case report, review article, or chapter suitable for publication in the subspecialty, or</li><li>• Presents an abstract or lecture in field of the subspecialty at a professional meeting.</li></ul>	<ul style="list-style-type: none"><li>• Designs and initiates original research in the field of the subspecialty.</li><li>• Develops an educational curriculum in the subspecialty.</li></ul>	<ul style="list-style-type: none"><li>• Publishes original peer-reviewed research.</li><li>• Serves as a research mentor.</li></ul>
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9. Imaging in Vascular Neurosciences – Medical Knowledge				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>● Recognizes emergent imaging findings on brain MR and CT.</li> <li>● Recognizes major abnormalities on vascular imaging.</li> <li>● Differentiates normal from abnormal findings and identifies potential significance.</li> </ul>	<ul style="list-style-type: none"> <li>● Discusses general diagnostic approach appropriate to clinical presentation.</li> <li>● Explains risks and benefits of tests to patient.</li> <li>● Selects imaging protocols based on patient comorbidities and/or provisional diagnosis.</li> </ul>	<ul style="list-style-type: none"> <li>● Individualizes diagnostic approach to the specific patient.</li> <li>● Selects imaging modalities based on comparative effectiveness and cost.</li> <li>● Identifies risks and benefits of various imaging tests as they pertain to an individual patient.</li> </ul>	<ul style="list-style-type: none"> <li>● Recognizes subtle abnormalities on vascular imaging.</li> <li>● Demonstrates knowledge of indications for, and limitations of, anatomic and physiologic imaging studies.</li> <li>● Accurately interprets results of less common diagnostic testing.</li> <li>● Recognizes indications for advanced imaging and other diagnostic studies.</li> <li>● Assesses clinically relevant temporal changes based on prior imaging.</li> </ul>	<ul style="list-style-type: none"> <li>● Serves as a role model for use of imaging studies in patient management.</li> <li>● Engages in scholarly activity on neuro imaging to steward or individualize neurologic treatment plans.</li> <li>● Critically appraise other neuroimaging studies from outside institutions.</li> </ul>
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10. Neuro-Oncology – Medical Knowledge				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>Recognizes common neuroimaging presentations of a brain or spine mass.</li> </ul>	<ul style="list-style-type: none"> <li>Identifies neuro-oncological emergencies and communicates promptly to clinical team.</li> <li>Participates in multidisciplinary conferences.</li> </ul>	<ul style="list-style-type: none"> <li>Provides differential diagnoses of brain or spine masses.</li> <li>Identifies neurologic complications due to cancer or the treatment of cancer.</li> <li>Communicates the extent of diagnostic uncertainty with the clinical team.</li> </ul>	<ul style="list-style-type: none"> <li>Correctly interprets advanced imaging.</li> <li>Appropriately uses alternative neuroimaging modalities when necessary, e.g., during pregnancy, contrast allergic, etc.</li> <li>Applies imaging standards specific to the patient's condition.</li> <li>Recognizes technical limitations of certain imaging modalities.</li> </ul>	<ul style="list-style-type: none"> <li>Engages in scholarly activity in neuro-oncology imaging (e.g., teaching, research).</li> <li>Adjudicates discrepancies between neuroimaging and clinical data.</li> </ul>
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11. General Neuro-imaging – Medical Knowledge				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>Identifies basic neuroanatomy on brain magnetic resonance (MR) and computerized tomography (CT).</li> </ul>	<ul style="list-style-type: none"> <li>Identifies neuroimaging emergencies and communicates promptly to clinical team.</li> <li>Describes abnormalities of the brain and spine on MR and CT.</li> </ul>	<ul style="list-style-type: none"> <li>Recognizes subtle abnormalities in the neuroimaging of the central and peripheral nervous system.</li> <li>Identifies major abnormalities on CT and MR angiography</li> <li>Interprets common findings on MR and CT neuroimaging of brain and spine</li> </ul>	<ul style="list-style-type: none"> <li>Interprets complex findings on MR and CT neuroimaging of brain and spine</li> <li>Detects subtle structural or common functional abnormalities</li> </ul>	<ul style="list-style-type: none"> <li>Identifies subtle abnormalities on angiography</li> <li>Interprets functional or perfusion neuroimaging</li> <li>Interprets nuclear neuroimaging</li> <li>Interprets spectroscopic or advanced neuroimaging studies in subspecialized clinical contexts</li> </ul>
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12. Medical Knowledge 1: Application of Neuroscience to Neuroimaging				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>Discusses basic pathophysiology, anatomy, and treatment-related effects of the brain, neck, and spine.</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrates knowledge of pathophysiology, anatomy, and treatment-related effects to image interpretation and management of common conditions.</li> </ul>	<ul style="list-style-type: none"> <li>Utilizes knowledge of pathophysiology, anatomy, genetics of diseases, and treatment-related effects to image interpretation and management of uncommon conditions.</li> </ul>	<ul style="list-style-type: none"> <li>Masters knowledge of pathophysiology, anatomy, genetics of diseases, and treatment-related effects to image interpretation and management of rare or unusual conditions.</li> </ul>	<ul style="list-style-type: none"> <li>Teaches and advances the application of neuroscience to neuroimaging.</li> </ul>
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13. Medical Knowledge 2: Protocol Selection, Contrast Agent Selection/Dosing, and Image Optimization				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>• Discusses protocols and contrast agent/dose.</li> <li>• Discusses imaging technology and image acquisition.</li> </ul>	<ul style="list-style-type: none"> <li>• Selects protocols and contrast agent/dose for common exams.</li> <li>• Demonstrates knowledge of image acquisition and processing and recognizes common imaging artifacts and technical problems.</li> </ul>	<ul style="list-style-type: none"> <li>• Selects protocols and contrast agent/dose for advanced exams.</li> <li>• Applies knowledge of image acquisition and processing and troubleshoots for imaging artifacts and technical problems.</li> </ul>	<ul style="list-style-type: none"> <li>• Independently tailors protocols to answer complex clinical questions.</li> <li>• Proficiently optimizes image acquisition and processing in collaboration with the technologist/imaging team.</li> <li>• Coordinates appropriate sedation regimens with other members of the multi-disciplinary team.</li> </ul>	<ul style="list-style-type: none"> <li>• Teaches and/or develops imaging protocols.</li> <li>• Teaches and advances knowledge of image acquisition and processing.</li> <li>• Recommends sedation regimens to other members of the multi-disciplinary team.</li> </ul>
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14. Diagnostic Neuroimaging Examinations – Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>• Selects protocols for common neurologic examinations.</li> <li>• Makes efficient and accurate interpretations of common neurologic examinations.</li> </ul>	<ul style="list-style-type: none"> <li>• Tailors protocols for common neuroimaging examinations.</li> <li>• Makes efficient, accurate, and comprehensive interpretations of common and advanced or invasive neuroimaging examinations, including secondary findings.</li> </ul>	<ul style="list-style-type: none"> <li>• Tailors protocols for uncommon and multimodal neuroimaging examinations.</li> <li>• Makes efficient, accurate, and comprehensive interpretations of uncommon specialized brain and spine examinations, including secondary findings and subtle observations.</li> </ul>	<ul style="list-style-type: none"> <li>• Teaches common, advanced, and uncommon findings in neuroimaging examinations to junior learners.</li> <li>• Independently serves as a consultant to interdisciplinary clinical care teams.</li> </ul>	<ul style="list-style-type: none"> <li>• Creates protocols for emerging neuroimaging diagnostic or interventional applications.</li> <li>• Leads interdisciplinary clinical care teams.</li> </ul>
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15. Diagnostic and Functional Advanced Neuroimaging Examinations – Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>Describes and applies Appropriate Use Criteria for CT imaging and describes protocols for advanced neuroimaging modalities .</li> </ul>	<ul style="list-style-type: none"> <li>Ensures appropriateness and quality of MRI examinations and recognizes adequacy of interpretation and reporting.</li> </ul>	<ul style="list-style-type: none"> <li>Ensures appropriateness and quality of neurologic perfusion examinations and recognizes adequacy of interpretation and reporting.</li> </ul>	<ul style="list-style-type: none"> <li>Independently serves as a consultant to multidisciplinary care teams to direct neurologic and neurosurgical evaluations using functional neuroimaging.</li> </ul>	<ul style="list-style-type: none"> <li>Evaluates new paradigms for assessing neurologic disease with alternative imaging modalities.</li> </ul>
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16. Reporting and Information Sharing – Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>● Efficiently generates clear, concise, and thoroughly proofread reports which do not require substantive correction.</li> <li>● Describes lexicons and structured reporting.</li> <li>● Completes documentation in a timely fashion.</li> </ul>	<ul style="list-style-type: none"> <li>● Generates reports with appropriate elements for coding.</li> <li>● Uses lexicons and structured reporting that do not require substantive correction.</li> <li>● Effectively communicates during team meetings, and other transitions of care.</li> <li>● Educates patients about their disease and management, including risks and benefits of treatment options.</li> </ul>	<ul style="list-style-type: none"> <li>● Efficiently generates clear, concise, and thoroughly proofread reports which rarely require correction.</li> <li>● Uses lexicons and structured reporting which rarely require correction.</li> <li>● Effectively gathers information from collateral sources when necessary.</li> <li>● Integrates common clinically used reporting, e.g., ASPECTS score, ICH volume, etc.</li> </ul>	<ul style="list-style-type: none"> <li>● Proficiently uses lexicons and structured reporting to provide accurate and timely reports which do not require correction.</li> <li>● Effectively and ethically uses all forms of communication.</li> <li>● Mentors colleagues in timely, accurate, and efficient documentation.</li> <li>● Integrates subspecialty-specific clinically used reporting, e.g., RANO, MAGNIMS, etc.</li> </ul>	<ul style="list-style-type: none"> <li>● Creates and revises templates to meet the needs of the subspecialty care provider.</li> <li>● Serves as a role model for use of lexicons and structured reporting.</li> <li>● Develops patient education materials.</li> <li>● Engages in scholarly activity regarding interpersonal communication. Develops patient education materials.</li> <li>● Engages in scholarly activity regarding interpersonal communication.</li> </ul>
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17. Contrast Agent Safety – Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>• Demonstrates knowledge of contrast safety and reactions.</li> </ul>	<ul style="list-style-type: none"> <li>• Recognizes contrast safety issues and reactions.</li> </ul>	<ul style="list-style-type: none"> <li>• Manages contrast safety concerns and reactions, with supervision.</li> </ul>	<ul style="list-style-type: none"> <li>• Independently manages contrast safety concerns and reactions in complex situations, e.g., kidney dysfunction or pregnancy, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Serves as a role model and researches on or teaches contrast safety, including to referring providers.</li> </ul>
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18. Radiation Safety – Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>• Demonstrates knowledge of the mechanisms of radiation injury and the ALARA (“as low as reasonably achievable”) concept.</li> </ul>	<ul style="list-style-type: none"> <li>• Accesses resources to determine exam-specific average radiation dose information.</li> </ul>	<ul style="list-style-type: none"> <li>• Communicates the relative risk of exam-specific radiation exposure to patients and practitioners.</li> </ul>	<ul style="list-style-type: none"> <li>• Applies principles of ALARA in daily practice including for pediatric patients.</li> </ul>	<ul style="list-style-type: none"> <li>• Creates, implements, and assesses radiation safety initiatives at the divisional, departmental, or institutional level.</li> </ul>
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19. Magnetic Resonance (MR) Safety – Patient Care				
Level 1	Level 2	Level 3	Level 4	Level 5
<ul style="list-style-type: none"> <li>• Demonstrates knowledge of the risks of magnetic resonance imaging (MRI), including safety zones and pre-magnetic resonance (MR) screening.</li> </ul>	<ul style="list-style-type: none"> <li>• Accesses resources to determine the safety of implanted devices and retained foreign bodies.</li> </ul>	<ul style="list-style-type: none"> <li>• Discusses MR safety concerns, including implants and retained foreign bodies, with patients and practitioners.</li> </ul>	<ul style="list-style-type: none"> <li>• Independently applies principles of MR safety to daily practice.</li> </ul>	<ul style="list-style-type: none"> <li>• Creates, implements, and assesses MR safety initiatives at the divisional, departmental, or institutional level.</li> </ul>
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