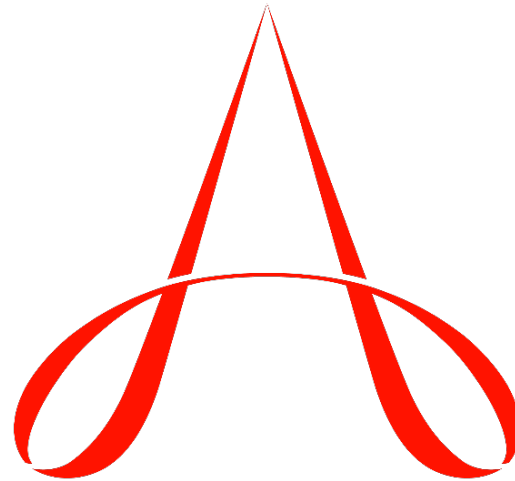




Supplemental Guide: Neuroradiology



A C G M E

May 2021

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Milestones Supplemental Guide

This document provides additional guidance and examples for the Neuroradiology Milestones. This is not designed to indicate any specific requirements for each level, but to provide insight into the thinking of the Milestone Work Group.

Included in this document is the intent of each Milestone and examples of what a Clinical Competency Committee (CCC) might expect to be observed/assessed at each level. Also included are suggested assessment models and tools for each subcompetency, references, and other useful information.

Review this guide with the CCC and faculty members. As the program develops a shared mental model of the Milestones, consider creating an individualized guide (Supplemental Guide Template available) with institution/program-specific examples, assessment tools used by the program, and curricular components.

Additional tools and references, including the Milestones Guidebook, Clinical Competency Committee Guidebook, and Milestones Guidebook for Residents and Fellows, are available on the [Resources](#) page of the Milestones section of the ACGME website.

Patient Care 1: Reporting

Overall Intent: To generate effective radiology reports tailored to the care provider

Milestones	Examples
<p>Level 1 <i>Generates reports with appropriate elements for coding</i></p> <p><i>Describes lexicons and structured reporting</i></p>	<ul style="list-style-type: none"> • For a head computerized tomography (CT) scan, creates a report that includes history, comparison, technique, contrast, findings, all required anatomy, and impressions/conclusions • Describes one of the lexicons used in neuroradiology reports; describes structured reporting used
<p>Level 2 <i>Efficiently generates clear, concise, and thoroughly proofread reports which do not require substantive correction</i></p> <p><i>Uses lexicons and structured reporting that do not require substantive correction</i></p>	<ul style="list-style-type: none"> • Creates a report for spine magnetic resonance imaging (MRI) using appropriate lexicon, such as Lumbar Disc Nomenclature 2.0, without major corrections
<p>Level 3 <i>Efficiently generates clear, concise, and thoroughly proofread reports which rarely require correction</i></p> <p><i>Uses lexicons and structured reporting which rarely require correction</i></p>	<ul style="list-style-type: none"> • Creates a report that describes the essential elements of stroke imaging including core infarct size, penumbra, perfusion, vascular occlusion location, collaterals, and presence of hemorrhage; rarely has grammatical errors
<p>Level 4 <i>Generates tailored reports meeting the needs of the subspecialty care provider</i></p> <p><i>Proficiently uses lexicons and structured reporting to provide accurate and timely reports which do not require correction</i></p>	<ul style="list-style-type: none"> • Creates a report (structured or unstructured) describing neck nodal staging to guide management decisions • Creates a report for post-treatment neck evaluation using appropriate lexicons and Neck Imaging Reporting and Data System (NI-RADS); accurately describes an abnormality
<p>Level 5 <i>Creates and revises templates to meet the needs of the subspecialty care provider</i></p> <p><i>Serves as a role model for use of lexicons and structured reporting</i></p>	<ul style="list-style-type: none"> • Creates a template that includes common data elements to provide classification of spine trauma, using a scoring system such as AO Spine • Creates a template that includes the elements for brain tumor including molecular markers, treatment course, enhancement and signal characteristics, perfusion and diffusion patterns, presence of hemorrhage
<p>Assessment Models or Tools</p>	<ul style="list-style-type: none"> • Direct observation • Evaluation of reports • Faculty evaluations

	<ul style="list-style-type: none"> ● Multisource feedback
Curriculum Mapping	<ul style="list-style-type: none"> ●
Notes or Resources	<ul style="list-style-type: none"> ● Lexicon usage may be variable between institutions ● A “substantive correction” to a report (Level 2) would be a description that needs changes to the lexicons, right versus left, or fails to modify template to reflect actual case ● American Society of Neuroradiology (ASNR). ASNR Neuroradiology CDE Distribution Supporting Documentation. https://www.asnr.org/resources/cde. 2020. ● American College of Radiology (ACR). ACR Practice Parameter for Communication of Diagnostic Imaging Findings. https://www.acr.org/-/media/acr/files/practice-parameters/communicationdiag.pdf. 2020. ● Fardon DF, Williams AL, Dohring EJ, et al. Lumbar dis nomenclature: version 2.0; Recommendations of the combined task forces of the North American Spine Society, the American Society of Spine Radiology and the American Society of Neuroradiology. <i>Spine J.</i> 2014;14(11):2525-2545. https://www.thespinejournalonline.com/article/S1529-9430(14)00409-4/pdf. 2020. ● Radiological Society of North America (RSNA). Rad Report. http://www.radreport.org. 2020. ● Flanders AE, Jordan JE. The ASNR-ACR-RSNA Common Data Elements Project: What Will It Do for the House of Neuroradiology? http://www.ajnr.org/content/40/1/14 ● RSNA RadReport. https://radreport.org/ ● ASNR 2019 Neuroradiology CDE Distribution Supporting Documentation https://www.asnr.org/resources/cde-new-layout/ ● ACR. Neck Imaging Reporting & Data System (NI-RADS™) https://www.acr.org/Clinical-Resources/Reporting-and-Data-Systems/NI-RADS ● ACR. Thyroid Imaging Reporting & Data System (TI-RADS™) https://www.acr.org/Clinical-Resources/Reporting-and-Data-Systems/TI-RADS

Patient Care 2: Consultant in Neuroradiology	
Overall Intent: To provide a high-quality clinical consultation	
Milestones	Examples
Level 1 <i>Uses established evidence-based imaging guidelines, such as American College of Radiology (ACR) Appropriateness Criteria®</i>	<ul style="list-style-type: none"> • Looks up glomerular filtration rate prior to protocolling a study with intravenous contrast • Consults the ACR Appropriateness Criteria to determine the best study to perform for a patient with a focal neurologic deficit
Level 2 <i>Integrates clinical data with imaging findings to develop a differential diagnosis; uses evidence-based imaging guidelines to recommend imaging of common neuroradiology conditions</i>	<ul style="list-style-type: none"> • Recommends dedicated pituitary imaging when asked by clinician about what study to order in a patient with elevated prolactin • Integrates imaging findings with distribution of pain or weakness when interpreting MRI lumbar spine images
Level 3 <i>Integrates clinical data with imaging findings to develop a differential diagnosis; uses evidence-based imaging guidelines to recommend imaging of complex neuroradiology conditions</i>	<ul style="list-style-type: none"> • Consults about a brain tumor and recommends advanced MRI in preparation for biopsy or surgery
Level 4 <i>Effectively provides independent consultation to subspecialists taking into consideration cost effectiveness, risks, and benefits</i>	<ul style="list-style-type: none"> • Appropriately makes subspecialist level recommendations during multidisciplinary conferences
Level 5 <i>Serves as an expert neuroradiology resource for other providers</i>	<ul style="list-style-type: none"> • Provides presurgical consultation including discussion of functional imaging and/or tractography findings in cases of surgically guided brain tumor resections • Discusses the implications of genetic markers in brain tumors
Assessment Models or Tools	<ul style="list-style-type: none"> • Case conferences • Direct observation • End-of-rotation evaluation • Faculty member evaluation • Multisource feedback • Report review of recommendations
Curriculum Mapping	<ul style="list-style-type: none"> •
Notes or Resources	<ul style="list-style-type: none"> • American College of Radiology. ACR Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. 2020. • ACR. ACR Appropriateness Modules for Radiology Residents. http://jhrad.com/acr/. 2020 • ACR. Manual on Contrast Media. https://www.acr.org/Clinical-Resources/Contrast-Manual. 2020. • Consultations can be over the phone, in the reading room, at tumor boards, etc.

- Image Gently. Pediatric Radiology and Imaging. <http://www.imagegently.org>. 2020.
- Institutional policies

Patient Care 3: Interpretation of Neuroimaging	
Overall Intent: To appropriately prioritize differential diagnosis for imaging findings and recommend management	
Milestones	Examples
Level 1 <i>Identifies primary imaging findings in common conditions</i>	<ul style="list-style-type: none"> • Identifies intracranial hemorrhage • Identifies an intracranial mass
Level 2 <i>Identifies secondary imaging findings, recognizes critical imaging findings, and formulates differential diagnoses</i>	<ul style="list-style-type: none"> • Identifies hemorrhage is in the parenchyma (rather than subarachnoid or extra-axial); generates differential considerations including tumor, stroke, trauma, vascular, and hypertension • Accurately determines if a mass is intra-axial, extra-axial, or intraventricular
Level 3 <i>Prioritizes differential diagnoses and helps to guide management</i>	<ul style="list-style-type: none"> • In the setting of an atraumatic hemorrhage, takes into consideration that the hemorrhage is in the basal ganglia and prioritizes hypertension • In the setting of an atraumatic hemorrhage, takes into consideration that the hemorrhage is in the subarachnoid space, recommends computed tomography angiography (CTA) or magnetic resonance angiography to look for aneurysm • Based upon additional imaging characteristics of a mass, provides a tailored differential diagnosis
Level 4 <i>Provides an accurate diagnosis with integration of clinical history</i>	<ul style="list-style-type: none"> • Reviews a CT/CTA brain showing M1 large vessel occlusion, determines how long since onset, and recommends consultation with neuro-interventional radiology • Recognizes emergent features or secondary effects of a mass necessitating immediate consultation with the referring provider or neurosurgery
Level 5 <i>Demonstrates expertise at a level expected of a subspecialist, including for rare or unusual conditions</i>	<ul style="list-style-type: none"> • Identifies brain lesion as tumefactive multiple sclerosis on pre-operative imaging and immediately contacts and informs the surgeon • Based upon unique features of the mass, suggests pausing on planned biopsy or surgery as it may be due an unusual infarct, amyloid angiopathy or therapy affects
Assessment Models or Tools	<ul style="list-style-type: none"> • Direct observation • End-of-rotation evaluation • Exam scores (e.g., RadExam, quizzes, multiple choice exams other types of national exams) • Simulation • Objective structured clinical examination (OSCE) • Multisource feedback
Curriculum Mapping	<ul style="list-style-type: none"> •
Notes or Resources	<ul style="list-style-type: none"> • ACR. ACR Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. 2020. • CME courses • Conferences

- Rotation goals and objectives for recommended reading
- Textbooks and online resources
- Tumor Board

Patient Care 4: Competence in Neuroradiology Procedures Overall Intent: To proficiently and independently perform procedures; to anticipate and manage complications of procedures	
Milestones	Examples
Level 1 <i>Performs pre-procedural work-up</i> <i>Discusses indications, contraindications, and potential complications</i>	<ul style="list-style-type: none"> ● Reviews available brain imaging and laboratory values ● Obtains patient informed consent and performs time-out ● Knows that a patient with a large intracranial mass causing midline shift should not undergo lumbar puncture
Level 2 <i>Competently performs procedures, with direct supervision</i> <i>Recognizes complications and enlists help</i>	<ul style="list-style-type: none"> ● Performs image guided lumbar puncture with direct supervision; recognizes spinal headache is the most common complication
Level 3 <i>Competently performs procedures, with indirect supervision</i> <i>Manages complications, with supervision</i>	<ul style="list-style-type: none"> ● Performs image guided lumbar puncture with indirect supervision; recognizes spinal headache is the most common complication and reassures patient that most headaches resolve within one to two days, advises increasing caffeine intake
Level 4 <i>Competently performs procedures independently</i> <i>Anticipates challenges and independently manages complications</i>	<ul style="list-style-type: none"> ● Recognizes patient has coagulopathy prior to procedure and develops a plan for management ● Performs image guided lumbar puncture, recognizes that patients with increased body mass index (BMI) or severe scoliosis may not be able to lie prone and modifies technique; plans approach prior to procedure using available imaging
Level 5 <i>Competently teaches procedural skills to others independently</i> <i>Modifies procedures in anticipation of potential challenges or complications</i>	<ul style="list-style-type: none"> ● Performs and teaches image-guided lumbar puncture ● Selects cervical approach in cases which preclude lumbar access
Assessment Models or Tools	<ul style="list-style-type: none"> ● Direct observation ● End-of-rotation evaluation ● Point-of-care procedural checklist ● Procedure logs ● Simulation
Curriculum Mapping	<ul style="list-style-type: none"> ●
Notes or Resources	<ul style="list-style-type: none"> ● Background and Intent: The ACGME Glossary of Terms defines conditional independence as “graded, progressive responsibility for patient care with defined oversight.”

- Invasive procedures are identified by local institution. Examples include: lumbar puncture, myelogram, salivary gland biopsy, disc aspiration, vertebral body biopsy, lymph node biopsy, and angiography.
- Society of Interventional Radiology. <https://www.sirweb.org/>. 2020.
- Society of NeuroInterventional Surgery. www.snisonline.org. 2020.
- The care of patients is undertaken with appropriate faculty supervision and conditional independence, allowing fellows to attain the knowledge, skills, attitudes, and empathy required for autonomous practice.

Medical Knowledge 1: Application of Neuroscience to Neuroradiology	
Overall Intent: To apply knowledge of pathophysiology, anatomy, genetics of diseases, and treatment related effects to image interpretation and management	
Milestones	Examples
Level 1 <i>Discusses basic pathophysiology, anatomy, genetics of diseases, and treatment-related effects of the brain, neck, and spine</i>	<ul style="list-style-type: none"> • Discusses pathophysiology of acute ischemia
Level 2 <i>Applies knowledge of pathophysiology, anatomy, genetics of diseases, and treatment-related effects to image interpretation and management of common conditions</i>	<ul style="list-style-type: none"> • Provides a focused differential diagnosis for a brain mass on MRI, using the patient’s demographics, presenting symptoms, laboratory values, and imaging features • Recognizes a necrotic cervical lymph node in an adult and recommends biopsy with HPV/p16 testing to evaluate for metastatic squamous cell carcinoma
Level 3 <i>Applies knowledge of pathophysiology, anatomy, genetics of diseases, and treatment-related effects to image interpretation and management of uncommon conditions</i>	<ul style="list-style-type: none"> • Identifies an acute infarct on a brain MRI of a child, localizes it to the correct vascular distribution, and recommends MR angiography and vessel wall imaging to evaluate for underlying vasculopathy which would be a common cause of stroke in a pediatric patient
Level 4 <i>Applies knowledge of pathophysiology, anatomy, genetics of diseases, and treatment-related effects to image interpretation and management of rare or unusual conditions</i>	<ul style="list-style-type: none"> • Recognizes the presence of cortical enhancement in a nonvascular distribution in a patient with a history of cancer treated with brain radiation therapy and proposes a diagnosis of stroke-like migraine attacks after radiation therapy (SMART) syndrome, distinguishing this from leptomeningeal metastasis
Level 5 <i>Teaches and advances the application of neuroscience to neuroradiology</i>	<ul style="list-style-type: none"> • Presents a grand rounds or lecture to a multidisciplinary audience at a national meeting or at the home institution on a topic pertaining to neuroimaging.
Assessment Models or Tools	<ul style="list-style-type: none"> • Direct observation at the workstation and multidisciplinary conferences • Quarterly evaluation • Case conference observation • Simulation • OSCE
Curriculum Mapping	<ul style="list-style-type: none"> •
Notes or Resources	<ul style="list-style-type: none"> • ASNR. Curriculum for Trainees. https://www.asnr.org/education/neuroradiology-curricula-for-trainees/. 2020.

Medical Knowledge 2: Protocol Selection, Contrast Agent Selection/Dosing and Image Optimization Overall Intent: To apply knowledge of protocol selection to optimize imaging	
Milestones	Examples
Level 1 <i>Discusses protocols and contrast agent/dose</i> <i>Discusses imaging technology and image acquisition</i>	<ul style="list-style-type: none"> ● Is familiar with and can use department protocols for imaging
Level 2 <i>Selects protocols and contrast agent/dose for common exams</i> <i>Demonstrates knowledge of image acquisition and processing, and recognizes common imaging artifacts and technical problems</i>	<ul style="list-style-type: none"> ● Determines appropriate contrast dose and timing for CTA ● Understands that a trauma patient should have an unenhanced CT of brain prior to additional trauma imaging with contrast
Level 3 <i>Selects protocols and contrast agent/dose for advanced exams</i> <i>Applies knowledge of image acquisition and processing and troubleshoots for imaging artifacts and technical problems</i>	<ul style="list-style-type: none"> ● Determines appropriate dose and timing for a multiphase parathyroid protocol ● Recognizes wrap artifact and appropriately conveys information to technologists
Level 4 <i>Independently tailors protocols to answer complex clinical questions</i> <i>Proficiently optimizes image acquisition and processing in collaboration with the technologist/imaging team</i>	<ul style="list-style-type: none"> ● Adjusts imaging techniques to limit metallic or motion artifacts in CT and MR ● Modifies standard contrast dosing for reduced renal function
Level 5 <i>Teaches and/or develops imaging protocols</i> <i>Teaches and advances knowledge of image acquisition and processing</i>	<ul style="list-style-type: none"> ● Designs a functional MRI protocol ● Develops a MR protocol for vessel wall imaging
Assessment Models or Tools	<ul style="list-style-type: none"> ● Direct observation ● End-of-rotation evaluation ● Exam and quiz scores ● Multisource feedback ● Protocol engagement report

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Curriculum Mapping	•
Notes or Resources	<ul style="list-style-type: none">• American College of Radiology. Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. 2020.• ACR. Radiology Safety. https://www.acr.org/Clinical-Resources/Radiology-Safety. 2020.• ACR. Radiation Safety in Adult Medical Imaging. https://www.imagewisely.org/. 2020.• Image Gently. Pediatric Radiology and Imaging. https://www.imagegently.org/. 2020.• RSNA. Physics Modules. https://www.rsna.org/en/education/trainee-resources/physics-modules. 2020.

Systems-Based Practice 1: Patient Safety	
Overall Intent: To engage in the analysis and management of patient safety events, including relevant communication with patients, families, and health care professionals	
Milestones	Examples
<p>Level 1 <i>Demonstrates knowledge of common patient safety events</i></p> <p><i>Demonstrates knowledge of how to report patient safety events</i></p>	<ul style="list-style-type: none"> • Aware that extravasation of contrast is a safety event and knows where and how to report
<p>Level 2 <i>Identifies system factors that lead to patient safety events</i></p> <p><i>Reports patient safety events through institutional reporting systems (simulated or actual)</i></p>	<ul style="list-style-type: none"> • Identifies that poor communication and poor patient hand-offs contribute to patient safety events • Has identified and reported a patient safety issue (real or simulated), along with system factors contributing to that issue
<p>Level 3 <i>Participates in analysis of patient safety events (simulated or actual)</i></p> <p><i>Participates in disclosure of patient safety events to patients and families (simulated or actual)</i></p>	<ul style="list-style-type: none"> • Has reviewed a patient safety event (e.g., preparing for morbidity and mortality (M and M) presentations), joining a root cause analysis group and has communicated with patients/families about such an event
<p>Level 4 <i>Conducts analysis of patient safety events and offers error prevention strategies (simulated or actual)</i></p> <p><i>Discloses patient safety events to patients and families (simulated or actual)</i></p>	<ul style="list-style-type: none"> • Presents root cause analysis at M and M conference and develops an action plan where appropriate • Collaborates with a team to lead the analysis of a patient safety event and can competently communicate with patients/families about those events
<p>Level 5 <i>Actively engages teams and processes to modify systems to prevent patient safety events</i></p> <p><i>Serves as a role model to or mentors others in the disclosure of patient safety events</i></p>	<ul style="list-style-type: none"> • Competently assumes a leadership role at the departmental or institutional level for patient safety, possibly even being the person to initiate action or call attention to the need for action
<p>Assessment Models or Tools</p>	<ul style="list-style-type: none"> • Direct observation • Documentation of patient safety project processes or outcomes • E-module multiple choice tests (e.g., Institute for Healthcare Improvement module, institutional module)

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	<ul style="list-style-type: none">• Medical record (chart) audit• M and M conference• Multisource feedback• Reflection• Simulation
Curriculum Mapping	<ul style="list-style-type: none">•
Notes or Resources	<ul style="list-style-type: none">• Institute of Healthcare Improvement. http://www.ihl.org/Pages/default.aspx. 2020.

Systems-Based Practice 2: Quality Improvement (QI)	
Overall Intent: To demonstrate knowledge of core QI concepts and how they inform the modern practice of medicine, to demonstrate an ability to conduct a QI project	
Milestones	Examples
Level 1 <i>Demonstrates knowledge of basic quality improvement methodologies and metrics</i>	<ul style="list-style-type: none"> • Knows that quality improvement methodologies include root cause analysis and fishbone diagraming
Level 2 <i>Describes local quality improvement initiatives</i>	<ul style="list-style-type: none"> • Is aware of institutional QI initiatives, for example handwashing initiative and time-outs
Level 3 <i>Participates in local quality improvement initiatives</i>	<ul style="list-style-type: none"> • Fellow participates in departmental or hospital QI committee • Has participated in a QI project
Level 4 <i>Demonstrates the skills required to identify, develop, implement, and analyze a quality improvement project</i>	<ul style="list-style-type: none"> • Participates in the completion or analysis of a QI project
Level 5 <i>Creates, implements, and assesses quality improvement initiatives at the divisional, departmental, or institutional level</i>	<ul style="list-style-type: none"> • Competently assumes a leadership role at the departmental or institutional level for patient safety and/or QI initiatives, possibly even being the person to initiate action or call attention to the need for action • Obtains advanced QI training <ul style="list-style-type: none"> ◦ Lean Six Sigma
Assessment Models or Tools	<ul style="list-style-type: none"> • Direct observation • Documentation of QI processes or outcomes • E-module multiple choice tests • Medical record (chart audit) • Multisource feedback • Reflection • Simulation
Curriculum Mapping	<ul style="list-style-type: none"> •
Notes or Resources	<ul style="list-style-type: none"> • Institute of Healthcare Improvement. http://www.ihl.org/Pages/default.aspx. 2020. • Institutional resources

Systems-Based Practice 3: System Navigation for Patient-Centered Care	
Overall Intent: To effectively navigate the health care system, including the interdisciplinary team and other care providers, to adapt care to a specific patient population to ensure high-quality patient outcomes	
Milestones	Examples
Level 1 <i>Demonstrates knowledge of care coordination and transitions of care in imaging/procedures</i>	<ul style="list-style-type: none"> ● Identifies the members of the interprofessional team, describes their roles and understands their various ways of interacting ● Describes an effective sign out to the next radiology team member
Level 2 <i>Coordinates care of patients and transitions of care in routine imaging/procedures</i>	<ul style="list-style-type: none"> ● Works with other members of the radiology team (e.g., nurses, technologists) to coordinate patient imaging, but requires supervision to ensure all necessary imaging or a procedure is performed ● Hands off appropriate follow up for a CT or MRI with an urgent or emergent finding
Level 3 <i>Coordinates care of patients and transitions of care in complex imaging/procedures</i>	<ul style="list-style-type: none"> ● Coordinates the imaging sequencing for complex patients such as multi-injured trauma patients ● Manages unexpected post-operative results on a CT or MRI exam ● Prioritizes urgent patients from the intensive care unit (ICU), trauma, immediate post-operative exams and medicine for imaging/procedures and hands off the plan to the team on the next shift
Level 4 <i>Role models effective coordination of patient-centered care and transitions of care among different disciplines and specialties</i>	<ul style="list-style-type: none"> ● Role models and educates students and more junior team members regarding the engagement of the radiology team as needed for each patient, and ensures the necessary resources have been arranged ● Provides efficient hand-offs to ICU team at the end of a rapid response event that occurred in radiology ● Coordinates and prioritizes consultant input for a new high-risk diagnosis (such as malignancy) to ensure the patient gets appropriate follow-up ● Guides more junior residents in an effective post-procedure hand-off to the referring service
Level 5 <i>Analyzes the process of care coordination or transitions of care and leads in the design and implementation of multidisciplinary process improvements</i>	<ul style="list-style-type: none"> ● Works with hospital or ambulatory site team members or leadership to analyze care coordination in that setting, and takes a leadership role in designing and implementing changes to improve the care coordination process ● Works with a QI mentor to identify better hand-off tools or to improve teaching sessions ● Engages with quality or lean management initiatives to improve the timeliness of imaging or procedures; reporting tools and templates; mechanisms of communication including unexpected findings; or other aspects of patient care and service
Assessment Models or Tools	<ul style="list-style-type: none"> ● Direct observation ● Medical record (chart) audit ● Multisource feedback including from patients and allied health staff ● OSCE

	<ul style="list-style-type: none"> ● Review of sign-out tools ● Use/completion of checklists
Curriculum Mapping	<ul style="list-style-type: none"> ●
Notes or Resources	<ul style="list-style-type: none"> ● “Routine” refers to imaging/procedures that are performed on a daily basis, such as coordinating a lumbar puncture. “Complex” refers to situations that require more thoughtful and careful coordination, such as coordinating a lumbar puncture in a patient with coagulopathy and that needs anesthesia. ● Institutional hand-off guidelines ● Joint Commission Center for Transforming Healthcare. Hand-off Communications Targeted Solutions Tool. https://www.centerfortransforminghealthcare.org/improvement-topics/hand-off-communications/. 2020. ● Working with the local population the fellow can participate in areas within or outside of radiology (e.g. open door clinics, diabetes screening)

Systems-Based Practice 4: Physician Role in Health Care Systems	
Overall Intent: To understand the physician’s role in the complex health care system and how to optimize the system to improve patient care and the health system’s performance	
Milestones	Examples
<p>Level 1 <i>Identifies key components of the complex health care system (e.g., hospital, finance, personnel, technology)</i></p> <p><i>Describes the mechanisms for reimbursement, including types of payors</i></p>	<ul style="list-style-type: none"> ● Recognizes that multiple components exist in a health care system, including various practice settings, reimbursement models, types of insurance, changes and trends related to ongoing health care reform efforts and government programs ● Describes various payment systems, such as Medicare, Medicaid, the US Department of Veterans Affairs (the VA), and commercial third-party payors ● Describes various practice models
<p>Level 2 <i>Describes how components of a complex health care system are interrelated, and how this impacts patient care</i></p> <p><i>States relative cost of common procedures</i></p>	<ul style="list-style-type: none"> ● Understands that pre-authorization may impact patient care and remuneration to the health system ● States relative costs of head CT versus head MRI
<p>Level 3 <i>Discusses how individual practice affects the broader system (e.g., length of stay, readmission rates, clinical efficiency)</i></p> <p><i>Describes the technical and professional components of imaging costs</i></p>	<ul style="list-style-type: none"> ● Understands that turnaround times and dictation errors may affect patient care (e.g., quality, safety, and length of stay) which impacts the broader system ● Differentiates between the technical and professional costs of a head CT or head MRI
<p>Level 4 <i>Manages various components of the complex health care system to provide efficient and effective patient care</i></p> <p><i>Describes the radiology revenue cycle and measurements of productivity (e.g., relative value units)</i></p>	<ul style="list-style-type: none"> ● Works collaboratively with pertinent stakeholders to improve procedural start times including using quality improvement tools and lean management philosophy ● Works collaboratively to improve informed consent for non-English-speaking patients requiring interpreter services ● Understands the multiple components of the revenue cycle applied to a CT or MRI exam ● Understands how relative value units differ between imaging exams, how they are calculated, and how they are refined at a national level with the government
<p>Level 5 <i>Advocates for or leads systems change that enhances high-value, efficient, and effective patient care</i></p> <p><i>Participates in health policy revenue and finance activities</i></p>	<ul style="list-style-type: none"> ● Publishes original research on high-value patient care in peer-reviewed journal(s) ● Works with local, regional, state, or national organizations to advocate for improved stroke recognition, triage and emergent treatment.
Assessment Models or Tools	<ul style="list-style-type: none"> ● Direct observation

	<ul style="list-style-type: none"> ● Medical record (chart) audit ● Multiple choice test
Curriculum Mapping	<ul style="list-style-type: none"> ●
Notes or Resources	<ul style="list-style-type: none"> ● Agency for Healthcare Research and Quality. Measuring the Quality of Physician Care. https://www.ahrq.gov/talkingquality/measures/setting/physician/index.html. 2020. ● Agency for Healthcare Research and Quality. Major Physician Performance Sets. https://www.ahrq.gov/talkingquality/measures/setting/physician/measurement-sets.html. 2020. ● The Commonwealth Fund. Health System Data Center. http://datacenter.commonwealthfund.org/?_ga=2.110888517.1505146611.1495417431-1811932185.1495417431#ind=1/sc=1. 2020. ● Dzau VJ, McClellan MB, McGinnis JM, et al. Vital directions for health and health care: Priorities from a National Academy of Medicine initiative. <i>JAMA</i>. 2017;317(14):1461-1470. https://nam.edu/vital-directions-for-health-health-care-priorities-from-a-national-academy-of-medicine-initiative/. 2020. ● Henry J Kaiser Family Foundation. https://www.kff.org/. 2020. ● Henry J Kaiser Family Foundation. Health Reform. https://www.kff.org/health-reform/. 2020. ● Lam DL, Medverd JR. How radiologists get paid: resource-based relative value scale and the revenue cycle. <i>AJR</i>. 2013;201:947-958. https://www.ajronline.org/doi/full/10.2214/AJR.12.9715. 2020. ● Oklahoma State University Medical Center Diagnostic Radiology Residency. Business of Radiology. http://www.osumcradiology.org/educationschedule/lectures/BusinessofRadiology/#0. 2020. ● RSNA. Online Learning Center. Level 1: Reimbursement Basic. http://education.rsna.org/diweb/catalog/item?id=2210377. 2020. ● RSNA. Online Learning Center. Level 2: Service Valuation and Costs. http://education.rsna.org/diweb/catalog/item?id=2223133. 2020.

<p align="center">Systems-Based Practice 5: Contrast Agent Safety</p> <p>Overall Intent: Demonstrates competence in recognizing and managing contrast (iodinated and gadolinium) reactions in adult and pediatric patients</p>	
Milestones	Examples
<p>Level 1 <i>Demonstrates knowledge of contrast safety and reactions</i></p>	<ul style="list-style-type: none"> ● Has basic knowledge and awareness of contrast reactions, including recognition and management of contrast reactions. ● Accesses resources for recommended pre-treatment options for a known contrast reaction ● Has basic knowledge of safe utilization of contrast agents for MRI, CT, angiography, and myelography ● Can describe the management of: <ul style="list-style-type: none"> ○ Bronchospasm ○ Contrast extravasation ○ Diffuse erythema ○ Hives ○ Hypotension with bradycardia ○ Hypotension with tachycardia ○ Laryngeal edema ○ Premedication regimens
<p>Level 2 <i>Recognizes contrast safety issues and reactions</i></p>	<ul style="list-style-type: none"> ● Consistently and reliably recognizes different signs of a contrast reaction in simulation or actual in the CT or MRI department ● Recognizes clinical scenarios when contrast agents may not be appropriate to administer ● Recognizes the following: <ul style="list-style-type: none"> ○ Bronchospasm ○ Diffuse erythema ○ Hives ○ Hypotension with bradycardia ○ Hypotension with tachycardia ○ Laryngeal edema
<p>Level 3 <i>Manages contrast safety concerns and reactions, with supervision</i></p>	<ul style="list-style-type: none"> ● Consistently and reliably manages (with supervision) contrast reactions in simulation or actual in the CT or MRI department ● Consistently and reliably makes appropriate choices (with supervision) regarding utilization of contrast agents ● Recognizes that pediatric patients may require weight-based dosing of some medications and that normal vital signs in pediatric patients differ from adults ● Manages the following: <ul style="list-style-type: none"> ○ Bronchospasm

	<ul style="list-style-type: none"> ○ Diffuse erythema ○ Hives ○ Hypotension with bradycardia ○ Hypotension with tachycardia ○ Laryngeal edema
Level 4 <i>Independently manages contrast safety concerns and reactions</i>	<ul style="list-style-type: none"> ● Consistently and reliably recognizes and manages contrast reactions independently in simulation or actual in the CT or MRI department ● Consistently and reliably makes appropriate choices independently regarding utilization of contrast agents
Level 5 <i>Serves as a role model and researches on or teaches contrast safety, including to referring providers</i>	<ul style="list-style-type: none"> ● Assumes a leadership role in the department or institution to conduct a seminar or continuing medical education (CME) session for a variety of contrast reaction(s) or safety issues around contrast utilization
Assessment Models or Tools	<ul style="list-style-type: none"> ● Direct observation ● Medical record (chart) audit ● Multiple choice test ● Reflection ● Simulation
Curriculum Mapping	<ul style="list-style-type: none"> ●
Notes or Resources	<ul style="list-style-type: none"> ● ACR. Contrast Card. https://www.acr.org/-/media/ACR/Files/Clinical-Resources/Contrast-Reaction-Card.pdf. 2020. ● ACR. Manual on Contrast Media. https://www.acr.org/Clinical-Resources/Contrast-Manual. 2020. ● BLS and ACLS certification courses

Systems-Based Practice 6: Radiation Safety	
Overall Intent: To demonstrate competence in and to be an advocate for radiation safety awareness	
Milestones	Examples
Level 1 <i>Demonstrates knowledge of the mechanisms of radiation injury and the ALARA (“as low as reasonably achievable”) concept</i>	<ul style="list-style-type: none"> • Describes fundamental concepts in radiation biology addressing the mechanism of injury at different radiation exposures • Describes the ALARA (“as low as reasonably achievable”) concept including nuances related to pediatric patients
Level 2 <i>Accesses resources to determine exam-specific average radiation dose information</i>	<ul style="list-style-type: none"> • Accesses online resources to determine the average dose information for a routine head CT
Level 3 <i>Communicates the relative risk of exam-specific radiation exposure to patients and practitioners</i>	<ul style="list-style-type: none"> • Effectively communicates relative risks of the radiation exposure during a CT of the head to the patient, patient’s family or referring provider
Level 4 <i>Applies principles of ALARA in daily practice including for pediatric patients</i>	<ul style="list-style-type: none"> • Modifies CT parameters for a lumbar spine CT in keeping with the ALARA principles routinely in daily practice
Level 5 <i>Creates, implements, and assesses radiation safety initiatives at the divisional, departmental, or institutional level</i>	<ul style="list-style-type: none"> • Begins a radiation safety initiative with the radiation safety officer addressing modifications to CT perfusion scanning protocols for acute stroke
Assessment Models or Tools	<ul style="list-style-type: none"> • Chart, protocoling or other system documentation by fellow • Direct observation • Documentation of QI or radiation safety project processes or outcome • Multiple choice test
Curriculum Mapping	<ul style="list-style-type: none"> •
Notes or Resources	<ul style="list-style-type: none"> • ACR. ACR Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. 2020. • ACR. Radiation Safety. https://www.acr.org/Clinical-Resources/Radiology-Safety/Radiation-Safety. 2020. • ACR. Radiology Safety. https://www.acr.org/Clinical-Resources/Radiology-Safety. 2020. • Image Gently. Pediatric Radiology and Imaging. https://www.imagegently.org/. 2020. • Image Wisely. https://www.imagewisely.org/. 2020. • RSNA. Physics Modules. https://www.rsna.org/en/education/trainee-resources/physics-modules. 2020.

Systems-Based Practice 7: Magnetic Resonance (MR) Safety	
Overall Intent: To understand the practical aspects of MR safety	
Milestones	Examples
Level 1 <i>Demonstrates knowledge of the risks of magnetic resonance imaging (MRI), including safety zones and pre-magnetic resonance (MR) screening</i>	<ul style="list-style-type: none"> • Describes safety zones Level I through IV • Lists key components of MRI screening process • Describes risks of the MRI environment
Level 2 <i>Accesses resources to determine the safety of implanted devices and retained foreign bodies</i>	<ul style="list-style-type: none"> • Knows how to find resources to determine if it is safe to perform an MRI on a patient with shrapnel or an implanted medical device in the patient’s body
Level 3 <i>Discusses MR safety concerns, including implants and retained foreign bodies, with patients and practitioners</i>	<ul style="list-style-type: none"> • Communicates any risks of performing an MRI on a patient with shrapnel or an implanted medical device in the patient’s body to the patient and other practitioners
Level 4 <i>Independently applies principles of MR safety to daily practice</i>	<ul style="list-style-type: none"> • Consistently makes appropriate decisions regarding safety of MRI in patients with implanted devices or retained foreign bodies • Manages a patient with an MRI-conditional pacemaker or programmable shunt throughout the MRI process
Level 5 <i>Creates, implements, and assesses MR safety initiatives at the divisional, departmental, or institutional level</i>	<ul style="list-style-type: none"> • Participates as an active member in a divisional, departmental, or hospital MRI safety committee in creating or assessing MRI safety protocols • Implements a protocol for safely imaging patients with a new type of implanted device
Assessment Models or Tools	<ul style="list-style-type: none"> • Multisource feedback, including from MRI Technologists • RadExam patient safety assessment • Safe MR Practices: Self-Assessment Module AJR 2007;188:S50–S54 0361-803X/07/1886–S50 © American Roentgen Ray Society
Curriculum Mapping	<ul style="list-style-type: none"> •
Notes or Resources	<ul style="list-style-type: none"> • ACR. ACR Manual on MR Safety. https://www.acr.org/-/media/ACR/Files/Radiology-Safety/MR-Safety/Manual-on-MR-Safety.pdf. 2020. • ACR. MR Safety. https://www.acr.org/Clinical-Resources/Radiology-Safety/MR-Safety. 2020. • Complete AAPM/RSNA Web Module: MRI Course #9 Quality/ Bioeffects/Safety • MRI Questions. MRI Suite: Safety Zones. http://mriquestions.com/acr-safety-zones.html. 2020. • MRI Safety. http://mrisafety.com/. 2020. • RSNA. Physics Modules. https://www.rsna.org/education/trainee-resources/physics-modules. 2020.

Practice-Based Learning and Improvement 1: Evidence-Based and Informed Practice	
Overall Intent: To incorporate evidence and patient values into clinical practice	
Milestones	Examples
Level 1 <i>Demonstrates how to access and use available evidence to determine the best imaging examination for a routine patient/diagnosis</i>	<ul style="list-style-type: none"> • Understands the importance of imaging safety literature and websites
Level 2 <i>Articulates clinical questions and elicits patient preferences and values in order to guide evidence-based imaging</i>	<ul style="list-style-type: none"> • Identifies patients with conditional risks for MRI safety, radiation safety, or contrast use
Level 3 <i>Locates and applies the best available evidence, integrated with patient preferences and values, to the care of complex patients</i>	<ul style="list-style-type: none"> • Uses radiology literature to determine patient MRI safety, radiation safety, or contrast use
Level 4 <i>Critically appraises conflicting evidence to guide care, tailored to the individual patient</i>	<ul style="list-style-type: none"> • Knows how to direct the clinical team for atypical situations in imaging (e.g., CT or MRI in pregnant patients, contrasting use in chronic kidney disease, or pediatric patient imaging)
Level 5 <i>Coaches others to critically appraise and apply evidence for complex patients; and/or participates in the development of evidence-based care guidelines</i>	<ul style="list-style-type: none"> • Writes or revises department policy on MRI safety, radiation safety, or contrast use according to best practices
Assessment Models or Tools	<ul style="list-style-type: none"> • Direct observation • Oral or written examination • Simulation
Curriculum Mapping	<ul style="list-style-type: none"> •
Notes or Resources	<ul style="list-style-type: none"> • ABR 2019 Noninterpretive Skills Study Guide. https://www.theabr.org/wp-content/uploads/2018/11/NIS-Study-Guide-2019.pdf. 2020. • ACR. ACR Manual on MR Safety. https://www.acr.org/-/media/ACR/Files/Radiology-Safety/MR-Safety/Manual-on-MR-Safety.pdf. 2020. • Harvey L. Neiman Health Policy Institute. http://www.neimanhpi.org/. 2020. • Image Gently. Pediatric Radiology and Imaging. www.imagegently.org. 2020. • Image Wisely. www.imagewisely.org. 2020. • Institutional Review Board (IRB) guidelines • MRI Safety. http://mrisafety.com. 2020. • Moriates C, Arora V, Shah N. <i>Understanding Value Based Healthcare</i>. 1st ed. New York, NY: McGraw Hill Education; 2015. • NIH U.S. National Library of Medicine. PubMed Tutorial. https://www.nlm.nih.gov/bsd/disted/pubmedtutorial/cover.html. 2020.

- National Institutes of Health. Write Your Application. <https://grants.nih.gov/grants/how-to-apply-application-guide/format-and-write/write-your-application.htm>. 2020.
- The University of Texas at Austin Dell Medical School. Discovering Value-Based Health Care. <https://vbhc.dellmed.utexas.edu/>. 2020.
- Various journal submission guidelines

Practice-Based Learning and Improvement 2: Reflective Practice and Commitment to Professional Growth Overall Intent: To seek clinical performance information with the intent to improve care; reflect on all domains of practice, personal interactions, and behaviors, and their impact on patients and colleagues (reflective mindfulness); develop clear objectives and goals for improvement in some form of a learning plan	
Milestones	Examples
<p>Level 1 <i>Accepts responsibility for professional development by establishing goals</i></p> <p><i>Identifies factors that contribute to gap(s) between expectations and actual performance</i></p> <p><i>Actively seeks opportunities to improve performance</i></p>	<ul style="list-style-type: none"> ● Is aware of need to improve ● Understands the importance of continued self-improvement ● Identifies that lack of sleep, incomplete preparation, and other social factors can lead to performance gaps ● Seeks additional material to review
<p>Level 2 <i>Receptive to performance data and feedback in order to adjust goals</i></p> <p><i>Analyzes and reflects on factors that contribute to gap(s) between expectations and actual performance</i></p> <p><i>Designs and implements a learning plan, with prompting</i></p>	<ul style="list-style-type: none"> ● Uses feedback to set goals to increase efficiency and complexity of cases read each day ● Reflects on factors contributing to lack of efficiency ● With prompting, develops a learning plan to improve efficiency
<p>Level 3 <i>Episodically seeks performance data and feedback, with humility and adaptability</i></p> <p><i>Institutes behavioral change(s) to narrow the gap(s) between expectations and actual performance</i></p> <p><i>Designs and implements a learning plan independently</i></p>	<ul style="list-style-type: none"> ● Takes input from technologists, peers, and supervisors to gain insight into personal strengths and areas to improve ● Follows up on the outcomes of patient for which they have dictated reports, with prompting ● Changes daily practice habits to increase efficiency ● Documents goals in a more specific and achievable manner, such that attaining them is measurable
<p>Level 4 <i>Consistently seeks performance data and feedback with humility and adaptability</i></p>	<ul style="list-style-type: none"> ● Independently follows up on the outcomes of patients for which they have dictated reports

<p><i>Analyzes effectiveness of behavioral changes where appropriate and considers alternatives in narrowing the gap(s) between expectations and actual performance</i></p> <p><i>Uses performance data to measure the effectiveness of the learning plan and, when necessary, improves it</i></p>	<ul style="list-style-type: none"> ● Consistently identifies learning gaps and addresses areas to work on ● Seeks out mentor(s) to help achieve goals ● Uses scores and comments from in-house evaluations to create a learning plan
<p>Level 5 <i>Coaches other learners to consistently seek performance data and feedback</i></p> <p><i>Coaches others on self-assessment and effective behavioral changes</i></p> <p><i>Facilitates the design and implementation of learning plans for others</i></p>	<ul style="list-style-type: none"> ● Actively discusses learning goals with supervisors and colleagues; may encourage other learners on the team to consider how their behavior affects the rest of the team ● Provides constructive feedback to peers for improvement ● Provides relevant learning plans for peers to address gaps ● Acts as a mentor to radiology residents
<p>Assessment Models or Tools</p>	<ul style="list-style-type: none"> ● Direct observation ● Review of learning plan
<p>Curriculum Mapping</p>	<ul style="list-style-type: none"> ●
<p>Notes or Resources</p>	<ul style="list-style-type: none"> ● Burke AE, Benson B, Englander R, Carraccio C, Hicks PJ. Domain of competence: practice-based learning and improvement. <i>Academic Pediatrics</i>. 2014;14(2 Suppl):S38-S54. https://www.academicpedsjnl.net/article/S1876-2859(13)00333-1/pdf. 2020. ● Collins J. Lifelong learning in the 21st century and beyond. <i>Radiographics</i>. 2009;29(2):613-622. https://pubs.rsna.org/doi/pdf/10.1148/rq.292085179. 2020. ● Hojat M, Veloski JJ, Gonnella JS. Measurement and correlates of physicians' lifelong learning. <i>Academic Medicine</i>. 2009;84(8):1066-1074. https://journals.lww.com/academicmedicine/fulltext/2009/08000/Measurement_and_Correlates_of_Physicians_Lifelong.21.aspx. 2020. ● Lockspeiser TM, Schmitter PA, Lane JL, Hanson JL, Rosenberg AA, Park YS. Assessing residents' written learning goals and goal writing skill: validity evidence for the learning goal scoring rubric. <i>Academic Medicine</i>. 2013;88(10):1558-1563. https://journals.lww.com/academicmedicine/fulltext/2013/10000/Assessing_Residents_Written_Learning_Goals_and.39.aspx. 2020.

Professionalism 1: Professional Behavior and Ethical Principles	
Overall Intent: To recognize and address lapses in ethical and professional behavior, demonstrate ethical and professional behaviors, and use appropriate resources for managing ethical and professional dilemmas	
Milestones	Examples
<p>Level 1 <i>Demonstrates knowledge of expectations for professional behavior and describes how to appropriately report professional lapses</i></p> <p><i>Demonstrates knowledge of the ethical principles underlying informed consent, surrogate decision making, advance directives, confidentiality, error disclosure, and stewardship of limited resources</i></p>	<ul style="list-style-type: none"> ● Identifies and describes potential triggers for professionalism lapses, describes when and how to appropriately report professionalism lapses, and outlines strategies for addressing common barriers to reporting ● Discusses the basic ethical principles (beneficence, nonmaleficence, justice, autonomy) and professionalism (professional values and commitments), and how they apply in various situations (e.g., informed consent process)
<p>Level 2 <i>Demonstrates insight into professional behavior in routine situations and takes responsibility for own professionalism lapses</i></p> <p><i>Analyzes straightforward situations using ethical principles</i></p>	<ul style="list-style-type: none"> ● Demonstrates professional behavior in routine situations and uses ethical principles to analyze straightforward situations, such as those where: <ul style="list-style-type: none"> ○ there are no or few conflicts (between values or patients) ○ the fellow may be tired or hungry, but is not excessively fatigued, overwhelmed, or otherwise distressed ○ workload is not unusually high, and there is no significant time pressure to make decisions ● Acknowledges and takes corrective action for the lapse(s) ● Articulates strategies for preventing similar lapses in the future
<p>Level 3 <i>Demonstrates professional behavior in complex or stressful situations</i></p> <p><i>Recognizes need to seek help in managing and resolving complex ethical situations</i></p>	<ul style="list-style-type: none"> ● Analyzes complex situations, such as how the clinical situation evokes strong emotions, conflicts (or perceived conflicts) between patients or between professional values ● Navigates a situation while not at personal best due to fatigue, hunger, stress, etc. ● Navigates a situation where the system poses barriers to professional behavior (e.g., inefficient workflow, inadequate staffing, conflicting policies) ● Recognizes own limitations and seeks resources to help manage and resolve complex ethical situations ● Analyzes difficult (real or hypothetical) ethical dilemmas and situations, or professional case scenarios

<p>Level 4 <i>Recognizes situations that may trigger professionalism lapses and intervenes to prevent lapses in self and others</i></p> <p><i>Recognizes and uses appropriate resources for managing and resolving ethical dilemmas as needed</i></p>	<ul style="list-style-type: none"> ● Monitors and responds to fatigue, hunger, stress, etc. in self and team members ● Recognizes and responds effectively to the emotions of others ● Actively seeks to consider the perspectives of others ● Models respect for patients and expects the same from others ● Seeks ethics consult when there is a conflict in balancing the needs of the patient, the wishes of the family, and the requests of the ordering provider
<p>Level 5 <i>Engages in professional development educational activities or coaches others when their behavior fails to meet professional expectations</i></p> <p><i>Identifies and seeks to address system-level factors that induce or exacerbate ethical problems or impede their resolution</i></p>	<ul style="list-style-type: none"> ● Coaches others when their behavior fails to meet professional expectations ● Identifies and seeks to address system-wide factors or barriers to promoting a culture of ethical and professional behavior through participation in a work group, committee, or taskforce
<p>Assessment Models or Tools</p>	<ul style="list-style-type: none"> ● Direct observation ● End-of-rotation evaluation ● Multisource feedback ● Oral or written self-reflection ● RSNA professionalism modules ● Simulation
<p>Curriculum Mapping</p>	<ul style="list-style-type: none"> ●
<p>Notes or Resources</p>	<ul style="list-style-type: none"> ● American Association of Physicists in Medicine. ABR/ACR/RSNA/AAPM/ASTRO/ARR/ARS Online Modules on Ethics and Professionalism. https://www.aapm.org/education/onlinemodules.asp. 2020. ● ACR. Code of Ethics. https://www.acr.org/-/media/ACR/Files/Governance/Code-of-Ethics.pdf. 2020. ● AMA. Ethics. https://www.ama-assn.org/delivering-care/ethics. 2020. ● Association of University Radiologists. Professionalism and Ethics Competencies for Radiology Residents. http://www.aur.org/Secondary.aspx?id=10263. 2020. ● Association of University Radiologists. Professionalism Curriculum Resources. http://www.aur.org/ProfessionalCurriculum/. 2020. ● Byyny RL, Papadakis MA, Paauw DS, Pfiel S, Alpha Omega Alpha. <i>Medical Professionalism Best Practices</i>. Menlo Park, CA: Alpha Omega Alpha Honor Medical Society; 2015. https://alphaomegalpha.org/pdfs/2015MedicalProfessionalism.pdf. 2020.

- Levinson W, Ginsburg S, Hafferty FW, Lucey CR. *Understanding Medical Professionalism*. 1st ed. New York, NY: McGraw-Hill Education; 2014. <https://accessmedicine.mhmedical.com/book.aspx?bookID=1058>. 2020.
- RSNA. Professionalism for Residents. <https://www.rsna.org/education/professionalism-and-quality-care/professionalism-self-assessments/professionalism-for-residents>. 2020.

Professionalism 2: Accountability/Conscientiousness	
Overall Intent: To take responsibility for one’s own actions and the impact on patients and other members of the health care team	
Milestones	Examples
Level 1 <i>Responds promptly to requests or reminders to complete tasks and responsibilities</i>	<ul style="list-style-type: none"> • Takes responsibility for getting informed consent for a procedure
Level 2 <i>Performs tasks and responsibilities in a timely manner to ensure that the needs of patients, teams, and systems are met in routine situations</i>	<ul style="list-style-type: none"> • Dictates reports for routine cases in a timely fashion
Level 3 <i>Performs tasks and responsibilities in a timely manner to ensure that the needs of patients, teams, and systems are met in complex or stressful situations</i>	<ul style="list-style-type: none"> • Efficiently dictates reports and communicates results for Stroke Alert cases in a timely fashion
Level 4 <i>Recognizes and raises awareness of situations that may impact others’ ability to complete tasks and responsibilities in a timely manner</i>	<ul style="list-style-type: none"> • Identifies issues that could impede others from completing tasks and provides leadership to address those issues • Advises residents on effective communication with the stroke and neurological surgery teams
Level 5 <i>Coaches and educates on professional accountability and managing performance gaps</i>	<ul style="list-style-type: none"> • Partners with stroke and neurological surgery teams to provide the best possible team approach to improve patient care and outcome
Assessment Models or Tools	<ul style="list-style-type: none"> • Compliance with deadlines and timelines • Direct observation • Multisource feedback • Self-evaluations • Simulation
Curriculum Mapping	<ul style="list-style-type: none"> •
Notes or Resources	<ul style="list-style-type: none"> • Code of conduct from institutional manual • RSNA. Professionalism for Residents. https://www.rsna.org/education/professionalism-and-quality-care/professionalism-self-assessments/professionalism-for-residents. 2020.

Professionalism 3: Self-Awareness and Help-Seeking Overall Intent: To identify, use, manage, improve, and seek help for personal and professional well-being for self and others	
Milestones	Examples
<p>Level 1 <i>Recognizes status of personal and professional well-being, with assistance, and is aware of available resources</i></p> <p><i>Recognizes limits in the knowledge/skills of self or team, with assistance</i></p>	<ul style="list-style-type: none"> ● Identifies potential stressors specific to the learner in the educational program or in this specialty ● Is aware of well-being resources available at the institution as well as locally and/or nationally ● Requests and/or accepts feedback and exhibits positive responses to corrective feedback
<p>Level 2 <i>Independently recognizes status of personal and professional well-being using available resources when appropriate</i></p> <p><i>Independently recognizes limits in the knowledge/skills of self or team and demonstrates appropriate help-seeking behaviors</i></p>	<ul style="list-style-type: none"> ● Independently identifies possible sources of personal stress or lack of clinical knowledge and independently seeks help
<p>Level 3 <i>With assistance, proposes a plan to optimize personal and professional well-being</i></p> <p><i>With assistance, proposes a plan to remediate or improve limits in the knowledge/ skills of self or team</i></p>	<ul style="list-style-type: none"> ● With supervision, develops a personal learning or action plan to address stress and/or burnout for self or team and gaps in personal clinical knowledge
<p>Level 4 <i>Independently develops or modifies a plan to optimize personal and professional well-being</i></p> <p><i>Independently develops a plan to remediate or improve limits in the knowledge/skills of self or team</i></p>	<ul style="list-style-type: none"> ● Independently develops a personal learning or action plan to address stress and/or burnout for self or team and gaps in personal clinical knowledge
<p>Level 5 <i>Engages in professional well-being educational activities or coaches others to optimize personal and professional well-being</i></p>	<ul style="list-style-type: none"> ● Mentors colleagues in self-awareness

<p><i>Coaches and guides others when their emotional responses or limitations in knowledge/skills do not meet professional expectations</i></p>	<ul style="list-style-type: none"> ● Establishes health management plans to limit stress and burnout
<p>Assessment Models or Tools</p>	<ul style="list-style-type: none"> ● Direct observation ● Group interview or discussions for team activities ● Institutional online training modules ● Participation in institutional well-being programs ● Personal learning plan ● Self-assessment ● Semi-annual review
<p>Curriculum Mapping</p>	<ul style="list-style-type: none"> ●
<p>Notes or Resources</p>	<ul style="list-style-type: none"> ● American Academy of Pediatrics. Resilience Curriculum: Resilience in the Face of Grief and Loss. https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/hospice-palliative-care/Pages/Resilience-Curriculum.aspx. 2020. ● ACGME. “Well-Being Tools and Resources.” https://dl.acgme.org/pages/well-being-tools-resources. Accessed 2022. ● Local and institutional resources ● Stanford Medicine. WellMD. https://wellmd.stanford.edu/. 2020. ● This subcompetency is not intended to evaluate a fellow’s well-being. Rather, the intent is to ensure that each fellow has the fundamental knowledge of factors that impact well-being, the mechanism by which those factors impact well-being, and available resources and tools to improve well-being.

Interpersonal and Communication Skills 1: Patient- and Family-Centered Communication	
Overall Intent: To deliberately use language and behaviors to form a therapeutic relationship with a patient and family members; to identify communication barriers, including self-reflection on personal biases, and minimize them in the doctor-patient relationship; to organize and lead communication around shared decision making	
Milestones	Examples
<p>Level 1 <i>Accurately communicates own role within the health care system</i></p> <p><i>Identifies the need to adjust communication strategies based on assessment of patient/family expectations and understanding of their health status and treatment options</i></p>	<ul style="list-style-type: none"> ● Identifies self as a fellow during patient interactions and describes the fellow’s role in care ● Understands that communication may need to be adjusted when there is an inadvertent dural puncture during epidural steroid injection
<p>Level 2 <i>Identifies barriers to effective communication (e.g., language, health literacy, cultural)</i></p> <p><i>Organizes and initiates communication with patient/family by clarifying expectations and verifying understanding of the clinical situation</i></p>	<ul style="list-style-type: none"> ● Identifies need for an interpreter; knows to speak in a manner at a level of understanding commensurate with education level of patient; realizes when the presence of a caregiver will be needed to aid in management decision making; asks patients their preferred pronouns ● Before and/or after communication with patient/family, closes the loop and asks if they are clear about expectations and understanding the clinical situation, as well as encourages questions
<p>Level 3 <i>Identifies biases that hinder effective communication</i></p> <p><i>With guidance, sensitively and compassionately delivers medical information, elicits patient goals and preferences, and acknowledges uncertainty and conflict</i></p>	<ul style="list-style-type: none"> ● Recognizes own bias about race, sexuality, and gender identity ● While on the neurointerventional team, requires guidance to communicate with a patient about the presence of a 4 mm aneurysm and conveys the option to coil the aneurysm or to follow it; patient goals are at the forefront of the discussion
<p>Level 4 <i>Actively improves communication barriers</i></p> <p><i>Independently, uses shared decision making to align patient goals, and preferences with treatment options to make a personalized care plan</i></p>	<ul style="list-style-type: none"> ● Takes responsibility and apologizes after using wrong pronoun with a patient ● While on the neurointerventional team, independently communicates with a patient about the presence of a 4 mm aneurysm and conveys the option to coil the aneurysm or to follow it; patient goals are at the forefront of the discussion
<p>Level 5 <i>Coaches other learners to improve communication barriers</i></p>	<ul style="list-style-type: none"> ● Role models and supports colleagues in self-awareness and reflection to improve communication with patients, and demonstrates intuitive understanding of a patient’s

<p><i>Coaches or teaches other learners in shared decision making</i></p>	<p>perspective; uses a contextualized approach to minimize barriers for patients and colleagues</p> <ul style="list-style-type: none"> ● Role models proactive self-awareness and reflection around explicit and implicit biases with a context-specific approach to mitigating communication barriers ● Leads shared decision making with clear recommendations to patients and families even in more complex clinical situations
<p>Assessment Models or Tools</p>	<ul style="list-style-type: none"> ● Direct observation ● Kalamazoo Essential Elements Communication Checklist (Adapted) ● Mini-clinical evaluation exercise (CEX) ● Multisource feedback ● Self-assessment including self-reflection exercises ● Simulation ● Skills needed to Set the state, Elicit information, Give information, Understand the patient, and End the encounter (SEGUE) ● Standardized patients or structured case discussions
<p>Curriculum Mapping</p>	<ul style="list-style-type: none"> ●
<p>Notes or Resources</p>	<ul style="list-style-type: none"> ● Laidlaw A, Hart J. Communication skills: An essential component of medical curricula. Part I: Assessment of clinical communication: AMEE Guide No. 51. <i>Med Teach</i>. 2011;33(1):6-8. https://www.tandfonline.com/doi/full/10.3109/0142159X.2011.531170. 2020. ● Makoul G. Essential elements of communication in medical encounters: the Kalamazoo consensus statement. <i>Acad Med</i>. 2001;76(4):390-393. https://insights.ovid.com/crossref?an=00001888-200104000-00021. 2020. ● Makoul G. The SEGUE Framework for teaching and assessing communication skills. <i>Patient Educ Couns</i>. 2001;45(1):23-34. https://www.sciencedirect.com/science/article/abs/pii/S0738399101001367?via%3Dihub. 2020. ● Symons AB, Swanson A, McGuigan D, Orrange S, Akl EA. A tool for self-assessment of communication skills and professionalism in residents. <i>BMC Med Educ</i>. 2009;9:1. https://bmcmmededuc.biomedcentral.com/articles/10.1186/1472-6920-9-1. 2020.

Interpersonal and Communication Skills 2: Interprofessional and Team Communication	
Overall Intent: To effectively communicate with the health care team, including with consultants, in both straightforward and complex situations	
Milestones	Examples
<p>Level 1 <i>Respectfully receives a consultation request</i></p> <p><i>Demonstrates knowledge of the institutional and national communication guidelines</i></p>	<ul style="list-style-type: none"> ● Accepts a request to do a late afternoon image-guided procedure and offers to discuss with the attending without offering resistance ● Reviews imaging findings with a neurology team at the PACS workstation and asks an attending for help when necessary ● Demonstrates knowledge of emergent or unexpected findings that necessitate communication with the health care team in accordance with institutional and national guidelines
<p>Level 2 <i>Clearly and concisely responds to a consultation request</i></p> <p><i>Communicates emergent findings according to institutional or national guidelines</i></p>	<ul style="list-style-type: none"> ● Offers consulting service guidance on the appropriateness of an imaging test or procedure when it can reasonably be performed after discussion with the attending and technologists ● Communicates and documents emergent findings in the imaging report in accordance with institutional and national guidelines
<p>Level 3 <i>Checks understanding of recommendations when providing consultation</i></p> <p><i>Communicates non-emergent findings where failure to act may adversely affect patient outcome</i></p>	<ul style="list-style-type: none"> ● Offers detailed instructions on post-procedural care of a patient to the health care team, answers questions, and verifies understanding on how to care for a groin puncture site following cerebral angiography ● Communicates unexpected findings on an imaging study (such as an aneurysm on a CTA or renal mass on a lumbar spine MRI) with appropriate recommendations for follow-up in accordance with institutional and national guidelines
<p>Level 4 <i>Coordinates recommendations from different members of the health care team to optimize patient care</i></p> <p><i>Communicates findings and management options (as appropriate) that are tailored to the referring provider</i></p>	<ul style="list-style-type: none"> ● After performing an imaging guided lumbar puncture and discussing the presence of leptomeningeal enhancement on MRI with the neurology team, decides to send the cerebrospinal fluid for cytology to evaluate for central nervous system lymphoma as well as for inflammatory markers ● Communicates to a generalist that the patient had a stroke but presents greater clinical data to a neurologist (such as the European Cooperative Acute Stroke Study (ECASS) score for hemorrhagic transformation, or Alberta stroke program early CT score (ASPECTS) score, and which gyri are involved) ● Communicates to a general practitioner that a patient has oropharyngeal squamous cell carcinoma but tailors a neck CT report to the otolaryngology surgeon or head/neck

	oncologist with details regarding appropriate staging using eighth edition of the American Joint Committee on Cancer (AJCC)'s cancer staging system criteria
Level 5 <i>Role models flexible communication strategies that value input from all health care team members, resolving conflict when needed</i>	<ul style="list-style-type: none"> • Role models the resolution of conflict between neurological surgery, orthopedic surgery, neurology, and the emergency department for MRI scan prioritization
<i>Coaches and teaches other learners in tailored communications to referring providers</i>	<ul style="list-style-type: none"> • Coaches other learners in subspecialty-level communication of findings and reporting
Assessment Models or Tools	<ul style="list-style-type: none"> • Direct observation • End-of-rotation evaluation • Multisource feedback • Simulation
Curriculum Mapping	<ul style="list-style-type: none"> •
Notes or Resources	<ul style="list-style-type: none"> • ACR. Communication Curriculum for Radiology Residents. https://www.acr.org/Member-Resources/rfs/learning/Communication-for-Radiology-Residents. 2020. • Dehon E, Simpson K, Fowler D, Jones A. Development of the faculty 360. <i>MedEdPORTAL</i>. 2015;11:10174. https://www.mededportal.org/publication/10174/. 2020. • François J. Tool to assess the quality of consultation and referral request letters in family medicine. <i>Can Fam Physician</i>. 2011;57(5):574–575. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3093595/. 2020.

Interpersonal and Communication Skills 3: Communication within Health Care Systems Overall Intent: To effectively communicate using a variety of methods	
Milestones	Examples
Level 1 <i>Demonstrates knowledge of institutional communications policies, including the safeguarding patient information</i>	<ul style="list-style-type: none"> ● Describes the appropriate and inappropriate use of cell phone, personal computer, email, and social media ● Does not disclose protected health information in public areas
Level 2 <i>Communicates appropriately as required by institutional policy</i>	<ul style="list-style-type: none"> ● Uses secured email for communication of patient information
Level 3 <i>Communicates systems concerns in a respectful manner</i>	<ul style="list-style-type: none"> ● Communicates with the appropriate radiology department supervisor or hospital reporting system about CT or MRI resource prioritization
Level 4 <i>Communicates clear and constructive suggestions to improve systems</i>	<ul style="list-style-type: none"> ● Communicates that efficiency in interpretations could improve significantly if phone calls were diverted to a radiology aide or to a central call center in the department
Level 5 <i>Facilitates dialogue regarding systems issues among larger community stakeholders (division, department, institution, health care system)</i>	<ul style="list-style-type: none"> ● Through participation on the hospital stroke committee, helps facilitate improvement in the reporting of acute stroke head CT results to the stroke team through a standardized reporting process, aiding in efficient and timely patient management
Assessment Models or Tools	<ul style="list-style-type: none"> ● Assessment of QI projects ● Audit of hospital notification system submissions ● Direct observation ● Medical record (chart) audit ● Multisource feedback ● Simulation
Curriculum Mapping	<ul style="list-style-type: none"> ●
Notes or Resources	<ul style="list-style-type: none"> ● ACR. Communication Curriculum for Radiology Residents. https://www.acr.org/Member-Resources/rfs/learning/Communication-for-Radiology-Residents. 2020. ● HIPAA training ● Hryhorczuk AL, Hanneman K, Eisenberg RL, Meyer EC, Brown SD. Radiologic professionalism in modern health care. <i>Radiographics</i>. 2015;35(6):1779-1788. https://pubs.rsna.org/doi/pdf/10.1148/rq.2015150041. 2020. ● Institutional communication policies ● Kelly AM, Mullan PB. Designing a curriculum for professionalism and ethics within radiology: identifying challenges and expectations. <i>Acad Radiol</i>. 2018;25(5):610-618. https://www.academicradiology.org/article/S1076-6332(18)30091-6/pdf. 2020.

Neuroradiology Supplemental Guide

To help programs transition to the new version of the Milestones, the ACGME has mapped the original Milestones 1.0 to the new Milestones 2.0. Indicated below are where the subcompetencies are similar between versions. These are not exact matches, but are areas that include similar elements. Not all subcompetencies map between versions. Inclusion or exclusion of any subcompetency does not change the educational value or impact on curriculum or assessment.

Milestones 1.0	Milestones 2.0
	PC1: Reporting
PC1: Consultant in Neuroradiology	PC2: Consultant in Neuroradiology
PC2: Competence in Invasive and Non-invasive Procedures	PC4: Competence in Neuroradiology Procedures
PC3: Patient Safety	SBP1: Patient Safety SBP5: Contrast Agent Safety SBP6: Radiation Safety SBP7: Magnetic Resonance (MR) Safety
MK1: Application of Neuroscience in Neuroradiology	MK1: Application of Neuroscience to Neuroradiology
MK2: Interpretation of Neuroimaging	PC3: Interpretation of Neuroimaging
MK3: Protocol selection and Optimization of Images	MK2: Protocol Selection, Contrast Agent Selection/Dosing, and Image Optimization
SBP1: Health Care Economics	SBP4: Physician Role in Health Care Systems
	SBP3: System Navigation for Patient-Centered Care
PBL11: Self-directed Learning	PBL11: Evidence-Based and Informed Practice PBL12: Reflective Practice and Commitment to Professional Growth
PBL12: Scholarly Activity	
PBL13: Implements Quality Improvement Project	SBP2: Quality Improvement
PROF1: Personal	PROF1: Professional Behavior and Ethical Principles PROF3: Self-Awareness and Help Seeking
PROF2: Systems	PROF2: Accountability/Conscientiousness
ICS1: Effective Communication with Patients, Families and Caregivers	ICS1: Patient- and Family-Centered Communication
ICS2: Effective Communication with Members of the Health Care Team (Written and Oral)	ICS2: Interprofessional and Team Communication ICS3: Communication within Health Care Systems

Available Milestones Resources

Milestones 2.0: Assessment, Implementation, and Clinical Competency Committees Supplement, 2021 - <https://meridian.allenpress.com/jgme/issue/13/2s>

Milestones Guidebooks: <https://www.acgme.org/milestones/resources/>

- *Assessment Guidebook*
- *Clinical Competency Committee Guidebook*
- *Clinical Competency Committee Guidebook Executive Summaries*
- *Implementation Guidebook*
- *Milestones Guidebook*

Milestones Guidebook for Residents and Fellows: <https://www.acgme.org/residents-and-fellows/the-acgme-for-residents-and-fellows/>

- *Milestones Guidebook for Residents and Fellows*
- *Milestones Guidebook for Residents and Fellows Presentation*
- *Milestones 2.0 Guide Sheet for Residents and Fellows*

Milestones Research and Reports: <https://www.acgme.org/milestones/research/>

- *Milestones National Report*, updated each fall
- *Milestones Predictive Probability Report*, updated each fall
- *Milestones Bibliography*, updated twice each year

Developing Faculty Competencies in Assessment courses - <https://www.acgme.org/meetings-and-educational-activities/courses-and-workshops/developing-faculty-competencies-in-assessment/>

Assessment Tool: Direct Observation of Clinical Care (DOCC) - <https://dl.acgme.org/pages/assessment>

Assessment Tool: Teamwork Effectiveness Assessment Module (TEAM) - <https://team.acgme.org/>

Improving Assessment Using Direct Observation Toolkit - <https://dl.acgme.org/pages/acgme-faculty-development-toolkit-improving-assessment-using-direct-observation>

Remediation Toolkit - <https://dl.acgme.org/courses/acgme-remediation-toolkit>

Learn at ACGME has several courses on Assessment and Milestones - <https://dl.acgme.org/>