Supplemental Guide: Diagnostic Radiology

ACGME

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Milestones Supplemental Guide

This document provides additional guidance and examples for the Diagnostic Radiology 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.

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Patient Care 1: Reporting **Overall Intent:** To generate effective radiology reports tailored to the care provider	
Milestones	**Examples**
Level 1 *Generates reports with appropriate elements for coding* *Describes lexicons and structured reporting*	● For a complete abdominal ultrasound, the report includes history, comparison, technique, findings, all required anatomy, impressions/conclusions ● Describes one of the lexicons used at his/her training site; describes structured reporting used
Level 2 *Efficiently generates clear and concise reports which do not require substantive correction* *Uses lexicons and structured reporting that do not require substantive correction*	● Creates a report for screening mammogram using appropriate lexicon and Breast Imaging Reporting and Data System (BI-RADS) without major corrections in the description of the focal asymmetry versus mass, when appropriate
Level 3 *Efficiently generates clear and concise reports which rarely require correction* *Uses lexicons and structured reporting which rarely require correction*	● Creates a report for liver mass characterization using appropriate lexicons and Liver Reporting and Data System (LI-RADS); accurately describes the lesion and rarely has grammatical errors, when appropriate
Level 4 *Generates tailored reports meeting the needs of the care provider* *Proficiently uses lexicons and structured reporting to provide accurate and timely reports which do not require correction*	● Creates a report (structured or unstructured) describing pancreatic carcinoma to stage the tumor and guide management decisions, when appropriate
Level 5 *Generates tailored reports meeting subspecialty needs*	● Dictates a neck computed tomography (CT) report to include all required information in order to stage the primary and the nodes in a P16+ oropharyngeal cancer
Assessment Models or Tools	● Direct observation ● Evaluation of the reports ● Faculty evaluations
Curriculum Mapping	●

Notes or Resources	● A substantive change would be a description that needs changes to the lexicons, i.e., BI-RADS2 when it is BI-RADS4, right versus left, or fails to modify template to reflect actual case ● Reports that have description of the findings is not complete. A bone lesion described as lytic but description does not include additional information such as characteristics of the borders or internal matrix. This would be a Level 2 report. ● Reports that come to appropriate conclusion but may require grammatical or syntax corrections. This would be a Level 3 Report. ● American College of Radiology. ACR Practice Parameter for Communication of Diagnostic Imaging Findings. https://www.acr.org/-/media/acr/files/practice-parameters/communicationdiag.pdf. 2019. ● Radiological Society of North America (RSNA). Rad Report. http://www.radreport.org. 2019.

Patient Care 2: Clinical Consultation **Overall Intent:** To provide a high-quality clinical consultation	
Milestones	**Examples**
Level 1 *Uses electronic health records (EHRs) to obtain relevant clinical information*	● Looks up glomerular filtration rate (GFR) prior to protocol a study with intravenous contrast ● Reviews relevant history and laboratory results for a patient with abdominal pain
Level 2 *For emergent and routine radiology consultations, delineates the clinical question, obtains appropriate clinical information, and uses evidence-based imaging guidelines, recommends next steps, with assistance*	● Determines that patient has right lower quadrant pain, refers to American College of Radiology (ACR) Appropriateness Criteria and suggests appropriate exam ● Determines that a pregnant patient has right lower quadrant pain, refers to ACR Appropriateness Criteria and suggests appropriate exam
Level 3 *For complex radiology consultations, delineates the clinical question, obtains appropriate clinical information, and uses evidence-based imaging guidelines, recommends next steps, with assistance*	● A primary care physician has a patient with cirrhosis and a liver mass on ultrasound; the resident provides consultation to address the next step in imaging ● Provides consultation for a patient with a pacemaker and requires magnetic resonance imaging (MRI)
Level 4 *Manages radiology consultations independently, taking into consideration cost effectiveness and risk benefit analysis*	● Independently recommends a scrotal ultrasound and tumor markers first on a consultation for a lung biopsy on a 25-year-old male patient who presents with multiple lung masses on x-ray and a retroperitoneal mass on CT.
Level 5 *Provides comprehensive radiology consultations at the expected level of a subspecialist*	● Consults about a brain tumor and recommends advanced MRI in preparation for biopsy or surgery
Assessment Models or Tools	● Case conferences ● Direct observation ● End-of-rotation evaluation ● Faculty evaluation ● Multisource feedback ● Report review of recommendations
Curriculum Mapping	●
Notes or Resources	● Routine represents those situations in which a resident is expected to provide consultation prior to call/float ● Complex represents those situations in which the patient has a complex clinical history/presentation ● Consultations can be over the phone, in the reading room, at tumor boards, etc. ● American College of Radiology. ACR Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. 2019. ● American College of Radiology. Manual on Contrast Media. https://www.acr.org/Clinical-Resources/Contrast-Manual. 2019.

	● Image Gently. Pediatric Radiology and Imaging. http://www.Imagegently.org. 2019. ● Institutional policies ● ACR Appropriateness Modules for Radiology Residents. http://jhrad.com/acr/. 2019. ● American College of Radiology. ACR Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. 2019.

Patient Care 3: Image Interpretation **Overall Intent:** To appropriately prioritize differential diagnosis for imaging findings and recommend management	
Milestones	**Examples**
Level 1 *Identifies primary imaging findings*	● Identifies intracranial hemorrhage
Level 2 *Identifies secondary and critical imaging findings and formulates differential diagnoses*	● Identifies hemorrhage is in the parenchyma (rather than subarachnoid or extra-axial); generates differential considerations including tumor, stroke, trauma, vascular, and hypertension
Level 3 *Prioritizes differential diagnoses and recommends management options*	● In the setting of an atraumatic hemorrhage, takes into consideration the hemorrhage is in the basal ganglia and prioritizes hypertension ● In the setting of an atraumatic hemorrhage, takes into consideration the hemorrhage is in the subarachnoid space, recommends computed tomography angiography (CTA) to look for aneurysm
Level 4 *Provides a single diagnosis with integration of current guidelines to recommend management, when appropriate*	● Reviews a CT brain showing M1 large vessel occlusion, determines how long since onset, and recommends consultation with neuro-interventional radiology
Level 5 *Demonstrates expertise and efficiency at a level expected of a subspecialist*	● Identifies brain mass as tumefactive multiple sclerosis on pre-operative imaging and immediately contacts surgeon to inform him/her
Assessment Models or Tools	● Direct observation ● End of rotation evaluation ● Exam scores (e.g., RadExam, quizzes, multiple choice exams) ● Simulation ● Objective structured clinical examination
Curriculum Mapping	●
Notes or Resources	● Rotation goals and objectives for recommended reading ● American College of Radiology. ACR Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. 2019. ● Conferences ● Tumor Board

Patient Care 4: Competence in Procedures **Overall Intent:** To proficiently and independently perform procedures; to anticipate and manage complications of procedures	
Milestones	**Examples**
Level 1 *Discusses the indications for and assists with procedures* *Discusses potential procedural complications*	● Knows that a patient with large-volume ascites would be an appropriate candidate for paracentesis and that complications include bleeding
Level 2 *Performs procedures, with direct supervision* *Recognizes complications of procedures and enlists help*	● Performs ultrasound guided paracentesis with direct supervision; recognizes subsequent hypotension and asks for help
Level 3 *Competently performs procedures, with indirect supervision* *Manages complications of procedures, with supervision*	● Performs ultrasound guided paracentesis with indirect supervision; recognizes subsequent hypotension and initiates hydration with supervision
Level 4 *Proficiently and independently performs procedures as expected of a general radiologist* *Anticipates and independently manages complications of procedures performed by a general radiologist*	● Recognizes patient has coagulopathy prior to procedure and develops a plan for management prior, during and after procedure; performs ultrasound guided paracentesis
Level 5 *Proficiently and independently performs procedures expected of a subspecialist* *Proficiently and independently manages complications of procedures performed by a subspecialist*	● Performs transjugular intrahepatic portosystemic shunt (TIPS) procedure for treatment of ascites; manages complication of hepatic encephalopathy
Assessment Models or Tools	● Direct observation ● End-of-rotation evaluation ● Point-of-care procedural checklist ● Procedure logs ● Simulation
Curriculum Mapping	●

Notes or Resources	● The care of patients is undertaken with appropriate faculty supervision and conditional independence, allowing residents to attain the knowledge, skills, attitudes, and empathy required for autonomous practice. ● Background and Intent: The ACGME Glossary of Terms defines conditional independence as “graded, progressive responsibility for patient care with defined oversight.” ● Invasive procedures expected of a general radiologist may include: paracentesis, thoracentesis, thyroid biopsy, superficial lymph node, lumbar puncture, and/or abscess drainage. ● *The New England Journal of Medicine*. Videos in Clinical Medicine. https://www.nejm.org/multimedia/medical-videos. 2019. ● Society of Interventional Radiology. https://www.sirweb.org/. 2019. ● RSNA. Physics Modules. https://www.rsna.org/education/trainee-resources/physics-modules. 2019.

Medical Knowledge 1: Diagnostic Knowledge **Overall Intent:** To apply knowledge of anatomy, pathophysiology, and cellular and molecular systems to generate a differential diagnosis	
Milestones	**Examples**
Level 1 *Demonstrates knowledge of imaging anatomy* *Demonstrates knowledge of pathophysiology of disease processes* *Demonstrates knowledge of cellular and molecular systems*	● Identifies pulmonary lobar anatomy ● Knows spectrum of primary lung pathology ● Knows that lung cancer genomic profiling exists ● Knows thyroid anatomy, knows basic differential for thyroid nodule, knows thyroid cancer can be derived from different cells
Level 2 *Applies knowledge of anatomy to make common imaging diagnoses* *Applies knowledge of pathophysiology to make common imaging diagnoses* *Applies knowledge of cellular and molecular systems to make common imaging diagnoses*	● Accurately identifies lobar pneumonia ● Uses positron emission tomography (PET)-CT to diagnose/stage lung cancer ● Accurately identifies a thyroid nodule on ultrasound, raises the possibility of toxic adenoma in a patient with a thyroid nodule and hyperthyroidism, uses I-123 uptake and scan to identify a hyperfunctioning thyroid adenoma
Level 3 *Applies knowledge of anatomy to make uncommon imaging diagnoses* *Applies knowledge of pathophysiology to make uncommon imaging diagnoses* *Applies knowledge of cellular and molecular systems to make uncommon imaging diagnoses*	● Accurately classifies interstitial pneumonia ● Uses somatostatin receptor imaging to diagnose neuroendocrine tumor ● Identifies abnormal lymph node on ultrasound for follow up post-thyroidectomy in thyroid cancer patient, identifies a metastatic lymph node in patient with prior papillary thyroid cancer post thyroidectomy and new uptake in lymph node on I-123 whole body scan, and recommends PET CT to evaluate for dedifferentiated thyroid cancer in post-thyroidectomy papillary thyroid cancer patient with new elevated thyroglobulin levels and a negative whole body radioiodine scan
Level 4 *Proficiently integrates knowledge of anatomic and molecular imaging with pathophysiology to formulate a diagnosis*	● Suggests sarcoidosis over malignancy on patient with metabolically active mediastinal and hilar lymphadenopathy and appropriately distributed pulmonary nodules
Level 5 *Proficiently integrates knowledge of anatomic and molecular imaging with*	● Recognizes that genetic mutational status of lung cancer exists and guides intervention (fine needle aspiration [FNA] versus multiple core biopsies), work-up, and treatment

pathophysiology to formulate a diagnosis at the expected level of a subspecialist	
Assessment Models or Tools	● Case conference ● Direct observation ● Exam scores ● Report review
Curriculum Mapping	●
Notes or Resources	● Common imaging diagnosis refers to those diseases that one could expect to encounter in regular practice (e.g., pneumonia, pneumothorax, small bowel obstruction, renal stones, appendicitis, stroke, central nervous system bleed, pregnancy, cholecystitis, pulmonary embolism, fractures) ● Uncommon imaging diagnosis refers to those diseases that one would not expect to encounter regularly (e.g., primary bone malignancy, pulmonary arteriovenous malformations, leukodystrophies, congenital heart disease, neuroendocrine tumors, interstitial pneumonia) ● Lydiatt WM, Patel SG, O'Sullivan B, et al. Head and neck cancers - major changes in the American Join Committee on cancer eighth edition cancer staging manual. *CA Cancer J Clin*. 2017;67(2):122-137. https://onlinelibrary.wiley.com/doi/full/10.3322/caac.21389. 2019. ● Louis DN, Perry A, Reifenberger G, et al. The 2016 World Health Organization classification of tumors of the central nervous system: a summary. *Acta Neuropathol*. 2016;131(6):803-820. https://link.springer.com/article/10.1007%2Fs00401-016-1545-1. 2019. ● Glastonbury CM, Mukherji SK, O'Sullivan B, Lydiatt WM. Setting the stage for 2018: how the changes in the American Joint Committee on Cancer/Union for International Cancer Control Cancer Staging Manual eighth edition impact radiologists. *AJNR Am J Neuroradiol.* 2017;38(12):2231-2237. http://www.ajnr.org/content/38/12/2231.long. 2019. ● American College of Radiology. Practice Parameters and Technical Standards. https://www.acr.org/Clinical-Resources/Practice-Parameters-and-Technical-Standards. 2019.

Medical Knowledge 2: Physics **Overall Intent:** To apply knowledge of physics to imaging, including dose reduction strategies, and minimizing risk to patient	
Milestones	**Examples**
Level 1 *Discusses the basic physics for diagnostic radiology*	● Understands optimal positioning of image intensifier for obtaining an image
Level 2 *Demonstrates knowledge of basic medical physics and radiobiology in diagnostic radiology*	● Able to discuss the stochastic and deterministic effects of radiation
Level 3 *Applies knowledge of basic medical physics and radiobiology to imaging*	● Appropriately positions image intensifier to reduce radiation and minimizes use of fluoroscopy during procedure
Level 4 *Applies physical principles to optimize image quality, including dose reduction strategies*	● Uses pulse fluoroscopy to minimize radiation dose to patient
Level 5 *Teaches physical principles to optimize image quality to other specialties*	● Teaches dose reduction strategies to orthopedic surgery residents
Assessment Models or Tools	● Direct observation ● End-of-rotation evaluation ● Evaluation of fluoroscopy times ● Exam and quiz scores ● Multisource feedback ● Protocol engagement report
Curriculum Mapping	●
Notes or Resources	● American College of Radiology. Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. 2019. ● Image Gently. Pediatric Radiology and Imaging. https://www.imagegently.org/. 2019. ● American College of Radiology. Radiation Safety in Adult Medical Imaging. https://www.imagewisely.org/. 2019. ● American College of Radiology. Manual on Contrast Media. https://www.acr.org/Clinical-Resources/Contrast-Manual. 2019. ● American College of Radiology. Radiology Safety. https://www.acr.org/Clinical-Resources/Radiology-Safety. 2019. ● RSNA. Physics Modules. https://www.rsna.org/en/education/trainee-resources/physics-modules. 2019.

Medical Knowledge 3: Protocol Selection and Contrast Agent Selection/Dosing **Overall Intent:** To apply knowledge of protocol selection to optimize imaging	
Milestones	**Examples**
Level 1 *Discusses the protocols and contrast agent/dose for imaging*	● Is familiar with and can use department protocols for imaging
Level 2 *Selects appropriate protocols and contrast agent/dose for emergent and routine imaging*	● Evaluates patient's renal function prior to CT with contrast ● Understands that a trauma patient should have an unenhanced CT of brain prior to additional trauma imaging with contrast
Level 3 *Selects appropriate protocols and contrast agent/dose for complex imaging*	● Knows the indications and specific features of a three phase liver CT scan, including timing
Level 4 *Modifies protocols and contrast agent/dose as determined by clinical circumstances*	● Able to adjust imaging techniques to limit metallic or motion artifacts in CT and MR ● Modifies standard contrast dosing for reduced renal function
Level 5 *Develops imaging protocols*	● Designs a functional MRI protocol ● Develops a MR protocol for vascular wall imaging ● Develops a protocol for contrast enhanced ultrasound characterization of a renal mass
Assessment Models or Tools	● Direct observation ● End-of-rotation evaluation ● Evaluation of fluoroscopy times ● Exam and quiz scores ● Multisource feedback ● Protocol engagement report
Curriculum Mapping	●
Notes or Resources	● American College of Radiology. Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. 2019. ● Image Gently. Pediatric Radiology and Imaging. https://www.imagegently.org/. 2019. ● American College of Radiology. Radiation Safety in Adult Medical Imaging. https://www.imagewisely.org/. 2019. ● American College of Radiology. Radiology Safety. https://www.acr.org/Clinical-Resources/Radiology-Safety. 2019. ● RSNA. Physics Modules. https://www.rsna.org/en/education/trainee-resources/physics-modules. 2019.

Medical Knowledge 4: Imaging Technology and Image Acquisition **Overall Intent:** To optimize image acquisition	
Milestones	**Examples**
Level 1 *Discusses imaging technology and image acquisition*	● Understands different ultrasound transducers
Level 2 *Demonstrates knowledge of basic image acquisition and image processing, and recognizes common imaging artifacts and technical problems*	● Selects correct transducer to image the thyroid; identifies aliasing artifact with Doppler imaging
Level 3 *Demonstrates knowledge of instrument quality control and image reconstruction and troubleshoots for artifact reduction*	● Knows strategies to reduce aliasing artifact for Doppler imaging
Level 4 *Proficiently optimizes image acquisition and processing in collaboration with the technology/imaging team*	● Changes scale to optimize color Doppler imaging
Level 5 *Presents or publishes research on imaging technology*	● Presents or publishes original research on contrast enhanced ultrasound imaging of the kidneys
Assessment Models or Tools	● Direct observation ● End-of-rotation evaluation ● Exam scores ● Multisource feedback ● Point of care checklist
Curriculum Mapping	●
Notes or Resources	● American College of Radiology. Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. 2019. ● Image gently. Pediatric Radiology and Imaging. https://www.imagegently.org/. 2019. ● American College of Radiology. Radiation Safety in Adult Medical Imaging. https://www.imagewisely.org/. 2019. ● American College of Radiology. Manual on Contrast Media. https://www.acr.org/Clinical-Resources/Contrast-Manual. 2019. ● American College of Radiology. Radiology Safety. https://www.acr.org/Clinical-Resources/Radiology-Safety. 2019. ● RSNA. Physics Modules. https://www.rsna.org/en/education/trainee-resources/physics-modules. 2019.

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**
Level 1 *Demonstrates knowledge of common patient safety events* *Demonstrates knowledge of how to report patient safety events*	● Aware that extravasation of contrast is a safety event and knows where and how to report
Level 2 *Identifies system factors that lead to patient safety events* *Reports patient safety events through institutional reporting systems (simulated or actual)*	● Identifies that poor communications 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
Level 3 *Participates in analysis of patient safety events (simulated or actual)* *Participates in disclosure of patient safety events to patients and families (simulated or actual)*	● Has reviewed a patient safety event (e.g., preparing for morbidity and mortality (M and M) presentations), joining a Root Cause Analysis (RCA) group and has communicated with patients/families about such an event
Level 4 *Conducts analysis of patient safety events and offers error prevention strategies (simulated or actual)* *Discloses patient safety events to patients and families (simulated or actual)*	● Resident presents RCA 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
Level 5 *Actively engages teams and processes to modify systems to prevent patient safety events* *Role models or mentors others in the disclosure of patient safety events*	● 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
Assessment Models or Tools	● Direct observation ● Documentation of patient safety project processes or outcomes ● E-module multiple choice tests (e.g., Institute for Healthcare Improvement module, institutional module)

	● Medical record (chart) audit ● M and M conference ● Multisource feedback ● Portfolio ● Reflection ● Simulation
Curriculum Mapping	●
Notes or Resources	● Institute of Healthcare Improvement. http://www.ihi.org/Pages/default.aspx. 2019.

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 *Demonstrates knowledge of basic quality improvement methodologies and metrics*	● Knows that quality improvement methodologies include root cause analysis and fish-bone diagraming
Level 2 *Describes local quality improvement initiatives*	● Is aware of institutional QI initiatives including the handwashing initiative and time-outs
Level 3 *Participates in local quality improvement initiatives*	● Resident participates in departmental or hospital QI committee ● Has participated in a QI project
Level 4 *Demonstrates the skills required to identify, develop, implement, and analyze a quality improvement project*	● Participates in the analysis of a QI project
Level 5 *Creates, implements, and assesses quality improvement initiatives at the institutional or community level*	● 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 ○ Lean Six Sigma
Assessment Models or Tools	● Direct observation ● Documentation of QI processes or outcomes ● E-module multiple choice tests ● Learning portfolio ● Medical record (chart audit) ● Multisource feedback ● Reflection ● Simulation
Curriculum Mapping	●
Notes or Resources	● Institute of Healthcare Improvement. http://www.ihi.org/Pages/default.aspx. 2019. ● 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 *Demonstrates knowledge of care coordination in radiology imaging/procedures*	● Identifies the members of the interprofessional team and describes their roles
Identifies key elements for safe and effective transitions of care and hand-offs	● Describes an effective sign-out to the next radiology team member
Demonstrates knowledge of population and community health needs	● Knows that patients without insurance are less likely to get a mammogram
Level 2 *Coordinates care of patients in routine radiology imaging/procedures effectively using the roles of interprofessional teams*	● Works with other members of the radiology team (nurses, technologists) to coordinate patient imaging, but requires supervision to ensure all necessary imaging is performed
Performs safe and effective transitions of care/hand-offs in routine clinical situations	● Hands off a follow up of chest x-ray after line placement
Identifies specific population and community health needs for their local population	● Identifies that the local population of coal miners may need more screening for lung disease
Level 3 *Coordinates care of patients in complex radiology imaging/procedures effectively using the roles of interprofessional teams*	● Coordinates the imaging sequencing for complex patients such as multi-injured trauma patients
Performs safe and effective transitions of care/hand-offs in complex clinical situations	● Prioritizes urgent patients from the intensive care unit (ICU), trauma, and medicine for imaging/procedures and hands off the plan to the team on the next shift
Identifies local resources available to meet the needs of a patient population and community	● Identifies a breast cancer outreach program in the community
Level 4 *Role models effective coordination of patient-centered care among different disciplines and specialties*	● Role models and educates students and junior team members regarding the engagement of the radiology team as needed for each patient, and ensures the necessary resources have been arranged
Role models safe and effective transitions of care/hand-offs	● Provides efficient hand-offs to ICU team at the end of a rapid response event that occurred in radiology

Participates in adapting the practice to provide for the needs of specific populations (actual or simulated)	● Coordinates and prioritizes consultant input for a new high risk diagnosis (such as malignancy) to ensure the patient gets appropriate follow-up ● Guides junior residents in an effective post-procedure hand off to the referring service ● Participates in screening outreach programs, such as mobile mammogram program
Level 5 *Analyzes the process of care coordination and leads in the design and implementation of improvements* *Improves quality of transitions of care to optimize patient outcomes* *Leads innovations and advocates for populations and communities with specific health care needs*	● 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 ● Works with local outreach programs to develop screening for lung cancer
Assessment Models or Tools	● Direct observation ● Learning portfolio ● Medical record (chart) audit ● Multisource feedback ● Objective structured clinical examination ● Review of sign-out tools ● Use/Completion of checklists
Curriculum Mapping	●
Notes or Resources	● Working with the local population the resident can participate in areas within or outside of radiology (e.g., open door clinics, diabetes screening) ● Institutional hand-off guidelines ● Joint Commission Center for Transforming Healthcare. Hand-off Communications Targeted Solutions Tool. https://www.centerfortransforminghealthcare.org/tsthoc.aspx. 2019.

Systems-Based Practice 4: Physician Role in Health Care Systems **Overall Intent:** To understand his/her 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**
Level 1 *Identifies key components of the complex healthcare system (e.g., hospital, finance, personnel, technology)* *Describes the mechanisms for reimbursement, including types of payors*	● Recognizes that multiple components exist in a health care system, including various practice settings, reimbursement models, and types of insurance ● Describes various payment systems, such as Medicare, Medicaid, the US Department of Veterans Affairs, and commercial third-party payors ● Describes various practice models
Level 2 *Describes how components of a complex health care system are inter-related, and how this impacts patient care* *States relative cost of common procedures*	● Understands that pre-authorization may impact patient care and remuneration to the health system ● States relative costs of chest x-ray versus chest CT
Level 3 *Discusses how individual practice affects the broader system (e.g., length of stay, readmission rates, clinical efficiency)* *Describes the technical and professional components of imaging costs*	● Understands that turnaround times and dictation errors may affect patient care, e.g., length of stay, which impacts the broader system ● Differentiates between the technical and professional costs of a head CT
Level 4 *Manages various components of the complex health care system to provide efficient and effective patient care and transition of care* *Describes the radiology revenue cycle and measurements of productivity (e.g., relative value units)*	● Works collaboratively with pertinent stakeholders to improve procedural start times ● Works collaboratively to improve informed consent for non-English-speaking patients requiring interpreter services ● Understands the multiple components of the revenue cycle applied to an MRI exam ● Understands how relative value units differ between imaging exams and how they are calculated
Level 5 *Advocates for or leads systems change that enhances high-value, efficient, and effective patient care and transition of care* *Participates in health policy advocacy activities*	● Publishes original research on high-value patient care in peer-reviewed journal ● Works with community or professional organizations to advocate for no smoking ordinances or enrollment in lung cancer screening program
Assessment Models or Tools	● Direct observation

	● Medical record (chart) audit ● Multiple choice test ● Objective structured clinical examination ● QI project
Curriculum Mapping	●
Notes or Resources	● Lam DL, Medverd JR. How radiologists get paid: resource-based relative value scale and the revenue cycle. *AJR*. 2013;201:947-958. https://www.ajronline.org/doi/full/10.2214/AJR.12.9715. 2019. ● Agency for Healthcare Research and Quality. The Challenges of Measuring Physician Quality. https://www.ahrq.gov/$(SERVE_NS_)/professionals/quality-patient-safety/talkingquality/create/physician/challenges.html. 2019. ● Agency for Healthcare Research and Quality. Major Physician Performance Sets. https://www.ahrq.gov/talkingquality/measures/setting/physician/measurement-sets.html. 2019. ● Henry J Kaiser Family Foundation. https://www.kff.org/. 2019. ● Henry J Kaiser Family Foundation. Health Reform. https://www.kff.org/health-reform/. 2019. ● National Academy of Medicine. Vital Detections for Health and Health Care: A Policy Initiative of the National Academy of Medicine. https://nam.edu/initiatives/vital-directions-for-health-and-health-care/. 2019. ● The Commonwealth Fund. Health System Data Center. http://datacenter.commonwealthfund.org/?_ga=2.110888517.1505146611.1495417431-1811932185.1495417431#ind=1/sc=1. 2019. ● The Commonwealth Fund. Health Reform Resource Center. http://tools.commonwealthfund.org/interactives-and-data/health-reform-resource-center#/f:@facasubcategoriesfacet63677=[Individual%20and%20Employer%20Responsibility]. 2019. ● Oklahoma State University Medical Center Diagnostic Radiology Residency. Business of Radiology. http://www.osumcradiology.org/educationalschedule/lecutres/BusinessofRadiology/#0. 2019. ● RSNA Online Learning Center. Level 2: Service Valuation and Costs. http://education.rsna.org/diweb/catalog/item?id=2223133. 2019. ● RSNA Online Learning Center. Level 1: Reimbursement Basic. http://education.rsna.org/diweb/catalog/item?id=2210377. 2019.

Systems-Based Practice 5: Contrast Agent Safety **Overall Intent:** To demonstrate competence in recognizing and managing contrast (iodinated and gadolinium) reactions	
Milestones	**Examples**
Level 1 *Demonstrates knowledge of contrast reactions*	● Has basic knowledge and awareness of contrast reactions, including their recognition and management ● Can describe the management of: ○ Bronchospasm ○ Contrast extravasation ○ Hives ○ Hypotension with bradycardia ○ Hypotension with tachycardia ○ Laryngeal edema ○ Premedication regimens
Level 2 *Recognizes contrast reactions (simulated or actual)*	● Is able to consistently and reliably recognize different signs of a patient's contrast reaction in simulation or actual in the CT or MRI department ● Can recognize the following: ○ Bronchospasm ○ Hives ○ Hypotension with bradycardia ○ Hypotension with tachycardia ○ Laryngeal edema
Level 3 *Manages contrast reactions, with supervision (simulated or actual)*	● Consistently and reliably manages (with supervision) contrast reactions in simulation or actual in the CT or MRI department ● Can manage the following: ○ Bronchospasm ○ Hives ○ Hypotension with bradycardia ○ Hypotension with tachycardia ○ Laryngeal edema
Level 4 *Independently manages contrast reactions (simulated or actual)*	● Consistently and reliably recognizes and manages contrast reactions independently in simulation or actual in the CT or MRI department
Level 5 *Leads educational experience in simulation laboratory for contrast reaction*	● Assumes a leadership role in the department or institution to conduct a seminar or experience for a variety of contrast reaction(s)
Assessment Models or Tools	● Direct observation

	● Medical record (chart) audit ● Multiple choice test ● Objective structured clinical examination ● Reflection ● Simulation
Curriculum Mapping	●
Notes or Resources	● American College of Radiology. Manual on Contrast Media. https://www.acr.org/Clinical-Resources/Contrast-Manual. 2019. ● BLS and ACLS certification courses ● American College of Radiology. Contrast Card. https://www.acr.org/-/media/ACR/Files/Clinical-Resources/Contrast-Reaction-Card.pdf. 2019.

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 *Demonstrates knowledge of the mechanisms of radiation injury and the ALARA ("as low as reasonably achievable") concept*	● Is able to describe fundamental concepts in radiation biology addressing the mechanism of injury at different radiation exposures
Level 2 *Accesses resources to determine exam-specific average radiation dose information*	● Can readily access online resources to determine a CT of the head average dose information
Level 3 *Communicates the relative risk of exam-specific radiation exposure to patients and practitioners*	● Is able to effectively communicate relative risks of the radiation exposure during a CT of the head to the patient, patient's family or referring provider
Level 4 *Applies principles of ALARA in daily practice*	● Can modify CT parameters for an abdominal CT in keeping with the ALARA principles routinely in daily practice
Level 5 *Creates, implements, and assesses radiation safety initiatives at the institutional level*	● Begins a radiation safety initiative with the Radiation Safety Officer addressing CT use for appendicitis in pregnant women
Assessment Models or Tools	● Chart, protocoling or other system documentation by resident ● Direct observation ● Documentation of QI or radiation safety project processes or outcome ● Multiple choice test ● Objective structured clinical examination
Curriculum Mapping	●
Notes or Resources	● American College of Radiology. ACR Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. 2019. ● Image Gently. Pediatric Radiology and Imaging. https://www.imagegently.org/. 2019. ● American College of Radiology. Radiology Safety. https://www.acr.org/Clinical-Resources/Radiology-Safety. 2019. ● Image Wisely. https://www.imagewisely.org/. 2019. ● RSNA. Physics Modules. https://www.rsna.org/en/education/trainee-resources/physics-modules. 2019. ● American College of Radiology. Radiation Safety. https://www.acr.org/Clinical-Resources/Radiology-Safety/Radiation-Safety. 2019.

Systems-Based Practice 7: Magnetic Resonance (MR) Safety **Overall Intent:** To have an understanding of the practical aspects of MR safety	
Milestones	**Examples**
Level 1 *Demonstrates knowledge of the risks of magnetic resonance imaging (MRI), including safety zones and pre-MR screening*	● Describes safety zones Level 1 through IV ● Lists key components of MRI screening process
Level 2 *Accesses resources to determine the safety of implanted devices and retained foreign bodies*	● Knows how to find out if it's safe to perform an MRI on a patient with a cochlear implant
Level 3 *Communicates MR safety, including implants and retained foreign bodies, to patients and practitioners*	● Communicates any risks of performing an MRI with shrapnel to a patient
Level 4 *Applies principles of MR safety to daily practice*	● Explains the principles of MR safety; handles a patient with a pacemaker, and can gets them through the scan (complex case), programmable shunt (complex case)
Level 5 *Creates, implements, and assesses MR safety initiatives at the institutional level*	● Is a member of the Hospital wide Safety Committee and is considered the definitive resource for MR safety
Assessment Models or Tools	● Multisource feedback, including MRI Technologist ● 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	●
Notes or Resources	● American College of Radiology. MR Safety. https://www.acr.org/Clinical-Resources/Radiology-Safety/MR-Safety. 2019. ● MRI Questions. MRI Suite: Safety Zones. http://mriquestions.com/acr-safety-zones.html. 2019. ● Expert Panel on MR Safety, Kanal E, Barkovich AJ, et al. ACR guidance document on MR safe practices: 2013. *J Magn Reson Imaging*. 2013;37(3):501-530. https://onlinelibrary.wiley.com/doi/pdf/10.1002/jmri.24011. 2019. ● Complete AAPM/RSNA Web Module: MRI Course#9 Quality/ Bioeffects/Safety ● RSNA. Physics Modules. https://www.rsna.org/education/trainee-resources/physics-modules. 2019. ● MRI Safety. http://mrisafety.com/. 2019. ● American College of Radiology. MR Safety. https://www.acr.org/ClinicalResources/Radiology-Safety/MR-Safety. 2019.

Systems-Based Practice 8: Informatics **Overall Intent:** To understand the technology underlying image acquisitions, transmission, and interpretation; to have a broader understanding of data use for regulatory requirements, billing, and quality and patient care improvement	
Milestones	**Examples**
Level 1 *Demonstrates familiarity with information systems, including EHR, radiology information system, and picture archiving system*	● Navigates all the various information systems to dictate a study to include finding the study on the correct worklist, looking up history, and displaying images with comparisons.
Level 2 *Demonstrates familiarity with information standards in radiology, and describes their roles*	● Describes information standards in radiology to include DICOM, HL7, SNOMED-CT, LOINC/RadLex, ICD-10 and CPT
Level 3 *Describes approaches to capture and integrate data from radiology examinations into medical decision making*	● Describes/explains how to use Structured Reporting and Common Data Elements to create radiology reports and to enable extraction of data for analytics ● Describes how data from Common Data Elements can impact decision making
Level 4 *Applies knowledge of information systems, standards, and data to support radiology initiatives, as appropriate*	● Participates on committees responsible for implementation of solutions that address regulatory requirements ● Participates on committee responsible for implementing state legislated bills, for example, patient test results notification ● Describes examples of artificial intelligence (AI) in radiology that include both image interpretation as well as applications beyond image interpretation
Level 5 *Participates in operational and strategic information systems meetings; applies informatics knowledge to help guide direction and operation of the radiology department*	● Participates actively in information system decision making; is a member of the departmental informatics leadership council ● Understands that AI algorithms are amoral and are built to optimize function, and are prone to bias and potentially can produce significant ethical issues
Assessment Models or Tools	● Quiz
Curriculum Mapping	●
Notes or Resources	● Branstetter BF IV. Basics of imaging informatics: part 1. *Radiology*. 2007;243(3):656-667. https://pubs.rsna.org/doi/abs/10.1148/radiol.2433060243. 2019. ● Branstetter BF IV. Basics of imaging informatics: part 2. *Radiology*. 2007;244(1):78-84. https://pubs.rsna.org/doi/10.1148/radiol.2441060995. 2019. ● Wang KC, Kohli M, Carrino JA. Technology standards in imaging: a practical overview. *J AM Coll Radiol*. 2014;11(12 Pt B):1251-1259. https://drive.google.com/file/d/0BywqhJQDpUSjYTlYOC1sZkNPZkk/view. 2019. ● Horii SC. Primer on computers and information technology. Part four: A nontechnical introduction to DICOM. *Radiographics*. 1997;17(5):1297-1309. https://pubs.rsna.org/doi/pdf/10.1148/radiographics.17.5.9308117. 2019.

	● Channin DS. Integrating the healthcare enterprise: a primer. Part 2. Seven brides for seven brothers: the IHE integration profiles. *Radiographics*. 2001;21(5):1343-1350. https://drive.google.com/file/d/0BywqhJQDpUSjY1ppNGxiemliSFk/view. 2019. ● Kohli M, Geis R. Ethics, artificial intelligence, and radiology. *JACR*. 2018;15(9):1317-1319. https://www.jacr.org/article/S1546-1440(18)30628-8/fulltext. 2019. ● Carlos RC, Kahn CE, Halabi S. Data science: big data, machine learning, and artificial intelligence. *JACR*. 2018;15(3 Part B):497-498 https://www.jacr.org/article/S1546-1440(18)30055-3/abstract. 2019. ● Hosny A, Parmar C, Quackenbush J, Schwartz LH, Aerts HJWL. Artificial intelligence in radiology. *Nat Rev Cancer*. 2018;18(8):500-510. https://www.ncbi.nlm.nih.gov/pubmed/29777175. 2019.

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 *Demonstrates how to access and use available evidence to determine the best imaging examination for a routine patient/diagnosis*	● Understands the importance of imaging safety literature and websites
Level 2 *Articulates clinical questions and elicits patient preferences and values in order to guide evidence-based imaging*	● Identifies patients with conditional risks for MRI safety, radiation safety, or contrast use
Level 3 *Locates and applies the best available evidence, integrated with patient preferences and values, to the care of complex patients*	● Uses radiology literature to determine patient MRI safety, radiation safety, or contrast use
Level 4 *Critically appraises conflicting evidence to guide care, tailored to the individual patient*	● 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 *Coaches others to critically appraise and apply evidence for complex patients; and/or participates in the development of guidelines*	● Writes or revises department policy on MRI safety, radiation safety, or contrast use according to best practices
Assessment Models or Tools	● Direct observation ● Learning portfolio ● Oral or written examination ● Simulation (objective structured clinical examination)
Curriculum Mapping	●
Notes or Resources	● National Institutes of Health. Write Your Application. https://grants.nih.gov/grants/how-to-apply-application-guide/format-and-write/write-your-application.htm. 2019. ● NIH U.S. National Library of Medicine. PubMed Tutorial. https://www.nlm.nih.gov/bsd/disted/pubmedtutorial/cover.html. 2019. ● Institutional Review Board (IRB) guidelines ● Various journal submission guidelines ● ABR 2019 Noninterpretive Skills Study Guide. https://www.theabr.org/wp-content/uploads/2018/11/NIS-Study-Guide-2019.pdf. 2019. ● MRI Safety. http://mrisafety.com. 2019. ● Expert Panel on MR Safety, Kanal E, Barkovich AJ, et al. ACR guidance document on MR safe practices: 2013. *J Magn Reson Imaging*. 2013;37(3):501-530. https://onlinelibrary.wiley.com/doi/pdf/10.1002/jmri.24011. 2019. ● Image Gently. Pediatric Radiology and Imaging. www.imagegently.org. 2019.

	● Image Wisely. www.imagewisely.org. 2019. ● Harvey L. Neiman Health Policy Institute. http://www.neimanhpi.org/. 2019. ● Moriates C, Arora V, Shah N. *Understanding Value Based Healthcare*. 1st ed. New York, NY: McGraw Hill Education; 2015. ● The University of Texas at Austin Dell Medical School. Discovering Value-Based Health Care. https://vbhc.dellmed.utexas.edu/. 2019.

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**
Level 1 *Accepts responsibility for professional development by establishing goals* *Identifies factors which contribute to gap(s) between expectations and actual performance* *Actively seeks opportunities to improve performance*	● 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 to prepare for call
Level 2 *Receptive to performance data and feedback in order to adjust goals* *Analyzes and reflects on factors which contribute to gap(s) between expectations and actual performance* *Designs and implements a learning plan, with prompting*	● Uses feedback to set goals to read more studies each day ● Reflects on factors contributing to lack of efficiency ● With prompting, develops a learning plan to improve efficiency
Level 3 *Episodically seeks performance data and feedback, with humility and adaptability* *Analyzes, reflects on, and institutes behavioral change(s) to narrow the gap(s) between expectations and actual performance* *Designs and implements a learning plan independently*	● 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
Level 4 *Consistently seeks performance data and feedback with humility and adaptability*	● Independently follows up on the outcomes of patients for which they have dictated reports

Analyzes effectiveness of behavioral changes where appropriate and considers alternatives in narrowing the gap(s) between expectations and actual performance *Uses performance data to measure the effectiveness of the learning plan and when necessary, improves it*	● Consistently identifies learning gaps and addresses areas to work on ● Uses scores from standardized assessments (e.g., RadExam, ACR In-Training) to create a learning plan
Level 5 *Coaches other learners to consistently seek performance data and feedback* *Coaches others on reflective practice* *Facilitates the design and implements learning plans for others*	● 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
Assessment Models or Tools	● Direct observation ● Review of learning plan ● Standardized assessments
Curriculum Mapping	●
Notes or Resources	● Hojat M, Veloski JJ, Gonnella JS. Measurement and correlates of physicians' lifelong learning. *Academic Medicine*. 2009;84(8):1066-1074. https://journals.lww.com/academicmedicine/fulltext/2009/08000/Measurement_and_Correlates_of_Physicians__Lifelong.21.aspx. 2019. ● 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. *Academic Medicine*. 2013;88(10):1558-1563. https://journals.lww.com/academicmedicine/fulltext/2013/10000/Assessing_Residents__Written_Learning_Goals_and.39.aspx. 2019. ● Burke AE, Benson B, Englander R, Carraccio C, Hicks PJ. Domain of competence: practice-based learning and improvement. *Academic Pediatrics*. 2014;14(2 Suppl):S38-S54. https://www.academicpedsjnl.net/article/S1876-2859(13)00333-1/pdf. 2019. ● Collins J. Lifelong learning in the 21st century and beyond. *Radiographics.* 2009;29(2):613-622. https://pubs.rsna.org/doi/pdf/10.1148/rg.292085179. 2019.

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**
Level 1 *Demonstrates knowledge of expectations for professional behavior and describes how to appropriately report professional lapses* *Demonstrates knowledge of the ethical principles underlying informed consent, surrogate decision making, advance directives, confidentiality, error disclosure, and stewardship of limited resources*	● 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) ● Obtains informed consent for procedures
Level 2 *Demonstrates insight into professional behavior in routine situations and takes responsibility for own professionalism lapses* *Analyzes straightforward situations using ethical principles*	● Demonstrates professional behavior in routine situations and uses ethical principles to analyze straightforward situations, such as those where: ○ there are no or few conflicts (between values or patients) ○ the resident 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 responsibility for lapse ● Apologizes and takes corrective action for the lapse(s) if necessary ● Articulates strategies for preventing similar lapses in the future
Level 3 *Demonstrates professional behavior in complex or stressful situations* *Recognizes need to seek help in managing and resolving complex ethical situations*	● Analyzes complex situations, such as how the clinical situation evokes strong emotions, conflicts (or perceived conflicts) between patients or between professional values; the trainee or learner navigates a situation while not at his/her personal best (due to fatigue, hunger, stress, etc.), or 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 ● Recognizes own limitations, and consistently demonstrates professional behavior
Level 4 *Recognizes situations that may trigger professionalism lapses and intervenes to prevent lapses in self and others*	● 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

Recognizes and uses appropriate resources for managing and resolving ethical dilemmas as needed (e.g., ethics consultations, literature review, risk management/legal consultation)	● Models respect for patients and expects the same from others ● Recognizes and utilizes appropriate resources for managing and resolving ethical dilemmas (e.g., ethics consultations, literature review, risk management/legal consultation)
Level 5 *Coaches others when their behavior fails to meet professional expectations* *Identifies and seeks to address system-level factors that induce or exacerbate ethical problems or impede their resolution*	● Coaches others when their behavior fails to meet professional expectations, either in the moment (for minor or moderate single episodes of unprofessional behavior) or after the moment (for major single episodes or repeated minor to moderate episodes of unprofessional behavior) ● 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 (e.g., ethics committee or sub-committee, risk management committee, root cause analysis review, patient safety or satisfaction committee, professionalism work group, Institutional Review Board (IRB), fellow grievance committee, etc.
Assessment Models or Tools	● Direct observation ● End-of-rotation evaluation ● Multisource feedback ● Oral or written self-reflection ● Objective structured clinical examination ● RSNA professionalism modules ● Simulation
Curriculum Mapping	●
Notes or Resources	● Radiological Society of North America. Professionalism for Residents. https://www.rsna.org/education/professionalism-and-quality-care/professionalism-self-assessments/professionalism-for-residents. 2019. ● AMA. Ethics. https://www.ama-assn.org/delivering-care/ethics. 2019. ● Byyny RL, Papadakis MA, Paauw DS, Pfiel S, Alpha Omega Alpha. *Medical Professionalism Best Practices*. Menlo Park, CA: Alpha Omega Alpha Honor Medical Society; 2015. https://alphaomegaalpha.org/pdfs/2015MedicalProfessionalism.pdf. 2019. ● 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. 2019. ● American College of Radiology. Code of Ethics. https://www.acr.org/-/media/ACR/Files/Governance/Code-of-Ethics.pdf. 2019. ● 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. 2019.

	● Association of University Radiologists. Professionalism Curriculum Resources. http://www.aur.org/ProfessionalCurriculum/. 2019. ● Association of University Radiologists. Professionalism and Ethics Competencies for Radiology Residents. http://www.aur.org/Secondary.aspx?id=10263. 2019.

Professionalism 2: Accountability/Conscientiousness **Overall Intent:** To take responsibility for his/her actions and the impact on patients and other members of the health care team	
Milestones	**Examples**
Level 1 *Responds promptly to requests or reminders to complete tasks and responsibilities*	● Takes responsibility for getting informed consent for a procedure
Level 2 *Performs tasks and responsibilities in a timely manner to ensure that the needs of patients, teams, and systems are met in routine situations*	● Dictates reports for routine cases in a timely fashion
Level 3 *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*	● Efficiently dictates reports and communicates results for emergent cases in a timely fashion
Level 4 *Recognizes and raises awareness of situations that may impact others' ability to complete tasks and responsibilities in a timely manner*	● Identifies issues that could impede others from completing tasks and provides leadership to address those issues ● On-call example: senior residents advise junior residents on how to manage their time, communicate effectively, and guide ordering providers and other members of the team including technologists on-call
Level 5 *Takes ownership of system outcomes*	● Sets up a meeting with the emergency medicine department to streamline patient flow
Assessment Models or Tools	● Compliance with deadlines and timelines ● Direct observation ● Multisource feedback ● Objective structured clinical examinations ● Self-evaluations ● Simulation
Curriculum Mapping	●
Notes or Resources	● Code of conduct from institutional manual ● Radiological Society of North America. Professionalism for Residents. https://www.rsna.org/education/professionalism-and-quality-care/professionalism-self-assessments/professionalism-for-residents. 2019.

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**
Level 1 *Recognizes status of personal and professional well-being, with assistance, and is aware of available resources* *Recognizes limits in the knowledge/skills of self or team, with assistance*	● Requests and/or accepts feedback and exhibits positive responses to corrective feedback ● Is aware of or can identify potential stressors specific to the learner in training, or in this specialty
Level 2 *Independently recognizes status of personal and professional well-being using available resources when appropriate* *Independently recognizes limits in the knowledge/skills of self or team and demonstrates appropriate help-seeking behaviors*	● Identifies possible sources of personal stress or lack of clinical knowledge and independently seeks help
Level 3 *With assistance, proposes a plan to optimize personal and professional well-being* *With assistance, proposes a plan to remediate or improve limits in the knowledge/ skills of self or team*	● 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
Level 4 *Independently develops a plan to optimize personal and professional well-being* *Independently develops a plan to remediate or improve limits in the knowledge/skills of self or team*	● Independently develops a personal learning or action plan to address stress and/or burnout for self or team and gaps in personal clinical knowledge
Level 5 *Coaches others when emotional responses or limitations in knowledge/skills do not meet professional expectations*	● Mentors colleagues in self-awareness ● Establishes health management plans to limit stress and burnout
Assessment Models or Tools	● 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
Curriculum Mapping	●
Notes or Resources	This subcompetency is not intended to evaluate a fellow's well-being, but to ensure each fellow has the fundamental knowledge of factors that impact well-being, the mechanisms by which those factors impact well-being, and available resources and tools to improve well-being. ● Local resources, including Employee Assistance Program. ● ACGME. "Well-Being Tools and Resources." https://dl.acgme.org/pages/well-being-tools-resources. 2019. ● Stanford Medicine. WellMD. https://wellmd.stanford.edu/. 2019. ● 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. 2019.

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 his/her family; to identify communication barriers, including self-reflection on biases, and minimize them in the doctor-patient relationship; to organize and lead communication around shared decision making	
Milestones	**Examples**
Level 1 *Accurately communicates own role within the health care system* *Identifies the need to adjust communication strategies based on assessment of patient/family expectations and understanding of their health status and treatment options*	● Identifies that they are a resident during patient interactions ● Understands that communication may need to be adjusted for a patient unaware of fetal demise while undergoing an ultrasound
Level 2 *Identifies barriers to effective communication (e.g., language, health literacy)* *Organizes and initiates communication with patient/family by clarifying expectations and verifying understanding of the clinical situation*	● 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 ● Before and/or after communication with patient/family closes the loop and asks them if they are clear about expectations and have knowledge of the clinical situation
Level 3 *Identifies biases that hinder effective communication* *With guidance, sensitively and compassionately delivers medical information, elicits patient goals and preferences, and acknowledges uncertainty and conflict*	● Recognizes bias about sexuality and identity ● With guidance, communicates with a patient the presence of a probably benign breast mass, makes the decision to follow the mass or if patient wishes biopsy the mass after involving the patient in discussion, thereby aligning with patient goals
Level 4 *Actively minimizes communication barriers* *Independently, uses shared decision making to align patient goals, and preferences with treatment options to make a personalized care plan*	● Takes responsibility and apologizes after using wrong pronoun with a patient ● Independently communicates with a patient the presence of a probably benign breast mass, makes the decision to follow the mass or if patient wishes biopsy the mass after involving the patient in discussion, thereby aligning with patient goals
Level 5 *Coaches other learners to minimize communication barriers*	● Role models and supports colleagues in self-awareness and reflection to improve therapeutic relationships with patients, and demonstrates intuitive understanding of a patient's perspective; uses a contextualized approach to minimize barriers for patients and colleagues

Coaches other learners in shared decision making	● Role models proactive self-awareness and reflection around 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
Assessment Models or Tools	● Direct observation ● Kalamazoo Essential Elements Communication Checklist (Adapted) ● Mini-clinical evaluation exercise (CEX) ● Multisource feedback ● Objective structured clinical examination ● 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
Curriculum Mapping	●
Notes or Resources	● Laidlaw A, Hart J. Communication skills: an essential component of medical curricula. Part I: Assessment of clinical communication: AMEE Guide No. 51. *Med Teach*. 2011;33(1):6-8. https://www.tandfonline.com/doi/full/10.3109/0142159X.2011.531170. 2019. ● Makoul G. Essential elements of communication in medical encounters: the Kalamazoo consensus statement. *Acad Med*. 2001;76(4):390-393. https://insights.ovid.com/crossref?an=00001888-200104000-00021. 2019. ● Makoul G. The SEGUE Framework for teaching and assessing communication skills. *Patient Educ Couns*. 2001;45(1):23-34. https://www.sciencedirect.com/science/article/abs/pii/S0738399101001367?via%3Dihub. 2019. ● O'Sullivan P, Chao S, Russell M, Levine S, Fabiny A. Development and implementation of an objective structured clinical examination to provide formative feedback on communication and interpersonal skills in geriatric training. *J Am Geriatr Soc*. 2008;56(9):1730-1735. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1532-5415.2008.01860.x. 2019. ● Symons AB, Swanson A, McGuigan D, Orrange S, Akl EA. A tool for self-assessment of communication skills and professionalism in residents. *BMC Med Educ*. 2009;9:1. https://bmcmededuc.biomedcentral.com/articles/10.1186/1472-6920-9-1. 2019. ● American Academy of Hospice and Palliative Medicine. Hospice and Palliative Medicine Competencies Project. http://aahpm.org/fellowships/competencies#competencies-toolkit. 2019.

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**
Level 1 *Respectfully receives a consultation request* *Demonstrates knowledge of the institutional and national communication guidelines*	● Accepts a request to do a late afternoon procedure and offers to discuss with the attending without offering resistance ● Documents communication of findings to the health care team
Level 2 *Clearly and concisely responds to a consultation request* *Communicates emergent findings according to institutional or national guidelines*	● Offers consulting service guidance on the necessity of the procedure and when it can be reasonably be performed after discussion with the attending ● Communicates and documents communication of emergent findings
Level 3 *Checks understanding of recommendations when providing consultation* *Communicates non-emergent findings where failure to act may adversely affect patient outcome*	● Communicates management of a percutaneously placed drain with regards to output and when it should be removed ● Communicates finding a lung nodule on chest x-ray and suggests a chest CT
Level 4 *Coordinates recommendations from different members of the health care team to optimize patient care* *Communicates findings and management options (as appropriate) which are tailored to the referring provider*	● After discussion with the infectious diseases doctor and oncologist who have been consulted on the case, decides to send a sample for infection analysis in addition to surgical pathology after being presented an immunocompromised patient for biopsy of a mass-like lesion in the lung by the primary care physician ● Communicates to a generalist that the patient had a stroke but to neurologist gives much more detailed information
Level 5 *Role models flexible communication strategies that value input from all health care team members, resolving conflict when needed* *Coaches other learners in tailored communications to referring providers*	● Role models the resolution of conflict between neurosurgery and the emergency department for MRI scan prioritization ● Coaches junior residents in subspecialty level communications
Assessment Models or Tools	● Direct observation ● End-of-rotation evaluation ● Multisource feedback

	● Objective structured clinical examination ● Simulation
Curriculum Mapping	●
Notes or Resources	● François J. Tool to assess the quality of consultation and referral request letters in family medicine. *Can Fam Physician*. 2011;57(5):574–575. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3093595/. 2019. ● Dehon E, Simpson K, Fowler D, Jones A. Development of the faculty 360. *MedEdPORTAL*. 2015;11:10174. https://www.mededportal.org/publication/10174/. 2019. ● American College of Radiology. Communication Curriculum for Radiology Residents. https://www.acr.org/Member-Resources/rfs/learning/Communication-for-Radiology-Residents. 2019.

Interpersonal and Communication Skills 3: Communication within Health Care Systems **Overall Intent:** To effectively communicate using a variety of methods	
Milestones	**Examples**
Level 1 *Demonstrates knowledge of institutional communications policies*	● Describes the appropriate and inappropriate use of cell phone, email, and social media
Level 2 *Communicates appropriately as required by institutional policy*	● Uses secured email for communication of patient information
Level 3 *Communicates systems concerns in a respectful manner*	● Communicates with the appropriate radiology department supervisor or hospital reporting system about systems concerns in an objective respectful manner
Level 4 *Communicates clear and constructive suggestions to improve systems*	● Communicates that efficiency in the trauma reader could be significantly improved if phone calls were diverted to a radiology aide or to a central call center in the department
Level 5 *Facilitates dialogue regarding systems issues among larger community stakeholders (institution, health care system, field)*	● Through participation on the hospital stroke committee, helps facilitates improvement in the reporting of code stroke head CT results to the stroke team through a standardized reporting process, aiding in efficient and timely management of stroke patients
Assessment Models or Tools	● Assessment of QI projects ● Audit of hospital notification system submissions ● Direct observation ● Medical record (chart) audit ● Multisource feedback ● Simulation
Curriculum Mapping	●
Notes or Resources	● Institutional communication policies ● HIPAA training ● Hryhorczuk AL, Hanneman K, Eisenberg RL, Meyer EC, Brown SD. Radiologic professionalism in modern health care. *Radiographics*. 2015;35(6):1779-1788. https://pubs.rsna.org/doi/pdf/10.1148/rg.2015150041. 2019. ● Kelly AM, Mullan PB. Designing a curriculum for professionalism and ethics within radiology: identifying challenges and expectations. *Acad Radiol*. 2018;25(5):610-618. https://www.academicradiology.org/article/S1076-6332(18)30091-6/pdf. 2019. ● American College of Radiology. Communication Curriculum for Radiology Residents. https://www.acr.org/Member-Resources/rfs/learning/Communication-for-Radiology-Residents. 2019.

In an effort to aid programs in the transition to using the new version of the Milestones, we have mapped the original Milestones 1.0 to the new Milestones 2.0. Below we have indicated where the subcompetencies are similar between versions. These are not necessarily exact matches, but are areas that include some of the same elements. Note that 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: Consultant	PC2: Clinical Consultation
PC2: Competence in Procedures	PC4: Competence in Procedures
No match	MK1: Diagnostic Knowledge
MK1: Protocol Selection and Optimization of Images	MK2: Physics
MK1: Protocol Selection and Optimization of Images	MK3: Protocol Selection and Optimization of Images
MK1: Protocol Selection and Optimization of Images	MK4: Imaging Technology and Image Acquisition
MK2: Interpretations of Examinations	PC3: Image Interpretation
No match	SBP1: Patient Safety
SBP1: Quality Improvement	SBP2: Quality Improvement
SBP2: Health Care Economics	SBP4: Physician Role in Health Care Systems
No match	SBP3: System Navigation for Patient-Centered Care
PBLI1: Patient Safety: Contrast Agents; Radiation Safety; MR Safety; Sedation	SBP5: Contrast Safety Agent SBP6: Radiation Safety SBP7: MR Safety
No match	SBP8: Informatics
PBLI2: Self-directed Learning	PBLI2: Reflective Practice and Commitment to Personal Growth
PBLI3: Scholarly Activity	PBLI1: Evidence-Based and Informed Practice
PROF1: Professional Values and Ethics	PROF1: Professional Behavior and Ethical Principles
PROF1: Professional Values and Ethics	PROF2: Accountability/ Conscientiousness
No match	PROF3: Self-Awareness and Help Seeking
ICS1: Effective Communication with Patients, Families, and Caregivers	ICS1: Patient and Family-Centered Communication
ICS2: Effective Communication with Health Care Team	PC1: Reporting ICS2: Interprofessional and Team Communication
ICS2: Effective Communication with Health Care Team	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/