Supplemental Guide: Musculoskeletal Radiology

ACGME

May 2021

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Milestones Supplemental Guide

This document provides additional guidance and examples for the Musculoskeletal 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.

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: Consultant **Overall Intent:** To provide high-quality consultation	
Milestones	**Examples**
Level 1 *Independently recommends appropriate imaging of common general conditions*	● Follows American College of Radiology (ACR) Appropriateness Criteria® in recommending magnetic resonance imaging (MRI) without contrast for a patient with low back pain for greater than six weeks and no red flag symptoms
Gathers essential patient information	● When consulted for spine biopsy for suspected discitis, gathers appropriate clinical information, including inflammatory markers and recent cultures, and patient's ability to consent
Level 2 *Independently recommends appropriate imaging of common musculoskeletal conditions (e.g., osteomyelitis, trauma, metastatic disease)*	● Recommends focused osteomyelitis protocol MRI of the foot for cases of suspected pedal osteomyelitis
With supervision, synthesizes the image findings and complete clinical picture to provide differential diagnoses or next clinical step for common musculoskeletal conditions	● Identifies lytic bone lesions and characterizes how aggressive the lesion looks, and recommends additional imaging as needed
Level 3 *With some supervision, recommends appropriate imaging of uncommon musculoskeletal conditions (e.g., primary bone tumors, post- operative complications)*	● Recommends appropriate imaging in patients with a history of hip arthroplasty and suspected hip osteolysis, with supervision
With supervision, synthesizes the image findings and complete clinical picture to provide differential diagnoses or next clinical step for uncommon musculoskeletal conditions	● Identifies osteitis of the clavicle on radiograph and recommends bone scan or other whole-body imaging given its association with synovitis, acne, pustulosis, hyperostosis, osteitis syndrome, with supervision
Level 4 *Independently recommends appropriate imaging of uncommon musculoskeletal conditions*	● Recommends appropriate imaging in patients with a history of hip arthroplasty and suspected hip osteolysis
Independently synthesizes the image findings and complete clinical picture to provide differential diagnoses or next clinical step for uncommon musculoskeletal conditions	● Identifies osteitis of the clavicle on radiograph and recommends bone scan or other whole-body imaging given its association with synovitis, acne, pustulosis, hyperostosis, and osteitis syndrome

Level 5 *Operates at the level of expert subspecialty consultant in practice* *Serves as a consultant for other specialties*	● Is sought in consultation by members of the orthopedic service for second opinion of outside imaging ● Is contacted by members of other radiology subspecialties for consultations on incidental findings
Assessment Models or Tools	● Case conferences ● Direct observation ● Multisource feedback
Curriculum Mapping	●
Notes or Resources	● American College of Radiology (ACR). ACR Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. 2021. ● ACR Appropriateness Modules for Radiology Residents. http://jhrad.com/acr/. 2021. ● ACR. Manual on Contrast Media. https://www.acr.org/Clinical-Resources/Contrast-Manual. 2021. ● Consultations can be over the phone, in the reading room, at tumor boards, etc. ● Institutional policies

Patient Care 2: Diagnostic and Therapeutic Procedures **Overall Intent:** To perform procedures proficiently and independently; to anticipate and manage complications of procedures	
Milestones	**Examples**
Level 1 *Describes the indications and contra-indications to performing diagnostic and therapeutic procedures and obtains informed consent* *Recognizes potential post-procedural complications*	● Appropriately identifies candidates for therapeutic hip steroid injections under ultrasound or fluoroscopic guidance ● Discusses complications from arthrogram injections
Level 2 *Safely executes basic and advanced diagnostic and therapeutic procedures; is sensitive to pain management, with supervision* *With supervision, manages common intra-procedural and post-procedural complications*	● Performs therapeutic hip steroid injections under ultrasound or fluoroscopic guidance, with supervision ● Manages a patient with a vasovagal reaction following a hip steroid injection
Level 3 *Plans and safely executes basic and advanced diagnostic and therapeutic procedures; is sensitive to pain management, with supervision* *With supervision, anticipates and manages potential post-procedural complications*	● Identifies biopsy trajectory for sampling of a soft tissue mass taking into consideration soft tissue planes and surgical approach, with supervision ● Selects use of local anesthetic versus conscious sedation based on patient preference and procedure type, with supervision ● Manages post-procedural pain following palliative cryoablation of a painful bone metastasis, with supervision
Level 4 *Independently plans and safely executes basic and advanced diagnostic and therapeutic procedures; is sensitive to pain management* *Independently anticipates and manages potential post-procedural complications*	● Identifies biopsy trajectory for sampling of a soft tissue mass taking into consideration soft tissue planes and surgical approach ● Selects use of local anesthetic versus conscious sedation based on patient preference and procedure type ● Manages post-procedural pain following palliative cryoablation of a painful bone metastasis
Level 5 *Teaches peers and/or develops novel diagnostic or therapeutic procedures and techniques*	● Works with vendor to employ new needle device for bone biopsies and introduces it to other fellows and attendings
Assessment Models or Tools	● Assessment of presentation at multidisciplinary conference ● Direct observation ● Medical record (chart) review

	● Multisource feedback
Curriculum Mapping	●
Notes or Resources	● The care of patients is undertaken with appropriate faculty member supervision and conditional independence, allowing fellows 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.” ● The New England Journal of Medicine. Videos in Clinical Medicine. https://www.nejm.org/multimedia/medical-videos. 2021. ● RSNA. Physics Modules. https://www.rsna.org/education/trainee-resources/physics-modules. 2021. ● Society of Interventional Radiology. https://www.sirweb.org/. 2021.

Patient Care 3: Musculoskeletal Radiology Reporting **Overall Intent:** To generate effective radiology reports tailored to the care provider	
Milestones	**Examples**
Level 1 *Generates musculoskeletal radiology reports with appropriate elements for coding* *Describes lexicons and structured reporting*	● For a musculoskeletal MRI, the report includes history, comparison, technique, findings, all required anatomy, impressions/conclusions ● Describes one of the lexicons used at the training site; describes structured reporting used
Level 2 *Efficiently generates clear and concise musculoskeletal radiology reports that do not require substantive correction* *Uses lexicons and structured reporting that do not require substantive correction*	● Creates a report for musculoskeletal MRI using appropriate lexicon describing femoral osteonecrosis without major corrections
Level 3 *Efficiently generates clear and concise musculoskeletal radiology reports that rarely require correction* *Uses lexicons and structured reporting that rarely require correction*	● Creates a report (structured or unstructured) describing osteomyelitis to guide management decisions, when appropriate
Level 4 *Generates tailored musculoskeletal radiology reports meeting the needs of the care provider* *Proficiently uses lexicons and structured reporting to provide accurate and timely reports that do not require correction*	● Creates a report for bone and soft tissue tumor using the World Health Organization (WHO) classification system for initial presentation and for subsequent recurrent and/or metastatic disease; accurately describes the lesion and rarely has grammatical errors
Level 5 *Develops novel reporting classification system or reporting template that improves patient care*	● Develops a reporting template to clearly delineate staging for soft tissue or bone tumor
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., 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. ● ACR. ACR Practice Parameter for Communication of Diagnostic Imaging Findings. https://www.acr.org/-/media/acr/files/practice-parameters/communicationdiag.pdf. 2021. ● Radiological Society of North America (RSNA). Rad Report. http://www.radreport.org. 2021.

Medical Knowledge 1: Image Interpretation – Anatomy and Physiology **Overall Intent:** To demonstrate knowledge of anatomy, biomechanics, physiology, and pathophysiology	
Milestones	**Examples**
Level 1 *Demonstrates basic knowledge of musculoskeletal anatomy* *Demonstrates basic knowledge of bone physiology*	● Identifies anterior cruciate ligament (ACL) on MRI ● Describes expected radiologic findings of bone healing
Level 2 *Demonstrates basic knowledge of biomechanics and application to injury patterns* *Recognizes differences between normal variants and pathology*	● Identifies and synthesizes pattern of bone and soft tissue injury to identify mechanism of injury on knee MRI ● Correctly identifies an apparent abnormality in the proximal radius as a pseudo-lesion
Level 3 *Demonstrates advanced knowledge of anatomy and biomechanics and its application to injury patterns and radiographic findings* *Distinguishes clinically relevant from benign incidental findings (e.g., non-ossifying fibroma or bone island)*	● Identifies and stages scapholunate advanced collapse wrist ● Distinguishes between sclerotic osseous metastases and bone island
Level 4 *Teaches detailed anatomy and basic biomechanics and application to mechanisms of injury* *Teaches bone physiology; understands drug- and treatment-induced changes in bone*	● Teaches differences in wrist instability in dorsal intercalated segmental instability and volar intercalated segmental instability ● Recognizes and describes osseous changes of atypical proximal femoral fracture related to bisphosphonate therapy
Level 5 *Advances knowledge of musculoskeletal conditions through research and presentation at local, national, and international meetings*	● Presents original research on imaging findings of bone tumors following cryoablation ● Develops educational materials and presents at the Radiological Society of North America (RSNA)
Assessment Models or Tools	● Direct observation ● Evaluation of reports ● Faculty evaluations ● Interdisciplinary conference ● Multisource feedback
Curriculum Mapping	●

Notes or Resources	● Chung CB, Steinbach LS. *MRI of the Upper Extremity: Shoulder, Elbow, Wrist and Hand*. Lippincott Williams & Wilkins; 2009. ISBN:978-0781753135. ● Musculoskeletal Imaging Core Courses. https://radiologycorelectures.org/msk/. 2021. ● Resnick DL, Kang HS, Petterklieber ML. *Internal Derangements of Joints.* 2nd ed. Saunders/Elsevier; 2007. ISBN:978-0721695525. ● Society of Skeletal Radiology. Web Resources. https://skeletalrad.org/web-resources. 2021.

Medical Knowledge 2: Image Interpretation – Diagnosis **Overall Intent:** To appropriately prioritize differential diagnosis for imaging findings and recommend management	
Milestones	**Examples**
Level 1 *Recognizes normal appearance of tissues, anatomy, and common artifacts on all modalities*	● Identifies normal appearance of the meniscus on MRI ● Distinguishes pulsation artifact from soft tissue mass or bone lesion on MRI ● Is familiar with the anatomic lines of the pelvis on plain radiographs
Level 2 *Demonstrates knowledge of usual imaging presentations and injury patterns of common musculoskeletal diseases and post-operative findings of common procedures (e.g., sports injuries, trauma, tumor, infection, arthritides)*	● Identifies ACL tear and associated osseous contusions ● Identifies findings of rheumatoid arthritis on hand radiographs
Level 3 *Recognizes subtle findings and integrates imaging information leading to the appropriate diagnosis, with additional imaging as needed and clinical management in complex cases, including immediate and delayed complications*	● Understands and applies the Weber's classification of ankle injury and identifies when additional imaging is needed ● Recognizes Lisfranc interval widening and recommends appropriate follow-up imaging
Level 4 *Defines more advanced imaging findings, such as post-operative appearance (e.g., post-tumor resection and treatment changes, anterior cruciate ligament (ACL) revision)*	● Distinguishes between a compressive or tensile proximal femoral stress fracture and understands the implications on management ● Demonstrates familiarity with the normal post-operative appearance following ACL reconstruction and can identify early and late complications
Level 5 *Conducts research on cross-sectional imaging, and presents findings at local, national, and/or international meetings*	● Studies the use of novel MRI sequences to distinguish post-operative changes versus recurrent tumor following sarcoma resection
Assessment Models or Tools	● Case-based discussion ● Direct observation ● Multisource feedback
Curriculum Mapping	●
Notes or Resources	● Chung CB, Steinbach LS. *MRI of the Upper Extremity: Shoulder, Elbow, Wrist and Hand*. Lippincott Williams & Wilkins; 2009. ISBN:978-0781753135. ● Musculoskeletal Imaging Core Courses. https://radiologycorelectures.org/msk/. 2021. ● Resnick DL, Kang HS, Petterklieber ML. *Internal Derangements of Joints.* 2nd ed. Saunders/Elsevier; 2007. ISBN:978-0721695525.

	● Society of Skeletal Radiology. Web Resources. https://skeletalrad.org/web-resources. 2021.

Medical Knowledge 3: Protocols **Overall Intent:** To demonstrate knowledge of image acquisition and protocols	
Milestones	**Examples**
Level 1 *Demonstrates basic knowledge of image acquisition (magnetic resonance (MR) pulse sequences, physics, basic computer tomography (CT) physics, radiographs, ultrasounds)*	● Selects MRI to evaluate internal derangement of the knee ● Selects correct ultrasound probe
Level 2 *Demonstrates basic knowledge of protocoling advanced musculoskeletal MR, CT, and ultrasound, as well as less commonly obtained radiographic views and utilization of contrast material, when appropriate*	● Selects MRI arthrogram of the shoulder for evaluation of the labrum in the setting of shoulder instability ● Uses dual energy computerized tomography (CT) to evaluate for monosodium urate deposition in a patient with suspected gout
Level 3 *Demonstrates advanced knowledge of protocoling advanced musculoskeletal MR, CT, and ultrasound, as well as less commonly obtained radiographic views, and tailors protocols as needed*	● Adds flexed elbow abducted shoulder and forearm supinated view for biceps rupture ● Uses dynamic ultrasound to evaluate for suspected peroneal tendon subluxation/dislocation
Level 4 *Provides feedback to technical staff members and other learners regarding image acquisition and optimization in complex cases*	● Describes technique and appropriate usage of metal artifact reduction in patients with arthroplasty to residents ● Teaches musculoskeletal ultrasound to other fellows and residents
Level 5 *Designs or optimizes protocols tailored to specific imaging conditions*	● Optimizes brachial plexus MRI protocol
Assessment Models or Tools	● Direct observation ● Evaluation of reports ● Faculty evaluations ● Interdisciplinary conference ● Multisource feedback ● Simulation
Curriculum Mapping	●
Notes or Resources	● ACR. ACR Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. 2021. ● Jacobson J. *Fundamentals of Musculoskeletal Ultrasound*. 3rd ed. Elsevier; 2017. ISBN:978-0323445252. ● Resnick Resnick DL, Kang HS, Petterklieber ML. *Internal Derangements of Joints.* 2nd ed. Saunders/Elsevier; 2007. ISBN:978-0721695525.

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) 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)*	● Fellow presents a case 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. 2021.

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 fishbone 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*	● 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. 2021. ● 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 key elements for safe and effective transitions of care and hand-offs*	● Identifies the members of the interprofessional team and describes their roles ● Describes an effective sign-out to the next radiology team member
Level 2 *Coordinates care of patients in routine radiology imaging/procedures effectively using the roles of interprofessional teams* *Performs safe and effective transitions of care/hand-offs in routine clinical situations*	● Works with other members of the radiology team (nurses, technologists) to coordinate patient imaging, but requires supervision to ensure all necessary imaging is performed ● Signs out request for biopsy request for inpatient CT-guided discitis-osteomyelitis pending blood culture results
Level 3 *Coordinates care of patients in complex radiology imaging/procedures effectively using the roles of interprofessional teams* *Performs safe and effective transitions of care/hand-offs in complex clinical situations*	● Coordinates the imaging sequencing for complex patients such as multi-injured trauma patients ● 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
Level 4 *Role models effective coordination of patient-centered care among different disciplines and specialties* *Role models safe and effective transitions of care/hand-offs*	● 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 ● 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 *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*	● 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

Assessment Models or Tools	● Direct observation ● Learning portfolio ● Medical record (chart) audit ● Multisource feedback ● Objective structured clinical examination (OSCE) ● 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. 2021.

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**
Level 1 *Identifies key components of the complex health care 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 (VA), and commercial third-party payors ● Describes various practice models
Level 2 *Describes how components of a complex health care system are interrelated, 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 knee radiographs versus knee magnetic resonance (MR)
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 knee MR
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 bone density screening for osteoporosis in communities with limited access to health care
Assessment Models or Tools	● Direct observation ● Medical record (chart) audit

	● Multiple choice test ● OSCE ● QI project
Curriculum Mapping	●
Notes or Resources	● Agency for Healthcare Research and Quality (AHRQ). Measuring the Quality of Physician Care. https://www.ahrq.gov/talkingquality/measures/setting/physician/index.html. 2021. ● Agency for Healthcare Research and Quality. Major Physician Measurement Sets. https://www.ahrq.gov/talkingquality/measures/setting/physician/measurement-sets.html. 2021. ● The Commonwealth Fund. Health System Data Center. http://datacenter.commonwealthfund.org/?_ga=2.110888517.1505146611.1495417431-1811932185.1495417431#ind=1/sc=1. 2021. ● Kaiser Family Foundation. https://www.kff.org/. 2021. ● Kaiser Family Foundation. Health Reform. https://www.kff.org/health-reform/. 2021. ● 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. 2021. ● 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/. 2021. ● Oklahoma State University Medical Center Diagnostic Radiology Residency. Business of Radiology. http://www.osumcradiology.org/educationalschedule/lecutres/BusinessofRadiology/#0. 2021. ● RSNA Online Learning Center. Level 1: Reimbursement Basic. http://education.rsna.org/diweb/catalog/item?id=2210377. 2021. ● RSNA Online Learning Center. Level 2: Service Valuation and Costs. http://education.rsna.org/diweb/catalog/item?id=2223133. 2021.

Systems-Based Practice 5: Contrast Agent Safety **Overall Intent:** To recognize and manage 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)*	● Consistently and reliably recognizes 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

	● OSCE ● Reflection ● Simulation
Curriculum Mapping	●
Notes or Resources	● ACR. Contrast Card. https://www.acr.org/-/media/ACR/Files/Clinical-Resources/Contrast-Reaction-Card.pdf. 2021. ● ACR. Manual on Contrast Media. https://www.acr.org/Clinical-Resources/Contrast-Manual. 2021. ● 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 *Demonstrates knowledge of the mechanisms of radiation injury and the ALARA ("as low as reasonably achievable") concept*	● Describes 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 the average dose information for a particular CT examination
Level 3 *Communicates the relative risk of exam-specific radiation exposure to patients and practitioners*	● Effectively communicates relative risks of the radiation exposure during a CT of the extremity to the patient, patient's family, or referring provider
Level 4 *Applies principles of ALARA in daily practice*	● Modifies CT parameters for a musculoskeletal CT examination 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 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 ● OSCE
Curriculum Mapping	●
Notes or Resources	● American College of Radiology. ACR Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. 2021. ● ACR. Radiation Safety. https://www.acr.org/Clinical-Resources/Radiology-Safety/Radiation-Safety. 2021. ● ACR. Radiology Safety. https://www.acr.org/Clinical-Resources/Radiology-Safety. 2021. ● Image Gently. Pediatric Radiology and Imaging. https://www.imagegently.org/. 2021. ● Image Wisely. https://www.imagewisely.org/. 2021. ● RSNA. Physics Modules. https://www.rsna.org/en/education/trainee-resources/physics-modules. 2021.

Systems-Based Practice 7: Magnetic Resonance (MR) Safety **Overall Intent:** To understand 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 I 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 medical implanted device
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 ● 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	● ACR. MR Safety. https://www.acr.org/Clinical-Resources/Radiology-Safety/MR-Safety. 2021. ● Complete AAPM/RSNA Web Module: MRI Course#9 Quality/ Bioeffects/Safety ● 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. 2021. ● MRI Questions. MRI Suite: Safety Zones. http://mriquestions.com/acr-safety-zones.html. 2021. ● MRI Safety. http://mrisafety.com/. 2021. ● RSNA. Physics Modules. https://www.rsna.org/education/trainee-resources/physics-modules. 2021.

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 the electronic health record (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 Digital Imaging and Communications in Medicine (DICOM), Health Level 7 International (HL7), SNOMED-CT, Logical Observation Identifiers Names and Codes (LOINC)/RadLex, International Classification of Diseases (ICD)-10, and Current Procedural Terminology (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. 2021. ● Branstetter BF IV. Basics of imaging informatics: part 2. *Radiology*. 2007;244(1):78-84. https://pubs.rsna.org/doi/10.1148/radiol.2441060995. 2021. ● 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. 2021. ● 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. 2021.

	● 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. 2021. ● 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. 2021. ● 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. 2021. ● 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. 2021.

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 and procedural safety literature and websites
Level 2 *Articulates clinical questions and elicits patient preferences and values to guide evidence-based imaging*	● Identifies patients with conditional risks for procedures, 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 procedure safety, 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 procedural safety, MRI safety, radiation safety, or contrast use according to best practices
Assessment Models or Tools	● Direct observation ● Learning portfolio ● Oral or written examination ● Simulation (OSCE)
Curriculum Mapping	●
Notes or Resources	● ABR. 2019 Noninterpretive Skills Study Guide. https://www.theabr.org/wp-content/uploads/2018/11/NIS-Study-Guide-2019.pdf. 2021. ● 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. 2021. ● Harvey L. Neiman Health Policy Institute. http://www.neimanhpi.org/. 2021. ● Image Gently. Pediatric Radiology and Imaging. www.imagegently.org. 2021. ● Image Wisely. www.imagewisely.org. 2021. ● Institutional Review Board (IRB) guidelines ● MRI Safety. http://mrisafety.com. 2021. ● Moriates C, Arora V, Shah N. *Understanding Value Based Healthcare*. 1st ed. New York, NY: McGraw Hill Education; 2015. ISBN:978-0071816984.

	● National Institutes of Health (NIH). Write Your Application. https://grants.nih.gov/grants/how-to-apply-application-guide/format-and-write/write-your-application.htm. 2021. ● NIH U.S. National Library of Medicine. PubMed Tutorial. https://www.nlm.nih.gov/bsd/disted/pubmedtutorial/cover.html. 2021. ● The University of Texas at Austin Dell Medical School. Discovering Value-Based Health Care. https://vbhc.dellmed.utexas.edu/. 2021. ● 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**
Level 1 *Accepts responsibility for professional development by establishing goals* *Identifies factors that contribute to gap(s) between expectations and actual 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
Level 2 *Is receptive to performance data and feedback to adjust goals* *Analyzes and reflects on factors that contribute to gap(s) between expectations and actual performance*	● Uses feedback to set goals to read more studies each day ● Reflects on factors contributing to lack of 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 and develops a learning plan*	● 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* *Analyzes effectiveness of behavioral changes where appropriate, considers alternatives in narrowing the gap(s) between expectations and actual performance, and improves the learning plan*	● Independently follows up on the outcomes of patients for which they have dictated reports or to which they have done interventional procedures ● Consistently identifies learning gaps and addresses areas to work on
Level 5 *Coaches other learners to consistently seek performance data and feedback* *Coaches others on reflective practice*	● 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

Assessment Models or Tools	● Direct observation ● Review of learning plan ● Standardized assessments
Curriculum Mapping	●
Notes or Resources	● 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. 2021. ● 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. 2021. ● 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. 2021. ● 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. 2021.

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*	● 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
Demonstrates knowledge of ethical principles	● 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 ● Underlying informed consent, surrogate decision making, advance directives, confidentiality, error disclosure, and stewardship of limited resources
Level 2 *Demonstrates insight into professional behavior in routine situations and takes responsibility for one's own professionalism lapses*	● 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
Analyzes straightforward situations using ethical principles	● Articulates strategies for preventing similar lapses in the future
Level 3 *Demonstrates professional behavior in complex or stressful 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 need to seek help to manage and resolve complex ethical situations	● 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 oneself and others* *Recognizes and uses appropriate resources for managing and resolving ethical dilemmas as needed*	● 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 ● Recognizes and uses 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 ● Multisource feedback ● Oral or written self-reflection ● Simulation
Curriculum Mapping	●
Notes or Resources	● American Association of Physicists in Medicine (AAPM). ABR/ACR/RSNA/AAPM/ASTRO/ARR/ARS Online Modules on Ethics and Professionalism. https://www.aapm.org/education/onlinemodules.asp. 2021. ● ACR. Code of Ethics. https://www.acr.org/-/media/ACR/Files/Governance/Code-of-Ethics.pdf. 2021. ● AMA. Ethics. https://www.ama-assn.org/delivering-care/ethics. 2021. ● Association of University Radiologists. Professionalism and Ethics Competencies for Radiology Residents. http://www.aur.org/Secondary.aspx?id=10263. 2021.Byyny RL, Paauw DS, Papadakis M, Pfeil S. *Medical Professionalism Best Practices: Professionalism in the Modern Era*. Menlo Park, CA: Alpha Omega Alpha Medical Society; 2017. https://alphaomegaalpha.org/pdfs/Monograph2018.pdf. 2021. ● Association of University Radiologists. Professionalism Curriculum Resources. http://www.aur.org/ProfessionalCurriculum/. 2021.

	● 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. 2021. ● Radiological Society of North America. Professionalism for Residents. https://www.rsna.org/education/professionalism-and-quality-care/professionalism-self-assessments/professionalism-for-residents. 2021.

Professionalism 2: Accountability/Conscientiousness **Overall Intent:** To take responsibility for personal 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 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 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: fellow advises 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 orthopedic outpatient clinic to streamline patient flow
Assessment Models or Tools	● Compliance with deadlines and timelines ● Direct observation ● Multisource feedback ● 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. 2021.

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* *With assistance, recognizes limits in the knowledge/skills of self or team*	● 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 oneself or the 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 oneself or the 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 oneself or the 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 ● Formal feedback/evaluations ● Group interview or discussions for team activities ● Institutional online training modules

	● Participation in institutional well-being programs ● Personal learning plan ● Self-assessment
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. ● American Academy of Pediatrics (AAP). 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. 2021. ● ACGME. "Well-Being Tools and Resources." https://dl.acgme.org/pages/well-being-tools-resources. 2021. ● Local resources, including Employee Assistance Program. ● Stanford Medicine. WellMD. https://wellmd.stanford.edu/. 2021.

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 one's own role within the health care system* *Identifies the need to adjust communication strategies based on assessment of patient's /patient's family's expectations and understanding of their health status and treatment options*	● Identifies self as a fellow during patient interactions ● Understands that communication may need to be adjusted for a patient with joint aspiration who is not able to consent and power of attorney is needed for consent
Level 2 *Identifies barriers to effective communication (e.g., language, health literacy)* *Organizes and initiates communication with the patient/patient's 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 own bias about sexuality and identity ● With guidance, communicates with a patient the presence of an osseous mass and the need for biopsy to determine pathology or something else similar
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 need for musculoskeletal biopsy of osseous or soft tissue mass and the reasoning behind the biopsy
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 ● Role models proactive self-awareness and reflection around biases with a context-specific approach to mitigating communication barriers
Coaches other learners in shared decision making	● Leads shared decision making with clear recommendations to patients and families even in more complex clinical situations
Assessment Models or Tools	● Direct observation ● 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
Curriculum Mapping	●
Notes or Resources	● American Academy of Hospice and Palliative Medicine. Hospice and Palliative Medicine Competencies Project. http://aahpm.org/fellowships/competencies#competencies-toolkit. 2021. ● 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. 2021. ● 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. 2021. ● 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. 2021. ● 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. 2021. ● 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. 2021.

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 *With supervision, responds to a consultation request and employs necessary members of the radiology team* *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 *Independently responds to a consultation request and employs necessary members of the radiology team* *Communicates non-emergent findings where failure to act may adversely affect patient outcome*	● Communicates management of a postprocedural care with regards to wound care and postprocedural pain ● Communicates finding of a suspicious adnexal mass on hip MRI and suggests appropriate follow up based on imaging characteristics and patient age
Level 4 *Independently responds and coordinates care with different members of the health care team to optimize patient care* *Communicates findings and management options (as appropriate) that 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 vastus lateralis by the primary care physician ● Communicates to an orthopedic surgeon that the patient had an atypical stress fracture but to a primary care physician gives much more detailed information
Level 5 *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 orthopedic surgery and the emergency department for MRI scan prioritization ● Coaches residents in subspecialty level communications
Assessment Models or Tools	● Direct observation

	● End-of-rotation evaluation ● Multisource feedback ● Simulation
Curriculum Mapping	●
Notes or Resources	● American College of Radiology. Communication Curriculum for Radiology Residents. https://www.acr.org/Member-Resources/rfs/learning/Communication-for-Radiology-Residents. 2021. ● Dehon E, Simpson K, Fowler D, Jones A. Development of the faculty 360. *MedEdPORTAL*. 2015;11:10174. https://www.mededportal.org/publication/10174/. 2021. ● 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/. 2021.

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 oncology networks, helps facilitates definitive care and management through the reporting of results to the oncology team through a standardized reporting process, aiding in efficient and timely management of 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	● American College of Radiology. Communication Curriculum for Radiology Residents. https://www.acr.org/Member-Resources/rfs/learning/Communication-for-Radiology-Residents. 2021. ● 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. 2021. ● Institutional communication policies ● 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. 2021.

To help programs transition to the new version of the Milestones, the original Milestones 1.0 have been mapped to the new Milestones 2.0; it is indicated if subcompetencies are similar between versions. These are not exact matches but include some of the same 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: Patient Safety	SBP5: Contrast Agent Safety SBP6: Radiation Safety SBP7: Magnetic Resonance (MR) Safety
PCTS1: Consultant	PC1: Consultant
PCTS2: Competence in Procedures: Arthrography, Biopsy, other Therapeutic Procedures	PC2: Diagnostic and Therapeutic Procedures
MK1: Image Interpretation-Radiography	MK1: Image Interpretation – Anatomy and Physiology MK2: Image Interpretation – Diagnosis
MK2: Image Interpretation-Cross Sectional	MK1: Image Interpretation – Anatomy and Physiology MK2: Image Interpretation – Diagnosis
MK3: Cross-sectional Protocols	MK3: Protocols
SBP1: Quality Improvement	SBP1: Patient Safety SBP2: Quality Improvement
SBP2: Healthcare Economics	SBP4: Physician Role in Health Care Systems
	SBP3: System-Navigation for Patient-Centered Care
	SBP8: Informatics
PBLI1: Self-directed Learning	PBLI2: Reflective Practice and Commitment to Personal Growth
PBLI2: Scholarly Activity	PBLI1: Scholarly Activity
PROF1: Individual	PROF1: Professional Behavior and Ethical Principles
PROF2: Systems	PROF2: Accountability/Conscientiousness
	PROF3: Self-Awareness and Help-Seeking
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)	PC3: Musculoskeletal Radiology Reporting 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/