Supplemental Guide: Interventional Radiology - Integrated

ACGME

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Milestones Supplemental Guide

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

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

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

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

Patient Care 1: Reporting **Overall Intent:** To generate effective 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, writes report including history, comparison, technique, findings, all required anatomy, impressions/ conclusions ● For a procedure with moderate sedation, writes report including sedation type, time, and statement of monitoring as well as any institutional requirements ● Describes one of the lexicons used at their training site; describes structured reporting used
Level 2 *Efficiently generates clear and concise reports that 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 ● Creates a report for a right subclavian port, but incorrectly describes the right jugular approach
Level 3 *Efficiently generates clear and concise reports that rarely require correction* *Uses lexicons and structured reporting that 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 ● Chooses correct template and appropriately modifies the report but may include errors in spelling
Level 4 *Generates tailored reports meeting the needs of the care provider and complex interventional reports with appropriate elements for coding* *Proficiently uses lexicons and structured reporting to provide accurate and timely reports that do not require correction*	● Creates a report (structured or unstructured) describing pancreatic carcinoma for the surgeon to stage the tumor and make management decisions, when appropriate ● Creates a complex catheter directed locoregional therapy report outside of standard template. Includes microcatheter tip position for appropriate coding
Level 5 *Generates tailored reports meeting the referring 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 and feedback ● Faculty evaluations ● Multisource feedback
Curriculum Mapping	●

Notes or Resources	● Elements for billing may change over time ● A substantive change would be a description that needs changes to the lexicons, i.e., BI-RADS2 when it is BI-RADS4, right vs. left, or fails to modify template to reflect actual case ● Reports that have incomplete description of the findings. A bone lesion described as lytic but description does not include additional information such as characteristics of the borders or internal matrix. This is 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-SIR-SPR Practice Parameter for the Reporting and Archiving of Interventional Radiology Procedures*. Reston, VA: American College of Radiology; 2014. https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Reporting-Archiv.pdf?la=en. Accessed 2019. ● American College of Radiology. *ACR Practice Parameters for Communication of Diagnostic Imaging Findings.* Reston, VA: American College of Radiology; 2014. https://www.acr.org/-/media/ACR/Files/Practice-Parameters/CommunicationDiag.pdf?la=en. Accessed 2019. ● RadReport. http://radreport.org/ ● RSNA Informatics. RadLex. http://radlex.org/. Accessed 2019. ● American College of Radiology. ACR BI-RADS Atlas. https://www.acr.org/Clinical-Resources/Reporting-and-Data-Systems/Bi-Rads. Accessed 2019. ● Society of Interventional Radiology. SIR Coding Manual. https://www.sirweb.org/special-pages/search/?q=coding+manual. Accessed 2019. ● Society of Interventional Radiology. Standardized reporting. https://www.sirweb.org/practice-resources/quality-improvement2/standardized-reporting/. Accessed 2019.

Patient Care 2: Imaging Consultation **Overall Intent:** To provide a high-quality imaging consultation	
Milestones	**Examples**
Level 1 *Uses electronic health record (EHR) 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 imaging consultations, delineates the clinical question, obtains appropriate clinical information, uses evidence-based imaging guidelines, and 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 imaging consultations, delineates the clinical question, obtains appropriate clinical information, uses evidence-based imaging guidelines, and recommends next steps, with assistance*	● Primary care physician refers a patient with cirrhosis and a liver mass on ultrasound; the consultation addresses the next step in management ● Provides consultation for a patient with a pacemaker and requires an magnetic resonance imaging (MRI)
Level 4 *Manages imaging consultations independently, taking into consideration cost effectiveness and risk benefit analysis*	● A consultation is requested 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. The resident independently recommends a scrotal ultrasound and tumor markers first
Level 5 *Provides comprehensive imaging consultation at the expected level of a subspecialist*	● A resident is consulted about a brain tumor and recommends advanced MRI in preparation for biopsy or surgery
Assessment Models or Tools	● Case conferences ● Direct observation ● 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. ● Institutional policies ● American College of Radiology. ACR Appropriateness Criteria https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. Accessed 2019.

	● American College of Radiology. ACR Contrast Manual https://www.acr.org/Clinical-Resources/Contrast-Manual. Accessed 2019. ● Image Gently. https://www.imagegently.org/. Accessed 2019. ● Society of Interventional Radiology. Clinical practice essentials. https://www.sirweb.org/practice-resources/guidelines-by-document-type/guidelines-by-service-line/. Accessed 2019. ● Hopkins ACR Appropriateness Modules http://jhrad.com/acr/

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 ● Identifies abdominal aortic aneurysm (AAA) on computed tomography angiography (CTA)
Level 2 *Identifies secondary and critical imaging findings and formulates differential diagnoses*	● Identifies that a hemorrhage is in the parenchymal (rather than subarachnoid or extra-axial); generates differential considerations including tumor, stroke, trauma, vascular, and hypertension ● Identifies thickened wall around the AAA; generates differential considerations including infection, mycotic, impending rupture
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 CTA to look for aneurysm ● In the setting of acute abdominal pain, prioritizes impending rupture
Level 4 *Provides a single diagnosis, when appropriate, with integration of current guidelines to recommend management*	● A CT of the brain shows M1 large vessel occlusion, determines how long since onset, and recommends consultation with neuro-interventional specialist ● On serial CTAs, recognized growth of one (1) centimeter over past eight months and appropriately recommends urgent endovascular repair
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 ● Recognizes that an AAA extending to the level of the renal arteries means that it will be a complex endograft, and provides appropriate measurements
Assessment Models or Tools	● Direct observation ● End-of-rotation evaluation ● Exam scores ● Multisource feedback ● Objective structures clinical examination ● 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 oversightACR

	Appropriateness Criteria https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. Accessed 2019. ● Klein J, Vinson EN, Brant WE, Helms CA. *Brant and Helms' Fundamentals of Diagnostic Radiology.* 5th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2018. https://shop.lww.com/Brant-and-Helms--Fundamentals-of-Diagnostic-Radiology/p/9781496367396. Accessed 2019. ● Wolf FJ, Grozdanovic Z, Albrecht T, Heidenreich J, Schilling A, Wacker F. *Direct Diagnosis in Radiology: Vascular Imaging*. 1st Ed. New York, NY: Thieme; 2009. https://www.thieme.com/books-main/radiology/product/1266-vascular-imaging. Accessed 2019. ● Conferences ● Tumor Board

Patient Care 4: Pre-Procedural Consultation **Overall Intent:** To ensure progressive development of knowledge and skill required to evaluate and manage patients prior to intervention	
Milestones	**Examples**
Level 1 *Gathers a complete history and performs a physical* *Formulates a pre-procedural assessment and plan with guidance from a faculty member*	● Performs a complete history and physical exam and formulate treatment plan, but needs assistance in identifying most relevant findings and appropriate therapies ● Functions across a variety of settings including clinic, emergency department, and inpatient wards
Level 2 *Gathers a focused history and performs a physical* *Formulates a pre-procedural assessment and plan with minimal guidance from a faculty member*	● Focuses physical exam and history, identify relevant issues and formulate basic treatment plan with minimal guidance ● Needs guidance in appropriate pre-procedure testing and final plan
Level 3 *Chooses appropriate pre-procedural laboratory and imaging studies* *Independently formulates a pre-procedural assessment and plan for common disorders*	● Provides appropriate independent consultation for common procedures ○ abscess drainage ○ nephrostomy ○ venous access ● May need assistance with complex procedures and critically ill patients ● Orders appropriate pre procedure testing as needed
Level 4 *Adjusts procedural plan based upon pre-procedural laboratory and imaging results* *Independently formulates a pre-procedural assessment and plan for complex disorders*	● Independently provides pre-procedure consultation on complex and critically ill patients ● Adjusts management appropriately when care needs change ○ acute MI ○ abnormal coagulation parameters ○ sepsis ○ shock ○ respiratory failure
Level 5 *Mentors other learners in the pre-procedural consultation* *Develops patient care protocols/teaching materials*	● Develops patient teaching materials for women with uterine fibroids ● Updates pre-procedure antibiotic protocols for the department
Assessment Models or Tools	● Direct observation ● Medical record (chart) audit

	● Multisource feedback ● Objective structured clinical examination
Curriculum Mapping	●
Notes or Resources	● Society of Interventional Radiology. Guidelines: Clinical topics. https://www.sirweb.org/practice-resources/guidelines-by-document-type/guidelines-by-service-line/. Accessed 2019. ● Society of Interventional Radiology. Clinical practice essentials. https://www.sirweb.org/practice-resources/guidelines-by-document-type/. Accessed 2019. ● SIR Syllabus: Patient Care in Vascular and Interventional Radiology https://sir.personifycloud.com/PersonifyEBusiness/Default.aspx?tabid=251&productId=3516745. Accessed 2019.

Patient Care 5: Performance of Procedures **Overall Intent:** To ensure progressive development of technical skills required to perform procedures	
Milestones	**Examples**
Level 1 *Performs basic procedures (e.g., paracentesis, thoracentesis, non-targeted biopsy)* *Effectively uses basic image guidance (e.g., visualize needle tip with ultrasound)*	● Performs a paracentesis with effective real-time ultrasound visualization of needle tip
Level 2 *Performs advanced basic procedures (e.g., central venous access, targeted superficial biopsy)* *Demonstrates basic catheter and wire skills*	● Performs central venous line placement with real-time ultrasound guidance and confirms tip placement with fluoroscopy
Level 3 *Performs moderately complex procedures (e.g., nephrostomy, diagnostic angiography)* *Integrates catheter and wire skills with imaging of complex anatomy*	● Understands available closure devices, selects appropriate device and successfully deploys device ● Places percutaneous nephrostomy tube in obese patient with duplicated collecting system
Level 4 *Performs complex procedures (e.g., transarterial chemoembolisation therapy [TACE], transjugular intrahepatic portosystemic shunt [TIPS], stent graft)* *Integrates catheter and wire skills with advanced imaging guidance and device use*	● Performs an abdominal aortogram and crosses critical renal artery stenosis with wire and catheter for intervention ● Uses cone beam CT appropriately during procedure ● Incorporates intravascular ultrasound (IVUS) during TIPS placement ● Performs subselective catheter directed locoregional therapies with minimal assistance
Level 5 *Develops new techniques or tools*	● Researches new device development in cooperation with biomedical engineering
Assessment Models or Tools	● Direct observation ● Evaluations ● Self-assessment ● Simulation lab
Curriculum Mapping	●
Notes or Resources	● Society of Interventional Radiology. Annual meeting and video library. https://www.sirweb.org/special-pages/learning-center-list/. Accessed 2019.

	● Society of Interventional Radiology. RFS Trainee Website. http://rfs.sirweb.org. Accessed 2019. ● CIRSE Library. https://library.cirse.org. Accessed 2019. ● Society of Interventional Radiology. Spring Practicum. https://www.sirweb.org/learning-center/rfs-landing-page/fellows-spring-practicum/. Accessed 2019. ● IR Curriculum

Patient Care 6: Post-Procedural Patient Care **Overall Intent:** To ensure progressive knowledge base for the appropriate post procedure care of patients and the skills to manage post procedure complications	
Milestones	**Examples**
Level 1 *Manages routine post-procedural care with guidance* *Evaluates post-procedural complications*	● Places post angiogram orders for bed rest, groin checks, etc. and appropriately evaluates pulses post procedure with the help of an upper level resident or faculty member ● Will see the patient when a nurse calls about oozing at the groin site, gathers appropriate clinical information and relevant clinical exam, and holds pressure until bleeding resolves
Level 2 *Manages post-procedural care with minimal guidance* *Manages minor post-procedural complications*	● Places post angiogram orders for bed rest, groin checks, etc. and appropriately evaluates pulses post procedure ● Concern for pseudoaneurysm on bedside exam, gets appropriate ultrasound exam and prepares patient for thrombin injection
Level 3 *Formulates and implements post-procedural imaging and clinical follow-up for patients after basic procedures* *Manages major post-procedural complications*	● Orders follow-up cross sectional imaging in four weeks after catheter directed locoregional therapies to assess for response and arranges clinic visit ● In a patient complaining of a cold leg and pain after angiogram, performs appropriate clinical exam, imaging if appropriate or urgent intervention
Level 4 *Formulates and implements post-procedural imaging and clinical follow-up for patients after complex procedures* *Anticipates and mitigates post-procedural complications*	● Orders most appropriate clinical follow-up and imaging for type II endoleak after intervention based on procedure performed and patients symptoms/clinical scenario ● For a patient on anticoagulation that needs an emergent angiogram, uses a smaller sheath size or radial access to decrease risk of groin site complication
Level 5 *Mentors other learners in post-procedural care and management of complications* *Develops a clinical pathway or guideline for post-procedural care*	● Provides didactic curriculum to junior learners on post procedural care of patients after angiogram ● Develops department policy for closure device use
Assessment Models or Tools	● Direct observation ● End-of-rotation evaluation ● Multisource feedback ● Quality and safety (M and M) presentations

Curriculum Mapping	●
Notes or Resources	● Society of Interventional Radiology. Quality and Safety Toolkit https://www.sirweb.org/practice-resources/toolkits/quality-and-safety-toolkit/. Accessed 2019. ● Society of Interventional Radiology. Clinical practice essentials. https://www.sirweb.org/practice-resources/guidelines-by-document-type/. Accessed 2019. ● Society of Interventional Radiology. Guidelines: Clinical topics. https://www.sirweb.org/practice-resources/guidelines-by-document-type/guidelines-by-service-line/. Accessed 2019. ● SIR Syllabus: Patient Care in Vascular and Interventional Radiology. https://sir.personifycloud.com/PersonifyEBusiness/Default.aspx?tabid=251&productId=3516736. Accessed 2019. ● American College of Radiology. Practice Parameters and Technical Standards https://www.acr.org/Clinical-Resources/Practice-Parameters-and-Technical-Standards. Accessed 2019.

Medical Knowledge 1: Diagnostic Imaging 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 the 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 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, 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 versus multiple core biopsies), work-up, and treatment

pathophysiology to formulate a diagnosis at the expected level of a subspecialist	
Assessment Models or Tools	● Assessment of Case Conference Presentation ● Direct observation ● Faculty member evaluations ● 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 AV malformations, leukodystrophies, congenital heart disease, neuroendocrine tumors, interstitial pneumonia) ● Amin MB, Edge SB, Greene FL, et al. *AJCC Cancer Staging Manual.* 8th ed. New York, NY: Springer; 2017. https://cancerstaging.org/references-tools/deskreferences/pages/default.aspx. Accessed 2019. ● World Health Organization. WHO Classification of Tumors. http://whobluebooks.iarc.fr/. Accessed 2019. ● American College of Radiology. Practice Parameters and Technical Standards. https://www.acr.org/Clinical-Resources/Practice-Parameters-and-Technical-Standards. Accessed 2019.

Medical Knowledge 2: Physics, Protocol Selection, and Optimization of Images **Overall Intent:** To apply knowledge of physics to optimize imaging, including dose reduction strategies, and minimizing risk to patient	
Milestones	**Examples**
Level 1 *Discusses the basic physics for imaging and image-guided intervention* *Discusses the protocols and contrast agent/dose for imaging and image-guided intervention*	● Understands optimal positioning of image intensifier for obtaining an image ● Is familiar with and can use department protocols for imaging
Level 2 *Demonstrates knowledge of basic medical physics and radiobiology in imaging and image-guided intervention* *Selects appropriate protocols and contrast agent/dose for emergent and routine imaging and image guided intervention*	● Discusses the stochastic and deterministic effects of radiation ● Evaluates the 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 *Applies knowledge of basic medical physics and radiobiology to imaging and image-guided intervention* *Selects appropriate protocols and contrast agent/dose for complex imaging and image-guided intervention*	● Appropriately positions image intensifier to reduce radiation and minimizes use of fluoroscopy during procedure ● Knows the indications and specific features of a three phase liver CT scan, including timing
Level 4 *Applies physical principles to optimize image quality, including dose reduction strategies* *Modifies protocols and contrast agent/dose as determined by clinical circumstances*	● Uses pulse fluoroscopy to minimize radiation dose to patient ● Adjusts imaging techniques to limit metallic or motion artifacts in CT and MR ● Modifies standard contrast dosing for reduced renal function
Level 5 *Teaches physical principles to optimize image quality to other specialties* *Develops imaging and image-guided intervention 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 ● 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. Accessed 2019. ● Image gently. Pediatric Radiology and Imaging https://www.imagegently.org/. Accessed 2019. ● American College of Radiology. Radiation Safety in Adult Medical Imaging. https://www.imagewisely.org/. Accessed 2019. ● American College of Radiology. Manual on Contrast Media https://www.acr.org/Clinical-Resources/Contrast-Manual. Accessed 2019. ● American College of Radiology. Radiology Safety https://www.acr.org/Clinical-Resources/Radiology-Safety. Accessed 2019. ● Radiological Society of North America. Physics modules. https://www.rsna.org/en/education/trainee-resources/physics-modules. Accessed 2019.

Medical Knowledge 3: 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 reverberation artifacts
Level 3 *Demonstrates knowledge of instrument quality control and image reconstruction, troubleshoots for artifact reduction*	● Knows to adjust transducer positioning and angle to reduce reverberation and side-lobe artifacts ● 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. Accessed 2019. ● Image gently: Pediatric Radiology and Imaging https://www.imagegently.org/. ● American College of Radiology: Radiation Safety in Adult Medical Imaging https://www.imagewisely.org/. Accessed 2019. ● American College of Radiology: Manual on Contrast Media https://www.acr.org/Clinical-Resources/Contrast-Manual. Accessed 2019. ● American College of Radiology: Radiology Safety https://www.acr.org/Clinical-Resources/Radiology-Safety. Accessed 2019. ● Radiological Society of North America. Physics modules. https://www.rsna.org/en/education/trainee-resources/physics-modules. Accessed 2019.

Medical Knowledge 4: Pathophysiology and Treatment **Overall Intent:** To demonstrate progressive knowledge of pathophysiology and treatment of disease conditions in interventional radiology; to ensure understanding how treatment affects underlying pathophysiology	
Milestones	**Examples**
Level 1 *Demonstrates knowledge of pathophysiology of common conditions*	● Demonstrates knowledge of pathophysiology of patients with ○ ascites ○ simple pleural effusion ○ venous thromboembolic disease
Level 2 *Demonstrates knowledge of pathophysiology and treatment of patients with common conditions*	● Demonstrates knowledge of treatment options for patients with common diseases that are informed by an understanding of the underlying pathophysiology ● Consults on a patient with lower extremity deep vein thrombosis and recent intracranial surgery and recommends inferior vena cava filter placement
Level 3 *Demonstrates knowledge of pathophysiology and treatment of patients with complex conditions*	● Demonstrates knowledge of treatment options for patients with complex diseases that are informed by an understanding of the underlying pathophysiology ● On a patient with gastrointestinal (GI) bleeding and ascites, recognizes that bleeding is likely due to underlying alcoholic cirrhosis and portal hypertension with varices and recommends TIPS
Level 4 *Demonstrates knowledge of the pathophysiologic changes after treatment*	● Recognizes hepatic encephalopathy secondary to shunt placement and prescribes appropriate treatment for hepatic encephalopathy in a patient experiencing confusion after recent TIPS procedure.
Level 5 *Contributes to peer-reviewed literature on pathophysiology and/or treatment*	● Publishes retrospective series ● Designs clinical trial ● Contributes patients to clinical trials ● Develops educational materials
Assessment Models or Tools	● Direct observation ● Faculty member evaluation ● In-service exam ● Morbidity and mortality (M and M) conference ● Multiple choice knowledge tests
Curriculum Mapping	●
Notes or Resources	● Kaufman JA, Lee MJ. *Vascular and Interventional Radiology: The Requisites*. 2nd ed. Philadelphia, PA: Saunders; 2013. https://www.elsevier.com/books/vascular-and-interventional-radiology-the-requisites/kaufman/978-0-323-04584-1. Accessed 2019. ● Geschwind J, Drake M. *Abrams' Angiography: Interventional Radiology*. 3rd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2013. https://shop.lww.com/Abrams--Angiography/p/9781609137922. Accessed 2019.

	● Society of Interventional Radiology. Learning Center. https://learn.sirweb.org/. Accessed 2019.

Medical Knowledge 5: Procedural Anatomy **Overall Intent:** To understand normal, variant, and postoperative anatomy to effectively perform basic and complex procedures	
Milestones	**Examples**
Level 1 *Identifies normal anatomy during procedures*	● Performs central line placement on normal compressible vein adequate for catheter placement ● Accurately identifies normal pelvic arterial anatomy during uterine artery embolization procedure
Level 2 *Identifies anatomic variants during procedures*	● Correctly identifies a duplicated superior vena cava while advancing a left central venous line ● Correctly identifies replaced right hepatic artery during arteriogram for liver laceration
Level 3 *Articulates the implications of varying anatomy for procedural planning*	● Understands implications of duplicated inferior vena cava during filter placement ● Correctly identifies high origin of profunda femoral artery during arterial access
Level 4 *Identifies post-operative anatomy and its implications for procedures*	● Identifies iatrogenic bile duct injury from laparoscopic cholecystectomy and effectively plans bile duct drainage ● Understands implication of roux-en-Y anatomy prior to gastrostomy tube placement
Level 5 *Develops simulation models or other resources*	● Builds simulation model for renal biopsy ● Develops curriculum for training medical students and other residents to perform safe ultrasound guided vascular access
Assessment Models or Tools	● Faculty member observation ● Multisource feedback ● Portfolio ● Reflection ● Simulation lab ● Self-assessment
Curriculum Mapping	●
Notes or Resources	● Society of Interventional Radiology. General Clinical Resources http://rfs.sirweb.org/clinical-resources/educational-resources/. Accessed 2019. ● Society of Interventional Radiology. Procedure Guide http://rfs.sirweb.org/clinical-resources/ir-procedure-guides/. Accessed 2019. ● CIRSE Library. https://library.cirse.org. Accessed 2019. ● Textbooks of Interventional Radiology (analog or virtual)

Medical Knowledge 6: Pharmacology **Overall Intent:** To build progressive knowledge base of medications used in interventions to make procedures safe, patient comfortable or alter physiological states	
Milestones	**Examples**
Level 1 *Demonstrates basic knowledge of the pharmacologic agents used in interventional radiology*	● Knows commonly used medications for moderate sedation
Level 2 *Demonstrates knowledge of dosing and drug choice for sedation and other commonly used pharmacologic agents*	● Orders 1 mg Versed and 50 mcg fentanyl for a hemodynamically stable patient undergoing a tunneled central venous catheter placement and knows to lock the catheter with heparin per hospital protocol
Level 3 *Demonstrates knowledge of the indications, contraindications, side-effects, and complications of pharmacologic agents*	● In a patient with decreased oxygen saturation during a procedure, appropriately orders flumazenil and knows that the patient needs to have extended post procedure monitoring
Level 4 *Applies functional knowledge of pharmacology to interventional radiology procedures and peri-procedural care*	● Appropriately adjusts tissue plasminogen activator dosing for acute lower extremity deep vein thrombosis lysis overnight based on laboratory values and clinical situation
Level 5 *Develops pharmacologic protocols or departmental guidelines*	● Helps to develop departmental guidelines for the dosing and adjustment tissue plasminogen activator in routine lysis cases
Assessment Models or Tools	● Direct observation ● End-of-rotation evaluation ● In-training exam ● Multisource feedback
Curriculum Mapping	●
Notes or Resources	● American College of Radiology. ACR-SIR Practice Parameter for Sedation Analgesia. https://www.acr.org/-/media/ACR/Files/Practice-Parameters/Sed-Analgesia.pdf. Accessed 2019. ● American College of Radiology. Manual on Contrast Media. https://www.acr.org/Clinical-Resources/Contrast-Manual. Accessed 2019. ● Society of Interventional Radiology. SIR Standards of Practice Pre-Procedure Patient Safety Checklist. https://www.jvir.org/article/S1051-0443%2816%2900390-0/pdf. Accessed 2019. ● Anesthesiology. Practice Guidelines for Moderate Procedural Sedation and Analgesia 2018. http://anesthesiology.pubs.asahq.org/article.aspx?articleid=2670190. Accessed 2019.

	● Olsen JW, Barger RL Jr, Doshi SK. Moderate sedation: what radiologists need to know. *American Journal of Roentgenology*. 2013;201(5): 941-946. https://www.ajronline.org/doi/10.2214/AJR.12.9501. Accessed 2019. ● Institutional Pharmacy

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 handoffs 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)*	● Participates in departmental M and M conferences ● Participates in a Root Cause Analysis group ● Discloses contrast reaction to a patient or family with supervising physician present
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)*	● Collaborates with a team to analyze a patient safety event, develops, and implements an action plan to prevent future reactions ● Competently communicates with patients/families about the contrast reaction
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 ● E-module multiple choice tests ● Medical record (chart) audit ● M and M conference

	● Multisource feedback ● Portfolio ● Reflection ● Simulation
Curriculum Mapping	●
Notes or Resources	● Institute for Healthcare Improvement. http://www.ihi.org/Pages/default.aspx. Accessed 2019.

Systems-Based Practice 2: Quality Improvement (QI) **Overall Intent:** To demonstrate knowledge of core quality improvement concepts and how they inform the modern practice of medicine and demonstrate competence 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 handwashing initiatives and time-outs
Level 3 *Participates in local quality improvement initiatives*	● Participates in hospital or departmental QI committee ● Has participated in a QI project, though the resident may not have yet designed a QI project
Level 4 *Demonstrates the skills required to identify, develop, implement, and analyze a quality improvement project*	● Resident works with department QI committee to analyze data from handwashing project and proposes strategies to improve compliance
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 ● E-module multiple choice tests ● Medical record (chart) audit ● Multisource feedback ● Portfolio ● Reflection ● Simulation
Curriculum Mapping	●
Notes or Resources	● Institute for Healthcare Improvement. http://www.ihi.org/Pages/default.aspx. Accessed 2019. ● Agency for Healthcare Research and Quality. https://www.ahrq.gov/. Accessed 2019. ● Society of Interventional Radiology. Quality and Safety Toolkit. https://www.sirweb.org/practice-resources/toolkits/quality-and-safety-toolkit/. Accessed 2019.

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, and 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* *Performs safe and effective transitions of care/hand-offs in basic clinical situations*	● Identifies the members of the interprofessional team and describes their roles ● Lists the essential components of an effective sign-out ● Communicates to team that central line is ready for use
Level 2 *Coordinates care of patients in routine radiology imaging/ procedures effectively using the roles of the interprofessional teams* *Performs safe and effective transitions of care/hand-offs in moderately complex clinical situations*	● In a patient with thrombocytopenia and need for tunneled line placement for treatment, communicates with referring service need for platelets prior to procedure and discusses when to call for the patient with the interventional radiology team ● Performs an effective sign-out for a post g tube patient giving appropriate anticipatory guidance to primary team and overnight covering interventional resident ● 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 the interprofessional teams* *Performs safe and effective transitions of care/hand-offs in complex clinical situations*	● For a patient with cirrhosis presenting with GI bleed, coordinates with gastroenterologist, intensive care unit (ICU) team and anesthesia to initially stabilize the patient, endoscopy if appropriate and to interventional radiology (IR) if bleeding refractory/uncontrolled and calls in IR team when appropriate ● Provides effective anticipatory guidance for unstable post embolization for GI bleed patient including medication reconciliation and checklists to transition from procedure room to ICU ● 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 safe and effective transitions of care/hand-offs*	● Proactively calls the outpatient doctor to ensure a discharged patient can get their international normalized ratio checks, provides efficient hand-off to the ICU team at the end of a rapid response event, 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 *Analyses the process of care coordination and leads in the design and implementation of improvements*	● Takes a leadership role in designing and implementing changes to improve the care coordination process ● Develop better hand-off tools or improve teaching sessions

Improves quality of transitions of care within and across health care delivery systems to optimize patient outcomes	● Works with local outreach programs to develop screening for lung cancer
Assessment Models or Tools	● Direct observation ● Medical record (chart) audit ● Multisource feedback ● Patient reports/events ● Review of sign-out tools, use of checklists between units, from IR to post-anesthesia care unit or inpatient unit ● Simulation
Curriculum Mapping	●
Notes or Resources	● Institutional hand-off guidelines ● Joint Commission Center for Transforming Healthcare. Hand-off Communications Targeted Solutions Tool. https://www.centerfortransforminghealthcare.org/what-we-offer/targeted-solutions-tool/hand-off-communications-tst. Accessed 2019.

Systems-Based Practice 4: Multidisciplinary Conferences **Overall Intent:** To demonstrate knowledge of importance of multidisciplinary conferences in providing high-quality patient care	
Milestones	**Examples**
Level 1 *Demonstrates basic knowledge of how a multidisciplinary conference operates*	● Identifies appropriate stakeholders in treating complex patients and the value of a multidisciplinary approach to treatment
Level 2 *Attends multidisciplinary conferences*	● Attends gastrointestinal cancer tumor board and identifies stakeholders
Level 3 *Contributes meaningfully to the multidisciplinary conference*	● Works with attending to prepare cases for tumor board
Level 4 *Initiates and presents their own patients at multidisciplinary conference, and is responsible for comprehensive discussion*	● Sees a patient with metastatic colon cancer in clinic, refers patient to the tumor board and presents patient history and imaging to the group
Level 5 *Leads a multidisciplinary conferences*	● Takes a leadership role in multidisciplinary tumor boards ● Actively participates in treatment decisions
Assessment Models or Tools	● Direct observation ● Faculty member evaluation ● Feedback from interprofessional team
Curriculum Mapping	●
Notes or Resources	● Lesslie M, Parikh JR. Implementing a multidisciplinary tumor board in the community practice setting. *Diagnostics (basel)*. 2017;7(4):55. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5745391/. Accessed 2019. ● Interventional Oncology 360. Tumor Board: From Preparation to Practice Building. https://www.interventionaloncology360.com/article/tumor-board-preparation-practice-building. Accessed 2019.

Systems-Based Practice 5: Population Health **Overall Intent:** To adapt care to a specific patient population to ensure high-quality patient outcomes	
Milestones	**Examples**
Level 1 *Demonstrates knowledge of population and community health needs and disparities*	● Knows that patients without insurance are less likely to get a mammogram ● Knows that a homeless patient is less likely to receive follow-up care
Level 2 *Identifies specific population and community health needs and inequities for their local population*	● Knows which patients are at high risk due for specific health outcomes related to health literacy concerns, cost, etc. ● Identifies that patients with cirrhosis will need routine screening for hepatocellular carcinoma
Level 3 *Uses local resources effectively to meet the needs of a patient population and community*	● Appreciates the need for and uses clinic or local resources, such as the social worker/health navigator, to ensure patients with low literacy understand how to schedule a procedure ● Works with free-care clinic to provide appropriate screening exams to uninsured patients
Level 4 *Participates in changing and adapting practice to provide for the needs of specific populations*	● Identifies patient populations at high risk for poor post-operative outcomes due to health disparities and implements strategies to improve care ● Works with a care coordinator to have a port placed as an inpatient to decrease patient costs ● Develops multilingual patient education materials
Level 5 *Leads innovations and advocates for populations and communities with health care inequities*	● Works with local outreach program for peripheral arterial disease
Assessment Models or Tools	● Panel management quality metrics and goals mined from electronic health records (EHR)
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 ● The Joint Commission Targeted Solutions Tool for Handoff Communications https://www.centerfortransforminghealthcare.org/tst_hoc.aspx

Systems-Based Practice 6: 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 health care system* *Describes the mechanisms for reimbursement, including types of payers*	● 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 payers
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 chest x-ray versus chest CT
Level 3 *Discusses how individual practice affects the broader system* *Describes the technical and professional components of imaging costs*	● Understands that turn-around 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* Describes the radiology revenue cycle and measurements of productivity	● 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 trauma embolization
Level 5 *Advocates for or leads systems change that enhances high-value, efficient, and effective patient care* *Participates in health policy advocacy activities*	● Decreases opioid prescribing on one or more clinical services, incorporates e-consults into the EHR ● Serves on hospital committees that advocate for systems changes to improve patient care ● Publishes original research on high value patient care in peer reviewed journal
Assessment Models or Tools	● Direct observation ● Medical record (chart) audit ● Multiple choice test ● Objective structured clinical examination
Curriculum Mapping	●
Notes or Resources	● Examples of health care system components are finance, personnel, technology

	● National Alliance of Healthcare Purchaser Coalitions. https://connect.nationalalliancehealth.org/home. Accessed 2019. ● American College of Radiology. Radiology Leadership Institute. https://www.acr.org/Practice-Management-Quality-Informatics/Radiology-Leadership-Institute/Programs-and-Training/Online. Accessed 2019. ● American College of Radiology. Practice Management, Quality, and Informatics. https://www.acr.org/Practice-Management-Quality-Informatics. Accessed 2019. ● Agency for Healthcare Research and Quality. The Challenges of Measuring Physician Quality. https://www.ahrq.gov/talkingquality/measures/setting/physician/challenges.html. Accessed 2019. ● Agency for Healthcare Research and Quality. Major Physician Measurement Sets. https://www.ahrq.gov/talkingquality/measures/setting/physician/measurement-sets.html. Accessed 2019. ● Henry J Kaiser Family Foundation. https://www.kff.org/. Accessed 2019. ● Dzau VJ, McClellan M, Burke S, et al. Vital directions for health and health care: priorities from a National Academy of Medicine initiative. *JAMA*. 2017;317(14):1461-1470. https://jamanetwork.com/journals/jama/fullarticle/2612013. Accessed 2019. ● The Commonwealth Fund. Health System Data Center. http://datacenter.commonwealthfund.org/?_ga=2.110888517.1505146611.1495417431-1811932185.1495417431#ind=1/sc=1. Accessed 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]. Accessed 2019. ● Society of Interventional Radiology. MACRA Matters. https://www.sirweb.org/practice-resources/macra-matters/. Accessed 2019. ● United States Nuclear Regulatory Commission. Part 35 - Medical Use of Byproduct Material. https://www.nrc.gov/reading-rm/doc-collections/cfr/part035/. Accessed 2019.

Systems-Based Practice 7: 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 and commonly used pre-medication regimens*	● Demonstrates basic knowledge and awareness of contrast reactions, including their recognition and management ● Describes 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 radiology department ● Recognizes 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 radiology department ● Manages 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 radiology 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. Accessed 2019. ● American College of Radiology. Contrast Card. https://www.acr.org/-/media/ACR/Files/Clinical-Resources/Contrast-Reaction-Card.pdf. Accessed 2019. ● BLS and ACLS certification courses

Systems-Based Practice 8: Radiation Safety **Overall Intent:** 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* *Wears lead apron and dosimeter at all times*	● Describes fundamental concepts in radiation biology addressing the mechanism of injury at different radiation exposures
Level 2 *Applies principles of ALARA in daily practice* *Uses fluoroscopy techniques that decrease exposure, with guidance* *Uses radiation protection devices, including shielding, as appropriate, with guidance*	● Readily accesses online resources to determine a CT of the head average dose information ● Uses screen capture instead of spot radiograph for documentation of central venous catheter tip position, when reminded ● Lowers the image detector closer to the patient, when reminded ● Brings overhead shield in-between patient and operator, when reminded
Level 3 *Accesses resources to determine exam-specific radiation dose information* *Independently uses radiation protection devices, including shielding, as appropriate*	● Effectively communicates relative risks of the radiation exposure during a CT of the head to the patient, patient's family or referring provider ● Independently uses screen capture instead of spot radiograph for documentation of central venous catheter tip position ● Independently lowers the image detector closer to the patient ● Independently brings overhead shield in-between patient and operator
Level 4 *Communicates the relative risk and benefits of exam-specific radiation exposure to patients and practitioners* *Counsels colleagues and allied health staff regarding radiation exposure*	● Modifies CT parameters for an abdominal CT in keeping with the ALARA principles routinely in daily practice ● Counsels patients of the risks of skin effects relative to dose received ● Instructs junior residents in radiation dose reduction techniques ● Answers questions from colleagues regarding risk of cataracts from radiation exposure
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

Participates in radiation safety education and research	● Changes the department protocol for infant lumbar puncture using ultrasound instead of fluoroscopy
Assessment Models or Tools	● Direct observation ● Documentation of QI or radiation safety project processes or outcome ● Medical record (chart) audit ● 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. Accessed 2019. ● Image Gently. Pediatric Radiology and Imaging. https://www.imagegently.org. Accessed 2019. ● American College of Radiology. Radiation Safety in Adult Medical Imaging. https://www.imagewisely.org. Accessed 2019. ● American College of Radiology. Radiology Safety https://www.acr.org/Clinical-Resources/Radiology-Safety. Accessed 2019. ● Radiological Society of North America. Physics modules. https://www.rsna.org/en/education/trainee-resources/physics-modules. Accessed 2019. ● American College of Radiology. Radiation Safety https://www.acr.org/Clinical-Resources/Radiology-Safety/Radiation-Safety. Accessed 2019.

Systems-Based Practice 9: Magnetic Resonance (MR) Safety **Overall Intent:** To understand the practical aspects of MR Safety and safety surrounding the MR environment	
Milestones	**Examples**
Level 1 *Demonstrates knowledge of the risks of MR, 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*	● Uses resources to assess MR compatibility for a patient with a cochlear implant
Level 3 *Communicates MR safety, including implants and retained foreign bodies, to patients and practitioners*	● Communicate the risks of undergoing an MR exam to a patient with embedded shrapnel
Level 4 *Applies principles of MR safety to complex cases, such as MR guided interventions*	● Explains the principles of MR safety; handles a patient with a pacemaker and can get them through the scan ● Safely sets up and performs MR guided biopsy
Level 5 *Creates, implements, and assesses MR safety initiatives at the institutional level*	● Is a member of the Hospital wide Safety Committee ● Lectures on patient safety in the MR suite to ICU nurses
Assessment Models or Tools	● Institutional Radiation Safety Training Module ● Multisource feedback ● RadExam Patient Safety Assessment ● Safe MR Practices: Self-Assessment Module
Curriculum Mapping	●
Notes or Resources	● American College of Radiology. MR Safety. https://www.acr.org/Clinical-Resources/Radiology-Safety/MR-Safety. Accessed 2019. ● Questions and Answers in MRI. MRI Suite: ACR Safety Zones. http://mriquestions.com/acr-safety-zones.html. Accessed 2019. ● ACR Guidance Document on MR Safe Practices: 2013. https://onlinelibrary.wiley.com/doi/pdf/10.1002/jmri.24011. Accessed 2019. ● Kanal E, Barkovich AJ, Bell C, et al. ACR guidance document on MR safe practices. *Journal of Magnetic Resonance Imaging.* 2013;37(3):501-530. https://onlinelibrary.wiley.com/doi/pdf/10.1002/jmri.24011. Accessed 2019. ● Radiological Society of North America. Physics modules. https://www.rsna.org/en/education/trainee-resources/physics-modules. Accessed 2019.

	● Chew FS, Stewart BK. Safe MR practices: self-Assessment module. American Journal of Roentgenology. 2007;188:S50–S54 0361-803X/07/1886–S50 https://www.ajronline.org/doi/pdf/10.2214/AJR.07.0197 Accessed 2019.

Systems-Based Practice 10: 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 EHRs, radiological information systems, and picture archiving and communication systems*	● 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?journalCode=radiology. Accessed 2019. ● Branstetter BF IV. Basics of imaging informatics: part 2. *Radiology*. 2007;244(1):78-84. https://pubs.rsna.org/doi/abs/10.1148/radiol.2441060995?journalCode=radiology. Accessed 2019.

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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 guide routine patient care*	● Offers evidence that tunneled peritoneal catheter drainage can provide symptomatic relief to a patient with abdominal distension related to malignant ascites
Level 2 *Articulates clinical questions and elicits patient preferences and values in order to guide evidence-based care*	● Articulates evidence that tunneled central venous access is best option for patient with renal insufficiency and is consistent with patient's preference to avoid visible catheter in neck or arm
Level 3 *Locates and applies the best available evidence, integrated with patient preference and values, to care for complex patients*	● Identifies potential treatment options for management of a patient with renal cell carcinoma, incorporating available guidelines
Level 4 *Critically appraises conflicting evidence to guide care, tailored to the individual patient*	● Presents patient with metastatic liver disease at interdisciplinary tumor board to identify best treatment from surgical versus locoregional therapy versus oncologic treatment algorithms
Level 5 *Coaches others to critically appraise and apply evidence for complex patients; and/or participates in the development of guidelines*	● Participates in development of national guidelines for catheter directed therapy for acute pulmonary embolism ● Participates in the development of institutional guidelines for treatment of lower gastrointestinal bleeding
Assessment Models or Tools	● Analysis of journal club presentations and discussion ● Direct observation ● Patient evaluations ● Presentations at interdisciplinary rounds ● Reflection
Curriculum Mapping	●
Notes or Resources	● Society of Interventional Radiology. Guidelines: Clinical topics. https://www.sirweb.org/practice-resources/guidelines-by-document-type/guidelines-by-service-line/. Accessed 2019. ● Center for Evidence-Based Medicine. https://www.cebm.net/. Accessed 2019. ● American College of Radiology. Practice Parameters. https://www.acr.org/Clinical-Resources/Practice-Parameters-and-Technical-Standards. Accessed 2019. ● American College of Radiology. ACR Appropriateness Criteria. https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria. Accessed 2019.

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Practice-Based Learning and Improvement 2: Reflective Practice and Commitment to Personal 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*	● 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 ● Meets with assigned mentor
Level 2 *Receptive to performance data and feedback in order to inform 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 from others to improve patient care ● After working in clinic with an attending asks for recommendation on how to describe TIPS to a patient and family ● Requests meeting with mentor to begin developing a learning plan
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 nursing staff members, peers, and supervisors to gain insight into personal strengths and areas to improve ● Acts on input and is appreciative of feedback ● Changes daily practice habits to increase efficiency ● Documents goals in a more specific and achievable manner, such that attaining them is measureable
Level 4 *Consistently seeks performance data and feedback with humility and adaptability* *Analyzes effectiveness of behavioral changes where appropriate and considers alternatives in*	● Independently follows up on the results of biopsies ● Consistently identifies learning gaps and addresses areas to work on

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*	● 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 ● Mentors other learners on the team to consider how their behavior affects the rest of the team ● Advocates for improved work environment and develops concrete action plan ● Provides constructive feedback to peers for improvement ● Provides relevant learning plans for medical students
Assessment Models or Tools	● Direct observation ● Faculty member evaluation ● Multisource feedback ● Review of learning plan
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://www.ncbi.nlm.nih.gov/pubmed/19638773. Accessed 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://www.ncbi.nlm.nih.gov/pubmed/23969364. Accessed 2019. ● Hicks PJ, Schumacher D, Guralnick S, Carraccio C, Burke AE. Domain of competence: personal and professional development. *Academic Pediatrics.* 2014;14(2):S80-S97. https://www.ncbi.nlm.nih.gov/pubmed/24602666. Accessed 2019. ● Burke AE, Benson B, Englander R, Carraccio C, Hicks PJ. Domain of competence: practice-based learning and improvement. *Academic Pediatrics*. 2014;14(2):S38-S54. https://www.ncbi.nlm.nih.gov/pubmed/24602636. Accessed 2019.

Professionalism 1: Professional Behavior **Overall Intent:** To demonstrate professional behavior, recognize and address lapses in behavior, and use appropriate resources for managing 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
Level 2 *Demonstrates insight into professional behavior in routine situations and takes responsibility for own professionalism lapses*	● Acknowledges, apologizes, and takes responsibility for speaking angrily to a radiology technologist who hands the wrong catheter ● Articulates and implements strategies for preventing professional lapses in the future
Level 3 *Demonstrates professional behavior in complex or stressful situations and takes responsibility for own professionalism lapses*	● After the death of a critically ill patient, reaches out to team to express gratitude for coordinated effort in patient care
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 ● Models respect for patients and expects the same from others
Level 5 *Coaches others to meet professional expectations*	● Coaches others when their behavior fails to meet professional expectations ● Understands institutional resources and knows when to make referrals
Assessment Models or Tools	● Direct observation ● Global evaluation ● Multisource feedback ● Oral or written self-reflection ● Simulation
Curriculum Mapping	●
Notes or Resources	● American Medical Association. Code of Ethics. https://www.ama-assn.org/delivering-care/ama-code-medical-ethics. Accessed 2019. ● ABIM Foundation. American Board of Internal Medicine. Medical professionalism in the new millennium: a physician charter. *Annals of Internal Medicine*. 2002;136(3):243-246. https://abimfoundation.org/wp-content/uploads/2015/12/Medical-Professionalism-in-the-New-Millenium-A-Physician-Charter.pdf. Accessed 2019.

	● Byyny RL, Papadakis MA, Paauw DS. *Medical Professionalism: Best Practices.* Menlo Park, CA: Alpha Omega Alpha Honor Medical Society; 2015. https://alphaomegaalpha.org/pdfs/2015MedicalProfessionalism.pdf. Accessed 2019. ● Levinson W, Ginsburg S, Hafferty F, Lucey CR. *Understanding Medical Professionalism.* 1st ed. New York, NY: McGraw-Hill Education; 2014. https://www.amazon.com/Understanding-Medical-Professionalism-Denistry/dp/0071807438. Accessed 2019. ● Radiological Society of North America. Professionalism for residents. https://www.rsna.org/education/professionalism-and-quality-care/professionalism-self-assessments/professionalism-for-residents. Accessed 2019. ● Institutional GME professionalism guide

Professionalism 2: 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 the ethical principles underlying informed consent, surrogate decision making, advance directives, confidentiality, error disclosure, and stewardship of limited resources*	● Discusses the basic principles underlying ethics (beneficence, nonmaleficence, justice, autonomy) and professionalism (professional values and commitments), and how they apply in various situations ● Understands principles and key components of informed consent
Level 2 *Analyzes straightforward situations using ethical principles*	● Treats patients equally despite ability to pay ● Obtains informed consent from a competent adult patient
Level 3 *Recognizes need to seek help in managing and resolving complex ethical situations*	● Recognizes own limitations and seeks resources to help manage and resolve complex ethical situations ● Obtains counsel in obtaining informed consent when patient and patient's family are in disagreement with treatment plan
Level 4 *Recognizes and uses appropriate resources for managing and resolving ethical dilemmas as needed (e.g., ethics consultations, literature review, risk management/legal consultation)*	● Evaluates the literature and makes recommendations regarding first-trimester pregnant female with pain and kidney stones ● Obtains ethics consultation when family of brain dead patient request gastrostomy tube placement
Level 5 *Identifies and seeks to address system-level factors that induce or exacerbate ethical problems or impede their resolution*	● Serves as a resident member of the ethics committee
Assessment Models or Tools	● Direct observation ● Global evaluation ● Multisource feedback ● Objective structure clinical examination ● Oral or written self-reflection ● Simulation
Curriculum Mapping	●
Notes or Resources	● American Medical Association. Code of Ethics. https://www.ama-assn.org/delivering-care/ama-code-medical-ethics. Accessed 2019. ● American College of Radiology. The ACR 2018-2019 Bylaws. https://www.acr.org/-/media/ACR/Files/Governance/Code-of-Ethics.pdf. Accessed 2019.

	● Society of Interventional Radiology. Policies and guidelines. https://www.sirweb.org/about-sir/governance/policies/. Accessed 2019. ● ABIM Foundation. American Board of Internal Medicine. Medical professionalism in the new millennium: a physician charter. *Annals of Internal Medicine*. 2002;136(3):243-246. https://abimfoundation.org/wp-content/uploads/2015/12/Medical-Professionalism-in-the-New-Millenium-A-Physician-Charter.pdf. Accessed 2019. ● Byyny RL, Papadakis MA, Paauw DS. *Medical Professionalism: Best Practices.* Menlo Park, CA: Alpha Omega Alpha Honor Medical Society; 2015. https://alphaomegaalpha.org/pdfs/2015MedicalProfessionalism.pdf. Accessed 2019. ● Levinson W, Ginsburg S, Hafferty F, Lucey CR. *Understanding Medical Professionalism.* 1st ed. New York, NY: McGraw-Hill Education; 2014. https://www.amazon.com/Understanding-Medical-Professionalism-Denistry/dp/0071807438. Accessed 2019.

Professionalism 3: Accountability/Conscientiousness **Overall Intent:** To take responsibility for one's actions and the impact on patients and other members of the health care team and recognize the limits of one's own knowledge and skill set	
Milestones	**Examples**
Level 1 *Responds promptly to requests or reminders to complete tasks and responsibilities*	● When prompted, enters clinical and educational work hours and case logs ● Answers pages promptly
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*	● Promptly addresses patients pain after procedure and orders appropriate medications, communicating with all teams involved ● 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*	● Counsels angry patient with complaints about care while having multiple other clinical responsibilities ● Promptly updates patients family after an emergent procedure ● 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*	● Preemptively identifies strategies to lessen the impact of scheduled EHR down time ● Advises junior residents on how to manage their time in completing patient care tasks
Level 5 *Takes ownership of system outcomes*	● Sets up a meeting with the nurse manager to streamline pre-procedural work up of patients ● Implements a quality improvement project to decrease post port placement infection rates ● Volunteers to take extra call during unplanned absences of colleagues
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 ● Gunderman RB, Brown BP. Excellence and professionalism in radiology. *American Journal of Roentgenology*. 2013;200(6):W557-W559. https://www.ajronline.org/doi/pdf/10.2214/AJR.12.9130. Accessed 2019.

	● Halpern EJ, Spandorfer JM. Professionalism in radiology: ideals and challenges. *American Journal of Roentgenology.* 2014;202(2):352-357. https://www.ajronline.org/doi/pdf/10.2214/AJR.13.11342. Accessed 2019. ● 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/full/10.1148/rg.2015150041. Accessed 2019.

Professionalism 4: 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*	● Accepts feedback and exhibits positive responses to criticism ● Shows how to access an institutional crisis line ● Requests time off for a medical or dental appointment
Level 2 *Independently recognizes status of personal and professional well-being, and uses available resources when appropriate* *Independently recognizes limits in the knowledge/skills of self or team and demonstrates appropriate help-seeking behaviors*	● Recognizes when they are approaching clinical work and educational hour limits and develops a plan to ensure both compliance and fatigue mitigation ● Calls cab service for ride home when too tired to drive safely
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, assists in developing a personal learning or action plan to address gaps in knowledge or stress and burnout for self or team ● Based on feedback, proposes an exercise plan and meditation to improve resilience
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 personal learning or action plan to address stress and/or burnout for self or team and gaps in personal clinical knowledge ● Leads resident well-being committee and organizes resident retreat
Level 5 *Coaches others when emotional responses or limitations in knowledge/skills do not meet professional expectations*	● Mentors patients and colleagues in self-awareness and establishes health management plans to limit stress and burnout ● Acts as a mentor for distressed residents, helping them access department and institutional resources
Assessment Models or Tools	● Direct observation ● Group interview or discussions for team activities ● Self-assessment and personal learning plan

	● Individual interview ● Institutional online training modules ● Participation in institutional well-being programs
Curriculum Mapping	●
Notes or Resources	● This subcompetency is not intended to evaluate a resident's well-being, but to ensure each resident 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, Housestaff Counselor or Mental Health Professional ● Accreditation Council for Graduate Medical Education. "Well-Being Tools and Resources." https://dl.acgme.org/pages/well-being-tools-resources. Accessed 2022. ● Stanford Medicine. WellMD Center. https://wellmd.stanford.edu/center1.html. Accessed 2019. ● National Academy of Medicine. Clinician Resilience and Well-being. https://nam.edu/initiatives/clinician-resilience-and-well-being/. Accessed 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, identify communication barriers, including self-reflection on personal biases, and minimize them in the doctor-patient relationship; to organize and lead communication around shared decision making	
Milestones	**Examples**
Level 1 *Uses language and nonverbal behavior to demonstrate respect and establish rapport*	● Self-monitors and controls tone, non-verbal responses, and language and asks questions to invite the patient's participation
Accurately communicates own role within the health care system	● Introduces him/herself to the patient as a resident
Organizes and initiates communication with patient/family by clarifying expectations and verifying understanding of the clinical situation	● Identifies need and arranges for an interpreter
Level 2 *Establishes a therapeutic relationship in straightforward encounters using active listening and clear language*	● Knows to communicate at a level the patient can understand
Identifies barriers to effective communication (e.g. language, health literacy, cultural, personal biases)	● Realizes when a caregiver is needed in decision making
Adjusts communication strategies based on assessment of patient/family expectations and understanding	● Before and/or after communication with the patient/patient's family, closes the loop and asks if they are clear about expectations and have knowledge of the clinical situation
Level 3 *Establishes a therapeutic relationship in challenging patient encounters*	● Establishes rapport with a patient who is angry over a previous encounter and works to allay her/her fears
Identifies personal barriers that hinder effective communication	● Recognizes unconscious bias about sexuality and gender identity
With guidance, sensitively and compassionately delivers medical information, elicits patient goals and preferences, and acknowledges uncertainty and conflict	● With guidance, communicates with a patient the presence of a likely benign breast mass, and decides to follow the mass or, if patient wishes, biopsy the mass after involving the patient in discussion

Level 4 *Easily establishes therapeutic relationships, with attention to patient/family concerns and context, regardless of complexity*	● Establishes a longitudinal relationship with the family of a patient with mental disabilities and long-term feeding tube who has recurrent issues with tube failure and transportation difficulties
Actively minimizes communication barriers	● Takes responsibility and apologizes after using medical jargon
Independently uses shared decision making to make a personalized care plan	● Independently engages in shared decision making with the patient and family regarding hemodialysis access options
Level 5 *Mentors others in situational awareness and critical self-reflection to consistently develop positive therapeutic relationships*	● After a procedure is complete, reminds team members that patients are awake and can hear unprofessional or disparaging comments
Coaches other learners to minimize communication barriers	● Rounds with junior residents to guide development of therapeutic relationships and mitigation of communication barriers
Coaches other learners in patient/family communications and shared decision	● Creates a simulation lab for junior residents to learn techniques for delivering bad news
Assessment Models or Tools	● Direct observation ● Mini-clinical evaluation exercise (Mini-CEX) ● Multisource feedback ● Self-assessment including self-reflection exercises ● Skills needed to set the state, Elicit information, Give information, Understand the patient, and End the encounter (SEGUE) ● SECURE - Kalamazoo Essential Elements Communication Checklist (Adapted) 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.ncbi.nlm.nih.gov/pubmed/21182378. Accessed 2019. ● Makoul G. Essential elements of communication in medical encounters: the Kalamazoo consensus statement. *Academic Medicine.* 2001;76(4):390-393. https://www.ncbi.nlm.nih.gov/pubmed/11299158. Accessed 2019. ● Makoul G. The SEGUE Framework for teaching and assessing communication skills. *Patient Education and Counseling*. 2001;45(1):23-34. https://www.ncbi.nlm.nih.gov/pubmed/11602365. Accessed 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. *Journal of the American Geriatrics Society*. 2008;56(9):1730-1735. https://www.ncbi.nlm.nih.gov/pubmed/18721223. Accessed 2019. ● Symons AB, Swanson A, McGuigan D, Orrange S, Akl EA. A tool for self-assessment of communication skills and professionalism in fellows. *BMC Medical Education*. 2009;9(1):1. https://www.ncbi.nlm.nih.gov/pubmed/19133146. Accessed 2019. ● American Academy of Hospice and Palliative Medicine. Hospice and Palliative Medicine Competencies Project. http://aahpm.org/fellowships/competencies#competencies-toolkit. Accessed 2019. ● Goske Mj, Reid JR, Yaldoo-Poltorak D, Hewson M. RADPED: an approach to teaching communication skills to radiology residents. *Pediatric Radiology*. 2005;35(4):381-386. https://link.springer.com/article/10.1007%2Fs00247-004-1356-8. Accessed 2019. ● Drexel University College of Medicine. DocCom. Interactive learning resource for healthcare communication. https://webcampus.drexelmed.edu/doccom/db/read.aspx. Accessed 2019. ● Baile WF. The Complete Guide to Communication Skills in Clinical Practice. Presentation. October 2014. https://www.mdanderson.org/documents/education-training/icare/pocketguide-texttabscombined-oct2014final.pdf. Accessed 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 requests or receives consultations* *Uses language that values all members of the interventional team* *Demonstrates knowledge of institutional and national communication guidelines*	● Shows respect in health care team communications through words and actions by: ○ allowing others to express their opinions ○ consistently using inclusive language ○ listening to and considers others' points of view ● Is nonjudgmental and actively engaged, and demonstrates humility ● Accepts a request to do a late afternoon procedure and offers to discuss with the attending without offering resistance
Level 2 *Clearly and concisely requests or responds to consultations* *Communicates information effectively with all interventional team members* *Communicates emergent findings and/or management options*	● Communicates with the referring service in an organized and timely manner ● Politely accepts request for consult and informs referring service of recommendations; appropriately documents recommendations ● Communicates and documents communication of emergent findings such as aortic dissection or active bleeding
Level 3 *Checks understanding of recommendations when receiving or providing consultations* *Solicits feedback on performance as a member of the interventional team* *Communicates non-emergent findings and/or management options where failure to act may adversely affect patient outcome*	● Verifies understanding of his/her communications within the health care team using: ○ closed loop communication ○ AIDET (Acknowledge, Introduce, Duration, Explanation, and Thank You) ● Asks for feedback from the nurse after a rapid response during a procedure ● Communicates management of a percutaneously placed drain with regards to output and when it should be removed
Level 4 *Coordinates recommendations from different members of the health care team to optimize patient care*	● After discussion with the consulting infectious diseases doctor and oncologist, sends 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

Coordinates recommendations from different members of the interventional team to optimize patient care *Independently manages real-time consultations which are tailored to the referring provider*	● Listens to recommendations from the technologist regarding catheter availability and selection ● Independently manages consultation for variceal bleeding from a general practitioner, discusses endoscopic versus endovascular management, and refers to appropriate specialties
Level 5 *Role models flexible communication strategies that value input from all health care team members, resolving conflict when needed* *Uses interventional team feedback and recommendations to facilitate quality improvement* *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 ● Technologists raises concern about lack of site marking and resident leads QI project to integrate site marking into timeout ● Supervises a junior resident receiving a consult for fractured IVC filter and helps the junior resident to make appropriate recommendations
Assessment Models or Tools	● Direct observation ● Checklists ● Global assessment ● Medical record (chart) audit ● Multisource feedback ● Simulation encounters ● Standardized patient encounters or objective structured clinical examination
Curriculum Mapping	●
Notes or Resources	● François J. Tool to assess the quality of consultation and referral request letters in family medicine. *Canadian Family Physician*. 2011;57(5),574-575. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3093595/. Accessed 2019. ● Consultant Evaluation of Faculty form in Dehon E, Simpson K, Fowler D, Jones A. Development of the faculty 360. *MedEdPORTAL.* 2015;11:10174. https://www.mededportal.org/publication/10174/. Accessed 2019. ● AltaMed. AIDET Overview. http://paetc.org/wp-content/uploads/2014/07/AIDET-Training-Presentation1.pdf. Accessed 2019. ● Mills P, Neily J, Dunn E. Teamwork and communication in surgical teams: implications for patient safety. *Journal of the American College of Surgeons.* 2008;206(1):107-112. ● Team training courses

	● American College of Radiology. Radiology Leadership Institute. https://www.acr.org/Practice-Management-Quality-Informatics/Radiology-Leadership-Institute. Accessed 2019. ● American College of Radiology. Communication Curriculum for Radiology Residents. https://www.acr.org/Member-Resources/rfs/learning/Communication-for-Radiology-Residents. Accessed 2019.

Interpersonal and Communication Skills 3: Communication within Health Care Systems **Overall Intent:** To effectively communicate with health care system tools	
Milestones	**Examples**
Level 1 *Accurately records information in the patient record, safeguarding patient personal health information*	● Locks computer workstation when stepping away ● Ensures electronic devices are encrypted in accordance with local and national requirements ● Does not text patient personal health information to other health care providers using personal mobile device
Demonstrates knowledge of institutional communications policies	● Describes the appropriate and inappropriate use of cell phone, email, and social media
Level 2 *Appropriately selects direct (e.g., telephone, in-person) and indirect (e.g., progress notes, text messages) forms of communication based on context*	● Communicates presence of groin hematoma after procedure directly to primary team by telephone or in person ● Refrains from discussing patient information in public places, including the elevator and cafeteria
Communicates appropriately as required by institutional policy	● Uses secured email for communication of patient information
Level 3 *Demonstrates organized diagnostic and therapeutic reasoning through notes in the patient record*	● Documentation is accurate, organized, and concise with no extraneous information
Identifies issues in systems communications	● Identifies an incident in which a communication breakdown occurred and offers constructive suggestions for how to improve the system ● Communicates with the appropriate radiology department supervisor or hospital reporting system about systems concerns in an objective, respectful manner
Level 4 *Achieves written or verbal communication (patient notes, e-mail, etc.) that serves as an example for others to follow*	● Interventional report template completed with appropriate modifications to address specific procedure
Uses appropriate channels to offer clear and constructive suggestions to improve communication systems	● Interventional radiologist receives consults that should be directed to diagnostic radiology; contacts information technology to have calls rerouted

Level 5 *Guides departmental or institutional communication around policies and procedures Facilitates dialogue regarding systems issues among larger community stakeholders (institution, health care system, field)*	● Creates a template for admission history and physical examination including all elements required for billing ● Leads a task force to determine appropriate numbers and placement of imaging work stations for all health care providers
Assessment Models or Tools	• Direct observation • Medical record (chart) audit • Multisource feedback • Simulation
Curriculum Mapping	●
Notes or Resources	● Bierman JA, Hufmeyer KK, Liss DT, Weaver AC, Heiman HL. Promoting responsible electronic documentation: validity evidence for a checklist to assess progress notes in the electronic health record. *Teaching and Learning in Medicine.* 2017;29(4):420-432. https://www.ncbi.nlm.nih.gov/pubmed/28497983. Accessed 2019. ● Karasz HN, Eiden A, Bogan S. Text messaging to communicate with public health audiences: how the HIPAA Security Rule affects practice. *American Journal of Public Health.* 2013;103(4):617-622. https://www.ncbi.nlm.nih.gov/pubmed/23409902. Accessed 2019. ● Institutional learning modules ● ABIM Foundation. American Board of Internal Medicine. Medical professionalism in the new millennium: a physician charter. *Annals of Internal Medicine*. 2002;136(3):243. https://www.ncbi.nlm.nih.gov/pubmed/11827500. Accessed 2019. ● Society of Interventional Radiology. Standardized reporting. https://www.sirweb.org/practice-resources/quality-improvement2/standardized-reporting/. Accessed 2019. ● Institutional evaluation and management coders

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: Diagnostic Radiology: Consultant	PC2: Imaging Consultation
PC2: Diagnostic Radiology: Competence in Procedures	No match
PC3: Diagnostic Radiology: Safety	SBP7: Contrast Safety Agent SBP8: Radiation Safety SBP9: MR Safety
PC4: Interventional Radiology: Non-procedural Care/Consultation and Follow-Up	PC4: Pre-Procedural Consultation PC6: Post-Procedural Care
PC5: Interventional Radiology: Procedural Skills	PC5: Performance of Procedures
PC6: Diagnostic and Interventional Radiology: Procedural Radiation Safety	No match
No match	MK1: Diagnostic Imaging Knowledge
MK1: Diagnostic Radiology: Protocol Selection and Optimization of Images	MK2: Physics, Protocol Selection and Optimization of Images
MK2: Diagnostic Radiology: Interpretations of Examinations	PC3: Image Interpretation
MK3: Diagnosis and Intervention in Primary Vascular Disease	
No match	MK3: Imaging Technology and Image Acquisition
No match	MK4: Pathophysiology and Treatment
No match	MK5: Procedural Anatomy
No match	MK6: Pharmacology
MK4: Transcatheter Therapy – Embolization	No match
MK5: Percutaneous Organ Access and Intervention	No match
No match	SBP1: Patient Safety
SBP1: Quality Improvement	SBP2: Quality Improvement
SBP2: Health Care Economics	SBP6: Physician Role in Health Care Systems
No match	SBP3: System Navigation for Patient-Centered Care
No match	SBP4: Multidisciplinary Conferences
No match	SBP5: Population Health
No match	SBP10: Informatics

No match	PBLI1: Evidence-Based and Informed Practice
PBLI1: Self-directed Learning	PBLI2: Reflective Practice and Commitment to Personal Growth
PBLI2: Scholarly Activity	No match
PROF1: Administrative Tasks	PROF3: Accountability/ Conscientiousness
PROF2: Compassion, Integrity, Accountability, and Respect for Self and Others	PROF1: Professional Behavior PROF2: Ethical Principles
No match	PROF4: Self-Awareness and Help Seeking
ICS1: Effective Communication with Patients, Families, and Caregivers	ICS1: Patient and Family-Centered Communication
ICS2: Diagnostic Radiology: Effective Communication with Members of the Health Care Team	PC1: Reporting ICS2: Interprofessional and Team Communication
ICS3: Interventional Radiology: Effective Communication with Members of the Health Care Team	ICS1: Patient and Family-Centered Communication
No match	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/