



TEXAS TECH UNIVERSITY
HEALTH SCIENCES CENTER™
Paul L. Foster School of Medicine

Department of Radiology
2024-2025
Resident Manual

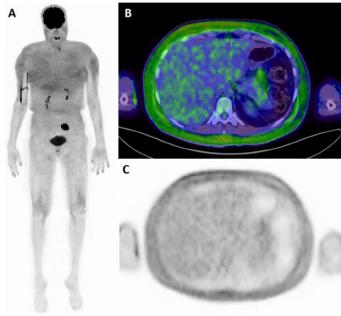


Fig. 1 - Initial staging FDG PET/CT scan. Images obtained 60 min after FDG was administered in the right arm. Blood glucose was 79 mg/dL at time of injection. (A) Maximum-intensity projection (MIP) image demonstrated altered radiotracer biodistribution in white adipose tissue predominantly in the upper torso. (B and C) Fused PET/CT (B) and attenuation corrected PET (C) at the level of the upper abdomen demonstrated increased uptake in the subcutaneous fat.



Fig. 2 - (A) Maximum-intensity projection (MIP) after corticosteroid cessation, demonstrated resolved altered radiotracer biodistribution in the white adipose tissue, with more conspicuous metastatic lesion in the left clavicle. (B) Initial MIP image with altered radiotracer biodistribution for comparison.

Front cover:

Parra Corral MA, Diaz JR. White adipose tissue uptake on 18F FDG PET/CT: A case report *Radiology Case Reports* 19 (2024) 3001-3003, April 8, 2024

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LETTER FROM THE PROGRAM DIRECTORS



TEXAS TECH UNIVERSITY
HEALTH SCIENCES CENTER
Paul L. Foster School of Medicine

Welcome to Radiology!

On behalf of the faculty, we would like to welcome you to the Texas Tech University HSC-El Paso in Diagnostic Radiology, Residency Program Women's Imaging and the Body Imaging Fellowship. Texas Tech has a distinguished history of residency training in most clinical specialties. The beginning of the radiology training program in 2008 was a most welcomed addition.

The residency training program is divided into subspecialty radiology sections of Abdominal Imaging, Angiography and Interventional Radiology, Breast Imaging, Diagnostic Ultrasound, Emergency Radiology, Musculoskeletal Radiology, Neuroradiology, Nuclear Radiology, Pediatric Radiology, and Thoracic Radiology. Technical modalities of CT, MRI, and Ultrasound are also incorporated into many of the subspecialty sections. Residents rotate through the sub-specialty areas and work closely with faculty members who have established expertise in these disciplines. The program was re-accredited in 2018 and is now approved for 12 residents with continued accreditation status in 2024. Presently, there are 12 residents and no fellows. The program can accommodate one fellow in Body Imaging or Women's Imaging. The fellow's schedule is designed to enhance the training of junior residents without dilution of experience or faculty attention to senior residents.

University Medical Center (UMC), the primary teaching hospital, is a Level I trauma center as well as a general hospital servicing El Paso county where radiology residents are able to gain experience working with patients who have both common and complex medical problems. Radiology residents interact regularly with residents from other programs. The technology base of the department is "state of the art" with the latest CT, MR, and information technology systems. The department has operated in a filmless and paperless environment since March 2005.

The imaging department at UMC completed a substantial expansion in June 2012. New facilities for emergency radiology are at the far west end of the medical center. There are 4 Interventional Radiology suites; one has biplanar capabilities to accommodate Cardiac and Neurology Intervention cases.

Outpatient radiology section at the east end accommodates ultrasound and fluoroscopy as well as a dual-energy CT scanner. Between the two are nuclear medicine, a new 3.0T MRI and two interventional radiology suites. The Pediatric Radiology Department of El Paso Children's

Hospital adjacent to the east of outpatient radiology. Radiology offices, workstations and teaching space across the street in the basement of the Clinic Sciences Building to the north include the Arvin and Beverly Robinson Conference Room.

In addition to nuclear radiology at UMC offering general nuclear interpretations, radionuclide therapy for thyroid conditions and metastatic prostate carcinoma, and PET/CT teleradiology interpretations, residents rotate in the new William Beaumont Army Medical Center Nuclear Medicine Department for radiopharmacy training, additional PET/CT, additional bone densitometry, general nuclear and unique nuclear cardiology interpretation.

The residency and fellowship training programs are designed to enable residents and fellows to acquire and demonstrate the knowledge, skills, and judgment necessary for competence in the practice of radiology. This is primarily achieved by involvement in clinical case management under direct supervision and guidance of the faculty. Formal teaching supplements this educational process by providing lectures, demonstrations and conferences, simulation activities as well as electronic teaching aids.

Competency in radiology consists of the ability to plan appropriate and most cost-effective imaging sequences, obtain these studies with utmost concern for patient care and safety, and transfer necessary information to the referring clinician in a timely manner. Residents not only learn interpretation skills in evaluating radiological images but obtain competency in transferring this information in an efficient and effective manner. The core knowledge, with which the resident radiologist must become familiar, and which will require continuous study for the rest of one's professional life, concerns the variety of pathologic findings that may be detected on images and the differentiation of these from normal, normal variations and technical artifacts. The resident also learns to work closely with support personnel on patient care and administrative matters in order to assume competent and responsive consultative services and quality patient care.

Implementation of the new American Board of Radiology certification schedule has allowed us to dedicate most of the fourth year of resident training to advanced selective experiences as a stepping stone to fellowship, clinical and practice and/or academic practice development.

Our program offers Early Specialization in Interventional Radiology (ESIR). The selected resident's fourth year is devoted to IR and IR-related rotations in addition to an ICU rotation in preparation for a fellowship year at another institution to complete IR subspecialty training. The first resident enrolled in this ESIR track started in July 2019.

The 12-month Body Imaging Fellowship is a non-ACGME accredited program approved by the Texas Medical Board, includes intensive added experience in special imaging that includes computed tomography, magnetic resonance imaging, and diagnostic ultrasound. The fellowship also provides an opportunity for imaging research and faculty development during an optional second year.

The Breast and Abdominal Imaging Divisions offer a 12-month Women's Imaging Fellowship is also a non-ACGME accredited program approved by the Texas Medical Board. This fellowship provides an in-depth training in all aspects of breast and body imaging. State-of-the-art breast imaging equipment include 2 Hologic's 3D mammography units, 2 full-field digital mammography units, 2 ultrasound units with high resolution transducers and Doppler capabilities,

Affirm upright breast biopsy guidance system with dual stereotactic and tomosynthesis biopsy capability and a 1.5-Tesla Siemens magnet with dedicated 16-channel breast coil. Most cross-sectional body imaging studies are generated on site with a 3-Tesla Siemens magnet and multiple state of the art multi-detector CT scanners. Studies are also performed on a 1.5-Tesla Siemens and CT scanner located at an off-site outpatient clinic adjacent to Family Medicine Kenworthy Clinic. Up-to-date imaging techniques and cutting-edge technology are utilized on a daily basis and incorporated into all imaging protocols. The fellowship also offers ample opportunities for clinical research and teaching.

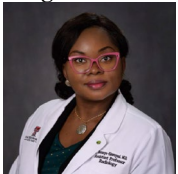
The first comprehensive cancer center to serve West Texas and our Borderplex region, the Steve and Nancy Fox Cancer Center is planned to open in 3 or so years will transform the way we treat cancer for our families, friends and neighbors, a world-class cancer care, elevate life-saving research and bring opportunities for innovative clinical trials with state-of-the-art conventional and cross-sectional imaging to include PET/CT and different therapy modalities to include brachytherapy and radioligand therapy for prostate and neuroendocrine carcinomas.

This manual describes the clinical, educational, and research opportunities for residents and fellows at Paul L. Foster School of Medicine, Texas Tech University HSC during the 2024-2025 academic year. It can be anticipated that the training experience will continue to prepare young radiologists to become most competent clinical practitioners and/or academicians with outstanding credentials. The learning experience begins on the first day of the residency and continues through every day of each rotation. Our residents need to stay focused and work hard throughout their residency so that they can be a successful addition to the practice of radiology in the Southwestern US or wherever they choose to go.

Welcome to the Radiology Residency, Women's Imaging and Body Imaging Fellowship Programs for 2024-2025.

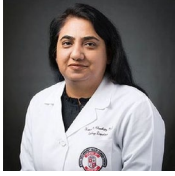


Jesus R. Diaz, MD
Program Director, Radiology Residency



Eseosa Bazuaye-Ekwuyasi, MD
Program Director, Women's Imaging Fellowship

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Humera Chaudhary MD
Program Director, Body Imaging Fellowship



J. Edmundo Calleros-Macias, MD
Acting Chair of Radiology



Arvin E. Robinson, MD, MPH
Chair Emeritus

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FACULTY

Faculty (arranged alphabetically)

Eseosa Bazuaye-Ekwuyasi, MD	Breast Imaging, Body Imaging
J. Edmundo Calleros, MD	Ultrasound, Body Imaging
Humera Chaudhary, MD	Abdominal Radiology, Body Imaging
Jesus R. Diaz, MD	Nuclear Radiology, Body Imaging
Scott Flemming, MD	Nuclear Radiology, WBAMC
Mel Ghaleb, MD	Vascular & Interventional Radiology
Brian Kim, MD	Body Imaging
Vamsi Kunam, MD	Vascular & Interventional Radiology
Shaked Laks, MD	MSK, Body Imaging
Alberto Maud, MD	Interventional Neuroradiology, Neurology
Chetan Moorthy, MD	Pediatric Radiology, Peds Interventional Radiology
Albert Moreno, MD	Nuclear Radiology, WBAMC
Anthony Naylor, MD	General Radiology
Thomas O'Neill, MD	Neuroradiology, Imaging Informatics
Gustavo Rodriguez, MD	Interventional Neuroradiology, Neurology
Steven Aaron Ross, MD	Pediatric Radiology
Gethin Williams, MD	Vascular & Interventional Radiology

RESIDENTS (2024-2025)

Resident IV



Anthony Bastian, MD

MD: TTUHSC El Paso PLFSOM

PGY4: IM Transitional, Las Palmas Del Sol Healthcare, El Paso, TX

Fellowship: Neuroradiology, Indiana University, Minneapolis, IN



Aleksandr Drozdov, MD

MD: Saint Petersburg State University Faculty of Medicine, Saint Petersburg, Russia

PGY4: IM Residency, NY Medical College-Metropolitan Program, New York, NY

Fellowship: Neuroradiology, George Washington University Hospital, Washington, DC



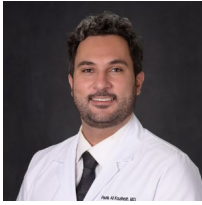
Josh Nichols, MD

MD: TTUHSC El Paso PLFSOM

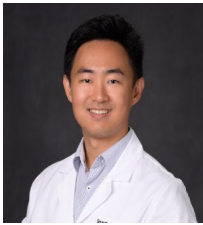
PGY4: IM Transitional, Las Palmas Del Sol Healthcare, El Paso, TX

Fellowship: Pediatric Radiology, Baylor College of Medicine, Houston, TX

Resident III



Pouria Koushesh, MD
MD: TTUHSC El Paso PLFSOM
PGY3: IM Transitional, Las Palmas Del Sol Healthcare, El Paso, TX



Seunghong Rhee, MD
MD: Chung-Ang University College of Medicine, Seoul, South Korea
PGY3: Wayne State SOM, Detroit, MI



Basel Yacoub, MD
MD: American University of Beirut, Lebanon
PGY3: Albany Medical Center, New York, NY

Resident II



Usman Dar, MD
MD: TTUHSC El Paso PLFSOM
PGY2: IM Transitional, Las Palmas Del Sol Healthcare, El Paso, TX



Habiba Khan, MD
MD: TTUHSC El Paso PLFSOM
PGY2: IM Transitional, Las Palmas Del Sol Healthcare, El Paso, TX



An Tran, MD
MD: TTUHSC El Paso PLFSOM
PGY2: IM Transitional, Las Palmas Del Sol Healthcare, El Paso, TX

Resident I



Matthew Ramirez, MD

MD: TTUHSC El Paso PLFSOM

PGY1: IM Transitional, Las Palmas Del Sol Healthcare, El Paso, TX



Christina Tompkins, MD

MD: Texas Tech University HSC, Lubbock, TX

PGY1: IM Transitional, Las Palmas Del Sol Healthcare, El Paso, TX



Dennis Wang, MD

MD: TTUHSC El Paso PLFSOM

PGY1: Nassau University Medical Center, New York, NY

Resident Graduates Appointments



Demetri Agriantonis, MD, ABNM, DABR

MD: Rutgers New Jersey School of Medicine

PGY1: Transitional Year, Lehigh Valley Hospital, Allentown, PA

PGY2-4: Nuclear Medicine, University of Wisconsin Hospital & Clinics, Madison, WI
Fellow, Interventional Radiology, Christiana Care Health System, Christiana, DE,
2012-2013

Faculty, Christiana Care Health System, Christiana, DE



Tejal Mody, MD, ABNM, DABR

MD: Kasturba University, India

PGY1: Transitional Year, TTUHSC, PLFSOM, El Paso, TX

PGY2-4: Nuclear Medicine, Memorial Sloan Kettering Cancer Center, New York, NY

Fellowship: Body Imaging, Texas Tech University HSC, PLFSOM, El Paso, TX, 2012-
2013

Pediatric Radiology, Texas Children's Hospital, Houston, TX, 2013-2014

Practice: Private, Nemours Children's, Wilmington, DE



Jesus R. Diaz, MD, DABR

MD: Universidad Autonoma de Chihuahua, Chihuahua, Chihuahua, Mexico

Residency: Nuclear Medicine, Universidad Nacional Autonoma de Mexico, Mexico City,
Mexico 1998-2001

Private practice, Nuclear Medicine, Centro Medico Quirurgico de Celaya, Celaya,
Guanajuato, Mexico 2001-2004

PGY1: Transitional Year, TTUHSC, PLFSOM, El Paso, TX 2007-2008

Fellowship: Body Imaging, Texas Tech University HSC, PLFSOM, El Paso, TX, 2012-
2013

Practice: Associate Professor and Program Director, Texas Tech University HSC,
PLFSOM, El Paso, TX



Melanie Flores-Pickering, DO, DABR

MD: Lake Erie College of Osteopathic Medicine, Erie, PA

PGY1: Preliminary Surgery, Union Memorial Hospital, Baltimore, MD

Fellowship: Women's Imaging, Vanderbilt University Medical Center, Nashville, TN, 2013-2014

Practice: Private, Rose Imaging Specialists, Lead Interpreting Physician, Houston, TX



Euyen Latour, MD, ABIM, ABNM, DABR

MD: Universidad Central del Caribe, San Juan, PR

PGY1: Bronx Lebanon Hospital Center, New York, NY

Fellowship: Nuclear Medicine, Medical University of South Carolina, Charleston, SC

Practice: Private, San Juan, Puerto Rico



Bryan J. Foley, MD, DABR

MD: University of Arizona College of Medicine, Tucson, AZ

PGY1: Preliminary Internal Medicine, University of Arizona, Tucson, AZ

Fellowship: Neuroradiology, University of Arizona, Tucson, AZ, 2014-2015

Practice: Private, Flagstaff, AZ



Thomas J. O'Neill, MD, DABR, CAQ, DABPM Clinical Informatics

MD: University of Texas, Houston, TX

PGY1: Preliminary Surgery, Atlanta Medical Center, Atlanta, GA

Robinson Scholar 2013-2014

Fellowship: Neuroradiology, University of Texas Southwestern, 2014-2015

Imaging Informatics

Faculty, University of Texas Southwestern, Dallas, TX

Practice: Associate Professor, TTUHSC, PLFSOM, El Paso, TX



Rob Shoots, MD, DABR

MD: University of Illinois College of Medicine, Chicago, IL

PGY1: Preliminary Internal Medicine, University of Illinois College of Medicine, Chicago, IL

PGY2: Diagnostic Radiology, Hahnemann-Drexel University Hospital, Philadelphia, PA

Fellowship: Neuroradiology, Yale University, New Haven, CT, 2014-2015

Practice: Private, RadPartners Regional Director, Las Cruces, NM



Kevan Stewart, MD, DABR

MD: Marshall University School of Medicine, Huntington, WV

PGY1: Transitional Year, TTUHSC, PLFSOM, El Paso, TX

Robinson Scholar 2014-2015

Fellowship: Interventional Radiology, University Rochester Medical Center, Rochester, NY, 2015-2016

Practice: Private, Advent Health, Orlando, FL



John Chua-Tuan, MD, DABR

MD: University of Texas Southwestern, Dallas, TX

PGY1: Transitional Year, University of Texas, Houston, TX

Fellowship: Neuroradiology, University of California, San Diego, CA, 2015-2016

Practice: Private, Houston Radiology Associates, Houston, TX



Jorge Aguila, MD, DABR

MD: New York Medical College, Valhalla, NY

PGY1: University of Las Vegas, Las Vegas, NV

Fellowship: Interventional Radiology, University Rochester Medical Center, Rochester, NY, 2016-2017

Practice: Private, Del Sol/Las Palmas Medical Center, El Paso, TX



Arya N. Bagherpour, DO, DABR

MD: University of North Texas Health Science Center, Fort Worth, TX

PGY1: Preliminary Surgery, Beth Israel Deaconess Medical Center, Albert Einstein College of Medicine, Bronx, NY

Fellowship: Interventional Radiology, University of Florida, Jacksonville, FL, 2016-2017
Faculty, University of Texas Medical Branch, Galveston, TX

Practice: Locums, El Paso, TX



Agnes O. Solberg, MD, ABIM, ABNM, DABR

MD: Uniformed Services University of the Health Sciences F. Edward Hebert School of Medicine, Bethesda, MD

PGY1-4: Internal Medicine Residency, Madigan Army Medical Center, Joint Base Lewis-McChord, WA

Nuclear Medicine Residency, University of Texas HSC at San Antonio, San Antonio, TX

Fellowship: Interventional Radiology, University of California, Irvine, CA, 2016-2017

Private Practice, St. Alexius Health, Bismarck, ND

Practice: Teleradiology, TTUHSC, PLFSOM, El Paso, TX



Anna N. Havey, MD, MBA, DABR

MD: University of Texas Medical Branch, Galveston, TX

PGY1: Transitional Year, University of Texas Health Science Center, Houston, TX

Fellowship: MSK, RadNet, Los Angeles, CA, 2017-2018

Fellow Breast Imaging, University of Virginia, Charlottesville, VA 2019-2020

Private Practice, RadNet, Los Angeles, CA 2018-2019

Practice: DeBakey VA, Houston, TX



David E. Hunte, MD, DABR

MD: Meharry Medical College, Nashville, TN

PGY1: Preliminary Surgery, Morehouse School of Medicine, Grady Memorial Hospital, Atlanta, GA

Fellowship: Pediatric Radiology, Cincinnati Children's, Cincinnati, OH 2017-2018
Private Practice, Bronx Care Health System, Bronx, NY

Practice: Private, Florida



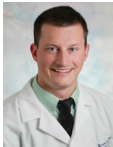
Younis Hamad Alazzawi, MBCHB, DABR

MD: Al-Kindy College of Medicine, Baghdad, Iraq

PGY1: Preliminary Surgery, Bronx Lebanon Hospital Center, New York, NY

Fellowship: Interventional Radiology, Emory University, Atlanta, GA, 2018-2019

Practice: Teleradiology, TTUHSC, PLFSOM, El Paso, TX



Nicholas Brent Hardin, DO, DABR

MD: A.T. Still University of Osteopathic Medicine, Mesa, Arizona

PGY1: Preliminary Internal Medicine, University of Nevada School of Medicine, Reno, NV

Fellowship: Body Imaging, Texas Tech University HSC, PLFSOM, El Paso, TX, 2018-2019

Practice: Teleradiology, TTUHSC, PLFSOM, El Paso, TX



Anthony Abou Karam, MD, DABR

MD: University Saint Joseph, Beirut, Lebanon

PGY1: Preliminary Surgery, Baystate Medical Center, Tufts University School of Medicine, Springfield, MA

Fellowship: Neuroradiology, Yale School of Medicine, New Haven, CT, 2018-2019

Practice: Yale University



Chadi Ahmad Diab, MD, DABR

MD: University Saint Joseph, Beirut, Lebanon

PGY1: Preliminary Surgery, TTUHSC PLFSOM, El Paso, TX

Fellowship: Interventional Radiology, University of Wisconsin Hospital & Clinics, Madison, WI, 2019-2020

Practice: University of Kentucky, Louisville, KY



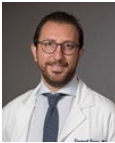
Nikoo Fattahi, MD, DABR

MD: Tehran University of Medical Sciences, Tehran, Iran

PGY1: Preliminary Internal Medicine, University of Nevada, Las Vegas, NV

Fellowship: Body MR Imaging, University of Texas HSC, Houston, TX, 2019-2020

Practice: Abdominal Imaging, University of Texas, Houston, TX



Kourosh Naeini, MD, DABR

MD: Islamic Azad University, Tehran, Iran

PGY1: Preliminary Surgery, USC Medical Center, Los Angeles, CA

PGY: Nuclear Medicine, UCLA, Los Angeles, CA

Fellowship: Neuroradiology, Penn Medicine, Philadelphia, PA, 2019-2020

Clinical Practice: Beverly Radiology Medical Group, Los Angeles, CA



Pablo A. Felix, MD, DABR (CAQ eligible 2022)

MD: Universidad Autonoma de Ciudad Juarez, Ciudad Juarez, Chihuahua, Mexico

Fellowship: Neuroradiology, Emory University, Atlanta, GA, 2020-2021

MSK Fellowship: ProScan, Cincinnati, OH

Clinical practice: ProScan, Cincinnati, OH



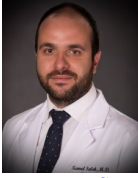
Manuel Trevino Garcia, MD, DABR (CAQ eligible 2022)
MD: Universidad Autonoma de Nuevo Leon, Monterrey, Nuevo Leon, Mexico
Diagnostic Radiology Universidad Autonoma de Nuevo Leon, Monterrey, Nuevo Leon, Mexico 2005-2009
Radiology Private Practice in Monterrey, Nuevo Leon, Mexico, 2009-2015
ESIR Resident 2019
Fellowship: Neuroradiology, Medical University of South Carolina, Charleston SC, 2020-2021
Clinical Practice, UPMC, New Castle, PA



Ryan Bou Said, MD, DABR
MD: Lebanese University Faculty of Medical Sciences, Beirut, Lebanon
PGY1: Internal Medicine, Oklahoma University College of Medicine, Oklahoma, OK
ESIR Resident 2020
Fellowship: Interventional Radiology, Emory University, Atlanta, GA, 2021-2022
Clinical Practice, Spectrum Healthcare, South Portland, ME



Charles R. De Jesus Morales, MD, DABR
MD: University of Puerto Rico School of Medicine, San Juan, PR
PGY1: Transitional Year, Hospital Episcopal San Lucas, Ponce, PR
Fellowship: Body Imaging, Baylor University, Houston, TX, 2021-2022
Oncological Head and Neck Imaging, MD Anderson, Houston, TX 2022-2023
Private Practice Focal Point, Teleradiology and Locums, TTUHSC, PLFSOM, El Paso, TX



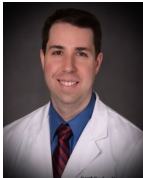
Kamel El Salek, MD, DABR

MD: University of Balamand Faculty of Medicine and Medical Sciences, Beirut, Lebanon

PGY1: Preliminary Surgery, Medstar Union Memorial Hospital, Baltimore, MD

ESIR Resident 2021

Fellowship: IR, University of Maryland, Baltimore, MD



Joseph T. Gamboa, MD, DABR

MD: University of Utah School of Medicine, Salt Lake, UT

PGY1: Preliminary Surgery, Texas Tech University HSC, PLFSOM, El Paso, TX

Fellowship: Body/MSK, University of Utah, Salt Lake, UT and Breast Imaging, UT Southwestern, Dallas, TX

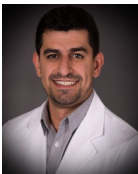


Charlton A. Lindsay, MD, DABR

MD: University of New Mexico School of Medicine, Albuquerque, NM

PGY1: Preliminary Surgery, Texas Tech University HSC, PLFSOM, El Paso, TX

Clinical Practice: RadPartners, El Paso, TX



Anthony Rohana, DO, DABR

DO: Marian University College of Osteopathic Medicine, Indianapolis, IN

PGY1: Transitional Year, Stony Brook Southampton Hospital, Southampton, NY

Fellowship: Neuroradiology, Indiana University, Indianapolis, IN



Claudia A. Jordan Guedes, MD (DABR eligible 2024)

MD: University of Puerto Rico School of Medicine, San Juan, PR

PGY1: Transitional Year, Hospital Episcopal San Lucas/Ponce School of Medicine Program, Ponce, PR; Preliminary Internal Medicine, VA Caribbean Healthcare System, San Juan, PR

Clinical practice in Puerto Rico



Charlene B. Ofosu, MD (DABR eligible 2024)

MD: Michigan State University College of Human Medicine, Grand Rapids, MI

PGY1: Transitional Year, Mercy Health in Grand Rapids, MI

ESIR Resident 2022

Fellowship: IR, UCSF, San Francisco, CA



Ronald T. Smith, Jr., MD, DABR

MD: St. George's University, Grenada

PGY1: Transitional Year, University of Central Florida, Ocala, FL

Fellowship: Neuroradiology, UT Southwestern, Dallas, TX

Practice: RadPartners, Phoenix, AZ



Howayda Jamal Al Mrad, MD (DABR eligible 2025)

MD: Lebanese University Faculty of Medical Sciences, Hadath, Lebanon

PGY1: Transitional Year, Stony Brook Southampton Hospital, Southampton, NY

Fellowship: Breast Imaging, University of Washington, Seattle, WA

Practice: Hawaii Pacific Health



Maria Andrea Parra Corral, MD (DABR eligible 2025)
MD: Universidad Autonoma de Baja California Tijuana, MX
PGY1: Preliminary Medicine Internship, Berkshire Medical Center, Pittsfield, MA
Fellowship: Body Imaging, University of Washington, Seattle, WA
Practice: Thomas Jefferson University Hospital, Philadelphia, PA



Abhay Raina, MD (DABR eligible 2025)
MD: McGovern Medical School at University of Texas HSC, Houston, TX
PGY1: Internal Medicine Prelim – UT Health Science Center at Houston, TX
ESIR 2023
Fellowship: Interventional Radiology, Mayo Clinic, Rochester, MN
Practice: RadPartners, Austin, TX

EDUCATION COMMITTEE (also serves as Clinical Competence Committee):

This committee, with faculty and resident representation, is charged with oversight of all issues related to the department's residency and fellowship program. The committee's monthly meeting agenda includes evaluation of the progress of all of the residents in each year of training so that each resident is evaluated at least twice each year. The committee also meets monthly with the faculty as a whole, or more often as needed. The committee regularly evaluates the effectiveness of the teaching program in meeting goals and objectives, establishes milestones for each rotation, reviews resident, fellow, and program evaluations, resident and fellow call and rotation schedules, and has input in choosing chief residents, and updating and revising the Residency Manual. Residents who have issues to be addressed by the Education Committee are to bring them through the chief residents. Fellows are to take issues to the corresponding fellowship program director.

2023-2024

Jesus R. Diaz, Program Director, ex-officio

J. Edmundo Calleros-Maciass, Acting Chair, ex-officio

Shaked Laks

Humera Chaudhary

Gethin Williams/Mel Ghaleb

Thomas J. O'Neill

Brian Kim

Anthony Bastian, Aleksandr Drozdov and Josh Nichols, Chief Residents (Education Committee only)

R3, R2 and R1 Guests

EDUCATIONAL PROGRAMS

A. RESIDENCY CURRICULUM

Residency Curriculum							
Radiology year			1st	2nd	3rd	4th	Total
PGY Year			II	III	IV	V	
Sections	Site	Block #					
CHEST	1	1	1.5	1	1	0	3.5
ABDOMEN	1	2	2	1	1	0	4
PEDIATRIC	2	3	1	1	1	0	3
ULTRASOUND	1	4	1.5	1	1	0	3.5
NEURORADIOLOGY	1	5	1.5	1	1	0	3.5
INTERVENTIONAL	1 & 4	6	1	1	1	0	3
NUCLEAR RADIOLOGY	1 & 3	7	1	1	1	1	4
MUSCULOSKELETAL	1	8	1	1.5	1.5	0	4
MAMMOGRAPHY	1	9	0	1	1	1	3
EMERGENCY RAD Day	1	10	2.5	1	1	0	4.5
EMERGENCY RAD Night	1	11	0	2.5	1	1	4.5
RAD-PATH	AIRP	12	0	0	1	0	1
SELECTIVE	1, 2, 3,4	13	0	0	0	10	10
TOTAL BLOCKS			13	13	13	13	52

NOTES:

Site 1: University Medical Center

Site 2: El Paso Children's Hospital

Site 3: William Beaumont Army Med Center

Site 4: The Hospital of Providence TM Campus

Selectives:

sites 1, 2, 3 or 4

sections as listed above

Research and same section up to 4 blocks

B. Body Imaging Fellowship Curriculum

Summary of Training	Duration of Assignment				Total
	Year 1	Year 2	Year 3	Year 4	
Ultrasound	12				
Computed tomography	16				
Magnetic resonance imaging	16				
Research	4				
Elective time (if not included above)	2				
Vacation	2				
Total (in weeks)	52				

C. Women's Imaging Fellowship Curriculum

Summary of Training	Duration of Assignment				Total
	Year 1	Year 2	Year 3	Year 4	
Breast Imaging and Interventions	24				
Computed tomography	8				
Magnetic resonance imaging	8				
Ultrasound	4				
Research	4				
Elective time (if not included above)	2				
Vacation	2				
Total (in weeks)	52				

SELECTIVE EXPERIENCE IN THE FOURTH YEAR

Implementation of the revised American Board of Radiology certifying examination schedule beginning in 2014 has allowed modification of the curriculum for entering residents effective July 2011. With the comprehensive examination given at the end of the 3rd year of residency, there is the opportunity for each resident to develop their own subspecialty skills during the 4th year prior to formal fellowship training and/or practice. Since the final examination is not until 15 months following residency and it is a subspecialty selective examination, there is no pressure on senior residents to feel obliged to study for that examination during the fourth year. Recently the ABR announced that in 2028 diplomate candidates will be tested in an oral virtual format with dates to be determined.

Therefore, our residency program has chosen to allow 8.5 blocks of selective experience in any combination during the 4th year of residency. This selective process requires approval of the service involved and will have the senior resident, in most instances, serve as the primary resident on the service. Any prior deficiency may need to be satisfied during the selective rotations as well as any remedial program needed to prepare for those sections of the comprehensive examination that may need to be repeated. All selective rotations are within the curriculum offered during the first three years. The other 4.5 blocks are filled with 4th year requirements; which includes 1.5 blocks of night float, 1 block of Emergency Radiology, Nuclear Radiology and Mammography.

A 3-block selective was developed and implemented in 2013 for those who might be interested in an academic career. The rotations were funded by a limited endowment provided by Arvin and Beverly Robinson and his former residents and colleagues. For various reasons, the program was discontinued in 2019 and the remaining funds were transferred to complete the chair endowment. Three residents successfully completed the program from 2013-2019. Discussions are underway to restore a block of selective rotations for mentored and prospective research, manuscript development, and other academic endeavors under the Robinson Scholar designation.

CONFERENCES

Resident and fellow education occurs through teaching at the workstation, conferences, courses and independent study.

Departmental:

One to two daily lectures or case conferences are given Monday through Friday 12 noon – 1:00 pm that are faculty or resident lead. Resident attendance at these conferences is required through a QR code using MyEvaluations.com app and reported with each resident's semi-annual performance evaluation. Imaging fellows are to attend imaging conferences as well. The minimum number of residents to be present for lectures to take place is at the faculty's discretion. Each resident is responsible for arriving at conference on time and bring own lunch. A monthly conference schedule is available on QGenda to all residents, fellows and faculty.

Journal Club:

Our journal club's aim is to introduce radiology residents to evidence-based radiology, enhance clinical knowledge, and improve practice quality thereby achieving competencies in the six areas put forward by the ACGME. This is achieved through:

- Review of original research published in premier radiology journals to teach critical appraisal techniques and basic statistical methodology.
- Review of highly relevant review articles to improve medical knowledge and clinical practice.
- Review of relevant educational articles that apply principles of quality management in health care.

The article (or articles) to be reviewed are chosen by the moderator and emailed to residents in advance. The moderator is encouraged to choose a classic article, a frequently pressing on-call issue, a complex area that is less understood, or a controversial topic with opposing views. Other faculty are invited to attend and participate. A short PowerPoint presentation by the presenting resident(s) reviews, analyzes, and summarizes the article. The moderator of the journal club reviews the presentation prior to the meeting to ensure that all the important points are emphasized. During the journal club session, the moderator solicits comments and opinion from the audience to facilitate discussion and participation. The performance of the journal club is evaluated by a participant survey to assess satisfaction.

Interdepartmental Conferences:

There are numerous interdepartmental conferences, tumor boards, and work rounds. At these sessions, cases of interest to the relevant radiology service are discussed primarily from a clinical point of view focused on decision making based on imaging findings. Residents and fellow are encouraged to attend when available. In some instances Residents and Fellow are to present the cases, but always in the presence of Faculty. There is Multidisciplinary Tumor Board with Surgery and Hem Onc, Internal Medicine Tumor Board, Breast Tumor Board, Ob Gyn Tumor Board, Neuro Tumor Board and Head & Neck Tumor Board. Simulation activities take place with Emergency Medicine, Surgery, Nursing and Medical Students as part of the Interprofessional Education institutional curriculum.

Core Curriculum Presentations:

Presentations on core curriculum topics are provided by both the TTUHSC/PLFSOM-GME throughout the year, and as a series of electronic presentations on non-interpretive issues that are shown to residents throughout the year. The ABR issued free access to a Non-interpretive Skills Study Guide available on line at <https://www.theabr.org/wp-content/uploads/2022/04/2022-NIS-Study-Guide-v2.pdf> that goes over professionalism, quality and safety, reimbursement, compliance, legal and imaging informatics. The ABR recently published on line an additional study guide on Radioisotope Safety at <https://www.theabr.org/radioisotope-safety-content-study-guide> that goes over radiation protection, radiation biology, transport and management of radioactive materials, exposure limits, administration of radioactive material, administrative/practice regulations, responsibilities and training and emergency procedures.

Other items considered to be part of the core curriculum are Professionalism, Resident Fatigue and Impairment, Competency and Communication Skills found at <https://www.acr.org/Member-Resources/rfs/learning/Communication-for-Radiology-Residents>

The ACR offers an online Communication curriculum on experiential exercise in patient- and family-centered care and Communication Skills Training Module found at <https://www.acr.org/-/media/ACR/NOINDEX/RFS-Communication-Toolkit/Radiology-Communication-Skills-Learning-Module.pdf>

Radiologic Physics

A basic understanding of medical imaging physics is important for the practice of all radiology subspecialties. A curriculum to accomplish this goal has been developed by the AAPM as RSNA self-instructional modules. Weekly one-hour conference time is dedicated for the residents to complete pertinent modules from Titan Radiology by Prometheus Lionhart, MD. Physics modules from Johns Hopkins University are also available. Monitoring and consultation is available by physics-trained faculty during these sessions. Some modules are designated to be completed during subspecialty instructional periods. A subscription to Core Physics Review is provided designed to build conceptual foundation from zero knowledge to a clinically-relevant working knowledge of radiology physics through modules, assignments and MCQs.

This process provides residents with comprehensive instruction in the basic physical properties and technology of the various methods of medical imaging. The modalities covered include: Conventional screen-film radiology, conventional tomography, mammography, fluoroscopy, digital radiography, computed tomography, ultrasound, magnetic resonance imaging, and nuclear medicine. Basic physics principles include: Radiation and atomic physics, interaction of radiation with matter, X-ray production, computer technology, image quality, radioactivity, radiation detection, magnetic resonance imaging, radiation biology, and radiation protection.

Residents are to regularly add assessment scores to their portfolios for semi-annual reviews. Requirements are established for each year of training.

Suggested Reading and Study Materials:

The Essential Physics of Medical Imaging, *2nd Edition* by JT Bushberg, et al.

Review of Medical Physics by W. Huda

Nuclear Medicine Physics - The basics, *5th Edition* by R Chandra

Diagnostic Ultrasound, Principles and Instruments, 5th Edition, by F. W. Kremkau

MRI the Basics by R Hashemi & W Bradley

A Non-Mathematic Approach to Basic MRI by H-J Smith & F Ranallo

Questions and Answers in Magnetic Resonance Imaging, by A. D. Elster

Resources

Departmental Library and Teaching Files

In addition to the medical school library, there was a new departmental library within the administrative offices suite that opened in June 2012. The reading room was stocked with books of interest to radiology. Periodicals and journals are also available through the chairman's office and other faculty.

The department library/conference room was designated as the Radiology Founders' Library and was dedicated in June 2012 in honor of the three founding radiologists of the department, Drs. Barbara Gainer, Lloyd Mark and Henry Uhrig. Former Dean and Acting Chair of Radiology Manuel De La Rosa MD, MSC was honored as a Radiology Founder in 2014. Former chair and residency director, Arvin E. Robinson MD, MPH was added upon his retirement in 2016. The Founders' Library fund provided state of the art electronic teaching aids as well as other teaching programs for residents and medical students.

Video presentations and the computerized teaching files were available on the teaching computers located in the Founders' Library, the residents' office area and the fellow office. These are especially helpful in the resident's later years for certifying exam preparation. Additional teaching file materials and periodicals are available in the reading areas, the libraries and in faculty offices. A Museum collection of historical significance was started in 2014. As of June of 2022 the new conference room located in the CSB basement across the Radiology Department offers state-of-the-art AV equipment for in-person and virtual meetings and is named Arvin and Beverly Robinson to honor our Chair Emeritus.

RESIDENT and FELLOW DUTIES and RESPONSIBILITIES

Night Call and Weekend Duties

Call responsibilities are divided into short and long call divisions. **Short call** is taken in addition to the residents and fellows primary rotations and is appropriately scheduled on weekend days to accommodate duty hour guidelines. **Long call (Night float)** is included in the annual rotation schedule as one-half or full block assignment. Block relief to meet duty hour guidelines is assigned on a rotational basis by the chief residents.

Resident and Fellow work days are generally from 8 am to 5 pm every weekday. Radiology faculty are on duty in-house or remotely from 8:00 am to 5:00 pm and from 5:00 pm to 12:00 am on weekdays. On weekends and Holidays in-house or remote coverage is provided from 8:00 am to 5:00 pm.

Teleradiology coverage is provided by vRad from midnight to 8 am on weekdays and 5 pm to 8 am on weekends and Holidays. OnRad teleradiology coverage is from 8 am to 5 pm on weekends and Holidays.

Resident and Body Imaging Fellow call duties in house are no more than five consecutive nights

- a. Resident weekend day: 8 am - 5pm (with senior resident if in first six months of residency)
- b. Resident night float: 5 pm to 12 am in-house

UMC and EPCH Faculty back up is scheduled for diagnostic/trauma and interventional radiology procedures.

Faculty review of resident and fellow interpretations:

- a. ongoing during week day
- b. ongoing during weekend day and Holidays

Residents and fellow are encouraged to work as a team so that prompt accurate medical care is provided. They provide preliminary interpretation of conventional studies for both inpatient and emergency department patients and ensure that pertinent information is accurately and efficiently conveyed to the referring physicians. Many times, this requires a phone call followed by a typed note in PACS if a final interpretation is not generated readily. They are representatives of the department and are responsible for ensuring the smooth operation of our services while on their shift. They are available for consultation with emergency department staff and other resident physicians to demonstrate radiology's commitment to attentive, responsive medical service.

With regards to all call, if ever a clinical problem arises that the resident or fellow is uncomfortable in handling, there is always faculty on duty or on call for immediate assistance. The resident or fellow will be asked to make judgments as to whether imaging is indicated in a particular clinical setting, and if so, what sequence should be followed. Coordination with on-call technologists and physicians is necessary. It is expected that they will be able to expedite most problems. To do this effectively, they have to maintain a close liaison with clinical colleagues.

On-duty residents and fellow are responsible for reviewing examinations with radiology faculty in am review time and before going off duty at the end of the day as appropriate. As in regular daily work, follow-up of interesting patients can be very educational.

Similar responsibilities apply to weekends and holidays. The resident, or faculty who is to be relieved has an obligation to stay and continue to function until an orderly transition of care is possible. The incoming resident should receive a written/typed sign out regarding any problems or scheduled examinations still to be performed. This process needs to be documented to assure effective hand-off is accomplished.

The chief(s) resident(s) is (are) in charge of resident daily schedules, conferences, and on-call issues. Night float rotation, weekends and holidays, are scheduled as evenly as possible, by the chief resident. Holiday coverage can usually be arranged so that no resident will be required to cover the same holiday during consecutive years. All residents are expected to share call. Absence due to illness or other emergencies will have to be "repaid" to the replacement resident. If there is variation from the monthly call schedule, the resident on duty is responsible to inform the hospital operator of the change. All changes in call need to be submitted through QGenda so the program coordinator can assure that there are no duty hour violations. QGenda is synced with MyEvaluations.com to generate automated duty hours to be confirmed by Residents, a report is reviewed by Program Coordinator and/or Program Director to ensure accuracy; with the actual work schedule it is highly unlikely to go over the 80-h limit a week.

RESIDENT and FELLOW DUTIES and RESPONSIBILITIES (continued)

Call and Post Call Time Off

- a. Residents are on short and/or long call (including weekends and holidays) throughout the four years of residency.
- b. On call residents currently follow a night float schedule which has the resident off duty for patient care 14 hours between shifts and off duty for 48 hours every 5th consecutive night. Duty hours average 47 hours/week over a 4-week period for the four years of residency (see Appendix VI).
- c. Any changes in Night Float/weekend call coverage by Residents must be made through QGenda.
- d. Half Monday off after weekend duty. The current work schedule ensures that residents have at least 4 days off on average within a 4-wk block or in any given month.

The Wet Desk

- e. In the past, the “Wet Desk” was the on-line film consultation service in a busy radiology department. It was called the “Wet Desk” because the radiologist was often asked to review radiographs that were still in film processing tanks and had not been hand passed to the dryers (which took another 20 minutes). Even though we have gone from hand processing, to automatic processors, and now to digitized images through PACS, the name is still appropriate for on-line image consultation.
- f. There is a resident-run wet desk (UMC Ext. 48121 forwarded to the CSB B30) in the Emergency Radiology Reading Room from 8 am to 12 am. This is a 2-wk rotation within a four-week block. First year residents receive Wet Desk exposure 1 block prior to their Emergency Radiology day rotations.
- g. The faculty members assigned to ER provide coverage on site or by telephone transfer during conferences. Other residents may cover when the assigned resident needs to be away. Appropriate sign off is expected and must be documented electronically on dedicated WetDesk Handoff PACS list.
- h. The resident at the Wet Desk primarily answers all telephone and on-site consult requests and/or refers them to the appropriate reading station if applicable. There is nothing wrong with taking down the patient identifying information and calling back with a report within a reasonable time frame. All verbal consultations need to be accompanied by a typed preliminary note in the PACS if a final interpretation is not generated readily. As with other preliminary reports, major discrepancies with the final report need to be communicated to a referring physician as a critical finding. Discrepancies recognized on teleradiology reads will be communicated to Dr. Calleros via email for proper handling and PI purposes.
- i. Protocols of studies is an important component of resident training. On a weekly basis a resident is scheduled to review the appropriateness of the studies requested on out-patients. Junior residents will be assigned to protocol studies under the supervision of a more senior resident, after 6 months of training they will be responsible to do so independently and encouraged to contact Senior Residents or attendings should a doubt arises. A protocol guide is located at:
https://elpaso.ttuhsct.edu/som/radiology/documents/CT_Ordering_Guide.pdf and
https://elpaso.ttuhsct.edu/som/radiology/documents/MRI_Ordering_Guide2_1_.pdf Patients whose studies/procedures require sedation will be identified to ensure that a history and physical exam is available and obtained within 30 days, otherwise, will be updated in advance. The Wet Desk resident and residents on other services are responsible for the appropriateness of the requests coming from ER and in-patients.
- j. Any changes in Wet Desk coverage by Residents must be made through QGenda.

Night Call Qualifying Examination

- k. Before beginning long call and emergency radiology rotations, every resident must pass Night Call Qualifying Examinations with RadPrimer, RadExam and University of Florida Gainesville simulation exam. The exams are given in the last 3 blocks of the first year. If necessary, a repeat examination is offered before the resident is allowed to proceed to night float duty rotation.

RESIDENT REQUIREMENTS FOR ADVANCEMENT

Resident Promotion and Reappointment

□ Successful completion of all clinical rotations is required before a resident can proceed to the next PGY level selective rotations. Texas Tech University HSC adheres to the ACGME milestone standards for the six areas of clinical competency. Residents must be deemed competent or show consistent improvement in all six areas of competency as defined in the appendix by the Association of Program Directors in Radiology (APDR).

□ Resident attendance at conferences as defined in this manual.

□ On-call qualifying examinations are given each year. PGY-2 residents are required to pass examinations prior to any night float call assignment.

□ All Residents are assigned end-of rotation exams (RadExam) and are required to take the ACR In-Training examination each year to:

1. Help them prepare for the ABR examination which is in a similar format;
2. Provide the residency with program scoring to assess the effectiveness of the curriculum components even if they have passed the ABR Core (Qualifying) Exam;
3. Provide a guide to the resident and the program as to their individual progress in medical knowledge and their preparation for successfully completing a standardized and timed test.

□ A combination of deficiencies in evaluations, excessive time away from rotations and conference, and In-Training scores will place the resident on **internal observation** or **observation**. An appropriate and a comparable medical knowledge makeup examination will be given in three months, service rotation deficiencies will be rescheduled, and attendance will be closely monitored. If there is inadequate improvement on review by the Education Committee, the resident does not improve his/her clinical performance and pass this make up examination; he/she will be placed on **probation**. The prior statuses are not reportable to the TMB, however, if the trainee applies in the future for a full license with the TMB, these statuses need to be reported by the applicant. The latter status is to be reported to the TMB by the Program Director. Further deficiencies on subsequent rotations can be grounds for dismissal.

□ Residents are to keep a procedure log in accordance with ACGME requirements. Case log is provided monthly by UMC PACS IT but need to be supplemented by each resident for studies performed outside of UMC and EPCH. PET/CTs and other studies/procedures performed at WBAMC and those PET/CTs performed at Desert Imaging on TT or UMC patients also need to be logged by residents in MyEvaluations. Additionally, all IR cases are to be logged by resident in the ACGME app. All IR and other procedures need to be logged in MyEvaluations.com Procedures tab as UMC requires this for verification purposes and determine competence in performing such procedures.

□ Every rotation will also have minimum procedure and case guidelines which need to be documented at the time of end of rotation and semi-annual reviews.

□ A QI case conference is presented for the purpose of departmental morbidity and mortality (M&M) on a monthly basis. Quarterly PI meetings are held in conjunction with Diagnostic Imaging UMC leadership.

□ Residents are expected to fill out anonymous monthly evaluations on the faculty involved with their instruction, on peers according to rotation schedule and semiannually evaluate the Program. An ACGME Program survey is to be filled annually by faculty and Residents.

□ The department adheres to GME policies in regards to disability and sick time, but if that time is in excess of twelve days per year, the Education Committee will review the resident's/fellow's activities as well as American Board of Radiology requirements for Initial Certification without an extension of training with "Time Off" that does not exceed an average of eight weeks (40 workdays) per academic year over the duration of the residency, to determine if additional days of training need to be added to that year before advancement to the next level of training or graduation from the program. Effective July 1, 2026, residents must have completed their four-year residency within eight years of the start date of the residency program. A minimum of four months of the four-year diagnostic radiology training program must be spent in nuclear radiology, any time away must be made up to fulfill the required months. A minimum

of three months must be spent in mammography/breast imaging, as well, any time away must be made up. No more than 16 months may be spent in any one subspecialty or in research.

Disciplinary Action

Standards of academic performance and personal professional development, are the responsibility of the Program Director, Chairman and Education Committee. A resident/fellow experiencing difficulty with academic performance, impairment or professional misconduct may have disciplinary action taken in one of the following ways as outlined by the institution current Housestaff Policies and Procedures and reported to the TMB by the Program Director.

Remediation

Educational difficulties are sometimes experienced and at the direction of the Program Director and the Education Committee, a resident/fellow may be recommended to seek remedial assistance to provide a good academic experience within the department. Departmental Faculty and Resident mentorship is offered to trainees. Selective rotations may be assigned to repeat specific areas of weakness for remediation.

DEPARTMENT POLICIES

Dress Code

Resident and Fellows should wear appropriate attire and a white coat at all times including weekends, holidays and during night float duties. There should be no doubt of the professional appearance of the resident or fellow on all patient encounters and interactions with other healthcare professionals at UMC or EPCH.

The WBAMC dress code is business casual and a white coat must be worn at all times while on duty. On Fridays, attire may be casual; however, if resident chooses to dress casual they must wear a patriotic themed shirt.

Moonlighting Policy

There is no permission for internal moonlighting in this residency at this time. However, our residents are free to do external moonlight during full week vacations or time off from duties only subject to the following limitations:

- Any extra work must **not** interfere with appropriate study or duties within the department.
- Each resident engaging in professional activities outside the training program must attest that:
 - a. the hours will be reported on the Office for Graduate Medical Education Work Hour Survey and on any Chairman/Program Director work hour surveys.
 - b. total hours of moonlighting must comply with the number of hours a trainee may work as outlined by ACGME guidelines and institution policy.
- All vacation and time off duties for external moonlighting by residents **must** be approved by the Chairman/ Program Director.
- The resident must obtain written assurance of malpractice and workers' compensation coverage from any outside employer. The professional liability insurance provided by the University's insurance program covers only those activities that are required by the training program. There is no coverage for professional activities outside the scope of this residency program.
- The residents must have a valid Texas State medical license and federal DEA number.
- The moonlighting policies of the department are the same as those of the institution.
- Those training with a J-1 visa are not eligible to external moonlight.

Resident and Fellow Supervision

The faculty is on-call during afterhours for Diagnostic Radiology and Interventional Radiology. There is in-house or remote coverage by Diagnostic Radiology faculty at UMC or EPCH on weekdays from 8:00 to midnight. On weekends and holidays, there is Faculty coverage only from 8:00 am to 5 pm in-house or remotely. The Interventional Radiology faculty is on call at all times according to schedule.

Faculty members are on-site or available during all interventional procedures performed by residents. There is a documented, supervised experience in interventional procedures as described by the ACGME Special Requirements for Core Residency Programs in Diagnostic Radiology.

Current and accurate procedure logs are to be maintained in each residents ACGME database as requirement for promotion. These logs need to be updated regularly and should be available for semiannual review by the program director. (Refer to Appendix page 137.)

All studies preliminarily interpreted and/or performed by residents and fellows are promptly reviewed and edited by a faculty member before final reports are submitted. Any significant difference between preliminary and final report is to be promptly called to the attention of the patient's physician as a "Critical Finding".

Resident and Fellow Teaching

After the first year, residents/fellows are encouraged to assume teaching responsibilities both for medical students and other residents. Any resident who has a special interest in teaching should make this known. It is anticipated that fellows would always be involved in formal and informal teaching of residents. Residents and fellows are expected to assist the faculty in medical student teaching during simulation labs and medical skills workshops in chest radiograph, renal US and hepatobiliary US, as well as radiology electives. These sessions occur in all areas during all four years of the Paul L. Foster School of Medicine curriculum.

Vacation

PLFSOM GME policy is as follows:

Vacation is approved for no more than 15 working days for PGY level 1 and 2 and not more than 20 working days for PGY levels 3 and above, subject to residency program requirements. Any variance from this policy must be justified by the Program Director/Chair, recommended by GME, and approved in advance by the Dean. Timing and scheduling of vacations is at the discretion of the individual department. Vacation benefits do not carry forward from year to year and must be taken within the current contract agreement year. Unused vacation benefits are not paid upon completion or termination of the agreement. Residents must ask for vacation requests at least one month before vacation time can be approved. Residents are discouraged from asking for vacation time as they enter their new rotation. No more than six residents at one time will be allowed to be out on vacation. If a resident fails to notify his/her absence, the time away will be deducted from vacation time regardless of the reason, this applies also to delays or cancellations of a flight or any other travel delay. For those arriving late the following morning as a result of flight cancellation or delay, they are expected to come to work directly from the airport no later than 1:00 pm and leave by 10:00 pm to allow for time off prior to next morning duty per ACGME. If unsure on how to proceed after a cancelled or delayed flight notify Faculty, Program Director, Program Coordinator and Chief Residents by email.

No more than one week of vacation per 3-blocks of service assignment can be anticipated without accommodation for selective rotation make-up assignment. Approval for more than one consecutive week of vacation is best scheduled before the beginning of the year and is *not* guaranteed. 75% of rotation attendance is required for evaluation purposes, hence, if more than one consecutive week is planned is best to schedule at the end and beginning of consecutive rotations.

Every effort is made to allow residents and fellows to obtain vacation when they wish, provided service assignments and night/weekend call can be adequately covered and limited to two residents per block. They can expect to have limited vacation time available during June and July when fewer trained residents are on duty. Times of the major radiological meetings (RSNA, ARRS, AAR, TRS), American Board of Radiology Qualifying examination or In-Training examination times are also not suitable for vacation. Ensure that days being requested are available with Program Coordinator. She will then confirm that there is not already more than the allowed number of residents scheduled off for days being requested prior to approval by Program Director.

Should a resident or fellow need to request a Leave of Absence, discussion with the Program Director is the first step. The department adheres to the procedure for leave of absence as outlined by the institution in the current GME Policies and Procedures Manual.

Absence from Education Program (Leave)

Educational Leave

Each year, residents are given an additional 6 days as Educational Leave to use for out of town fellowship interviews or when attending a conference meeting on which the resident is presenting. Fellows are given 6 days of Educational Leave to use when attending a conference meeting on which the fellow is presenting. If the resident will be attending a meeting during an Emergency Radiology rotation or Night Float, the resident is responsible for finding coverage, notifying Chief Residents, Program Director, Program Coordinator, and Faculty, with changes reflected in QGenda.

Short Term Disability

Those who need to apply for Short-Term Disability need to make arrangements with the Program Director and must adhere to institutional guidelines as outlined in the GME Policies and Procedures Manual.

Paternity Leave/ Maternity Leave

Paternity/maternity leave is provided to residents under the Family Medical Leave Act and allows for up to 12 weeks unpaid leave for the birth or adoption of a child. In order to qualify, a minimum of 1,250 hours must be worked during the preceding year (12-month period).

It is the resident's responsibility to make his/her request directly to the Program Director well in advance in order to provide adequate coverage and make appropriate schedule and rotation adjustments, as well as filing the appropriate paperwork with the residency program.

Declared Pregnancy and Radiation Safety

A resident or fellow who is pregnant, for her safety and that of the child, must notify the Program Director and UMC Radiation Safety Officer as soon as possible, in order to ensure that proper safety measures are taken in conjunction with guidelines set by the hospital and institution.

Radiology Resident/Fellow policy is as follows:

Resident absence from the educational program (leave) is classified as one of the following:

1. Education Leave
 - a. AIRP: 4 weeks in the third year of residency according to schedule (See Radiologic-Pathologic Correlation Course)
 - b. Meeting attendance and/or presentations: up to 6 work days (see guidelines below)
 - c. .
 - d. Attendance to more than one meeting will be subject to approval from the Educational Committee
 - e. ABR Qualifying examinations: according to schedule
 - f. Scheduled Research related activities
2. Disability/Maternity/Paternity Leave (see GME policies)
3. Sick Leave (see policy below)
4. Leave of Absence (see institution policy)
5. Job/Fellowship Interview Leave: up to 12 days during application cycle. Additional days will come out of vacation time
6. Bereavement, family leave: based on individual circumstances as determined by the Program Director
7. Vacation: 15/20 working days per year, includes all other leaves such as:
 - a. Additional fellowship interview time
 - b. Additional examination preparation review courses
 - c. Vacation
 - d. Moonlighting

The program director can make additional time available under exceptional circumstances, as long as total educational time away does not exceed American Board of Radiology limitations and does not negatively impact learning objectives of scheduled rotations. It can be anticipated that allowances of additional non-educational time away may impact the availability of other allowances.

The proper procedure to request away time (vacation and leave) is:

*Check the number of days of available vacation time with Program Coordinator first, who will notify Program Director

*Submit a request through QGenda after cleared by Program Coordinator and Program Director

*Chief Resident is to assure that night/weekend call is covered

*Obtain approval from the Program Director via QGenda

*The Section Chief will be notified for that rotation/time with indication that total leave from the service rotation is within guidelines; no more than 5 days of leave is allowed within a rotation since a minimum of 75% of attendance is required for evaluation purposes.

Sick Time

Residents and fellows are required to notify their attending, chief residents, program coordinator, and program director by e-mail (or telephone if messaging system is not available) of any unexpected absence due to sickness by 8:00 a.m. of that workday. A sick day request on QGenda must be submitted right after notification has been sent to all listed above. Same applies for night float shift, with notification before 3:00 p.m to allow for coverage arrangements. If the resident calls in sick for more than three consecutive week days, on a day prior to or after a holiday, or on a Monday or Friday, a physician affirmation must be presented before returning to work.

Sick leave entitlement may be approved for up to twelve working days per year and carried forward from one contract year to another. Residents or fellows will not be compensated for accumulated sick leave. If this number is exceeded, the resident or fellow must extend the residency or use vacation days. Deficiencies in total service attendance guidelines will need to be accommodated.

Inappropriate use of sick time is a serious cause for concern as it impacts patient care, education and workflow and does not conform to institutional, departmental standards and milestones for professionalism. The Department of Radiology adheres to GME policies in regards to disability and sick time, but if that disability or sick time is in excess of twelve days per year, the Education Committee will review the resident's or fellow's activities and determine if additional days of training need to be added to that year before advancement to the next year or graduation from the program. The Education Committee also reserves the right to take similar action in instances suspected of being excessive use of sick time.

When these determinations are made the information will be relayed to the resident or fellow in a timely manner so that arrangements in the individual's personal schedule/commitments can be adjusted accordingly. The resident needs to be aware that any incompleteness of residency requirements must be recorded annually in the ABR database of training rotation completion. *Consequently, vacation days for the following year may not be used to make-up time lost.*

For the above and any other type of leave while on Emergency Radiology rotation, the resident is responsible for finding coverage, notifying Chief Residents, Program Director, Program Coordinator, and Faculty, with changes reflected in QGenda.

A resident with "Time Off" that exceeds an average of eight weeks (40 workdays) per training year will require an extension of training beyond the planned graduation date to be considered eligible for Initial Certification. The length of such extension will be determined by the Program Director but, at a minimum, must equal the excess number of workdays missed during the training period.

Reimbursement and Purchasing Guidelines

The residents and fellows are permitted a \$2,500 professional allowance designed to cover radiology professional expenses over their training program. Residents and fellows may use the professional account money to pay for radiology "review course" – registration, housing, airfare and ABR fees. Residents and fellows may **NOT** use the "professional account money" for any other expenses, including: computers, cameras, USMLE fees, tablets, radiation protection equipment, foreign or out-of-state medical licenses and exam fees and any other items included in the institutional purchasing policy HSCEP OP 72.15. Any and all purchases and/or reimbursements must be approved by the Program Director via email. All items, including books, purchased through the professional allowance are considered Texas Tech property and are to be returned when the resident leaves the program. If not, there will be a fee to cover taxes unless the item(s) are considered obsolete and gifted by the department to the resident or fellow.

Books can only be purchased by departmental requisition or departmental credit card, provided there is an adequate balance, with the understanding that the institution does NOT reimburse for sales tax or use of personal credit cards. The Radiology Accounting office, Program Director and the Department Chair reserve the right to refuse

reimbursement with adequate explanation. It is best to inquire prior to purchase. However, all books and other goods remain the property of Texas Tech and need to be accounted for before graduation.

Travel and Conference

Residents and fellows are also entitled to travel and conference reimbursement within the USA and Canada for allowable expenses where the resident or fellow is the first author for an oral presentation, scientific poster presentation or as an invited speaker at a regional or national meeting with prior permission obtained from the program director.

The presenting resident or fellow must submit a copy of the abstract along with the verification letter or email from the society. Reimbursement up to \$1,500 and up to a total of five working days is allowed as per approval by Program Director. Any additional days will come from the resident's or fellow's educational leave. After educational leave is exhausted, vacation days and personal funds may be used with prior approval.

In addition to the above, the resident or fellow may use their academic allowance and educational leave to attend a meeting or course when they are not presenting, they are not representing the institution, or they are not serving on a committee. A resident or fellow may attend RSNA as member of a steering committee, being given five days and \$1,500 allowance with prior approval.

As incoming Chief Resident or as outgoing Chief Resident, a resident can attend the AAR Annual Meeting. A Chief Resident may attend RSNA Annual Meeting if on a steering committee designated at the AAR meeting.

These are the allowable expenses, with appropriate receipts, for all meeting travel:

- Airfare travel – requires airline receipt, travel mileage if travel by personal vehicle,
- Hotel – requires hotel check-out statement, with statement showing payment, and balance due of \$ 0,
- Meals (excluding alcoholic beverages) with required receipts up to 50 USD/day

These items are not allowed for reimbursement:

- Expenses for spouse or person other than the resident or fellow attending the conference,
- Hotel expenses such as movies, spa, gym, gifts or alcoholic beverages,
- Capital purchases in excess of \$1,000, including independent purchase of computer parts,
- Residency materials, *i.e.* textbooks, including those purchased prior to the start of residency training

Radiologic-Pathologic Correlation Course

Attendance at the ACR-sponsored AIRP course in radiologic-pathologic correlation (formerly Armed Forces Institute of Pathology) is made available to all residents in the second or third year of training. Registration, housing, and travel are paid for by the department up to \$5,000 per resident. On the rare occasion that a resident would be unable to attend because of personal reasons, a four week alternative pathology elective is substituted. However, a virtual option is now available.

During this substitute elective, the resident will develop presentations in each of the basic areas of radiology providing appropriate radiologic correlation with pathologic images and descriptions. The presentations will be given during the basic core lecture series.

RESIDENT AND FELLOW EVALUATION PROCESS

(Fellows are considered PGY 6 residents and have the same evaluation process)

Evaluation and Competency of Residents

- Evaluation is primarily based on the resident's understanding of disease processes, anatomy, imaging and procedural skills, in keeping with the level of training.
- Evaluation of the resident include, but is not limited to, attendance, number and quality of reports, performance at image interpretation sessions, participation in conferences, observation of technical skills, and feedback from staff, and other residents.
- Evaluations are based on the six competencies as required by the ACGME
 - o Patient Care
 - o Medical Knowledge
 - o Practice-Based Learning and Improvement
 - o Interpersonal and Communication Skills
 - o Professionalism
 - o Systems-Based Practice

Residents are expected to participate in the 360⁰ evaluation process via the currently used program platform MyEvaluations.com. In this process, they are given the opportunity to evaluate other residents on their service.

RESIDENT GOALS AND OBJECTIVES BY ROTATION

The Department of Radiology follows the competency requirements set by the Accreditation Council for Graduate Medical Education (ACGME) and follows its guidelines. Each 4-week block rotation, therefore, has incorporated these six competencies into its educational goals and objectives. These competencies are listed in *RED* at the beginning of each goal and/or objective. Residents receive these goals and objectives prior to the start of their rotations.

ABDOMINAL IMAGING

The radiology resident will experience four 4-week block rotations in abdominal imaging, which includes GI, GU, and abdominal CT and MRI within the first three years of residency training. The VA rotation is focused on integrating multimodality skills of the more advanced Radiology resident after the Program Director has determined the Radiology Resident is sufficiently prepared to address integration of Multimodality Imaging studies of increasing complexity. Additional selective opportunities are available for the fourth year of the radiology residency program.

The learning experience takes place in the following ways:

1. One-on-one training during the clinical workday,
2. Weekly resident conferences, which will both be didactic and case conference in approach, and
3. Weekly imaging conferences.

General abdominal imaging textbooks and specific articles are recommended to the resident throughout the year.

I. First and second blocks (first year)

A. GASTROINTESTINAL RADIOLOGY

The resident should:

Patient Care and Procedural Skills, Practice-based Learning and Improvement

- Learn the skills of fluoroscopy and become facile in the operation of the fluoroscope:
- Develop hand/eye coordination during the examination.
- Demonstrate competence in basic fluoroscopic procedures:
 - Upper GI-single and biphasic,
 - Esophagram-single and biphasic,
 - Modified barium swallow study,
 - Barium enema-single and double contrast,
 - Small bowel exam-per oral and enteroclysis,
 - T-tube cholangiography,
 - NJ and NG tube placement under fluoroscopy

Medical Knowledge, Systems-based Practice

- Become familiar with radiation concerns during GI fluoroscopy:
 - The various components contributing to patient radiation during the exam, and
 - Methods to decrease both patient and staff radiation exposure without compromise of diagnostic outcome.
- Learn to discriminate between the diagnostic adequacies of various abdominal examinations.
- Learn the appropriate use of various contrast agents related to the GI tract and the pancreaticobiliary tree, including adverse effects and safety precautions.
- Develop a basic understanding of the normal, normal variants, and pathologic states of the oral pharynx, esophagus, stomach, duodenum, mesenteric small bowel, and colon as examined with contrast material.
- Demonstrate the ability to provide image interpretation of conventional images and ERCP examinations.

Interpersonal and Communication Skills, Professionalism

- Recognize the importance of patient/MD relationship during the GI examination with proper respect for patient privacy, comfort, and safety.
- Demonstrate the importance of communication with the referring clinician, both in regards to a well-crafted prompt report, as well as when to make immediate contact when pertinent abnormal findings are discovered at examination.

ABDOMINAL IMAGING (continued)

B. GENITOURINARY RADIOLOGY

The resident should:

Patient Care, Medical Knowledge, Practice-based Learning and Improvement

- Learn the basic skills of plain abdominal image interpretation and intravenous contrast examinations.
- Become facile in the performance of basic fluoroscopic procedures:
 - cystography,
 - voiding cystourethrography,
 - retrograde urethrography,
 - nephrostography, and
 - hysterosalpingography
- Become familiar with radiation concerns during GU fluoroscopy, the various components of patient radiation exposure during the exam, and ways to decrease both patient and staff radiation exposure without compromising the diagnostic outcome.
- Demonstrate a basic understanding of the normal, normal variants, and pathologic GU anatomy.
- Learn the appropriate use of various contrast agents related to the GU tract.
- Learn to recognize and treat contrast reactions.

Interpersonal and Communication Skills, Professionalism

- Be aware of the importance of the patient/MD relationship during the GU examination.
- Be aware of the importance of communication with the referring clinician. This includes a well-crafted prompt report, as well as when to make immediate contact when pertinent abnormal findings are discovered at examination.

C. ABDOMINAL COMPUTED TOMOGRAPHY

Practice-based Learning, Systems-based Practice

- Understand the basic physics of CT including slice thickness, pitch, helical vs. multi-row scanners, effects of mA and kV.
- Learn the basic principles of contrast distribution particularly as applied to arterial and venous phase scanning.
- Demonstrate the ability to follow protocols and monitor CT studies. Modify protocols when appropriate.
- Learn to recognize and treat contrast reactions.
- Develop skills in interpretation of basic CT pathology.

Medical Knowledge

Recognize the CT appearance of the following pathology

- Splenic and liver laceration
- Aortic dissection
- Aortic aneurysm and pseudoaneurysm
- Ascites
- Bowel perforation with free air
- Obstructive hydronephrosis due to ureteral calculus
- Bowel obstruction
- Active arterial extravasation
- Shock bowel

ABDOMINAL IMAGING (continued)

- Post traumatic urinary bladder leak
- Colon carcinoma
- Esophageal carcinoma
- Liver cancer
- Pancreas cancer
- Gastric cancer
- Renal Tumors
- Abdominal Lymphoma
- Retroperitoneal adenopathy
- Adrenal adenoma and myelolipoma
- Gallstones
- Cavernous hemangioma of the liver
- Cirrhotic liver
- Liver metastases
- Pancreatitis with pseudocyst
- Renal cystic disease
- CT artifacts

Interpersonal and Communication Skills, Professionalism

- Develop skills in consultation with house staff and referring physicians
- Learn the appropriate format for dictation of CT reports

II. (SECOND AND THIRD YEARS)

A. GASTROINTESTINAL RADIOLOGY

Patient Care and Procedural Skills, Medical Knowledge

•The residents will review the skills needed at fluoroscopy. Not only will the resident be instructed on how to become more facile with the fluoroscopic exam, he/she will also now be taught nuances to facilitate the various GI examinations at fluoroscopic exam. The resident should continue to increase in the facilitation of the basic GI examinations as stated under the first year rotations. A review and more information related to radiation concerns will be given. Further detail will be given to the GI tract pathology as begun in the first year rotations.

Practice-Based Learning, Systems-Based Practice

•There will be increasing application of correlation between cross-sectional images obtained prior or following the examination done in fluoroscopy. Also, the resident should be made aware of the place of the various imaging techniques of the abdomen in order to structure an imaging approach to different clinical problems using fluoroscopy, plain film, and axial imaging studies.

B. GENITOURINARY RADIOLOGY

Patient Care and Procedural Skills, Medical Knowledge

•The residents will review their skill of fluoroscopy. Not only will the resident be instructed on how to become more facile with the fluoroscopic exam, he/she will also be taught nuances to facilitate the various GU examinations at fluoroscopic exam. The resident should continue to increase their efficiency of the basic examinations as stated under the first year rotation.

•Further detail will be given to the GU tract pathology as begun in the first rotation.

ABDOMINAL IMAGING (continued)

Practice-Based Learning, Systems-Based Practice

•There will be increasing correlation between cross-sectional images obtained prior or following the examination done in fluoroscopy. The resident should be made aware of the place of various imaging techniques of the abdomen in order to structure an imaging approach to different clinical problems using fluoroscopy, plain film, and axial imaging studies.

Interpersonal and Communication Skill

•The residents should be able to assist in organizing the workday and working with the first year radiology resident.

C. ABDOMINAL COMPUTED TOMOGRAPHY

Patient Care and Procedural Skills, Medical Knowledge

- Refine interpretive skills with complex pathology
- Understand the principles of computed tomography angiography
- Be able to identify life-threatening findings, particular in trauma patients
- Identify the CT appearance of the following pathology:
 - Hepatic abscess
 - Pancreatic abscess
 - Renal abscess
 - Groin pseudoaneurysm
 - Biliary cancer
 - Budd Chiari Syndrome
 - Carcinomatosis with ascites
 - Diaphragmatic hernia
 - Interloop abscess
 - Focal nodular hyperplasia of the liver
 - Hepatocellular carcinoma
 - Islet cell tumor of the pancreas
 - Renal oncocytoma
 - Complications of renal transplantation
 - Cystic pancreatic neoplasm
 - Portal hypertension and varices
 - Retroperitoneal fibrosis
 - Von Hippel Lindau Syndrome

Interpersonal and Communication Skills, Professionalism

•Provide emergent provisional interpretation as needed.

Practice-Based Learning and Improvement

- Demonstrate the ability to direct the choice of imaging modality and protocol emergent studies.
- Understand when referral to other imaging modalities is necessary.

D. ABDOMINAL MRI (INCLUDING MRCP)

CHEST RADIOLOGY

The chest (cardiothoracic) radiology rotation includes three dedicated 4-weeks rotations in chest radiology, including chest and cardiac CT. The VA rotation is focused on integrating multimodality skills of the more advanced Radiology resident after the Program Director has determined the Radiology Resident is sufficiently prepared to address integration of Multimodality Imaging studies of increasing complexity.

A fourth rotation, taken as a fourth year selective, may be required by the chest imaging faculty and program director, if deficiencies are documented. Faculty supervision and evaluation is designated by weekly teaching schedule.

Chest imaging is also practiced and taught in Pediatric Radiology and Emergency Radiology.

YEAR ONE: FIRST and SECOND 4-WEEK ROTATION

Goals 1-2

Professionalism, Medical Knowledge, Interpersonal and Communications Skills, System-based Practice, Practice-based Learning and Improvement.

After completion of the first thoracic radiology rotation, the resident will be able to:

- 1 Demonstrate learning of the knowledge-based objectives.
- 2 Demonstrate a responsible work ethic.
- 3 Obtain pertinent patient information relative to radiologic examinations.
- 4 Demonstrate knowledge of the clinical indications for obtaining chest radiographs and when a chest CT or MR may be necessary.
- 5 Understand standard patient positioning in chest radiography.
- 6 Accurately and concisely dictate a chest radiograph report.
- 7 Communicate effectively with referring clinicians and supervisory staff.

Objectives 1-2

Medical Knowledge 1-2

- At the end of the first and second thoracic radiology rotations, the resident will demonstrate learning of at least one third of the knowledge-based objectives (see Addendum) appropriate for chest radiography and emergency thoracic CT
- Demonstrate knowledge of the “ACR Standards for Communication, Adult Chest”.
- Demonstrate knowledge of the Fleischner society: Glossary of Terms for Thoracic Imaging.

Professionalism 1-2

- Arrive for the rotation assignment on time and prepared after reviewing recommended study materials

Patient Care 1-2

- Obtain relevant patient history from electronic records, dictated reports, or by communicating with referring clinicians.
- Use appropriate chest radiography nomenclature when dictating reports and consulting with health care professionals.
- Communicate with ordering physicians about all significant or unexpected radiologic findings and document who was called and the date and time of the call.

Communication 1-2

- Dictate accurate and concise chest radiograph reports that include patient name, patient medical record number, date of exam, date of comparison exam, type of exam, indication for exam, brief and concise description of the findings, and short impression.
- Describe patient positioning and indications for posteroanterior (PA), anteroposterior (A), lateral decubitus, and lordotic chest radiographs.

CHEST RADIOLOGY (*continued*)

Practice-Based Learning and Improvement 1-2

- Utilize prior imaging studies and reports in the interpretation of current studies.
- Present at weekly resident chest conference.
- Residents are expected to place one case into the teaching file, each rotation with references to indicate understanding of evidence-based medicine.

Study Materials

1. Chest radiology: Plain film patterns and differential diagnoses, Reed J, 5e, Mosby, St Louis, 2003
2. Thoracic Radiology: The Requisites, McLoud TC & Boiselle PM, 2e, Mosby, St Louis, 2009

THIRD 4-WEEK ROTATION (SECOND YEAR)

Goals 3

Professionalism, Medical Knowledge, Interpersonal and Communications Skills, System-based Practice, Practice-based Learning and Improvement.

After completion of the second thoracic radiology rotation, the resident will be able to:

1. Demonstrate learning of the knowledge-based objectives.
2. Understand standard radiation doses, dose reduction techniques and radiation protection pertinent to chest imaging.
3. Understand different contrast agents, dosages, contrast reactions and management of reactions
4. Continue to build on chest radiograph interpretative skills.
5. Develop skills in setting protocols, monitoring and interpreting chest CT scans.
6. Develop an ability to generate multiplanar reformatted (MPR) and 3 dimensional images on CT.
7. Communicate effectively with referring clinicians and supervisory staff.
8. Participate in quality improvement/quality assurance and other operational activities.

Objectives 3 (In addition to those from Rotation 1)

Medical Knowledge 3

At the end of the second thoracic radiology rotation, the resident will demonstrate learning of at least one third of the knowledge-based objectives (see Addendum). The resident should also be able to identify the following structures on Chest and Cardiac CT.

- Lungs—Lobes, fissures and bronchopulmonary segments
- Pleura and extrapleural fat
- Airway—trachea, main bronchi, carina, lobar and segmental bronchi
- Heart—left ventricle, right ventricle, moderator band, left atrium, left atrial appendage, right atrium, right atrial appendage, mitral valve, aortic valve, tricuspid valve, pulmonary valve, coronary arteries (left main, left anterior descending, left circumflex, right, posterior descending), coronary veins, coronary sinus
- Pericardium—including pericardial recesses, Pulmonary arteries—main, right, left, interlobar, segmental
- Aorta— aortic root, sinuses of Valsalva, ascending aorta, arch, descending including normal measurements
- Arteries— brachiocephalic (innominate), common carotid, subclavian, axillary, vertebral, internal mammary, intercostal
- Veins—pulmonary, superior vena cava, inferior vena cava, brachiocephalic, subclavian, axillary, internal jugular, external jugular, azygos, hemiazygos, left superior intercostal, internal mammary
- Bones—ribs and costochondral cartilages, clavicles, scapulae, sternum, spine
- Esophagus
- Thymus
- Thyroid gland
- Muscles—sternocleidomastoid, anterior and middle scalene, infrahyoid, pectoralis major and minor, deltoid, trapezius, infraspinatus, supraspinatus, subscapularis, latissimus dorsi, serratus anterior
- Aortopulmonary window
- Azygoesophageal recess
- Diaphragm
- Phrenic nerve

CHEST RADIOLOGY (continued)

Patient Care and Procedural Skills 3

1. Appropriately protocol all requests for chest CT to include thin-section images, high-resolution images, expiratory images, or prone images when appropriate, and use of intravenous contrast, given the patient history.
2. Monitor all chest CT examinations and determine if additional imaging is needed before the patient CT examination is completed.
3. Demonstrate the ability to manage an intravenous contrast reaction that occurs during a chest CT examination.
4. Describe the principles of chest fluoroscopy, including the assessment of the diaphragm.
5. Demonstrate knowledge of CT parameters contributing to patient radiation exposure and techniques that can be used to limit radiation exposure.

Practice-Based Learning and improvement 3

1. Weekly resident chest conference.
2. Residents are expected to place one case into the teaching file, each rotation with references to indicate understanding of evidence-based medicine.

Study Materials

3. Chest radiology: Plain film patterns and differential diagnoses, Reed J, 5e, Mosby, St Louis, 2003
4. Thoracic Radiology: The Requisites, McLoud TC & Boiselle PM, 2e, Mosby, St Louis, 2009
5. Imaging of the chest, Muller NL, Silva IS, 1e, Saunders Elsevier, New York, 2009
6. High resolution CT of the lung, Webb RW, Muller NL, Naidich DP, 3e, Wolters Kluwercaiu Lippincott, Philadelphia, 2009

FOURTH 4-WEEK ROTATION (THIRD YEAR)

Goals 4

Medical Knowledge, Interpersonal and Communications Skills, System-based Practice, Practice-based Learning and Improvement.

After completion of the third cardiothoracic radiology rotation, the resident will be able to:

1. Demonstrate more advanced learning of the knowledge-based objectives.
2. Appropriately protocol all requests for cardiac CT and MRI, given the patient histories.
3. Develop skills in interpreting Cardiac CT and MRI examinations.
4. Continue to build on chest radiograph and chest CT interpretative skills.
5. Develop interpretative skills for multiplanar reformatted (MPR) and 3 dimensional CT images.
6. Correlate pathologic and clinical data with radiographic and CT findings.
7. Communicate effectively with referring clinicians and supervisory staff.

Objectives 4 (In addition to those in Rotations 1 and 2)

Medical Knowledge 4

- At the end of the third thoracic radiology rotations, the resident will demonstrate learning of the knowledge-based objectives (see Addendum)

Patient Care and Procedural Skills 4

1. State clinical indications for performing Cardiac CT
2. Understand cardiac planes and optimization for cardiac imaging
3. Monitor all Cardiac CT examinations and determine if additional imaging is needed before the patient CT examination is completed.
4. Develop an ability to generate and interpret three dimensional and multiplanar reformatted Cardiac CT images.
5. Dictate accurate, concise chest radiograph, CT scan reports with at least 75% accuracy.

CHEST RADIOLOGY (continued)

6. Understand the technical principles of all chest/cardiac exams and describe a protocol optimized for evaluating each of the following:
 - thoracic aorta
 - pulmonary arteries
 - thoracic veins (superior vena cava, brachiocephalic veins)
 - pericardium
 - cardiomyopathy and cardiac and paracardiac masses
 - ischemic heart disease, including function, viability and perfusion
 - valvular heart disease
 - arrhythmogenic right ventricular dysplasia
 - congenital heart disease in an adult
 - superior sulcus tumor

Practice-Based Learning and Improvement 3

1. Utilize prior imaging studies and reports in the interpretation of current studies.
2. Weekly resident chest conference.
3. Residents are expected to place one case into the teaching file, each rotation with references to indicate understanding of evidence-based medicine.

Addendum

Knowledge-Based Objectives (adapted from guidelines of educational society of thoracic radiology)

Normal Anatomy:

1. Name and define the three zones of the airways.
2. Define a secondary pulmonary lobule and acinus.
3. Name the bronchial anatomy and bronchopulmonary segments
4. Identify the following structures on the posteroanterior (PA) chest radiograph:
 - Lungs—right, left, right upper, middle and lower lobes, left upper (including lingula) and lower Lobes
 - Fissures—minor, superior accessory, inferior accessory, azygos
 - Airway—trachea, carina, main bronchi,
 - Heart—right atrium, left atrial appendage, left ventricle, location of the four cardiac valves
 - Pulmonary arteries—main, right, left, interlobar, truncus anterior
 - Aorta—ascending, arch, descending aorta
 - Veins—superior vena cava, azygos, left superior intercostal (“aortic nipple”)
 - Bones—spine, ribs, clavicles, scapulae, humeri
 - Lines and stripes (Right paratracheal stripe, anterior junctional line, posterior junctional line, paraspinous line etc)
 - Left subclavian artery
5. Identify the following structures on the lateral chest radiograph:
 - Lungs—right, left, right upper, middle and lower lobes, left upper (including lingula) and lower lobes
 - Fissures—major, minor, superior accessory
 - Airway—trachea, upper lobe bronchi, posterior wall of bronchus intermedius
 - Heart—right ventricle, right ventricular outflow tract, left atrium, left ventricle, the location of the four cardiac valves
 - Pulmonary arteries—right, left
 - Aorta—ascending, arch, descending
 - Veins—superior vena cava, inferior vena cava, left brachiocephalic (innominate), pulmonary vein confluence
 - Bones—spine, ribs, scapulae, humeri, sternum

CHEST RADIOLOGY (*continued*)

- Lines and stripes (Retrosternal line, Posterior tracheal stripe)
- Right and left hemidiaphragms
- Raider's triangle
- Brachiocephalic (innominate) artery

Signs in Thoracic Radiology:

1. Define, identify and state the significance of the following on a radiograph:

- air bronchogram—indicates a parenchymal process, including nonobstructive atelectasis, as distinguished from pleural or mediastinal processes
 - air crescent sign—indicates a lung cavity, often resulting from fungal infection or saprophytic colonization
 - deep sulcus sign on a supine radiograph—indicates pneumothorax
 - continuous diaphragm sign—indicates pneumomediastinum
 - ring around the artery sign (air around pulmonary artery, particularly on lateral chest radiograph)—indicates pneumomediastinum
 - fallen lung sign—indicates a fractured bronchus
 - flat waist sign—indicates left lower lobe collapse
 - gloved finger sign—indicates bronchial impaction, which can be seen in allergic bronchopulmonary aspergillosis
 - Golden S sign—indicates lobar collapse caused by a central mass, suggesting an obstructing bronchogenic carcinoma in an adult
 - luftsichel sign—indicates upper lobe collapse, suggesting an obstructing bronchogenic carcinoma in an adult
 - Hampton's hump—pleural-based, wedge-shaped opacity indicating a pulmonary infarct
 - silhouette sign—loss of the contour of the heart, aorta or diaphragm allowing localization of a parenchymal process
 - cervicothoracic sign—a mediastinal opacity that projects above the clavicles is retrotracheal and posteriorly situated, whereas an opacity effaced along its superior aspect and projecting at or below the clavicles is situated anteriorly.
 - tapered margins sign—a lesion in the chest wall, mediastinum or pleura may have smooth tapered borders and obtuse angles with the chest wall or mediastinum while parenchymal lesions usually form acute angles
 - figure 3 sign—abnormal contour of the descending aorta, indicating coarctation of the aorta
 - fat pad sign or sandwich sign—indicates pericardial effusion on lateral chest radiograph
 - scimitar sign—an abnormal pulmonary vein in venolobar syndrome
 - double density sign—opacity projecting over the right side of the heart, indicating enlargement of the left atrium
 - hilum overlay sign and hilum convergence sign used to distinguish a hilar mass from a non-hilar mass
2. Define, identify and state the significance of the following on a chest CT:
- CT angiogram sign—enhancing pulmonary vessels against a background of low attenuation material in the lung
 - halo sign—suggesting invasive pulmonary aspergillosis in a leukemic patient
 - split pleura sign—a sign of empyema and other inflammatory pleural processes

Interstitial Lung Disease:

1. List and identify on a chest radiograph and chest CT four patterns (nodular, reticular, reticulonodular, and linear) of interstitial lung disease (ILD).
2. Identify Kerley A and B lines on a chest radiograph and explain their etiology.
3. Make a specific diagnosis of ILD when supportive findings are present in the history or on radiologic imaging (eg, dilated esophagus and ILD in scleroderma, amiodarone lung).
4. Recognize the changes of congestive heart failure on a chest radiograph—enlarged cardiac silhouette, pleural effusions, vascular redistribution, interstitial or alveolar edema, Kerley lines, enlarged azygos vein, increased ratio of artery to bronchus diameter.

CHEST RADIOLOGY (*continued*)

5. Identify honeycombing on a radiograph and chest CT, state the significance of this finding (end-stage lung disease), and list the common causes of honeycomb lung.
6. Describe the radiographic classification of sarcoidosis
7. Define the terms “asbestos-related pleural disease” and “asbestosis”; identify each on a chest radiograph and chest CT.
8. Describe what a “B” reader is as related to the evaluation of pneumoconioses.
9. Recognize progressive massive fibrosis/conglomerate masses secondary to silicosis or coal worker’s pneumoconiosis on radiography and chest CT.
10. Recognize the typical appearance and patterns of cystic lung disease on a chest radiograph and CT (Langerhans cell histiocytosis, lymphangioliomyomatosis)
11. Identify and give appropriate differential diagnoses when the patterns of septal thickening, perilymphatic nodules, bronchiolar opacities (“tree-in-bud”), air trapping, cysts, and ground glass opacities are seen on CT.

Alveolar Lung Disease:

1. List four broad categories of acute alveolar lung disease (ALD).
2. List five broad categories of chronic ALD.
3. Name three pulmonary-renal syndromes.
4. List five of the most common causes of acute respiratory distress syndrome.
5. Name four predisposing causes of cryptogenic organizing pneumonia.
6. Suggest a specific diagnosis of ALD when supportive findings are present in the history or on the chest radiograph (eg, broken femur and ALD in fat embolization syndrome, ALD and renal failure in a pulmonary-renal syndrome, ALD treated with bronchoalveolar lavage in alveolar proteinosis).

Atelectasis, Airways, and Obstructive Lung Disease:

1. Recognize partial or complete atelectasis of the following on a chest radiograph and list an appropriate differential diagnosis for the etiology of collapse: right upper lobe, right middle lobe, right lower lobe, left upper lobe, left lower lobe.
2. Distinguish lung collapse from massive pleural effusion on a frontal chest radiograph.
3. Name the four types of bronchiectasis. Identify each type on a chest CT. Name five common causes of bronchiectasis.
4. Recognize the typical appearance of cystic fibrosis on chest radiography and CT.
5. Name the important things to look for on a chest radiograph when the patient history is “asthma.”
6. Define tracheomegaly. Recognize tracheal and bronchial stenosis on chest CT and name the most common causes.
7. Name the three types of pulmonary emphysema and identify each type on a chest CT.
8. Recognize alpha-1-antitrypsin deficiency on a chest radiograph and CT.
9. Recognize Kartagener syndrome on a chest radiograph and name the three components of the syndrome.
10. Define the term giant bulla, differentiate giant bulla from pulmonary emphysema, and state the role of imaging in patient selection for bullectomy and for lung volume reduction surgery.
11. Recognize and describe the significance of a pattern of mosaic lung attenuation on chest CT.

Mediastinal Masses and Mediastinal/Hilar Lymph Node Enlargement:

1. State the anatomic boundaries of the anterior, middle, posterior, and superior mediastinum.
2. Name the four most common causes of an anterior mediastinal mass and localize a mass to the anterior mediastinum on a chest radiograph, CT, and MRI.
3. Name the three most common causes of a middle mediastinal mass and localize a mass in the middle mediastinum on a chest radiograph, CT, and MRI.
4. Name the most common cause of a posterior mediastinal mass and localize a mass in the posterior mediastinum on a chest radiograph, CT, and MRI.
5. Name two causes of a mass that straddles the thoracic inlet and localize a mass to the thoracic inlet on a chest radiograph, CT, and MRI.
6. Identify normal vessels or vascular abnormality on chest CT and chest MRI that may mimic a solid mass.

CHEST RADIOLOGY (continued)

7. Name five etiologies of bilateral hilar lymph node enlargement.
8. State the three most common locations (Garland's triad) of thoracic lymph node enlargement in sarcoidosis.
9. List the four most common etiologies of "eggshell" calcified lymph nodes in the thorax.
10. Recognize a cystic mass in the mediastinum and suggest the possible diagnosis of a bronchogenic, pericardial, thymic, or esophageal duplication cyst.
11. Recognize the findings of mediastinal fibrosis on chest CT.

Solitary and Multiple Pulmonary Nodules:

1. Define the terms pulmonary nodule and pulmonary mass.
2. Name the three most common causes of a solitary pulmonary nodule.
3. Name four important considerations in the evaluation of a solitary pulmonary nodule.
4. Describe the indications for percutaneous biopsy of a solitary pulmonary nodule.
5. Describe the role of positron emission tomography in the evaluation of a solitary pulmonary nodule.
6. Describe an appropriate imaging algorithm to evaluate a solitary pulmonary nodule.
7. Name six causes of cavitory pulmonary nodules.
8. Name four causes of multiple pulmonary nodules.
9. Describe the indications for percutaneous biopsy when there are multiple pulmonary nodules.
10. Describe the complications and the frequency with which complications occur because of percutaneous lung biopsy using CT or fluoroscopic guidance.

Benign and Malignant Neoplasms of the Lung and Esophagus:

1. Name the four major histologic types of bronchogenic carcinoma and state the difference between non-small-cell and small-cell lung cancer.
2. Name the type of non-small-cell lung cancer that most commonly cavitates.
3. Name the types of bronchogenic carcinoma that are usually central.
4. Describe the TNM classification for staging non-small-cell lung cancer, including the components of each stage (I, II, III, IV, and substages) and the definition of each component (T1-4, N0-3, M0-1).
5. Describe the staging of small-cell lung cancer.
6. Name the four most common extrathoracic sites of metastases for non-small-cell and small-cell lung cancer.
7. Name the stages of non-small-cell lung cancer are potentially resectable.
8. Recognize postpneumectomy chest radiograph and state five possible etiologies for the abnormal shift.
9. Name the most common thoracic locations for adenoid cystic carcinoma and carcinoid tumors to occur.
10. Describe the acute and chronic radiographic and CT appearances of radiation injury in the thorax (lung, pleura, pericardium, esophagus) and the temporal relationship to radiation therapy.
11. State the role of MRI in lung cancer staging (eg, chest wall invasion, superior sulcus, Pancoast tumor).
12. Describe the role of positron emission tomography in lung cancer staging.
13. Describe the TNM classification for staging esophageal carcinoma, including the components of each stage (I, II, III, IV) and the definition of each component (T, N, and M).
14. Describe the role of imaging in the staging of esophageal carcinoma.
15. Name the stages of esophageal carcinoma are potentially resectable.
16. Describe the classification of lymphoma, the role of imaging in the staging of lymphoma and the typical and atypical imaging findings of thoracic lymphoma.
17. Define primary pulmonary lymphoma.
18. Describe the typical chest radiograph and chest CT appearances of Kaposi sarcoma.

Thoracic Trauma:

1. Identify a widened mediastinum on a trauma radiograph and state the differential diagnosis (including aortic/arterial injury, venous injury, fracture of sternum or spine).
2. Identify and describe the indirect and direct signs of aortic injury on contrast-enhanced chest CT.

CHEST RADIOLOGY (continued)

3. Identify and state the significance of chronic traumatic pseudoaneurysm of the aorta on a chest radiograph, CT, or MRI.
4. Identify fractured ribs, clavicle, spine, and scapula on a chest radiograph or CT.
5. Name five common causes of abnormal lung opacity on a trauma radiograph or CT.
6. Identify an abnormally positioned diaphragm or loss of definition of a diaphragm on a trauma chest radiograph and suggest the diagnosis of a ruptured diaphragm.
7. Recognize and describe the signs of diaphragmatic rupture on a chest CT.
8. Identify a pneumothorax, pneumopericardium, and pneumomediastinum on a trauma chest radiograph
9. Identify the fallen lung sign on a chest radiograph or CT and suggest the diagnosis of tracheobronchial tear.
10. Identify a cavitary lesion on a posttrauma radiograph or chest CT and suggest the diagnosis of laceration with pneumatocele formation, hematoma or abscess secondary to aspiration.
11. Name the three most common causes of pneumomediastinum in the setting of trauma.
12. Recognize and distinguish between pulmonary contusion and laceration.

Chest Wall, Pleura, and Diaphragm:

1. Recognize and name four causes of a large unilateral pleural effusion on a chest radiograph or CT.
2. Recognize a pneumothorax on an upright and supine chest radiograph.
3. Recognize a pleural based mass with bone destruction or infiltration of the chest wall on a chest radiograph or CT and name four likely causes.
4. Recognize pleural calcification on a chest radiograph or CT and suggest the diagnosis of asbestos exposure (bilateral involvement) or old tuberculosis or trauma (unilateral involvement).
5. Recognize the typical chest radiographic appearances of pleural effusion, given differences in patient positioning, and describe the role of the lateral decubitus view to evaluate pleural effusion.
6. Recognize apparent unilateral elevation of the diaphragm on a chest radiograph and suggest a specific etiology with supportive history and associated chest radiograph findings (eg, subdiaphragmatic abscess after abdominal surgery, diaphragm rupture after trauma, phrenic nerve involvement with lung cancer).
7. Recognize imaging findings suggesting a tension pneumothorax and understand the acute clinical implications.
8. Recognize diffuse pleural thickening, as seen in fibrothorax, malignant mesothelioma, and pleural metastases.
9. Describe and recognize the radiographic and CT findings of malignant mesothelioma.
10. Describe the difference in appearance of a pulmonary abscess and an empyema on chest CT and how the two are differently managed.
11. Distinguish pleural from ascitic fluid on chest CT.

Infection and Immunity:

1. Describe the radiographic manifestations of primary pulmonary tuberculosis. Name the most common segmental sites of involvement for postprimary tuberculosis in the lung. Define a Ghon lesion (calcified pulmonary parenchymal granuloma) and Ranke complex (calcified node and Ghon lesion); recognize both on a chest radiograph and CT and describe their significance.
2. Name and describe the types of pulmonary aspergillus disease.
3. Identify an intracavitary fungus ball on chest radiography and CT.
4. Describe the radiographic appearances of cytomegalovirus pneumonia. Name the major categories of disease causing chest radiograph or CT abnormalities in the immunocompromised patient.
5. Other than bacterial infection, name two important infections and two important neoplasms to consider in patients with AIDS and chest radiograph or CT abnormalities.
6. Describe the chest radiograph and CT appearances of Pneumocystis carinii (jiroveci) pneumonia
7. Name the four most important etiologies of hilar and mediastinal lymphadenopathy in patients with AIDS.
8. Describe the time course and chest radiographic appearance of a blood transfusion reaction.
9. Describe the radiographic appearances of mycoplasma pneumonia.
10. Describe the chest radiographic and CT appearance of a miliary pattern and provide a differential diagnosis.
11. Name the diagnostic considerations in a patient who presents with recurrent or persistent pneumonias.

CHEST RADIOLOGY (*continued*)

12. Name the endemic mycoses and the specific geographic regions where they are found, and describe their radiographic manifestations.
13. Name the most common pulmonary infections seen after solid-organ (ie, liver, renal, lung, cardiac) and bone marrow transplantation.
14. Describe the chest radiographic and CT findings of posttransplant lymphoproliferative disorders.

Unilateral Hyperlucent Hemithorax:

1. Recognize a unilateral hyperlucent hemithorax on a chest radiograph or CT.
2. Identify the common causes for unilateral hyperlucent hemithorax on a chest radiograph.
3. Give an appropriate differential diagnosis when a hyperlucent hemithorax is seen on a chest radiograph, and suggest a specific diagnosis when certain associated findings are seen (ie, absence of a breast in a patient after mastectomy, absence of a pectoralis muscle in a patient with Poland syndrome, unilateral bullous disease/emphysema, or air trapping on expiration in a patient with Swyer-James syndrome or an endobronchial foreign body).

Congenital Lung Disease:

1. Name the components of pulmonary venolobar syndrome.
2. Recognize venolobar syndrome on a frontal chest radiograph, chest CT, and chest MRI, and explain the etiology of the retrosternal band of opacity seen on the lateral radiograph.
3. Recognize a mass in the posterior segment of a lower lobe on a chest radiograph and CT and suggest the possible diagnosis of pulmonary sequestration.
4. Describe the differences between intralobar and extralobar sequestration.
5. Recognize bronchial atresia on a chest radiograph and CT and name the most common lobes in which it occurs.

Pulmonary Vasculature:

1. Recognize enlarged pulmonary arteries on a chest radiograph and distinguish them from enlarged hilar lymph nodes.
2. Recognize enlargement of the central pulmonary arteries with diminution of the peripheral pulmonary arteries on a chest radiograph and suggest the diagnosis of pulmonary arterial hypertension.
3. Name five common causes of pulmonary arterial hypertension.
4. Recognize lobar and segmental pulmonary emboli on chest CT and chest MRI (including magnetic resonance angiography).
5. Define the role of ventilation-perfusion scintigraphy, chest CT, chest MRI/MRA, CT venography, and lower extremity venous ultrasound studies in the evaluation of a patient with suspected venous thromboembolic disease, including the advantages and limitations of each modality depending on patient presentation.
6. Describe the anatomy of and identify the right and left superior and inferior pulmonary veins on chest CT and MRI and the use of radiofrequency ablation of pulmonary veins for treatment of atrial fibrillation.
7. Recognize variations in pulmonary venous anatomy, such as a separate right middle lobe vein and common ostium of the left superior and inferior pulmonary veins.

Thoracic Aorta and Great Vessels:

1. State the normal dimensions of the thoracic aorta.
2. Describe the classifications of aortic dissection (De Bakey I, II, III; Stanford A, B) and implications for classification on medical versus surgical management.
3. Describe and recognize the findings of, and distinguish between each of the following on CT and MR:
 - aortic aneurysm
 - aortic dissection
 - aortic intramural hematoma
 - penetrating atherosclerotic ulcer
 - ulcerated plaque
 - ruptured aortic aneurysm
 - sinus of Valsalva aneurysm

CHEST RADIOLOGY (*continued*)

- subclavian or brachiocephalic artery aneurysm
 - aortic coarctation
 - aortic pseudocoarctation
 - pulsation artifact at aortic root
4. Recognize a right aortic arch and a double aortic arch on a chest radiograph, chest CT, and chest MRI.
 5. State the significance of a right aortic arch with mirror image branching versus with an aberrant subclavian artery.
 6. Recognize a cervical aortic arch on a chest radiograph and CT.
 7. Recognize an aberrant subclavian artery on chest CT.
 8. Recognize normal variants of aortic arch branching, including common origin of brachiocephalic and left common carotid arteries (“bovine arch”), and separate origin of vertebral artery from arch on CT and MRI/MRA.
 9. Define the terms aneurysm and pseudoaneurysm.
 10. Describe the cardiac anomalies commonly associated with aortic coarctation.
 11. Describe and identify the findings of Takayasu arteritis on chest CT and chest MRI.
 12. Describe the advantages and disadvantages of CT, MRI/MRA, and transesophageal echocardiography in the evaluation of the thoracic aorta.

Ischemic Heart Disease:

1. Describe the anatomy of the coronary arteries and identify the following on a coronary arteriogram, MRI, and CT:
 - right coronary artery
 - left main coronary artery
 - left anterior descending coronary artery
 - left circumflex coronary artery
 - obtuse marginal
 - diagonals
 - acute marginals
 - septal perforators
2. Describe the clinical significance of coronary arterial calcification on a chest radiograph.
3. Recognize coronary arterial calcification on CT and describe the current role of coronary artery calcium scoring with helical or electron beam CT.
4. Name the coronary artery that is usually diseased when there is papillary muscle dysfunction.
5. Describe the common acute complications of myocardial infarction, including left ventricular failure, myocardial rupture, and papillary muscle rupture, and recognize radiologic findings indicating each.
6. Describe the common late complications of myocardial infarction, including ischemic cardiomyopathy, left ventricular aneurysm, left ventricular pseudoaneurysm, coronary-cameral fistula, dyskinesis, and akinesis, and recognize radiologic findings indicating each.
7. Identify signs of left heart failure on a chest radiograph and CT.
8. Define ejection fraction, including the normal value for left ventricular ejection fraction.
9. Identify myocardial calcification on CT and describe the etiology and significance of this finding.
10. Describe the difference between a left ventricular aneurysm and pseudoaneurysm.
11. Define and identify myocardial bridging on CT.
12. Define the role of angiography, echocardiography, stress perfusion scintigraphy, chest CT, and chest MRI in the evaluation of a patient with suspected ischemic heart disease as well as stunned myocardium and hibernating myocardium versus areas of infarction, including the advantages and limitations of each modality.
13. Differentiate viable from nonviable myocardium on MRI.
14. Identify myocardial perfusion defects on MRI.
15. Calculate right and left ventricular volumes, including ejection fraction, stroke volume, end-diastolic volume, and end-systolic volume using MRI and CT.

CHEST RADIOLOGY (*continued*)

Myocardial Disease:

1. Define the types of cardiomyopathy (dilated, hypertrophic, restrictive) and list the common causes of each.
2. Define right ventricular dysplasia, describe the role of MRI in its diagnosis, and identify MRI findings that support the diagnosis.
3. Name the most common benign primary cardiac tumors, including myxoma, lipoma, fibroma, and rhabdomyoma.
4. Name the most common malignant primary cardiac tumors, including angiosarcoma, rhabdomyosarcoma, and lymphoma.
5. Distinguish cardiac tumor from thrombus on CT and MRI.
6. Name the most common malignancies to metastasize to the heart, and describe the appearance on a chest radiograph, chest CT and chest MR
7. Describe the advantages and disadvantages of echocardiography, CT, and MRI for evaluation of cardiomyopathy and cardiac tumors.
8. Recognize calcification of papillary muscles as distinct from myocardial calcifications and describe the significance of each.

Cardiac Valvular Disease:

1. Identify and describe the findings of each on a chest radiograph:
 - enlarged right atrium
 - enlarged left atrium
 - enlarged right ventricle
 - enlarged left ventricle
2. Describe and recognize the chest radiograph findings associated with each of the following valvular diseases:
 - mitral regurgitation
 - mitral stenosis
 - aortic regurgitation
 - aortic stenosis
 - tricuspid regurgitation
3. Recognize an enlarged ascending aorta and aortic valve calcification on a chest radiograph and suggest the diagnosis of aortic stenosis when these findings are present.
4. Recognize an enlarged left atrium, vascular redistribution, and mitral valve calcification on a chest radiograph and suggest the diagnosis of mitral stenosis when these findings are present.
5. State the most common etiologies of the following:
 - aortic stenosis
 - aortic regurgitation
 - mitral stenosis
 - mitral regurgitation
 - tricuspid regurgitation
 - pulmonary stenosis
6. Name the cardiac diseases associated with mitral annulus calcification
7. Identify endocarditis or complications of endocarditis on a chest radiograph, CT, and MRI.
8. Describe the advantages and disadvantages of echocardiography and MRI for evaluation of valvular heart disease.
9. Describe the pulse sequences and appropriate planes for evaluating cardiac valvular disease and making quantitative measurements including pressure gradients, regurgitant fractions, and valve areas.

Pericardial Disease:

1. Recognize pericardial calcification on a chest radiograph and CT and name the most common causes.
2. Describe and identify two chest radiographic signs of a pericardial effusion.
3. Name five causes of a pericardial effusion.
4. Describe and recognize the findings of each of the following on a chest radiograph, CT, and MR:
 - pericardial cyst
 - constrictive pericarditis
 - pericardial hematoma

CHEST RADIOLOGY (continued)

- pericardial metastases
- partial and complete absence of the pericardium
- pneumopericardium

5. Describe the role of MRI in diagnosing constrictive pericarditis and differentiating constrictive pericarditis from restrictive cardiomyopathy.

Congenital Heart Disease in the Adult:

1. Recognize increased vascularity and decreased vascularity on a chest radiograph and name the common causes of each.

2. Describe and recognize the following on a chest radiograph, CT, or MRI.

Heart disease presenting during adulthood:

- Left-to-right shunts and Eisenmenger physiology
- Atrial septal defect
- Ventricular septal defect
- Partial anomalous pulmonary venous connection
- Patent ductus arteriosus
- Coarctation of the aorta
- Tetralogy of Fallot and pulmonary atresia with ventricular septal defect
- Congenitally corrected transposition of the great arteries
- Persistent left superior vena cava
- Truncus arteriosus
- Ebstein anomaly
- Cardiac malposition, including abnormal situs
- Coronary artery anomalies
- Heart disease originally treated in childhood:
 - Coarctation of the aorta
 - Tetralogy of Fallot and pulmonary atresia with ventricular septal defect
 - Complete transposition of the great arteries
 - Truncus arteriosus
- Commonly performed surgical corrections for congenital heart disease

3. Define the role of angiography, echocardiography, chest CT, and chest MRI in the evaluation of an adult patient with congenital heart disease, including the advantages and limitations of each modality depending on patient presentation.

Monitoring and support devices—“tubes and lines”:

1. Describe and identify on chest radiography the normal appearance and complications associated with each of the following:

- endotracheal tube
- central venous catheter
- peripherally inserted central venous catheter
- pulmonary artery catheter
- feeding tube
- nasogastric tube
- chest tube
- intra-aortic balloon pump
- pacemaker generator and leads (including triple lead devices)
- automatic implantable cardiac defibrillator
- left ventricular assist device
- atrial septal defect closure device
- pericardial drain
- extracorporeal life support cannulae
- intraesophageal manometer, temperature probe or pH probe
- tracheal, bronchial or esophageal stent

CHEST RADIOLOGY *(continued)*

2. Explain how an intra-aortic balloon pump works.
3. Describe the venous anatomy and expected course of veins from the axillary vein to the right atrium relative to anatomic landmarks.
4. Recognize the difference between a skinfold and pneumothorax on a portable chest radiograph.

Postoperative thorax:

Identify normal postoperative findings and complications of the following procedures on chest radiography, CT, and MRI:

- wedge resection, lobectomy, pneumonectomy
- coronary artery bypass graft surgery
- cardiac valve replacement
- aortic graft
- aortic stent
- transhiatal esophagectomy
- lung transplantation
- heart transplantation
- lung volume reduction surgery

EMERGENCY RADIOLOGY

Radiology residents rotate through the Emergency Radiology (ER) Section during all four years of training. Over time, it is expected that residents progressively develop their abilities to interpret emergency and other urgent imaging studies.

The skills to formally interpret “after hours” neuroradiology, ultrasound, chest, abdomen, musculoskeletal, pediatric, nuclear and MRI exams are taught in each of their respective sections. However, the ER resident learns to provide prompt telephone consults, PACS notes, and, subsequently, concise and appropriate written reports for conditions that are commonly seen in an Emergency Radiology setting. When necessary, requested, and appropriate, triage of patient studies to other subspecialty residents or services is requested. In addition, at the end of the assigned time period, incomplete consultations are relayed in written form to the resident/faculty coming on duty.

First year Residents

First year residents are initially taught the practical clinical skills necessary to interpret emergency and other urgent CR examinations while serving on the wet desk during weekdays (8am-6pm), weekend days (8am-6pm), and short call (5pm-10pm) under faculty and/or senior resident supervision.

First year residents are required to successfully pass the Night Call Qualifying Examination before progressing to night Emergency Radiology requirements.

Objectives

Medical Knowledge

- Learn the basic principles of musculoskeletal, chest and abdominal radiology with an emphasis on normal anatomy and normal variants seen on CR exams.
- Learn the types and pathophysiology of injuries associated with acute trauma, as well as acute medical and surgical conditions.
- Develop skills in the interpretation of CR examinations of the chest, musculoskeletal and abdomen in the setting of acute trauma.
- Understand the basic physics of radiography and computed radiography.
- Learn the basic principles of interpreting the emergent Nuclear Medicine exams, e.g. V/Q, HIDA, GI bleed and cerebral blood flow studies.

Patient Care and Procedural Skills

- Learn how to promptly provide a preliminary interpretation of CR examinations and then review the preliminary interpretations with an attending radiologist. PACS notes provided for consultations should not be erased or altered once saved. If immediate changes are appropriate, a second note should be added.
- Recognize that significant subsequent changes from the preliminary note or report are to be considered “critical findings”. The radiology resident should promptly contact the appropriate referring physician and relay the amended final interpretation. In most instances, these critical findings are brought to weekly interesting case conferences for discussion and education.
- Learn when to request consultation from other radiology subspecialists and/or faculty on duty

Interpersonal and Communication Skills

- Learn the appropriate format for providing PACS notes and/or dictations of emergency reports using PowerScribe.
- Develop skills in providing telephone and personal consultations for house staff and other physicians on routine emergent imaging studies

Professionalism

- Learn how to interact professionally with attending Emergency physicians and radiologist on call in regard to emergent radiologic exams.

EMERGENCY RADIOLOGY (continued)

Second, Third, and Fourth Year Residents

Residents beyond the first year of supervised call who have successfully completed the Night Call Qualifying Examination are assigned to Emergency Radiology as follows:

- A. Wet Desk during weekdays during appropriate rotations (see Wet Desk) as designated by the Chief Resident monthly on an evenly distributed basis among all residents.
- B. Weekend and Holiday days according to monthly schedule as designated by Chief Resident.
- C. Night Float according to annual rotation schedule and curriculum from 5 pm to 12 am with accommodations for duty hours restrictions.
- D. Evening short call as needed.

Objectives

Medical Knowledge

- Develop a more detailed understanding of the basic pathology and pathophysiology of trauma, tumors, infections, and inflammatory diseases.
- Continue to develop skills in the interpretation of emergent studies begun in the first year.
- Learn the CT, US, and MR findings of acute/emergent diseases.
- Continue to expand knowledge of the anatomy, especially on cross-sectional imaging modalities.
- Learn to prepare and present cases in clinical conferences for QA, teaching, and management.

Patient Care and Procedural Skills

- Direct the choice of imaging modality and protocol emergent studies.
- Demonstrate the ability to identify those cases that require the additional expertise in assessment of imaging studies.
- Learn when to call an attending radiologist to provide expertise for complex CT, US, or fluoroscopic exams.
- Consult on Level 1 and Level 2 Trauma Emergencies to coordinate emergency radiologic exams and interpretations.
- Protocol and monitor CT, US, and MRI studies.
- Learn to set up and refine imaging protocols in CT and MRI based on specific clinical indications.
- Be able to modify imaging protocols based on identification of unexpected or novel findings at the time of scanning

Interpersonal and Communication Skills

- Provide emergent provisional interpretations of CR, CT scans and Ultrasound scans as needed
- Act as a consultant for house staff and attending physicians in the Emergency Department

Professionalism, System Based Practice, Practice Based Learning and Improvement

Same as for first year residents

Addendum:

Upon completion of all Emergency Radiology assignments, the graduating resident is expected to be knowledgeable in the Emergency Radiology Curriculum developed by American the Society of Emergency Radiology and Edited By R. A. Novelline, MD

EMERGENCY RADIOLOGY (continued)

Objective:

To define the content, structure for residents in Emergency Radiology

Medical Knowledge

- Central Nervous System
- Skull fractures
- Brain
- Extra-axial hemorrhages: subdural and epidural hematoma
- Parenchymal injuries: cortical contusion, gray matter, brainstem
- Subarachnoid hemorrhage, Vascular injuries
- Penetrating injuries
- Herniation syndromes
- Cerebral infarction: arterial infarction, venous infarction,
- Diffusion perfusion imaging appearance Non-traumatic hemorrhage
- Subarachnoid, parenchymal hemorrhage
- Central Nervous System infections
- Meningitis, abscess/cerebritis, subdural empyema
- Dural sinus thrombosis
- Reversible posterior leukoencephalopathy syndrome
- Pituitary apoplexy
- Face and Neck
- Facial fractures
- Orbital fractures: blow-out fracture
- Zygoma , Isolated arch, zygomatic complex
- Nasal fractures, naso-orbital-ethmoid fractures
- Frontal fractures
- Maxillary fractures: dentoalveolar, maxillary sagittal, LeFort
- Mandible fractures
- Ocular injuries: rupture, cellulitis
- Paranasal sinusitis

Spine

- Initial assessment issues = "Clearance" in the Emergency Department
- The evaluation of low-risk patients; high-risk patients (multitrauma), and patients with neurologic deficits
- Concept and assessment of instability
- Concept of: mechanism of injury, radiographic patterns, normal variants, frequent types of injuries
- Cervical Trauma
- Cranio-cervical / C1-C2
- Occipital condyle fracture
- Atlanto-occipital dislocation / subluxation
- Jefferson burst fracture, C1 - posterior arch
- Dens fracture, Hangman's fracture
- Anterior subluxation / whiplash syndromes
- Hyperextension sprain / spinal cord injury without radiographic abnormalities
- Wedge compression, spinous process fractures
- Burst compression, flexion tear drop fracture, facet dislocation
- Articular mass and transverse process fractures
- Corner avulsion fracture (extension teardrop)
- Laminar fractures
- Facet dislocation with fracture

EMERGENCY RADIOLOGY *(continued)*

Thoraco-lumbar trauma

- Compression fracture, burst fracture
- Chance fracture, complex fracture-dislocation
- Pathological fracture, traumatic injuries to intervertebral disks
- Osteomyelitis /discitis, epidural abscess

Chest

Chest trauma

- Rib fractures, sternal and manubrial fractures
- Hemothorax, mediastinal hemorrhage
- Pneumothorax and pneumomediastinum
- Pulmonary contusion, laceration, hematoma
- Tracheobronchial injury
- Esophageal tear, diaphragm injury
- Pulmonary embolism
- Acute pulmonary infections
- Aspiration pneumonia
- Airway foreign bodies Obstructive airway disease
- ARDS: near-drowning, fat embolism syndrome
- Esophageal rupture

Cardiovascular Emergencies

- Myocardium and Pericardium
- Myocardial infarction, laceration, contusion
- Pericardial effusion. tamponade, pneumopericardium
- Aorta laceration, dissection, aneurysm
- Pulmonary edema, various etiologies
- Pulmonary embolism

Abdomen

- Abdominal Trauma
- Hemoperitoneum and intraperitoneal fluid
- Hemodynamic status assessment
- Retroperitoneal hemorrhage
- Gas collections: intraperitoneal and retroperitoneal
- Active arterial extravasation on CT
- Splenic and liver injuries
- Gallbladder and biliary injuries
- Bowel and mesenteric injuries
- Pancreatic injuries
- Renal and adrenal injuries
- Bladder injuries: intraperitoneal and extraperitoneal
- Abdominal wall injuries and diaphragmatic hernias
- Non-traumatic Abdominal Emergencies
- Peritoneal cavity
- Ascities, peritonitis, abdominal abscess
- Liver and biliary tract
- Jaundice: obstructive and non-obstructive
- Cholecystitis, pancreatitis
- Urinary tract
- Urinary stones, infection
- Pyelonephritis, renal abscess
- Gastrointestinal tract

EMERGENCY RADIOLOGY (continued)

- Gastrointestinal hemorrhage
- Bowel obstruction, bowel infarction, bowel infection
- Appendicitis, diverticulitis, Infectious enteritis and colitis
- Inflammatory bowel disease: Crohn disease, ulcerative colitis
- Male Genitourinary emergencies
- Urethral and penile trauma, foreign bodies, stones
- Scrotal and testicular trauma
- Acute non-traumatic scrotal conditions
- Testicular torsion
- Epididymitis, Orchitis, Epididymo-orchitis
- Acute fluid collections (Hydrocele, hematocele, pyocele)
- Infarction, Fournier's Gangrene
- Abscess

Upper Extremity

Dislocations:

- Scapulothoracic, Clavicle
- Sternoclavicular, Acromioclavicular, Glenohumeral, elbow

Fractures:

- Scapular fractures
- Humerus fractures
- Proximal (head & neck), Shaft, Supracondylar, intra articular, including unicondylar, bicondylar and capitellar
- Forearm fractures, wrist

Pelvis and Hip

Pelvis

Fractures of isolated bones of the pelvis that do not involve the pelvic ring

- Iliac wing (Duvrney), sacrum, coccyx
- Avulsion: ant. sup. iliac crest apoph. - sartorius m
- ant. inf. iliac crest apoph. - rectus femoris m
- ischial tuberosity - hamstring ms
- lesser troch. apoph. (femur) - iliopsoas

Pelvic ring disruption. Disruption, i.e., fracture or diastasis at two or more sites, the anterior and posterior pelvic arcs

- Diffuse: open-book pelvic ring disruption
- Vertical shear
- Types of pelvic ring disruption
- Malgaigne (ipsilateral)
- Open - book
- Insufficiency fractures, Stress fractures
- Acetabular fractures (Involve only one side of the pelvic ring.)
- Posterior column (most common) rim, anterior column, both columns

Hip

Dislocation

- Posterior or posterosuperior pure fracture-dislocation. Fracture involves posterior or posterosuperior acetabular rim
- Anterior (obturator)

Fractures (usually associated with dislocation).

- Posterior or posterosuperior acetabular rim
- Anterior (Involve the acetabular "tear-drop")

Proximal femur

- Slipped capital femoral epiphysis (SCFE)

EMERGENCY RADIOLOGY (continued)

- Salter-Harris physeal injuries
- Fractures
- Head - usually associated with hip dislocation
- Neck - subcapital, transcervical, basicervical
- Trochanteric, intertrochanteric
- subtrochanteric, isolated fracture, greater trochanter
- Avascular necrosis

Lower Extremity

Fractures:

- Femoral shaft, Patella fractures Tibial plateau, Tibial spine avulsion
- Tibial stress fractures, tibial and fibular shaft fractures
- Tibial plafond fracture (pilon fractures), ankle mortise injury,
- Tarsal fractures, metatarsal fractures, Toe fractures
- Cruciate and other ligamentous injuries of the knee, Meniscus tears
- Achilles tendon and ligamentous injuries of the ankle
- Knee dislocations, Tarso-metatarsal fracture dislocations (Lisfranc's fracture)
- Septic arthritis, Diabetic foot infections
- Compartment syndrome

MAGNETIC RESONANCE IMAGING

Each first year resident completes a 4-week block as an introduction to MRI. Otherwise MRI training and experience is included in most of the other rotations (abdomen, chest, ER, pediatric, neuroradiology, musculoskeletal, and mammography). The following outline presents the goals and objectives for the introductory rotation.

First Rotation Goals

- Understand the principles of Magnetic Resonance Imaging
- Demonstrate ability to identify life-threatening findings, particularly with aortic aneurysms and grafts
- Provide emergent provisional interpretation as needed
- Demonstrate ability to direct the choice of imaging modality and protocol emergent studies

Objectives

Medical Knowledge

- Understand the basic physics of MR including TR, TE, T1W, T2W, Spin echo, Gradient Recall Echo imaging, and Inversion Recovery.
- Identify the MR appearance of emergency conditions:

Patient Care and Procedural Skills

- Understand the principle of a saline chaser.
- Learn to recognize and treat contrast reactions.
- Protocol and monitor MR studies. Modify protocols when appropriate

MAGNETIC RESONANCE IMAGING (*continued*)

Practice-Based Learning and Improvement

- Learn the basic principles of contrast distribution, particularly as applied to arterial and venous phase scanning

Interpersonal and Communication Skills

- Develop skills in interpretation of basic MR pathology.
- Learn the appropriate format for dictation of MR reports.

Body MR suggested Reading:

1. Abdominal-Pelvic MRI. Semelka. Wiley-Liss. 2002
2. Body MRI. Siegelman. Saunders. 2005
3. Clinical Magnetic Resonance Imaging. Saunders. 3rd Edition. 2006
4. CT and MRI of the Abdomen and Pelvis: A Teaching File. Ros. Williams and Wilkins. 1997
5. Magnetic Imaging Review. Lippincott Williams. Wheeler. March 1996
6. Magnetic Resonance Imaging. Stark. Mosby. 1999
7. Magnetic Resonance Imaging of the Body. Higgins. November 1996.
8. Pocket Atlas of MRI Body Anatomy. Berquist. August 1995.
9. Primer on MR Imaging of the Abdomen and Pelvis. Martin. Wiley. 2005.
10. Sectional Anatomy by MRI. 2nd Edition. El-Khoury. Churchill-Livingstone. 1995.
11. Variants and Pitfalls in Body Imaging. Shirkhoda. Lippincott. 1999.

MRI Physics:

1. How does MRI Work? Weishaupt. Springer. 2003.
2. Magnetic Resonance Imaging: Physical Principles and Sequence Design. Haacke. Wiley. 1999.
3. MRI Principles. Mitchell and Cohen. Saunders. 2004.
4. MRI: The Basics. Hashemi. Lippincott Williams. Sept 2003.
5. Questions and Answers in Magnetic Resonance Imaging. Elster. Mosby. 2001.

MAMMOGRAPHY

The breast imaging rotation includes three 4-week rotations in mammography, breast ultrasound, breast MRI and breast interventions. Residents are required to document interpretation of at least 240 mammographic examinations during the last two years of their residency within a 6-month period. A total of 300 mammographic examinations are the ACGME required minimum numbers that need to be met during Residency.

FIRST 4-WEEK ROTATION (2ND YEAR)

Goals 1

Medical Knowledge, Patient Care and Procedural Skills, Interpersonal and Communications Skills, Practice-based Learning and Improvement, Professionalism, Systems-based Practice.

After completion of the first breast imaging rotation, the resident will be able to:

- Demonstrate learning of the knowledge-based objectives.
- Demonstrate a responsible work ethic.
- Obtain pertinent patient information.
- Understand standard mammographic positioning and mammographic quality assurance.
- Accurately and concisely dictate mammography and breast ultrasound reports.
- Understand the indications and technique of dual-energy x-ray absorptiometry (DEXA).
- Accurately and concisely dictate DEXA reports
- Communicate effectively with referring clinicians and supervisory staff.

Objectives 1

Medical Knowledge 1

1. At the end of the first breast imaging rotation, the resident will demonstrate learning at least one third of the knowledge-based objectives (see Addendum), primarily those related to normal anatomy, mammographic imaging, screening mammography, and BIRADS classification
2. Demonstrate knowledge of “ACR Practice Guidelines:
 - Performance of Screening Mammography,
 - Performance of Diagnostic Mammography,
 - Breast Ultrasound Examination,
 - ACR BI-RADS® lexicon terms for mammography and ultrasound.
 - Mammographic quality assurance
3. Demonstrate knowledge of:
 - Indications of DEXA in the diagnosis of osteoporosis and assessment of fracture risk,
 - Use of DEXA in monitoring of bone mineral density (BMD).
 - Performance and technique of DEXA
 - DEXA analysis and reporting.

Patient Care and Procedural Skills 1

1. Obtain relevant patient history from electronic records, dictated reports, or by communicating with referring clinicians.
2. Demonstrate knowledge on mammographic positioning and clinical image assessment.
3. Demonstrate knowledge on DEXA technique and result assessment.
4. Demonstrate proficiency in
 - Understanding the principles of quality DEXA scan acquisition, analysis and interpretation
 - Understanding the diagnosis of osteoporosis

- the assessment of fracture risk
- monitoring BMD change over time
- the interpretation and reporting of DEXA scans

Interpersonal and Communication Skills 1

1. Dictate accurate mammography reports.
2. Dictate accurate DEXA reports.
3. Communicate with ordering physicians about all significant or unexpected imaging findings and document who was called and the date and time of the call.

Practice-Based Learning and Improvement 1

1. Present at least one case at Bi-monthly resident breast imaging conference.
2. Residents are expected to place one case into the teaching file, each rotation with references to indicate understanding of evidence-based medicine.

Professionalism 1

- Perform the required quality control for the mammography reading workstation.
- Arrive for the rotation assignment on time and prepared after reviewing recommended study materials.

MAMMOGRAPHY (continued)

SECOND 4-WEEK ROTATION (3RD YEAR)

Goals 2

Professionalism, Medical Knowledge, Interpersonal and Communications Skills, Systems-based Practice, Practice-based Learning and Improvement.

After completion of the second breast imaging rotation, the resident will be able to:

- Demonstrate learning of the knowledge-based objectives.
- Continue to build on mammography and breast ultrasound interpretative skills.
- Develop skills in interpreting breast MRI examinations.
- Develop skills in breast interventional procedures.
- Communicate effectively with referring clinicians and supervisory staff.
- Participate in quality improvement/quality assurance and other operational activities.

Objectives:

In addition to the objectives in Rotation 1

Medical Knowledge 2

1. At the end of the second breast imaging rotation, the resident will demonstrate learning of at least two thirds of the knowledge-based objectives (see Addendum).
2. Demonstrate thorough understanding of “ACR Practice Guidelines:
 - ACR BI-RADS® lexicon terms for MRI.
 - Performance of MRI of the Breast,
 - Performance of Ultrasound-Guided Breast Interventional,
 - Performance of Stereotactically Guided Breast Interventional Procedures

Interpersonal and Communication Skills 2

1. Demonstrate proficiency in producing breast imaging reports.
2. Demonstrate proficiency in producing DEXA reports.

Practice-Based Learning and Improvement 2

1. Participation in Bi-monthly resident breast imaging conference.
2. Residents are expected to place one case into the teaching file, each rotation with references to indicate
3. understanding of evidence-based medicine.

MAMMOGRAPHY (continued)

THIRD 4-WEEK ROTATION (4TH YEAR)

Goals 3

Medical Knowledge, Interpersonal and Communications Skills, Practice-based Learning and Improvement Skills

After completion of the third breast radiology rotation, the resident will be able to:

1. Demonstrate thorough learning of the entire knowledge-based objectives.
2. Refine skills in interpretation of mammography, breast ultrasound and MRI examinations.
3. Correlate pathologic and clinical data with mammographic, ultrasound and MRI findings.
4. Refine skills in interpretation of DEXA examinations.
5. Become a more autonomous consultant and teacher.

Objectives 3 (In addition to those in Rotations 1 and 2)

Medical Knowledge 3

- At the end of third breast radiology rotation, the resident will demonstrate thorough learning of all of the knowledge-based objectives (see Addendum)

Communications 3

- Dictate accurate, concise mammography, breast ultrasound and breast MRI reports with no major interpretative errors
- Dictate accurate, concise DEXA reports with no major interpretative errors
-

Patient Care 3

- Demonstrate the ability to safely perform breast interventional procedures
- Demonstrate the ability to effectively present interesting or quality assurance cases at weekly case conference to other residents

Systems-Based Practice 3

- Work in the reading room independently, assisting clinicians with radiologic interpretation, and teaching other residents and medical students assigned to breast imaging

Practice-Based Practice 3

- Present Bi-monthly resident breast conference with faculty in attendance.
- Residents are expected to place one case into the teaching file, each rotation with references to indicate understanding of evidence-based medicine.
- In collaboration with a pathologist, present an interesting breast imaging case, with a confirmed diagnosis, correlating clinical history with pathologic and radiologic findings, to residents and faculty.

ADDENDUM

Knowledge-Based Objectives (adapted from guidelines of American College of Radiology/Society of Breast Imaging Curriculum for Resident Education)

Anatomy, physiology, and pathology:

1. Normal breast anatomy and histology; alteration with age, pregnancy, menstrual cycle, and hormonal effects; male breast anatomy; breast development
2. Pathologic appearance and clinical significance of
 - Benign breast lesions
 - Recognize benign processes in the breast
 - Recognize and understand management of breast abscess
 - Recognize benign processes in the male breast
 - Atypical ductal hyperplasia, atypical lobular hyperplasia, lobular carcinoma in situ, and other histologic risk factors
 - Ductal carcinoma in situ, including its histologic subtypes.
 - Invasive ductal carcinoma not otherwise specified; Subtypes of invasive ductal carcinoma (mucinous, medullary, papillary, tubular); invasive lobular carcinoma
 - Other types of breast cancer, such as Paget's disease and inflammatory carcinoma
 - Other malignancies involving the breast, including phyllodes tumor, lymphoma, leukemia, sarcomas, and metastases
3. Pathologic and histologic grading
4. Multifocal and multicentric carcinoma
5. Margin analysis for specimens containing malignancy.

Epidemiology:

1. Risk factors for breast cancer
2. Indications for genetic screening
3. Breast cancer incidence and mortality, including longitudinal trends
4. Breast cancer staging and survival rates by stage

Mammographic equipment and technique:

1. Both screen-film and full-field digital mammography
 - Features of dedicated mammographic units, including target, filtration, automatic exposure control, and grids
 - Factors affecting optical density, contrast, sharpness, and noise
 - Selection of technique factors: including effects of milliampere-seconds, kilovolt peak, target and filter material choice, and density settings on image quality and radiation dose
 - Effect of breast thickness and composition on technique, image quality, and radiation dose
 - Mammographic positioning for craniocaudal and mediolateral oblique views
 - Mammographic positioning for women with breast implants
 - Rationale for breast compression
 - Clinical image assessment for proper breast positioning, compression, exposure, contrast, sharpness, and noise
2. Full-field digital mammography
 - Characteristics of full-field digital mammographic systems, including advantages and limitations
 - Effects of postprocessing on the digital mammographic image
 - Effect of signal-to-noise ratio on radiation dose
 - Dedicated high-luminance, high-resolution viewing monitors.

- ACR Practice Guideline for the Performance of Whole Breast Digital Mammography
3. Digital Breast tomosynthesis
 - Characteristics of breast tomosynthesis
 - Advantages and limitations of breast tomosynthesis

Mammography quality assurance:

1. Familiarity with content in the ACR Mammography Quality Control Manual
2. Purpose and frequency of performance of quality control tests performed by the technologist and physicist
3. Demonstrate proficiency in recognizing the mammographic appearance of artifacts for both screen-film and digital mammography
4. Regulation
 - Equipment, quality control, and personnel (radiologist, technologist, physicist) requirements for ACR accreditation and MQSA certification
 - Responsibilities of the lead interpreting physician
5. Medical audit
 - Audit definitions as provided by BI-RADS®
 - Desirable goals and benchmarks for standard outcome parameters, for both screening and diagnostic mammography
 - Auditing requirements for MQSA certification

Mammographic interpretation:

1. Optimal viewing conditions, including a low ambient light environment
2. Demonstrate proficiency in
 - Recognizing normal mammographic anatomy
 - Recognizing the mammographic features of characteristically benign and suspicious breast calcifications
 - Recognizing the mammographic features of characteristically benign and suspicious breast masses
 - Recognizing the mammographic appearance of indirect signs of malignancy (architectural distortion, asymmetries, etc)
 - Recognizing the mammographic features of the surgically altered breast, including implants
 - Recognizing the mammographic features of probably benign (BI-RADS® category 3) lesions
3. Principles, methods, strengths, and pitfalls of computer-aided detection and double reading

Screening mammography:

1. Randomized clinical trials, case-control studies, service-screening studies: purpose, methods, results
2. Pitfalls in evaluating screening results: lead-time bias, length-bias sampling, selection bias, prevalence vs incidence screening, interval cancer rate, survival rates
3. Relative screening efficacy of clinical breast examination, breast self-examination, and mammography
4. Benefit-risk assessment, including radiation risk and false-positive results
5. Cost-effectiveness
6. Controversies regarding screening women aged 40 to 49 years; younger than age 40
7. Screening guidelines of the ACR, the American Cancer Society, the National Cancer Institute, the US Preventive Services Task Force, and others
8. Logistics and throughput issues in the performance and interpretation of screening mammography examinations
9. ACR Practice Guideline for the Performance of Screening Mammography

Diagnostic (problem-solving) mammography:

1. Techniques and indications for and value of supplementary mammographic views
2. Demonstrate proficiency in
 - Performing the workup of lesions seen on only 1 standard (mediolateral oblique or craniocaudal) screening view
 - Three-dimensional lesion localization
 - Correlation of palpable with imaging findings
 - Evaluation and management of a palpable mass (or other focal symptoms) when there are no associated mammographic findings
 - Assessment of extent of disease for suspicious and for known-malignant lesions
3. ACR Practice Guideline for the Performance of Diagnostic Mammography

Breast ultrasound:

1. Equipment and physical principles
2. Techniques
3. Indications
4. Demonstrate proficiency in
 - Scanning the breast
 - Recognizing normal sonographic anatomy
 - Recognizing features of simple cysts, complicated cysts, complex masses
 - Recognizing differential features of benign and malignant solid masses
 - Correlation with findings at mammography and clinical breast examination
5. Limitations in the detection and assessment of microcalcifications
6. Controversies regarding the role of screening whole breast ultrasound examination
7. ACR Practice Guideline for the Performance of a Breast Ultrasound Examination
8. ACR Breast Ultrasound Accreditation Program

Breast MRI:

1. Equipment and physical principles
2. Techniques
3. Indications
4. Strengths and limitations of kinetic and morphologic analysis
5. Demonstrate proficiency in
 - Recognizing normal MRI anatomy
 - Recognizing differential features of benign and malignant masses
 - Recognizing differential features of benign and malignant non-mass-like enhancement
 - Evaluating implant integrity
 - Correlation with findings at mammography, ultrasound, and clinical breast examination
6. Limitations in the detection and assessment of lesions presenting as microcalcifications
7. Controversies regarding the role of screening breast MRI examination
8. ACR Practice Guideline for the Performance of MRI of the Breast

Reporting and medicolegal aspects of breast imaging:

1. Demonstrate proficiency in producing breast imaging reports, including
 - ACR BI-RADS® lexicon terms for mammography, ultrasound, and MRI
 - Lesion location
 - Categorization of breast composition (BI-RADS® breast density descriptors)
 - Final assessment categories (ACR BI-RADS®; MQSA regulatory requirements)
 - Management recommendations
 - Concordance between lesion descriptors and assessment categories

- Concordance between assessment categories and management recommendations
- 2. MQSA regulatory requirements for reporting mammography results to referring clinician and patient
- 3. Medicolegal aspects of all breast imaging and interventional procedures
- 4. Understanding the supervisory responsibility for approving the technical quality of a given examination
- 5. Communication issues and follow-up of abnormal findings
- 6. Informed consent for invasive procedures

Interventional procedures:

1. Principles, indications and contraindications, equipment, preparation, technique, advantages, disadvantages, accuracy, and auditing for
 - Pre-operative radioactive seed localization guided by mammography and ultrasound
 - Ultrasound-guided core biopsy (also fine-needle aspiration, if available)
 - Stereotactically guided core biopsy (also fine-needle aspiration, if available)
 - Ultrasound-guided cyst aspiration
 - Second-look ultrasound to substitute ultrasound guidance for MRI guidance
 - MRI-guided core biopsy and preoperative localization
 - Use and limitations of using markers to indicate the site of percutaneous biopsy
 - Specimen radiography, including paraffin block radiography
 - Galactography
2. Assessment of imaging-pathologic concordance
3. Postprocedure follow-up imaging
4. ACR Practice Guideline for the Performance of Ultrasound-Guided Breast Interventional Procedures
5. ACR Practice Guideline for the Performance of Stereotactically-Guided Breast Interventional Procedures
6. ACR Ultrasound-Guided Breast Biopsy Accreditation Module (part of the ACR Breast Ultrasound Accreditation Program)
7. ACR Stereotactic Breast Biopsy Accreditation Program

Therapeutic and management considerations:

1. Basic understanding of breast cancer treatment options
2. Role of breast imaging in planning and monitoring of breast cancer treatment and post treatment follow-up
3. ACR Practice Guideline for the Management of Ductal Carcinoma In-Situ of the Breast
4. ACR Practice Guideline for Breast Conservation Therapy in the Management of Invasive Breast Carcinoma
5. ACR Appropriateness Criteria™ for breast microcalcifications, nonpalpable breast masses, palpable breast masses, stage I breast carcinoma

Economics of breast imaging practice:

1. Basic understanding of coding and billing
2. Revenue positive, revenue neutral, and revenue negative breast imaging examinations
3. Strategies to improve the profitability of a breast imaging practice

Dual energy x-ray absorptiometry:

1. Equipment and physical principles
2. Techniques of DEXA scan acquisition
3. Indications of DEXA in the diagnosis of osteoporosis, assessment of fracture risk and monitoring BMD change over time

4. Interpretation and reporting of DEXA scans
5. Variations in analysis

MAMMOGRAPHY (continued)

Study Materials

1. D'Orsi CJ, Sickles EA, Mendelson EB, Morris EA, et al. ACR BI-RADS® Atlas, Breast Imaging Reporting and Data System. Reston, VA, American College of Radiology; 2013
2. Debra Ikeda, Kanae Kawai Miyake, Breast Imaging: The Requisites, 3e, Mosby, St Louis, 2016
3. Gilda Cardenosa. Breast Imaging Companion. 4th Edition
4. Breast Ultrasound, Stavros T, Rapp CL, Parker SH, 1e, Lippincott, Williams & Wilkins, New York
5. Breast MRI: Diagnosis & Intervention, Morris E, Liberman L, 1e, Springer, New York, 2005
6. Krugh M, Langaker MD. Dual Energy X-ray Absorptiometry. [Updated 2022 Jun 11]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK519042/>
7. Choplin, R.H., Lenchik, L. & Wuertzer, S. A Practical Approach to Interpretation of Dual-Energy X-ray Absorptiometry (DXA) for Assessment of Bone Density. *Curr Radiol Rep* 2, 48 (2014). <https://doi.org/10.1007/s40134-014-0048-x>
8. Breast Imaging: The Requisites, Ikeda D, 2e, Mosby, St Louis, 2011
9. Breast Cancer: The art and science of early detection with mammography, Tabar L, Tot T, Dean PB, 1e, Thieme, New York, 2005
10. Breast Ultrasound, Stavros T, Rapp CL, Parker SH, 1e, Lippincott, Williams & Wilkins, New York
11. Breast MRI: Diagnosis & Intervention, Morris E, Liberman L, 1e, Springer, New York, 2005

MUSCULOSKELETAL

The musculoskeletal radiology rotation includes 4 four-week block rotations, one in each year of residency. The VA rotation is focused on integrating multimodality skills of the more advanced Radiology resident after the Program Director has determined the Radiology Resident is sufficiently prepared to address integration of Multimodality Imaging studies of increasing complexity.

Rotation 1-first year

Goals 1

After completing the first four-week rotation in musculoskeletal radiology, the resident will be able to:

- Demonstrate learning of knowledge based objectives and mastery of technical objectives for the first rotation
- Generate accurate and concise consultative reports
- Communicate effectively with patients, referring clinicians, technologists and supervisory staff
- Understand pertinent standard radiographic positioning and anatomy
- Obtain essential patient information pertinent to the radiologic examination
- Demonstrate knowledge of clinical indications for radiography and indications for urgent computed tomography (CT) and magnetic resonance (MR) examinations
- Demonstrate a responsible work ethic
- Participate in quality improvement/ quality assurance activities
- Participate in the education of students and interns

Objectives 1

Medical Knowledge 1

- Demonstrate learning of normal radiographic and CT anatomy of the axial and appendicular skeleton.
- Demonstrate learning of normal MRI anatomy of the
 - knee and shoulder
- Recognize and accurately describe common fractures and dislocations of the appendicular skeleton
- Demonstrate pathophysiology and radiologic appearance of fracture healing and complications of healing such as delayed union, malunion, and nonunion
- Demonstrate learning of radiographic presentation and evaluation of:
 - osteomyelitis and septic arthritis
- Recognize and describe complications of orthopedic devices including fracture fixation and arthroplasty hardware

Communication 1

- Dictate clear, detailed, and accurate reports that include all pertinent information as established in the American College of Radiology (ACR) Guidelines for Communication⁴
- Use appropriate nomenclature when reporting radiographic, CT, MR or ultrasound (US) findings of musculoskeletal disease

Patient Care and Procedural Skills 1

- Communicate all unexpected or significant findings to the ordering provider and document whom was called and the date and time of the discussion in the report
- Obtain relevant patient history from electronic records, dictated reports, the patient, or by communication with referring provider
- Recognize and describe positioning and anatomy of standard radiographic examinations of the musculoskeletal system

MUSCULOSKELETAL (*continued*)

Systems-Based Practice 1

- Effectively provide feedback to radiology technologists regarding quality of exposure and patient positioning
- Participate in discussions with faculty and staff regarding operational challenges and potential system solutions regarding all aspects of radiologic services and patient care
- Recognize when it is appropriate to obtain help from senior residents or faculty when assisting referring clinicians

Professionalism 1

- Demonstrate responsible, ethical behavior; positive work habits; and professional appearance
- adhere to principles of patient confidentiality

Rotation 2-Second Year

Goals 2

After completing the second four-week rotation in musculoskeletal radiology, the resident will be able to:

- Demonstrate learning of knowledge based objectives and mastery of technical objectives for the second rotation
- Continue to build and improve on skills developed during the first rotation
- Develop skills in assigning protocols and monitoring CT and MR examinations
- Demonstrate an understanding of the ACR Appropriateness Criteria⁵ and ACR Practice Guidelines and Technical Standards for musculoskeletal imaging⁶
- Participate in the education of junior residents, interns, and medical students

Objectives 2

Medical Knowledge 2

- Recognize and describe the radiographic presentation of:
 - Paget disease
- Demonstrate knowledge of a systematic approach to arthritis. Be able to describe and differentiate salient radiologic (radiographic, CT and MR) features of common arthropathies including
 - Osteoarthritis.
 - Inflammatory arthropathies (rheumatoid, psoriatic, reactive, juvenile, chronic, and septic).
 - Crystal deposition diseases (calcium pyrophosphate deposition, gout, hydroxyapatite deposition).
 - Neuropathic arthropathies.
 - Connective tissue diseases (systemic lupus erythematosus, scleroderma, dermatomyositis).
 - Pigmented villonodular synovitis.
 - Synovial chondromatosis.
- Demonstrate a systematic assessment of bone lesions:
 - Be able to categorize the lesion as aggressive or nonaggressive.
 - Develop an appropriate differential diagnosis based on patient age, lesion location, and lesion characteristics (margin, matrix, periosteal reaction, soft tissue extension).
 - Demonstrate knowledge of systematic, safe and cost effective radiologic work-up of bone lesions including biopsy approach and compartmental anatomy.

MUSCULOSKELETAL (*continued*)

- Recognize and describe common locations and radiologic manifestations of osteonecrosis
- Demonstrate knowledge of MRI safety issues including contraindication to scanning and use of contrast
- Demonstrate learning of the use of various pulse sequences and planes of imaging used in MRI of musculoskeletal disorders
- Demonstrate learning of common knee and shoulder pathology on MRI:
 - Meniscal Tear
 - Tendon and Ligament Injury
 - Fracture
 - Chondral Disease
 - Rotator Cuff Tear
 - Labral Pathology
- Demonstrate learning of the normal MRI anatomy:
 - Hip and ankle

Patient Care and Procedural Skills 2

- Build and improve on skills acquired during first rotation
- Demonstrate the ability to gather essential and accurate patient information (electronic, personal communication) to appropriately prescribe MRI protocols
- Demonstrate ability to monitor CT and MRI examinations to ensure the patient is adequately evaluated
- Demonstrate an understanding of indications, contraindications, needle path, risks and post procedural management of CT and US guided procedures including management of complications
- Safely perform fluoroscopically guided joint injections and aspirations with faculty supervision
- Demonstrate an ability to counsel a patient and obtain informed consent before performing a procedure, including a description of the procedure, risks, benefits, and alternatives

Professionalism 2

- solicit and respond to patient questions without discrimination based on religious, ethnic, sexual, economic, or educational differences

Practice-Based Learning and Improvement 2

- Maintain a log of all procedures performed including complications

Systems-Based Practice 2

- Provide effective and timely feedback and education to CT and MRI technologists regarding quality of examinations
- Provide technical and educational guidance to junior residents and students

Professionalism 2

- Solicit and respond to patient questions without discrimination based on religious, ethnic, sexual, economic, or educational differences
- Demonstrate responsible, ethical behavior; positive work habits; and professional appearance; and adhere to principles of patient confidentiality

MUSCULOSKELETAL (*continued*)

ROTATION 3 & 4 THIRD YEAR AND FOURTH YEAR (to be expanded by Dr. Laks)

Goals 3

After completing the third and fourth year four-week rotation in musculoskeletal radiology, the resident will be able to:

- Demonstrate learning of knowledge based objectives and mastery of technical objectives for the third rotation
- Continue to refine skills developed during the first two rotations
- Effectively use information technology to address clinical problems
- Participate in the education of junior residents and medical students
- Become a more independent provider of musculoskeletal radiologic interpretive services
- Manage clinical and technical questions from technical and support staff

Objectives

Medical Knowledge 3-4

- Recognize radiologic findings and describe pathophysiology of MSK findings in endocrine diseases including:
 - Hyperparathyroidism,
 - Renal Osteodystrophy
 - Osteomalacia/Rickets
 - Hypophosphatasia
 - Hypophosphatemia
- Recognize radiologic findings of hematopoietic and storage diseases including:
 - Sickle cell anemia
 - Thalassemia
 - Mastocytosis
 - Gaucher's disease
- Demonstrate systematic approach to relatively common dysplasias and congenital conditions such as:
 - Achondroplasia
 - Osteogenesis imperfecta
 - Osteopetrosis
- Demonstrate learning of common pathology:
 - Hip and ankle MRI
- Demonstrate learning of anatomy and common injuries/pathology:
 - Elbow and wrist MRI

Patient Care and Procedural Skills 3-4

- Improve and build on skills acquired during the first two rotations
- Demonstrate the ability to assess and prioritize requests for add-on procedures
- Demonstrate the ability to teach a junior colleague how to protocol examinations and plan procedures

Practice-based Learning and Improvement 3-4

- Demonstrate the ability to locate, appraise and assimilate evidence from scientific studies related to the performance and interpretation of musculoskeletal imaging

MUSCULOSKELETAL *(continued)*

Systems-Based Practice 3-4

- Demonstrate the ability to answer common procedural and policy questions from technologists and support staff

Interpersonal and Communication Skills 3-4

- Demonstrate ability to lead work rounds and interdepartmental MSK conferences with faculty attendance

References

1. American College of Radiology. ACR Practice Guideline for Communication of Diagnostic Imaging Findings. Available online at http://www.acr.org/s_acr/bin.asp?CID=541&DID=12196&DOC=FILE.PDF. Accessed 9/06/06.
2. American College of Radiology. ACR Appropriateness Criteria: Expert Panel on Musculoskeletal Imaging. Available online at http://www.acr.org/s_acr/sec.asp?CID=1206&DID=15047. Accessed 9/06/06.
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4. VIDEOS/STAT DX/STOLLERS

NEURORADIOLOGY

Division Chief: Thomas J. O'Neill MD

Revised 2023-07-13

Goals

Residents rotate through Neuroradiology during all four years of training. Selective opportunities are also available in the fourth year. Over this time, it is expected that residents will progressively develop their abilities to perform and interpret imaging studies of the central nervous system and develop the skills to competently perform basic neuroradiology image-guided procedures. Protocoling orders involves understanding the clinical context of the patient, appropriately directing the ordering provider and imaging technologist to perform the most appropriate scan for the patient. Residents will be taught the practical clinical skills necessary to interpret plain radiographs, CT scans, and MRI exams of 1) brain and skull; 2) spinal cord and vertebral column and; 3) head and neck. (Patient Care and Procedural Skills) They will be instructed in the performance and interpretation of invasive procedures including cerebral angiography, myelography/spinal canal puncture, spine interventional pain procedures, and imaged-guided biopsies of the spine and skull base. (Practice-based Learning and Improvement). Intravascular interventional procedures will also be covered during the Vascular and Interventional rotations. The goals and objectives listed below are, therefore, outlined by level of training. The residents will receive instruction in the science that underlies clinical neuroradiology, in particular neuroanatomy and neuropathology. They will learn the physical principles of CT, MR, conventional radiography, and angiography. (Medical Knowledge) They will learn the relative value of each modality, enabling to them to choose the appropriate study and the appropriate protocol for each patient. (Systems-based Practice)

It is expected that residents will participate in the performance of examinations done by the section. Residents will protocol and monitor CT and MR exams after they have demonstrated a sufficient level of knowledge and experience to perform these tasks. Residents will aid in the performance of invasive procedures including myelograms, spinal taps and vertebral biopsies. (Practice-based Learning and Improvement) They will learn to explain these procedures to the patients and their families obtain pre-procedure consent and write pre- and post-procedure orders. (Interpersonal and Communication Skills, Professionalism) They will learn to recognize and treat complications of these invasive procedures. (Practice-based Learning and Improvement) The residents will learn to dictate concise and appropriate radiographic reports and to serve as consultants to referring physicians. (Interpersonal and Communication Skills).

Expectations for All Rotations:

Rotation Time & Location:

- Day start: 07:30AM
- Day end: 05:00PM
- Location: CSB Basement Neuroradiology Reading Room

Daily and Logistical responsibilities:

- Receive and resolve questions and phone calls from providers and technologists—trainee assigned to protocolling duty is primary point of contact responsible for handling these inquiries.
- Attend mandatory conferences
- Check daily every morning with UMC Lead Fluoroscopy Technologist and UMC IR coordinator for procedure requests and review those requests with the attending
- Draft dictations on neuroradiology studies on studies in priority defined by the worklist or as directed by the attending
- Prelim dictations or contacting the treatment team when necessary, as directed by the attending
- Review cases with the attending on service, at the attending's discretion, with increasing autonomy as the trainee progresses through training
- Review with the attending the expectations of daily case volumes of exams read and perform an assessment of whether meeting those expectations

Conferences:

- **Neurology / Neuroradiology Conference:** every Friday except the first Friday of the month – Resident will be expected to prepare and present an interesting case in coordination with the neurology resident the imaging findings and teaching points. The cases will be selected by the neurology resident and imaging presentations

should be reviewed with the neuroradiology attending prior to presentation. These presentations should be archived per instructions from attending in the department archive.

- **Neuroradiology Tumor Board:** First Friday of every month – Resident required to attend, Presentation by attending. Advanced residents may participate in presentation at the discretion of the attending
- **Head and Neck Tumor Board:** Third Tuesday of every month – Resident required to attend, Presentation by attending. Advanced residents may participate in presentation at the discretion of the attending

Scholarly Activity:

- Present interesting cases encountered while on service at interdisciplinary Neurology-Radiology Conference
- Present interesting cases encountered while on service at internal Radiology department conferences (interesting case conference)
- Submit at least one interesting neuroradiology case encountered while on service to an online archive, publication, or presentation at a meeting during the course of residency.

First Rotation (FIRST YEAR)

During the first and second rotation, the resident should;

Medical Knowledge

- Learn the basic principles of neuroradiology with an emphasis on normal anatomy of the skull, brain, spine, spinal canal, and head and neck as identified on plain radiographs, CT, and MRI.
- Develop skills in the interpretation plain films of the skull, facial bones and spine in the setting of acute trauma.
- Learn to interpret CT scans of the brain, spine, and head and neck with a particular emphasis on studies performed on individuals presenting with acute or emergent clinical abnormalities.
- Brain - Infarction, spontaneous intracranial hemorrhage, aneurysmal subarachnoid hemorrhage, traumatic brain injury, infection, hydrocephalus, brain edema, and brain herniation.
- Head and Neck - fractures (orbital, facial and petrous), infection (sinusitis, orbital cellulitis, and neck abscess) and airway obstruction.
- Spine - trauma (stable and unstable injuries), degenerative disease, infection, neoplasm (vertebral metastases), and cord compression.
- Understand the basic physics of computed tomography (CT). Be familiar with various standard
- CT imaging protocols and imaging techniques including:
 - Use of various window and level settings;
 - Use of soft tissue and bone algorithms;
- Options in selecting slice thickness, interslice gap, and helical / multi-row scanner imaging parameters.
- Learn the basic physical principles of MRI and be able recognize and understand the clinical value of commonly utilized pulse sequences.
- Develop a detailed understanding of causes of density changes on CT and intensity changes on MR in a variety of lesions (e.g. intracranial hemorrhage)
- Recognize and understand common imaging artifacts.
- Understand the role of imaging in the acute stroke patient and demonstrate proficient application these principles in practice

NEURORADIOLOGY (continued)

Patient Care and Procedural Skills, Interpersonal and Communication Skills, Practice-Based Learning and Improvement

- Learn to obtain informed consent, by explaining the risks and benefits of contrast enhanced CT/MR to the patient
- Learn appropriate techniques for injection of contrast (including use of power injectors)
- Learn to recognize and treat contrast reactions
- Demonstrate 5 successful fluoroscopic-guided lumbar punctures

Interpersonal and Communication Skills

- Learn the appropriate format for dictation of reports of neuroradiologic imaging studies
- Develop skills in providing consultations for house staff and referring physicians on routine and emergent imaging studies.

Second Rotation

Medical Knowledge, Practice-Based Learning and Improvement, Patient Care and Procedural Skills

- Continue to expand knowledge of the anatomy of the brain and spine
- Become familiar with the complex anatomy of the orbit, petrous bone, skull base and soft tissues of the neck (supra- and infra hyoid) as displayed on plain radiographs CT and MR. Have knowledge of established anatomic classification systems for each of these areas
- Advance proficiency in the interpretation of plain radiographs and CT scans of the brain, head and neck, and spine
- Develop a greater understanding of the basic pathology and pathophysiology of disease of the brain, spine, and head & neck including neoplastic and inflammatory lesions
- Continue to develop skills in the interpretation of emergent studies that began in the first year. Learn the imaging features CT and MR of hyperacute infarction. Become familiar with the use of common MR protocols sequences (diffusion and perfusion) for the detection of these lesions
- Develop a more detailed understanding of causes of density changes on CT and intensity changes on MR in a variety of lesions (e.g. intracranial hemorrhage)
- Develop the ability to use imaging findings to differentiate different types of focal intracranial lesions based on anatomic location (e.g. intra- vs. extra-axial), contour, intensity and enhancement pattern
- Learn to identify and differentiate diffuse intracranial abnormalities (e.g. hydrocephalus and atrophy)
- Learn the vascular anatomy of the neck and head as displayed on catheter, MR, and CT angiography. Learn the indications, limitations, risks and benefits for each technique used for visualization of vascular anatomy
- Become proficient at the identification of common lesions of the orbit, petrous bones, skull base and soft tissues of the neck
- Be able to identify and characterize common inflammatory processes in the paranasal sinuses and mastoid bones
- Identify and classify traumatic lesions of the facial bones, petrous bones and orbits using established classification nomenclature
- Become proficient at the assessment of the spine and contents of the spinal canal using a variety of imaging techniques including plain radiographs, CT, MR and myelography. The resident should;
 1. understand spinal anatomy as displayed on multiplanar images including reformatted helical CT scans and MR scans
 2. be able to diagnose and differentiate degenerative spinal diseases including disc herniations, spinal stenosis, endplate changes, and facet joint disease
 3. be able to characterize traumatic lesions and identify signs of instability
 4. be able to identify spinal cord compression and the cause for the compression (e.g. neoplastic involvement of the vertebral body, infection, and trauma)
 5. Learn the imaging features that allow for spatial classification of spinal lesions (extradural, intra-dural extra-medullary, and intra-medullary)
 6. Learn the differential diagnosis for pathology in each of the intra-spinal spaces

Patient Care and Procedural Skills, Interpersonal and Communication Skills, Practice-Based Learning and Improvement

- Learn to obtain informed consent for invasive procedures, including myelography and image guided biopsies. The resident should understand and be able to explain the risks, benefits and complications of these procedures to patients and their families
- Demonstrate proficiency performing fluoroscopically guided punctures of the lumbar spinal canal for the purpose of myelography, spinal fluid collection, and intrathecal injection of medications with attending supervision
- Assist attending radiologists in the performance of biopsies and other spinal procedures

Patient Care and Procedural Skills, Interpersonal and Communication Skills, Professionalism

- Protocol and monitor CT studies. Be able to modify imaging protocols based on identification of unexpected or novel findings
- Act as a consultant for house staff and attending physicians in the Emergency department
- Provide emergent provisional interpretations of plain radiographs, CT scans and MR scans as needed
- Direct the choice of imaging modality and protocol emergent studies
- Be able to identify those cases that require urgent additional faculty expertise in assessment of imaging studies

Third Rotation

Medical Knowledge, Practice-Based Learning and Improvement, Patient Care and Procedural Skills

- Continue to expand knowledge of the anatomy and functional connections of the brain and spine begun during the first two rotations on the service
- Develop more detailed understanding of the basic pathology and pathophysiology of diseases of the brain, spine, and head & neck including neoplastic, vascular, and inflammatory lesions
- Expand and apply knowledge base in emergent neuroradiologic studies, including triage and protocols for patients with acute ischemic stroke, hemorrhage, and trauma
- Identify common inflammatory and neoplastic mass lesions of the soft tissues of the neck and have knowledge of criteria for identification and differentiation of causes of cervical adenopathy
- Study extracranial vascular anatomy and its pathophysiology using CT, MRA, catheter angiography, and ultrasound. Be familiar with strengths and weaknesses of these techniques for common imaging indications, and pitfalls in image interpretation
- Learn patterns of pediatric and developmental neuropathology, including neuronal migration disorders, metabolic disease, and disorders of myelination
- Refine understanding of indications for direct coronal imaging, and orthogonal and 3D reconstructions
- Learn to prepare and present cases in clinical conferences for tumor board, teaching, and management
- Develop a basic understanding of advanced MR imaging techniques including perfusion and MR spectroscopy

Patient Care and Procedural Skills, Interpersonal and Communication Skills, Professionalism

- Take increasing responsibility for obtaining informed consent for invasive procedures for including myelography, angiography and image guided biopsies. The resident must understand and be able to explain the risks, benefits and complications of these procedures to patients and their families.
- Expand clinical consultation and technical experience for fluoroscopically guided punctures of the lumbar spinal canal for the purpose of myelography, spinal fluid collection, and intrathecal injection of medications
- Perform myelograms, and biopsies with the attending, taking on an increasing role as appropriate

Interpersonal and Communication Skills, Professionalism, Patient Care and Procedural Skills

- Protocol and monitor CT and MRI studies. Learn to set up and refine imaging protocols in CT and MRI based on specific clinical indications. Be able to modify imaging protocols based on identification of unexpected or novel findings at the time of scanning
- Act as a consultant for house staff and attending physicians in the Emergency Department
- Provide emergent provisional interpretations of plain radiographs, CT scans and MR scans as needed
- Direct the choice of imaging modality and protocol emergent studies

- Identify those cases that require the urgent additional expertise of faculty radiologists in assessment of imaging studies
- Perform procedures with attending supervision

Medical Knowledge, Interpersonal and Communication Skills, Professionalism, Systems-Based Practice

- Become proficient at the interpretation of CT and MR scans
- Develop the ability to accurately describe complex findings and generate comprehensive yet precise differential diagnoses of a variety of common and uncommon lesions of the brain, skull, and spine
- Learn the imaging features of post-operative and post-radiation exams
- There should be a special emphasis on acquiring basic knowledge and experience in the interpretation of imaging studies of diseases of the orbits, petrous bones, skull base, and soft tissues of the neck
- Develop the ability to use neuroimaging studies to solve a broad range of clinical problems. Learn how to choose the appropriate study (e.g. CT vs. MR) and the appropriate protocol in a variety of clinical circumstances
- Increase proficiency with fluoroscopic guided spinal punctures and image-guided biopsies of the spine. Gain experience in the performance and interpretation of cerebral angiography and myelography
- Develop consultation skills

Patient Care and Procedural Skills, Interpersonal and Communication Skills, Professionalism

- Participate in the general performance of tasks within neuroradiology and sections (e.g. contrast injection, patient monitoring) -see above
- Interpret CT scans under the supervision of an attending at least twice a week
- Interpret MR scans at least three times a week under the supervision of an attending
- Provide emergent and/or provisional interpretations ("wet readings") for house staff and attending physicians.
- Monitor and protocol CT and MR exams
- Perform invasive procedures (spinal punctures, myelograms, CT guided biopsies and angiograms) under the guidance of attending radiologists.

Fifth Rotation May include Interventional Neuroradiology

- Demonstrate proficiency as a neuroradiology consultant to other services under attending supervision
- Perform invasive procedures (spinal punctures, myelograms, CT guided biopsies and angiograms) under the guidance of attending radiologists.
- Participate in the general performance of tasks within neurointerventional procedures, intracranial interventionwal neuroradiology

Neuroradiology Suggested Reading

General Texts

Diagnostic Neuroradiology - Anne G. Osborn, CV Mosby

Handbook of Head and Neck Imaging, - H. Ric Harnsberger, CV Mosby

MRI, the basics - Ray H. Hashemi and William G. Bradley, Williams and Wilkins

Reference Texts

Magnetic Resonance Imaging of the Brain and Spine - Scott W. Atlas, Lippincott (Companion CD available)

Head and Neck Imaging - Peter M. Som and Hugh D. Curtin, CV Mosby

Pediatric Neuroimaging - A. James Barkovich, Raven Press Journals

American Journal of Neuroradiology (AJNR)

Radiology

Radiographics with focus on https://pubs.rsna.org/page/radiographics/rgteam/top10_neuroradiology

American Journal of Roentgenology (AJR)

Neuroimaging Clinics of North America

Useful Articles

See references on RadRaider.org – Neuroradiology Division, categorized by Brain, Spine, Head & Neck, and tiered for Essential Readings, Advanced Readings, and Expert Readings

NUCLEAR RADIOLOGY

Each resident will have one rotation per year at either UMC under the supervision of Dr. Diaz or at William Beaumont Army Medical Center Nuclear Medicine Departments under the supervision of Drs. Moreno and Fleming, and their staff. The residents during their rotations at William Beaumont Army Medical Center rotation will participate in didactic nuclear medicine physics and radiation safety, compounding of radiopharmaceutical, QC of a nuclear medicine laboratory, performance, interpretation, and consultation of all procedures performed, including, PET-CT, bone densitometry and nuclear cardiology. During UMC rotation, the residents will concentrate on routing nuclear medicine diagnostic imaging and therapeutic applications with added teleradiology experience on PET-CT. However, they should concentrate their studies on those aspects emphasized in the medical knowledge sections for each rotation.

ROTATION I (UMC)

Medical Knowledge, Interpersonal and Communication Skills, Professionalism

At the end of the first rotation, the resident should be able to:

- Demonstrate basic knowledge of the clinical indications, general procedures (including radiopharmaceutical and dose) and scintigraphic findings to include PET-CT in:
 - thyroid imaging
 - brain imaging in brain death
 - tumor imaging
 - infection imaging
- Identify and discuss indications for isotopes used for therapeutic purposes
- Describe the protocol and participate in the use of I-131 for treatment of hyperthyroidism and differentiated thyroid carcinoma, including protocol for hospitalization and monitoring of patients who receive over 33 mCi of activity.

Interpersonal and Communication Skills, Patient Care, Systems Based Practice, Professionalism, Medical Knowledge

At the end of the first rotation, the resident should be able to:

- Interpret images with the assistance/review of the faculty radiologist
- Assist with radioactive therapy treatments, making sure the consent form is completed properly and that the appropriate dose is administered, giving particular attention to radiation safety practices during the procedure
- Assist with preparation/presentation of cases for resident case review

Practice Based Learning and Improvement, Interpersonal and Communication Skills, Professionalism

At the end of the first rotation, resident should be able to:

- Recognize limitations in personal skills and knowledge, always making sure dictations and consultations are checked, by the faculty radiologist
- Review all scans as they are performed for significant findings that require prompt attention, and make decisions in regard to notification of the referring physician if the faculty radiologist is not immediately available for consultation

Rotation II (WBAMC)

Medical Knowledge

At the end of the second rotation, the resident should be able to:

- Demonstrate a more thorough knowledge of the clinical indications, general procedures (including radiopharmaceutical and dose) and scintigraphic findings in:
 - ventilation and perfusion imaging in pulmonary embolism
 - brain imaging in brain death
 - liver/spleen imaging
 - GI bleeding
 - bone imaging and densitometry

NUCLEAR RADIOLOGY (*continued*)

Discuss the following information regarding all radiopharmaceuticals used in nuclear radiology studies:

- production of isotopes
 - physical properties of isotopes
 - general elution and quality control
 - compounding of radiopharmaceuticals
 - chemical, radiochemical and radionuclide purity quality control
 - biodistribution and mechanisms of localization
- Calculate patient doses, using information related to decay factors, volume concentration, and patient parameters
 - Describe the procedures and rationale for instrument quality control in nuclear medicine
 - Discuss rules and regulations that apply to the practice of nuclear radiology as outlined in 10CFR20 and other appropriate sources
 - Describe the types of records that must be maintained in order to comply with federal/ state guidelines for radiation safety and radioisotope receipt/use/disposal
 - Demonstrate an in-depth understanding of the physics of nuclear radiology
 - Discuss the basic physical principles of nuclear medicine imaging and instrumentation
 - Identify the isotopes (including physical and chemical properties) that are used routinely in the compounding of radiopharmaceuticals for nuclear radiology procedures

Medical Knowledge, System Based Practice

At the end of the second rotation, the resident should be able to:

- Compound radiopharmaceuticals from kits and do appropriate quality control procedures
- Elute a generator and do appropriate quality control procedures
- Calculate and draw up patient doses
- Demonstrate appropriate use of a survey meter to monitor radioactivity spills or other sources
- Perform a wipe test
- Perform quality control procedures on cameras, well counter, thyroid uptake probe and dose calibrators
- Handle radioactive sources according to the established guidelines

Practice Based Learning and Improvement

At the end of the second rotation, the resident should be able to:

Recognize limitations in personal knowledge and skills, being careful to not make decisions beyond the level of personal competence.

Patient Care, Interpersonal and Communication Skills, Medical Knowledge, System Based Practice

At the end of the second rotation, the resident should be able to:

- Review histories of patients to be imaged each day to determine the relevance of the study to clinical symptoms, to evaluate for contraindications to the study, and to advise technologists about pharmacologic interventions, special views or specific parameters of the study that require special attention
- Assist technologists in the determination of the radiopharmaceutical dosage when patients' conditions do not fit the criteria of the standard dose
- Observe the performance of at least one of each of the different scans routinely performed, as well as all the infrequently ordered studies
- Make a preliminary review of the images and advice technologists when additional views or repeat views are needed accordingly

NUCLEAR RADIOLOGY (continued)

ROTATION III (UMC)

Medical knowledge, Interpersonal and Communication Skills

At the end of the third rotation, the resident should be able to:

Demonstrate a thorough knowledge of the clinical indications, general procedures and findings in:

- renal imaging
- hepatobiliary imaging
- gastric emptying imaging
- infection imaging
- brain imaging in regional cerebral blood flow and reserve after acetazolamide intervention

System Based Practice, Patient Care, Interpersonal and Communication Skills, Professionalism

At the end of the third rotation, the resident should be able to:

- Carry out the practice of nuclear radiology with due regard to quality control, quality assurance, and radiation safety for the patient and personnel
- Correlate the results of various tests with interpretation of renal imaging without or after furosemide intervention
- Correlate the results of various tests with interpretation of hepatobiliary imaging without or after sincalide and morphine sulfate intervention
- Correlate the results of various tests with interpretation of gastric emptying imaging with solid meal and dual-isotope labeling solid and liquid meal

ROTATION IV (WBAMC)

Medical Knowledge, System Based Practice

At the end of the fourth rotation, the resident should be able to:

Demonstrate a thorough knowledge of the clinical indications, general procedures and findings in:

- multi-gated acquisition perfusion imaging and function studies (rest and stress)
- myocardial viability studies
- myocardial infarct imaging
- multi-gated acquisition radionuclide ventriculography (MUGA)
- PET-CT studies
- Describe the radiopharmaceuticals and collimators used in cardiac nuclear studies, including the methods of red blood cell labeling, patient dosages and physical properties of the isotopes
- Discuss patient conditions and patient monitoring requirements, particularly in relation to exercise and pharmacological stress studies
- Process computer data obtained in each of the different cardiac studies
- Discuss the range of invasive and noninvasive tests, test characteristics and the prognostic value of tests used to evaluate cardiac disease
- Describe the radiopharmaceuticals used and common indications in PET-CT in oncologic, neurologic, cardiac, and infectious diseases

Medical Knowledge, Interpersonal and Communication Skills, System Based Practice

At the end of the fourth rotation, the resident should be able to:

- Select tests for evaluation of cardiac disease on the basis of patient condition and clinical symptoms
- Correlate the results from various tests with interpretation of nuclear cardiology exams
- Correlate the results from various tests with interpretation of nuclear oncology, neurology and infection exams

NUCLEAR RADIOLOGY (*continued*)

PHYSICS AND RADIOPHARMACY (incorporated into each rotation)

Medical Knowledge, System Based Practice

Provisions will be made throughout the rotations to:

- Discuss the following information regarding all radiopharmaceuticals used in nuclear radiology studies:
 - production of radionuclides
 - physical properties of radionuclides
 - generator elution and quality control of eluate
 - compounding of radiopharmaceuticals
 - quality control of radiopharmaceuticals
 - biodistribution and mechanisms of localization
- Calculate patient doses, using information related to decay factors, volume concentration, and patient parameters
- Describe the rationale and procedures for instrument quality control in nuclear medicine

Nuclear Radiology Suggested Reading Texts:

1. Nuclear Medicine: The Requisites. Ziessman, O'Malley and Thrall. Elsevier Saunders. 2014.
2. Essential of Nuclear Medicine Imaging: Mettler and Guiberteau. Elsevier Saunders. 2012.
3. Nuclear Medicine Case Review Series. Ziessman and Rehm. Mosby Elsevier. 2011.
4. Rad Cases Nuclear Medicine. Applebaum, Miliziano, Nayak and Bradley. Thieme. 2011.
5. Nuclear Medicine. Henkin. Mosby. 2006.
6. Pediatric Nuclear Medicine/PET. Treves. Springer-Verlag. 2006.
7. Atlas of Clinical Positron Emission Tomography. Barrington. Oxford. 2005.
8. PET and PET/CT. Abass Alavi. Thieme. 2005.
9. Clinical Atlas of PET. Kipper. Saunders. 2004.
10. Clinical Nuclear Cardiology: State of the Art and Future Directions. Zaret. Elsevier. 2004.
11. Orthopedic Nuclear Medicine. Elgazzar. Springer-Verlag. 2004.
12. Nuclear Cardiology and Correlative Imaging. Delbeke. Springer-Verlag. 2004.
13. Nuclear Medicine in Psychiatry. Otte. Springer-Verlag. 2004.
14. Atlas of Nuclear Medicine in Sports Medicine. Cooper. McGraw-Hill. 2003.
15. Nuclear Cardiac Imaging. Iskandrian. Oxford. 2003.
16. Nuclear Cardiology. Heller. McGraw-Hill. 2003.
17. Nuclear Medicine in the Management of Inflammatory and Infectious Diseases: When and How. Signore. Springer-Verlag. 2003.
18. Pulmonary Nuclear Medicine. Atkins. Marcel Dekker. 2001.
19. Functional cerebral SPECT and PET Imaging. Van Heertum. Lippincott Williams & Wilkins. 2000.
20. Nuclear Oncology: Diagnosis and Therapy. Khalkhali. Lippincott Williams & Wilkins. 2000.
21. Teaching Atlas of Nuclear Medicine. Donohoe. Thieme. 2000.
22. Atlas of Nuclear Medicine. Coel. Saunders. 1996.
23. Nuclear Medicine Diagnosis and Therapy. Harbert. Thieme. 1996.
24. Nuclear Medicine in Clinical Diagnosis and Treatment. Murray. Churchill Livingstone. 1994.
25. Pediatric Nuclear Imaging. Miller. Elsevier. 1994.

Nuclear Radiology Suggested Reading Journals:

1. Journal of Nuclear Medicine and Molecular Imaging
2. European Journal of Nuclear Medicine and Molecular Imaging
3. Journal of Nuclear Cardiology
4. World Journal of Nuclear Medicine
5. Clinical Nuclear Medicine
6. Nuclear Medicine Communications
7. Seminars in Nuclear Medicine
8. Quarterly Journal of Nuclear Medicine
9. Yearbook of Nuclear Medicine. Elsevier
10. Nuclear Medicine Annual. Lippincott Williams & Wilkins

PEDIATRIC RADIOLOGY

Goals:

Residents rotate through pediatric radiology for a four-week block during each of the first three years of training. Additional selective opportunities are available in the fourth year. The total experience includes management, performance, and interpretation of conventional imaging, GI and GU fluoroscopic procedures, body and musculoskeletal CT and MR, as well as all ultrasound and nuclear medicine procedures on children.

What is taught and applied in the pediatric radiology complements and supplements what is taught in the similar modality adult rotations that the residents' experience.

Competencies and expectations are tailored to the residents' level of expertise and training

- At the completion of Year 1 Block 1, the resident should be able to interpret and report conventional emergency and newborn imaging studies in children as well as perform basic GI and GU fluoroscopic procedures.
- At the completion of Year 2 Block 2, the resident is to refine the skills listed above as well as perform, interpret, and report CT, ultrasound, and nuclear medicine procedures on children.
- At the completion of Year 3 Block 3, the resident is expected to monitor and protocol all imaging procedures in children and provide appropriate supervisory skills for the radiologic management of the pediatric patient.

OVERALL OBJECTIVES:

Patient Care and Procedural Skills

Provide pediatric imaging patient care through safe, efficient, appropriately utilized, and quality-controlled diagnostic imaging techniques.

- Determine and describe appropriate procedures for imaging investigation of a child.
- Apply appropriate diagnostic techniques to meet the imaging needs of the patients and referring practitioners
- Learn to prioritize urgent work.
- Perform and interpret appropriate fluoroscopic examinations. Identify and describe normal and abnormal gastrointestinal tract, and genitourinary tract in fluoroscopic examinations including single and double contrast upper GI, single and double contrast lower GI, VCUG, feeding tube evaluation and placement or replacement (except interventional procedures), and other "sinogram" studies on children of all ages utilizing low dose radiation exposure techniques.
- Determine, describe, and define techniques and protocols for CT scanning of children of all ages
- Determine, describe, review and assess, and perform when needed, specific pediatric ultrasound examinations of the brain, spine, general abdomen (especially for appendicitis and intussusception), pylorus, kidneys, pelvis, scrotum, hips, superficial lesions, and vascular lesions.

Evaluation:

Monthly evaluation forms by:

Faculty

Technologists

Nurses

Patient families (Patient Satisfaction Survey)

PEDIATRIC RADIOLOGY (continued)

Medical Knowledge

Continuously learn about the imaging findings of pediatric diseases and conditions. Information, feedback, and guidance are available from the pediatric radiologists and other clinicians. Reference books are available in the pediatric radiology section of the department and medical school libraries; journals are available in the faculty offices, medical school library, and/or on line. Self-instructional material is also available on the residents' computer.

- Be able to recognize normal findings and normal variants related to the growing child and imaging techniques
- Be familiar with symptoms and imaging findings of diseases, conditions, and congenital anomalies including:

Evaluation:

Monthly evaluation forms by:

Faculty

Expected annual performance on Pediatric Radiology section of ACR In-Service examination above 10th percentile

Practice-Based Learning and Improvement

- Self-assessment and review with pediatric faculty regarding technique and reports.
- Be able to ask for and accept help.
- Be familiar with radiology issues such as coordinating multiple studies for one patient related to the timing and sequence of the studies, sharing of vascular contrast in multi-level examinations, and timing of sedation
- Be aware of safety issues such as ALARA principle of keeping radiation dose "As Low As Reasonably Achievable", IV contrast, allergies and latex precautions, respiratory stability, and dangers of aspirated contrast, leaked contrast, and hypertonic intestinal contrasts

Evaluation:

Monthly evaluation by faculty

Self-Assessment provisions in learning portfolio

Oral presentation ratings

Interpersonal and Communication Skills

- Produce concise, yet thorough, and grammatically correct, dictated reports on studies reviewed
- Effectively and appropriately communicate with patients, families, technical and clerical staff, other radiologists, and clinicians concerning appropriateness of requested studies, consent if needed, safety issues
- Effectively communicate imaging results with the referring practitioner in a timely manner, as observed by faculty preceptors. This includes evaluating exam requests and relaying results.

Evaluation:

Monthly evaluation by faculty, technologists, nurses, clerical staff, patient families

Self-assessment of patient/family communication skills

Professionalism

- Commit to high standards of professional conduct; demonstrate altruism, compassion, honesty, and integrity
- Follow principles of ethics and confidentiality

PEDIATRIC RADIOLOGY (continued)

- Consider age, religious, ethnic, gender, educational, language, and other differences in interacting with patients and their parents or other caretakers and with other members of the health care team
- The resident should always maintain a personal appearance appropriate for a pediatric care physician

Evaluation:

Monthly evaluations by faculty, technologists, nurses, and patient families

Systems-Based Practice

- Understand how the components of the local and national healthcare system function interdependently and how changes to improve the system involve group and individual efforts
- Optimize coordination of patient care both within one's own practice and within the healthcare system
- Consult with other healthcare professionals, and educate healthcare consumers, regarding the most appropriate utilization of imaging resources

Evaluation:

Monthly evaluation by faculty

Oral presentation rating form

FIRST ROTATION OBJECTIVES:

Patient Care and Procedural Skills 1

- Demonstration of the safe and efficient use of fluoroscopy for UGIs, contrast enemas, and voiding cystourethrograms (VCUGs)
- Practice of basic safety practices in the immobilization and examination of children.
- Ability to gain the most information with the least radiation. Low or no radiation examinations should be considered before high dose examinations
- Consideration of risk of renal damage from iodine based vascular contrast
- Recognition of the relative dangers of barium vs. water-soluble contrast material in various body cavities
- Awareness of the potential consequences of water soluble intestinal contrast agents in children

Interpersonal & Communication Skills 1

- Provide pediatric specific interpretations of conventional images of chest, abdomen, and extremities and common fluoroscopic studies, such as upper GIs, single contrast lower GIs, and VCUGs.
- Basic pediatric radiographic interpretation skills for ED and intensive care unit conventional studies.
- Interact professionally and pleasantly with patients, families, technical and clerical staff, other radiologists, including explaining examinations and results to families, sharing results with other clinicians

Practice-Based Learning and Improvement 1

- To learn from attending radiologists, more senior residents, and experienced technologists
- To recognize personal shortcomings and appropriately request help in planning, performing, and interpreting studies

Systems-Based Practice 1

- To be aware of the need for coordination of patient care studies

PEDIATRIC RADIOLOGY (continued)

SECOND ROTATION OBJECTIVES:

Patient Care and Procedural Skills 2:

Provide pediatric imaging patient care through safe, efficient, appropriately utilized, and quality-controlled diagnostic imaging techniques.

- Update fluoroscopic skills previously learned.
- Perform the basic fluoroscopic procedures with less direction from an attending
- Develop skills in studies with more potential for complications, such as intussusceptions reduction and tube placement
- Guide the technicians in procedure organization and to prioritize pending studies by urgency
- Supervise and program general pediatric chest, abdomen, and pelvis CT
- Coordinate studies involving multiple body parts (e.g. body with neuroimaging or with musculoskeletal, CT with nuclear medicine or MRI)
- Coordinate patients requiring sedation

Medical Knowledge 2:

Continuously learn about the imaging findings of pediatric diseases and conditions. Information, feedback, and guidance are available from the pediatric radiologists and other clinicians. Reference books are available in the pediatric radiology section of the department and medical school libraries; journals are available in the faculty offices, medical school library, and/or on line. Self-instructional material is also available on the residents' computer.

- Be able to recognize normal findings and normal variants related to the growing child and imaging techniques
- Be familiar with symptoms and imaging findings of diseases, conditions, and congenital anomalies

Evaluation:

Monthly evaluation forms by:

Faculty

Expected annual performance on Pediatric Radiology section of ACR In-Service examination above 10th percentile

Practice-Based Learning and Improvement 2:

- Self-assessment and review with pediatric faculty regarding technique and reports.
- Be able to ask for and accept help
- Be familiar with radiology issues such as coordinating multiple studies for one patient related to the timing and sequence of the studies, sharing of vascular contrast in multi-level examinations, and timing of sedation
- Be aware of safety issues such as ALARA principle of keeping radiation dose "As Low As Reasonably Achievable", IV contrast, allergies and latex precautions, respiratory stability, and dangers of aspirated contrast, leaked contrast, and hypertonic intestinal contrasts

Evaluation:

Monthly evaluation by faculty

Self-Assessment provisions in learning portfolio

Oral presentation ratings

PEDIATRIC RADIOLOGY (continued)

Interpersonal and Communication Skills 2:

- Give initial urgent preliminary readings and to work with the referring physician, evaluating the requests made by referring physicians, and explaining results
- Demonstrate imaging basics to medical students and pediatric residents
- Continue to produce concise, yet thorough, and grammatically correct, dictated reports on studies reviewed
- Effectively and appropriately communicate with patients, families, technical and clerical staff, other radiologists, and clinicians concerning appropriateness of requested studies, consent if needed, safety issues.
- Effectively communicate imaging results with the referring practitioner in a timely manner, as observed by the faculty preceptors. This includes evaluating exam requests and relaying results.

Evaluation:

Monthly evaluation by faculty, technologists, nurses, clerical staff, patient families
Self-assessment in patient/family communication skills

Professionalism 2:

- Commit to high standards of professional conduct; demonstrate altruism, compassion, honesty, and integrity.
- Follow principles of ethics and confidentiality
- Consider age, religious, ethnic, gender, educational, language, and other differences in interacting with patients and their parents or other caretakers and with other members of the health care team
- The resident should always maintain a personal appearance appropriate for a pediatric care physician

Evaluation:

Monthly evaluations by faculty, technologists, nurses, and patient families

Systems-Based Practice 2:

By the second rotation, residents will generally have experience in multiple modalities, and should be able to:

Optimize coordination of patient care

Consult with other healthcare professionals

Educate healthcare consumers regarding the most appropriate utilization of imaging resources

- Understand how the components of the local and national healthcare system function interdependently and how changes to improve the system involve group and individual efforts
- Optimize coordination of patient care both within one's own practice and within the healthcare system
- Consult with other healthcare professionals, and educate healthcare consumers, regarding the most appropriate utilization of imaging resources

Evaluation:

Monthly evaluation by faculty
Oral presentation rating form

PEDIATRIC RADIOLOGY *(continued)*

THIRD ROTATION OBJECTIVES:

Patient Care and Procedural Skills 3

- Monitor and protocol all imaging procedures in children
- Provide appropriate supervisory skills for the radiologic management of the pediatric patient
- Provide pediatric imaging patient care through safe, efficient, appropriately utilized, and quality-controlled diagnostic imaging techniques
- Determine, describe, review and assess, and perform when needed, specific pediatric ultrasound examinations of the brain, spine, general abdomen (especially for appendicitis and intussusceptions), pylorus, kidneys, pelvis, scrotum, hips, superficial lesions, and vascular lesions

Evaluation:

Monthly evaluation forms by:

Faculty

Technologists

Nurses

Patient families (Patient Satisfaction Survey)

Medical Knowledge 3:

Continuously learn about the imaging findings of pediatric diseases and conditions. Information, feedback, and guidance are available from the pediatric imaging faculty and other clinicians. Reference books are available in the pediatric radiology section of the department and medical school libraries; journals are available in libraries or web-based. Self-instructional material is also available on the internet. *This standard does not vary during the four blocks of training.*

Evaluation:

Monthly evaluation forms by:

Faculty

Expected annual performance on Pediatric Radiology section of ACR In-Service examination above 10th percentile

Practice-Based Learning and Improvement 3

- Assist sonographers in performing specific pediatric ultrasound examinations of the brain, spine, general abdomen (especially for appendicitis and intussusceptions), pylorus, kidneys, pelvis, scrotum, hips, superficial lesions, and vascular lesions
- Self-assessment and review with pediatric faculty regarding technique and reports
- Demonstrate ability to coordinate multiple studies for one patient related to the timing and sequence of the studies, sharing of vascular contrast in multi-level examinations, and timing of sedation
- Routinely practice safety issues such as ALARA principle of keeping radiation dose "As Low As Reasonably Achievable"

Evaluation:

Monthly evaluation by faculty

Self-Assessment provisions in learning portfolio

Oral Presentation Ratings

PEDIATRIC RADIOLOGY *(continued)*

Interpersonal and Communication Skills 3

- Produce concise, yet thorough, and grammatically correct, dictated reports on studies reviewed
- Effectively and appropriately communicate with patients, families, technical and clerical staff, other radiologists, and clinicians concerning appropriateness of requested studies, consent if needed, safety issues
- Effectively communicate imaging results with the referring practitioner in a timely manner, as observed by the faculty preceptors. This includes evaluating exam requests and relaying results

Evaluation:

Monthly evaluation by faculty, technologists, nurses, clerical staff, patient families
Self-assessment of patient/family communication skills

Professionalism 3

- Commit to high standards of professional conduct; demonstrate altruism, compassion, honesty, and integrity
- Follow principles of ethics and confidentiality
- Consider age, religious, ethnic, gender, educational, language, and other differences in interacting with patients and their parents or other caretakers and with other members of the health care team
- Always maintain a personal appearance appropriate for a pediatric care physician

Evaluation:

Monthly evaluations by faculty, technologists, nurses, and patient families

Systems-Based Practice 3

- Understand how the components of the local and national healthcare system function interdependently and how changes to improve the system involve group and individual efforts.
- Optimize coordination of patient care both within one's own practice and within the healthcare system.
- Consult with other healthcare professionals, and educate healthcare consumers, regarding the most appropriate utilization of imaging resources.

Evaluation:

Monthly evaluation by faculty
Oral presentation rating form

ULTRASOUND

Each resident will have 4 four-week block rotations through ultrasound. In addition to observing, interpreting, and providing consultation on procedures, each resident is expected to gain proficiency in performing US examinations. The resident will keep a log of those examinations performed and review the log with the attending radiologist upon the completion of each rotation. Residents are expected to perform at least 200 ultrasound examinations during their residency. The VA rotation is focused on integrating multimodality skills of the more advanced Radiology resident after the Program Director has determined the Radiology Resident is sufficiently prepared to address integration of Multimodality Imaging studies of increasing complexity.

Rotation I

Medical Knowledge, Practice-Based Learning and Improvement, Patient Care and Procedural Skills

- At the end of the rotation, the resident should be able to:
- Discuss the ultrasound procedures and findings in
 - gallbladder/biliary tree ultrasound
 - cholelithiasis
 - cholecystitis
 - renal ultrasound
 - obstruction
 - renal failure
 - duplex Doppler
 - venous thrombosis of extremities
- Understand anatomic relationships and be able to individually image intra-abdominal organs-liver, spleen, kidneys, gallbladder, biliary tree, aorta, IVC
- Be familiar with common intra-abdominal pathology
- Understand basic ultrasound physics and its clinical applications
- Demonstrate ability to turn on a machine, select the appropriate exam program and transducer, enter patient data and annotate images
- Understand basic doppler and vascular principles to interpret extremity DVT studies and flow (i.e. portal vein thrombosis)
- Identify and localize fluid collections in the chest, abdomen and pelvis for aspiration

Systems-Based Practice

- Learn basic US triage – which exams should be performed by US, and which by another modality, i.e. MRI, CT

Technical and Performance Skills

Medical Knowledge, Patient Care and Procedural Skills, Interpersonal and Communication Skills

- At the end of the rotation, the resident should be able to
- Perform basic abdominal ultrasound
 - Advise the sonographer about special views or specific parameters of the study that require special attention

Decision Making and Value Judgment Skills

Medical Knowledge, Interpersonal and Communication Skills, Patient Care and Procedural Skills, Professionalism

- At the end of the rotation, the resident should be able to
- Given an ultrasound case, make a preliminary review of the images and advise the sonographers when additional views or repeat views are needed
 - Provide preliminary reports on routine abdomen/pelvis/extremity cases

Recommended Reading List

- Diagnostic Ultrasound by Carol M Rumack
 - Abdominal Ultrasound chapters*
- Ultrasound: The Requisites by Middleton
- Ultrasound Secrets by V Dogra, D Rubens

ULTRASOUND (continued)

Rotation II

Behavioral Objectives

Medical Knowledge, Patient Care and Procedural Skills, Interpersonal and Communication Skills

Knowledge Based Objectives

At the end of the rotation, the resident should be able to:

- Demonstrate thorough knowledge of the ultrasound procedure through performing or assisting the sonographer with performance of the following studies:
 - liver/biliary tree
 - o biliary obstruction
 - o tumors
 - o transplant evaluation
 - pancreas
 - o inflammatory processes
 - o tumors
 - renal
 - o tumors
 - o inflammatory processes
 - pelvis
 - o uterine leiomyoma
 - o ovarian neoplastic disease
 - o non-neoplastic disease
 - small parts transducer scans
 - o thyroid, scrotal, etc.
- Given appropriate sonograms, identify and discuss significant characteristics of the pathologies listed in #1 above.

Technical Skills

Interpersonal and Communication Skills, Patient Care and Procedural Skills, Professionalism

At the end of the rotation, the resident should be able to

- Review all scans as they are performed for significant findings that require prompt attention
 - Assist with the preparation and presentation of cases for the ultrasound/imaging conference
 - Discuss cases with the medical students on rotation in ultrasound during the reading session.
 - Prepare cases for the monthly Quality Assurance (QA) and teaching file and present them at the Ultrasound Quality Assurance Conference
 - Perform basic pelvic, scrotal, thyroid, and DVT (upper and lower extremity) exams.
- Assist in interventional procedures guided by ultrasound; demonstrating appropriate patient interaction and knowledge of safety precautions.

Decision Making and Value Judgment Skills

Patient Care and Procedural Skills, Professionalism, Interpersonal and Communication Skills

At the end of the rotation, the resident should be able to:

- Make decisions in regard to notification of the referring physician, if the faculty radiologist is not available for consultation.

Recommended Reading List

Diagnostic Ultrasound by C Rumack

Small Parts chapter

Ultrasound: The Requisites by Middleton

Ultrasound Secrets by V Dogra, D Rubens

Vascular, Pelvic and Small Parts chapters

Ultrasound in OB & Gynecology by Callen

ULTRASOUND *(continued)*

Rotation III

Behavioral Objectives
Knowledge Based Objectives

Medical Knowledge, Interpersonal and Communication Skills, Professionalism

At the end of the rotation, the resident should be able to:

- Discuss all aspects of ultrasound imaging, including indications, pathology, and correlative studies used for each examination
- Discuss with medical students, anatomical findings, pathology and reasons for doing the study, answering any questions the students may pose

Technical Skills

Patient Care and Procedural Skills, Medical Knowledge

At the end of the rotation, the resident should be able to

- Become adept at performance of doppler examinations, including carotids, extremities, abdomen, renal and liver transplants
- Become proficient in endocavitary scanning (transvaginal, transrectal)
- Demonstrate appropriate interactive skills with patients and staff

Decision Making and Value Judgment Skills

Medical Knowledge, Patient Care and Procedural Skills, Interpersonal and Communication Skills, Professionalism, Systems-Based Practice

At the end of the rotation, the resident should be able to

- Evaluate and read-out all US exams performed on service – pre-dictate routine cases
- Make preliminary decisions on all matters of interpretation and consultation and recognize the need to obtain assistance in situations that require immediate expertise of the faculty radiologist
- Decide on the appropriateness of procedures
- Schedule procedures
- Perform interventional procedures guided by ultrasound,

Recommended Reading List

- Diagnostic Ultrasound by C Rumack
- Vascular Ultrasound by Zweibel, et al
- Ultrasound in Obstetrics & Gynecology by Callen

Rotation IV

Behavioral Objectives

Medical Knowledge, Patient Care and Procedural Skills, Interpersonal and Communication Skills, Professionalism

Knowledge based objectives

At the end of the rotation, the resident should be able to:

- Demonstrate ability to run the entire US service – QA all exams, supervise junior residents or medical students, sonographers; check exams for adequacy, appropriateness, add or subtract exams, etc.
- Become familiar with specialty US exams; transcranial doppler, penile doppler, shunt and fistulae exams, intra-operative US, endoluminal (GI)US, and contrast US exams
- Demonstrate ability to interact appropriately with patients, staff, and referring physicians

ULTRASOUND (continued)

Technical Objectives

Medical Knowledge, Interpersonal and Communication Skills, Professionalism

At the end of the rotation, the resident should be able to

- Refine all scanning skills to include some subspecialty exams

Recommended Reading List

- Review as needed:
- Diagnostic Ultrasound by Rumack
- Ultrasound in Obstetrics and Gynecology by Callen
- Vascular Ultrasound by Zweibel
- Ultrasound: The Requisites, by Middleton
- Ultrasound Secrets by V Dogra, D Rubens
- Specific articles as needed from Radiology, AJR, JUM pertinent to topics.

OBSTETRICAL AND PELVIC ULTRASOUND

Following the one day/week of each rotation specifically dedicated to obstetrical and gynecological ultrasound, the resident should understand and be able to discuss:

Technical and Performance Skills

Medical Knowledge, Patient Care and Procedural Skills, Interpersonal and Communication Skills, Professionalism

Basic physical principles of medical ultrasound:

1. Relevant principles of acoustics, attenuation, absorption, reflection and speed of ultrasound;
2. Biological, thermal and non-thermal effects of pulsed and continuous wave ultrasound beams;
3. Basic operating principles of ultrasound equipment, Doppler and color Doppler imaging and signal processing;
4. How to interpret and avoid artifacts;
5. The principles of measuring, storage and analysis of the ultrasound and Doppler data;

Behavioral Objectives

Medical Knowledge, Interpersonal and Communication Skills

Gynecology and Human Reproduction:

1. Normal pelvic anatomy: a) *Uterus* (size, position, shape; cyclical morphological changes of the endometrium; measurement of the endometrial thickness); b) *Ovaries* (size, position, measurement; cyclical morphological changes; assessment of the size and growth of the follicles, detection of ovulation; c) evaluation of the retrouterine space;
2. Gynecological abnormalities of the: a) *Uterus* (fibroids, adenomyosis, endometrial hyperplasia, polyps, endometrial carcinoma, location of intrauterine contraceptive devices); b) *Ovaries* (cysts, endometriosis, differential diagnosis of pelvic masses, benign and malignant tumors, ovarian carcinoma); c) *Tubes* (hydrosalpinx, and tumors of the Fallopian tube);
3. Infertility (monitoring of the follicular development in spontaneous and stimulated cycles, detection of ovarian hyperstimulation syndrome, diagnosis of ovarian (polycystic ovaries), uterine (uterine anomalies and abnormalities) and tubal (hydrosalpinx) causes of infertility; know how to perform hystero-contrast-sonosalpingography);
4. The resident should be able to identify emergency gynecological problems by transvaginal and transabdominal ultrasound (differential diagnosis of acute abdomen, detection of the different sites of ectopic pregnancy).
5. To apply Doppler and color Doppler ultrasound in oncologic cases.
6. To interact effectively with patients and staff in a professional, safe, and compassionate manner.

ULTRASOUND (continued)

Obstetrics:

1. Investigation of early pregnancy (measurement of the gestational sac, yolk sac, embryonic pole, crown-rump length of the fetus, detection of multiple pregnancy and evaluation of the chorionicity and amnionicity);
2. Evaluation of the fetal anatomy and embryonic-fetal biometry;
3. Detection of fetal viability;
4. Measurement of the nuchal translucency, detection of cystic hygroma;
5. Ultrasound features of early pregnancy failure, threatened abortion, missed abortion, anembryonic pregnancy, and chorionic trophoblastic disease (e.g. hydatidiform mole);
6. Ultrasound features of different sites of ectopic pregnancy; correlation of the biochemical and ultrasound data;
7. Assessment of the amniotic fluid (estimation of the amniotic fluid volume), umbilical cord (number of cord vessels, presence of the cysts, coiling) and placenta (location and morphology); evaluation of the cervix (length, shape);
8. Assessment of the fetal anatomy at 18 to 22 weeks (shape of the skull, assessment of the face and profile, brain structures – cerebral ventricles, cisterna magna, choroid plexus; longitudinal and transverse assessment of the fetal spine; evaluation of the head size and position, heart rate and rhythm, four chamber view; outflow tract; thorax (size and morphology of fetal lungs) and abdomen (with emphasis to outer shape and continuity of the abdominal wall); abdomen: visualization of the stomach, liver, kidneys, urinary bladder and umbilicus; limbs: femur, tibia, humerus, radius, ulna, hands, and feet, evaluation of bone echogenicity, shape and movement of the extremities);
9. Detection, evaluation, differential diagnosis, epidemiology and natural history of structural and functional fetal anomalies of the – skeletal system, central nervous system, cardiovascular system, anomalies of the intrathoracic cavity, renal and gastrointestinal system, abdominal wall and diaphragm.
10. Detection of the ultrasound markers of chromosomal abnormalities;
11. Detection of the functional abnormalities, such as amniotic fluid abnormalities (polyhydramnios, oligohydramnios, fetal hydrops)
12. Perform fetal biometry (assessment of the fetal size, including biparietal diameter, head circumference, abdominal circumference, and femur length);
13. Perform the measurements of the central nervous system to diagnose cranial anomalies; anterior/posterior horn of the lateral ventricle, transcerebellar diameter;
14. Estimation of the gestational age;
15. Assessment of the fetal growth and fetal weight estimation;
16. Perform and interpret biophysical profile; analysis of fetal body movements, fetal breathing, heart rate and rhythm, eye movements, breathing movements;
17. Use Doppler for assessment of the blood flow velocity measurements and waveform analysis of normal and complicated pregnancies (e.g. intrauterine growth retardation);
18. Clinical implications of Doppler studies in monitoring rhesus iso-immunization and diabetic pregnancy; detection and follow-up of twin-to-twin transfusion syndrome.

Decision Making and Value Judgment Skills

Medical Knowledge, Patient Care and Procedural Skills, Interpersonal and Communication Skills, Professionalism

Medico-legal implications, bioethical principles and patient information confidentiality

VASCULAR AND INTERVENTIONAL RADIOLOGY

During the first three years of each resident completes 3 four-week block rotations in Vascular and Interventional Radiology. Additional selective rotations are available in the fourth year. The ensuing outline will detail the goals and objectives for each four week rotation on the service.

First Rotation

Goals

Medical Knowledge, Practice-Based Learning and Improvement

- Demonstrate the ability to obtain an informed consent
- Demonstrate the ability to obtain pertinent patient information from the PACS system and the patient chart prior to the performance of an invasive procedure

Professionalism

- Demonstrate timeliness and responsible work ethic

Patient Care and Procedural Skills, Systems-Based Practice

- Demonstrate the ability to monitor and follow patients assigned to him/her during the rotation and have at hand pertinent clinical information i.e. chest tube output, abscess tube output, findings from follow-up chest/abdomen/pelvic CT scans

Objectives

Medical Knowledge, Practice-based Learning and Improvement

- Name the pertinent labs that must be known prior to performing an arteriogram, a biliary drainage, and a percutaneous nephrostomy or abscess drainage
- Describe the superficial and deep venous system of the upper and lower extremity
- Describe the arterial anatomy of the lower extremity, the pelvis, and the abdomen
- Name the indications for PICC line placement

Second Rotation

Goals

Interpersonal and Communication Skills

- Ability to dictate in a clear, succinct fashion on a timely basis

Medical Knowledge, Practice-Based Learning and Improvement, Patient Care and Procedural Skills

- Knowledge of appropriate choice of antibiotics for bacterial coverage prior to percutaneous nephrostomy, biliary drainage, abscess drainage
- Demonstrate safety with sharps and timely removal of sharp objects from the tray and placement in the sharp's box
- Knowledge of deep venous disease including the indications for venography, duplex ultrasound, MR venography and therapeutic treatment options
- Knowledge of visceral arterial anatomy and common normal variants (i.e. replaced right hepatic artery, left gastric-left hepatic etc.)
- Knowledge of function of pleurovac system and Heimlich Valve

VASCULAR and INTERVENTIONAL RADIOLOGY *(continued)*

Objectives

Medical Knowledge, Practice-Based Learning and Improvement

- Name the arterial anatomy of the external and internal iliac arteries
- Name the venous anatomy of the chest, abdomen and pelvis; identify collateral pathway between the azygos system and svc and IVC
- Name and identify the renal arterial branches and describe Brödel's avascular zone and its relationship to percutaneous nephrostomy
- Describe the intrahepatic and extrahepatic biliary system and anatomy; describe the specific biliary complications that can result from laparoscopic gallbladder removal
- Describe the risk factors for pneumothorax secondary to percutaneous lung biopsy
- Describe the risk factors for hemoperitoneum secondary to liver biopsy
- Describe different types of aneurysms i.e. atherosclerotic, mycotic, post-traumatic and give an example of each
- Discuss when thrombolytics are helpful
- Discuss the indications for gastrostomy tube placement, gastrojejunostomy placement, and jejunostomy tube placement

Third Rotation

Goals

Medical Knowledge, Practice-Based Learning and Improvement

- Knowledge of peripheral vascular disease including risk factors, evolution of atherosclerotic plaques, site of plaque formation
- Knowledge of method for evaluating the patient with peripheral vascular disease from noninvasive to invasive modalities (history, physical, duplex sonography, MR angiography, diagnostic arteriography)
- Knowledge of complications of diagnostic arteriography and methods of reducing the incidence of these complications and their management
- Knowledge of contrast agents: ionic agents, nonionic agents and indications for premedication prior to contrast administration as well as medical protocol
- Ability to recognize various contrast agent reaction and appropriate treatment regimens

Medical Knowledge, Practice-Based Learning and Improvement, Patient Care and Procedural Skills

- Describe the various access routes for hemodialysis: Cimino-Brescia fistula, Bridge and Loop Gortex Dialysis Grafts, and dialysis catheters
- Describe when a temporary dialysis catheter is warranted and when a tunneled dialysis catheter is indicated; name access sites that appropriate for placement
- Name the central vein that is considered malpractice to place a temporary or tunneled dialysis catheter
- Describe when metallic stents would be indicated to preserve access for continued dialysis
- Name risk factors for contrast induced nephrotoxicity
- Discuss when it is appropriate to remove an abscess tube; what factors must be known prior to removal and if imaging is needed
- Discuss the indications and contraindications for IVC Filter placement; describe the currently available FDA approved filters, its respective advantages and disadvantages
- Discuss the checklist to be assessed prior to proceeding with a pulmonary arteriogram
- Draw a left bundle block pattern, as it would appear on a 12 lead EKG. Define when a temporary pacemaker is required prior to pulmonary arteriography. Discuss the contraindications to pulmonary arteriography
- Discuss the advantages of tunneled catheters for therapy versus PICC lines versus Ports and discuss when each would be appropriate/ inappropriate

VASCULAR and INTERVENTIONAL RADIOLOGY (continued)

Selective Rotations

Goals

Medical Knowledge, Practice-Based Learning and Improvement

- Knowledge of the mechanism of angioplasty
- Knowledge of complications of angioplasty
- Knowledge of indications for vascular stent placement
- Knowledge of indications for renal angioplasty and stent placement
- Knowledge of indications for biliary stent placement
- Knowledge of indications and contraindications for TIPS placement
- Knowledge of indications of gastrostomy tube placement
- Knowledge of indications for radiofrequency ablation of masses
- Knowledge of indicative for vertebroplasty/kyphoplasty
- Knowledge of venous ablations (laser radio frequency)

Objectives

Patient Care Skills, Medical Knowledge

- Discuss various embolic agents that are clinically available i.e. liquids, particulates, coils; discuss when each type of agent is clinically indicated and contraindicated
- Discuss the post-embolization syndrome
- Discuss the arterial blood supply to the uterus and ovaries; what is the incidence of ovarian failure after uterine artery embolization
- Discuss cholesterol embolization, its causes, and treatments (if any)
- Discuss hypercoagulable states
- Discuss heparin induced thrombocytopenia
- Discuss anticoagulants (unfractionated heparin, low molecular weight heparin, coumadin) and where in the coagulation cascade each works; discuss antiplatelet agents (ReoPro, Aggrastat, integrilin, clopidogrel)
- Discuss the types of portal hypertension (dynamic, presinusoidal, sinusoidal, postsinusoidal) and causes of each; discuss the hepatic venous anatomy and indications for free and wedged hepatic venous hemodynamic assessment
- Discuss the complications that can occur during tunneled dialysis catheter placement; specifically, discuss how to lessen the incidence of air embolism and treatment if this were to happen
- Discuss the dangers of local thrombolytic therapy and discuss compartment syndrome as it relates to reperfusion of a threatened ischemic extremity
- Discuss when local thrombolytic treatment is contraindicated. Why is echocardiography a necessary test prior to initiating local thrombolytic therapy in acute ischemia secondary to embolic disease
- Discuss different sclerosing agents for lymphoceles or cysts
- Define pelvic congestion syndrome and how is it analogous to varicocele formation in the male and their treatment options

VASCULAR and INTERVENTIONAL RADIOLOGY (continued)

TECHNICAL SKILLS THAT SHOULD BE MASTERED DURING THE FIRST THREE BLOCKS ON VASCULAR-INTERVENTIONAL RADIOLOGY:

First Rotation

Technical Skills

Patient Care and Procedural Skills

- Performance of PICC line under fluoroscopic and ultrasound guidance
- Performance common femoral venous puncture
- Performance of a single wall puncture of common femoral artery
- Correct access site compression after arteriography
- Performance of image guided biopsy

Second Rotation

Technical Skills

Patient Care and Procedural Skills

- Manual dexterity in using pigtail catheter to go around the aortic bifurcation
- Manual dexterity using the Omni Selective, Cobra, and Sos Omni
- Basic skills in suturing; interrupted, running, and subcuticular suturing techniques; knows when to use absorbable and nonabsorbable suture
- Performance of ultrasound-guided puncture of the internal jugular vein
- Ability to perform a tunneled dialysis catheter placement in the internal jugular vein

Third Rotations

Technical Skills

Patient Care and Procedural Skills

- Ability to place an IVC Filter
- Ability to safely reform a Simmons catheter and knows which one to use for the situation at hand
- Ability to perform pulmonary arteriography and knowledge of appropriate catheters use
- Ability to perform ultrasound guided percutaneous nephrostomy and biliary drainage

Selective Rotations

Technical Skills

Patient Care and Procedural Skills

- Ability to perform an antegrade femoral puncture
- Ability to perform graded ultrasonic compression to treat a puncture site pseudoaneurysm
- Ability to perform post-traumatic embolization of pelvic bleeders
- Ability to perform visceral arteriography
- Ability to perform lung biopsies and place Heimlich Valves for post lung biopsy pneumothorax
- Ability to perform cerebral and carotid angiography

Goals

Medical Knowledge, Practice-based Learning and Improvement

- Knowledge of the mechanism of angioplasty
- Knowledge of complications of angioplasty
- Knowledge of indications for vascular stent placement
- Knowledge of indications for renal angioplasty and stent placement
- Knowledge of indications for biliary stent placement
- Knowledge of indications and contraindications for TIPS placement
- Knowledge of indications of gastrostomy tube placement
- Knowledge of indications for radiofrequency ablation of masses.
- Knowledge of indications for vertebroplasty/kypoplasty
- Knowledge of venous ablations (laser radio frequency)

Body Imaging Fellowship Goals and Objectives

Goals

The overall goal of the fellowship in radiological imaging is to provide educational and training experience which:

- 1. Focus on the enhanced development of specific skills in the selective performance and interpretation in all areas of cross-sectional imaging including Computed Tomography (CT), Ultrasound (US) and Magnetic Resonance (MR) imaging;
- 2. Enhance capability for independent and accurate clinical decision making in all areas of cross-sectional imaging;
- 3. Enhance skills in diagnostic and therapeutic consultation practice
- 4. Provide opportunity for research in cross-sectional imaging.

Objectives: (related to goals above)

1. Clinical Experience and Skills:

At the end of each monthly CT rotation, the Fellow must have reviewed and read 160 CT

At the end of each monthly MRI rotation, the Fellow must have reviewed and read 80 MRIs

At the end of each monthly US rotation, the Fellow must have reviewed and read 240 USs

Monthly evaluation should have scores of (2) at level expected for training or (3) above level expected

2 and 3. Skills in Consultative Practice: Preliminary interpretations should be provided within 30 minutes of request and final interpretations within 24 hours. Significant error rate for preliminary reports should be less than 10%

4. Research Goal:

As a demonstration of completion of the research experience, the fellow is required to present the results in an assigned Grand Rounds session and is to prepare the research study for poster or paper presentation at a local, regional, or national meeting. Peer-reviewed publication is expected.

Body Imaging Fellowship Goals and Objectives (continued)

GOALS AND OBJECTIVES BY ROTATION

COMPUTED TOMOGRAPHY

- Understand the basic physics of CT including slice thickness, pitch, helical vs. multi-row scanners, effects of mA and kV.
- Learn the basic principles of contrast distribution particularly as applied to arterial and venous phase scanning
- Demonstrate the ability to follow protocols and monitor CT studies. Modify protocols when appropriate
- Learn to recognize and treat contrast reactions
- Develop skills in interpretation of CT pathology
- Demonstrate the ability to direct the choice of imaging modality and protocol emergent studies
- Refine techniques of reformatting CT images for vascular detail
- Consult on Level 1 and Level 2 Trauma Emergencies to coordinate emergency radiologic exams and interpretations. Preliminary interpretations should be provided within 30 minutes of request and final interpretations within 24 hours. Significant error rate for preliminary reports should be less than 10%.
- Protocol and monitor CT studies. Learn to set up and refine imaging protocols in CT based on specific clinical indications. Be able to modify imaging protocols based on identification of unexpected or novel findings at the time of scanning
- Expand clinical consultation and technical experience for fluoroscopically guided punctures of the lumbar spinal canal for the purpose of CT myelography
- Become familiar with the complex anatomy of the orbit, petrous bone, skull base and soft tissues of the neck (supra- and infra hyoid) as displayed on CT. Have knowledge of established anatomic classification systems for each of these areas
- Develop a greater understanding of the basic pathology and pathophysiology of disease of the brain, spine, and head & neck including neoplastic and inflammatory lesions
- Become familiar with the use of contrast enhanced CT sequences (perfusion) for the detection of neuroradiological lesions
- Develop the ability to use imaging findings to differentiate different types of focal intracranial lesions based on anatomic location (e.g. intra- vs. extra-axial), contour, intensity and enhancement pattern
- Learn to identify and differentiate diffuse intracranial abnormalities (e.g. hydrocephalus and atrophy)
- Learn the vascular anatomy as displayed on CT angiography. Learn the indications, limitations, risks and benefits for each technique used for visualization of vascular anatomy
- Develop a more detailed understanding of causes of density changes on CT
- Become proficient at the assessment of the spine and contents of the spinal canal using CT, myelography

Patient Care and Procedural Skills

- Act as a consultant for referring clinicians, recommending appropriate imaging studies based on “ACR Appropriateness Criteria
- Assist technical staff in the performance of CT angiography and its interpretation
- Work in the reading room independently, assisting clinicians with radiologic interpretation and teaching residents and medical students assigned to chest radiology
- Act as a consultant for house staff and attending physicians in the Emergency Department
- Provide emergent provisional interpretations as needed
- Direct the choice of imaging modality and protocol emergent studies

Systems-based Practice

- Understand when referral to other imaging modalities is necessary
- Demonstrate the ability to obtain pertinent patient information relative to chest imaging examinations
- Acts as a consultant for referring clinicians, recommending appropriate imaging studies based on “ACR Appropriateness Criteria

Body Imaging Fellowship Goals and Objectives (continued)

Interpersonal and Communication Skills

Develop skills in consultation with house staff and referring physicians

Learn the appropriate format for dictation of CT reports

The report will include the following items at a minimum:

- I. Patient demographics
 - Name of patient, age or date of birth
 - Medical record number
 - Name or type of examination
 - Date and time (if relevant) of the examination
- II. Clinical information
- III. Comparison examination
- IV. Procedure and Material
 - The report will include description of the study or procedure performed, any contrast media or device used. Any significant patient reaction, or complication treatment and patient response is recorded.
- V. Findings: Precise anatomic and radiologic terminology is used to describe the findings
- VI. **Impressions:** Precise diagnosis is given wherever possible. A differential diagnosis when appropriate is given. When appropriate the impression should include follow up or additional diagnostic studies to clarify or confirm.

Communicate effectively with referring clinicians and supervisory staff

Demonstrate knowledge of the "ACR Standards for Communication,"

Demonstrate the ability to effectively present interesting cases at the radiology case conference to residents and faculty by choosing and showing appropriate interesting or quality assurance cases, interacting with residents and guiding them through the cases, and being prepared to present brief discussion of the diagnoses for each case.

Present interesting cases, with a confirmed diagnosis, correlating clinical history with pathology and imaging, to residents and faculty

Professionalism

• Provide emergent provisional interpretation as needed.

Demonstrate a responsible work ethic by:

1. reporting to work on time
2. providing consultation in time to effect appropriate patient care
3. not leaving an assigned area before the work is completed, or incomplete studies are appropriately handed off to the next radiologist on duty

Demonstrate the ability to identify those cases that require the additional expertise in assessment of imaging studies

Medical Knowledge

Recognize the CT appearance of the following pathology

ABDOMINAL CT

- Splenic and liver laceration
- Aortic dissection
- Aortic aneurysm and pseudoaneurysm
- Ascites
- Bowel perforation with free air
- Obstructive hydronephrosis due to ureteral calculus
- Bowel obstruction

Body Imaging Fellowship Goals and Objectives (continued)

- Active arterial extravasation
- Shock bowel
- Post traumatic urinary bladder leak
- Esophageal carcinoma
- Liver cancer
- Pancreas cancer
- Gastric cancer
- Renal Tumors
- Abdominal Lymphoma
- Retroperitoneal adenopathy
- Adrenal adenoma and myelolipoma
- Gallstones
- Cavernous hemangioma of the liver
- Cirrhotic liver
- Liver metastases
- Pancreatitis with pseudocyst
- Renal cystic disease
- CT artifacts
- Refine interpretive skills with complex pathology
- Colon carcinoma
- Be able to identify life-threatening findings, particular in trauma patients

Identify the CT appearance of the following pathology:

- Hepatic abscess
- Pancreatic abscess
- Renal abscess
- Groin pseudoaneurysm
- Biliary cancer
- Budd Chiari Syndrome
- Carcinomatosis with ascites
- Sequela of cryoablation
- Diaphragmatic hernia
- Interloop abscess
- Focal nodular hyperplasia of the liver
- Hepatocellular carcinoma
- Islet cell tumor of the pancreas
- Renal oncocytoma
- Complications of renal transplantation
- Cystic pancreatic neoplasm
- Portal hypertension and varices
- Retroperitoneal fibrosis
- Von Hippel Lindau Syndrome
- CT angiography
- Renal artery stenosis
- Accessory renal arteries
- Virtual colonoscopy

Body Imaging Fellowship Goals and Objectives (continued)

CHEST CT

At the end of the CHEST CT rotations, the FELLOW should know basic radiological presentation of;

- Normal anatomy of the chest in regard to heart, lungs, mediastinum, and bony thorax
- Identify the major anatomic structures of the chest and mediastinum on chest CT

Recognize normal vascular anatomy and pathological processes in the chest

- Interstitial lung disease
 - Alveolar lung disease
 - Monitoring and support devices – “tubes and lines”
 - Mediastinal masses
 - Solitary and multiple pulmonary nodules
 - Acute chest trauma
 - Chest wall, pleura and diaphragm
 - Upper lung zone disease
 - Atelectasis
 - Peripheral lung disease
 - Central and peripheral airways
 - Unilateral hyperlucent lung
 - Neoplasms of the lung
 - Immunocompromised lung disease
 - Congenital and acquired heart disease
 - Develop skills in protocoling, monitoring, and interpretation of HRCT scans
 - Identify a secondary pulmonary lobule on HRCT
 - Identify and give appropriate differential diagnoses when the patterns of septal thickening, perilymphatic nodules, bronchiolar opacities (“tree-in-bud”), air trapping, cysts and ground glass opacities are seen in HRCT
 - Identify the major anatomic structures of the chest and mediastinum on chest CT
- Recognize normal vascular anatomy and pathological processes in the chest

EMERGENCY CT

Emergency Radiology Curriculum

Adapted from the Society of Emergency Radiology Edited By R. A. Novelline, MD

Central Nervous System

Skull fractures

Brain

- Extra-axial hemorrhages: subdural and epidural hematoma
- Parenchymal injuries: cortical contusion, gray matter, brainstem
- Subarachnoid hemorrhage, Vascular injuries
- Penetrating injuries
- Herniation syndromes
- Cerebral infarction: arterial infarction, venous infarction,
- Diffusion perfusion imaging appearance Non-traumatic hemorrhage
- Subarachnoid, parenchymal hemorrhage
- Central Nervous System infections
- Meningitis, abscess/cerebritis, subdural empyema
- Dural sinus thrombosis
- Reversible posterior leukoencephalopathy syndrome
- Pituitary apoplexy

Face and Neck

Facial fractures

- Orbital fractures: blow-out fracture
- Zygoma, Isolated arch, zygomatic complex
- Nasal fractures, naso-orbital-ethmoid fractures

Body Imaging Fellowship Goals and Objectives (continued)

- Frontal fractures
- Maxillary fractures: dentoalveolar, maxillary sagittal, LeFort
- Mandible fractures
- Ocular injuries: rupture, cellulitis
- Paranasal sinusitis

Spine

Initial assessment issues = "Clearance" in the Emergency Department.

The evaluation of low-risk patients; high-risk patients (multitrauma), and patients with neurologic deficits

Concept and assessment of instability

Concept of: mechanism of injury, radiographic patterns, normal variants, frequent types of injuries

Cervical Trauma

- Cranio-cervical / C1-C2
- Occipital condyle fracture
- Atlanto-occipital dislocation / subluxation
- Jefferson burst fracture, C1 - posterior arch
- Dens fracture, Hangman's fracture
- Anterior subluxation / whiplash syndromes
- Hyperextension sprain / spinal cord injury without radiographic abnormalities
- Wedge compression, spinous process fractures
- Burst compression, flexion tear drop fracture, facet dislocation
- Articular mass and transverse process fractures
- Corner avulsion fracture (extension teardrop)
- Laminar fractures
- Facet dislocation with fracture

Thoraco-lumbar trauma

- Compression fracture, burst fracture
- Chance fracture, complex fracture-dislocation
- Pathological fracture, traumatic injuries to intervertebral disks
- Osteomyelitis / discitis, epidural abscess

Chest

Chest trauma

- Rib fractures, sternal and manubrial fractures
- Hemothorax, mediastinal hemorrhage
- Pneumothorax and pneumomediastinum
- Pulmonary contusion, laceration, hematoma
- Tracheobronchial injury
- Esophageal tear, diaphragm injury
- Pulmonary embolism
- Acute pulmonary infections
- Aspiration pneumonia
- Airway foreign bodies Obstructive airway disease
- ARDS: near-drowning, fat embolism syndrome
- Esophageal rupture

Body Imaging Fellowship Goals and Objectives (continued)

Cardiovascular Emergencies

Myocardium and Pericardium

- Myocardial infarction, laceration, contusion
 - Pericardial effusion, tamponade, pneumopericardium
- Aorta laceration, dissection, aneurysm
Pulmonary edema, various etiologies
Pulmonary embolism

Abdomen

- Abdominal Trauma
- Hemoperitoneum and intraperitoneal fluid
- Hemodynamic status assessment
- Retroperitoneal hemorrhage
- Gas collections: intraperitoneal and retroperitoneal
- Active arterial extravasation on CT
- Splenic and liver injuries
- Gallbladder and biliary injuries
- Bowel and mesenteric injuries
- Pancreatic injuries
- Renal and adrenal injuries
- Bladder injuries: intraperitoneal and extraperitoneal
- Abdominal wall injuries and diaphragmatic hernias

Non-traumatic Abdominal Emergencies

Peritoneal cavity

- Ascites, peritonitis, abdominal abscess
- Liver and biliary tract
- Jaundice: obstructive and non-obstructive
- Cholecystitis, pancreatitis
- Urinary tract
- Urinary stones, infection
- Pyelonephritis, renal abscess
- Gastrointestinal tract
- Gastrointestinal hemorrhage
- Bowel obstruction, bowel infarction, bowel infection
- Appendicitis, diverticulitis, Infectious enteritis and colitis
- Inflammatory bowel disease: Crohn disease, ulcerative colitis

Male Genitourinary emergencies

Urethral and penile trauma, foreign bodies, stones

Scrotal and testicular trauma

Acute non-traumatic scrotal conditions

- Acute fluid collections (Hydrocele, hematocele, pyocele)
- Infarction, Fournier's Gangrene
- Abscess

Upper Extremity

Dislocations:

- Scapulothoracic, Clavicle
- Sternoclavicular, Acromioclavicular, Glenohumeral, elbow

Body Imaging Fellowship Goals and Objectives (continued)

Fractures:

- Scapular fractures
- Humerus fractures
- Proximal (head & neck), Shaft, Supracondylar, intra articular, including unicondylar, bicondylar and capetellar
- Forearm fractures, wrist

Pelvis and Hip

Pelvis

Pelvic ring disruption. Disruption, ie., fracture or diastasis at two or more sites, the anterior and posterior pelvic arcs

- diffuse: open-book pelvic ring disruption
- vertical shear
- Types of pelvic ring disruption
- Malgaigne (ipsilateral)
- open - book

Insufficiency fractures, Stress fractures

Acetabular fractures (Involve only one side of the pelvic ring.

Posterior column (most common) rim, anterior column, both columns

Hip

Dislocation

- Posterior or posterosuperior pure fracture-dislocation. Fracture involves posterior or posterosuperior acetabular rim
- Anterior (obturator)

Fractures (usually associated with dislocation).

- Posterior or posterosuperior acetabular rim
- Anterior (Involve the acetabular "tear-drop")

Proximal femur

- Slipped capital femoral epiphysis (SCFE)
- Salter-Harris physeal injuries
- Fractures

Head - usually associated with hip dislocation

Neck - subcapital, transcervical, basicervical

Trochanteric, intertrochanteric

subtrochanteric, isolated fracture, greater trochanter

Avascular necrosis

Lower Extremity

Fractures:

- Femoral shaft, Patella fractures
- Tibial plateau, Tibial spine avulsion
- Tibial stress fractures, tibial and fibular shaft fractures
- Tibial plafond fracture (pilon fractures), ankle mortise injury,
- Tarsal fractures, metatarsal fractures, Toe fractures
- Knee dislocations, Tarsometatarsal fracture dislocations (Lisfranc.s fracture)
- Septic arthritis, Diabetic foot infections

Body Imaging Fellowship Goals and Objectives (continued)

Musculoskeletal CT (Non Trauma)

- Congenital and Developmental Abnormalities
- Joint Disorders
- Infection
- Tumors and Tumor-Like Lesions
- Basic metabolic, systemic, and hematological disorders

NEURORADIOLOGY CT

1. understand spinal anatomy as displayed on multiplanar images including reformatted helical CT scans
2. be able to diagnose and differentiate degenerative spinal diseases including disc herniations, spinal stenosis, endplate changes, and facet joint disease
3. be able to characterize traumatic lesions and identify signs of instability
 - be able to identify spinal cord compression and the cause for the compression (e.g. neoplastic involvement of the vertebral body, infection, and trauma)
 - Learn the imaging features that allow for spatial classification of spinal lesions (extradural, intra-dural extra-medullary, and intra-medullary)
 - Learn the differential diagnosis for pathology in each of the intra-spinal spaces
 - Be able to identify and characterize common inflammatory processes in the paranasal sinuses and mastoid bones
 - Identify common inflammatory and neoplastic mass lesions of the soft tissues of the neck and have knowledge of criteria for identification and differentiation of causes of cervical adenopathy
 - Develop the ability to accurately describe complex findings and generate comprehensive yet precise differential diagnoses of a variety of common and uncommon lesions of the brain, skull, and spine
 - Learn the imaging features of post-operative and post-radiation exams
 - Develop the ability to use neuroimaging studies to solve a broad range of clinical problems. Learn how to choose the appropriate study (e.g. CT vs. MR) and the appropriate protocol in a variety of clinical circumstances

Neuroradiology Suggested Reading

General Texts

- Diagnostic Neuroradiology - Anne G. Osborn, CV Mosby
- Handbook of Head and Neck Imaging, - H. Ric Harnsberger, CV Mosby
- MRI, the basics - Ray H. Hashemi and William G. Bradley, Williams and Wilkins

Reference Texts

- Magnetic Resonance Imaging of the Brain and Spine - Scott W. Atlas, Lippincott (Companion CD available)
- Head and Neck Imaging - Peter M. Som and Hugh D. Curtin, CV Mosby
- Pediatric Neuroimaging - A. James Barkovich, Raven Press Journals

CT ROTATION EVALUATION

At the end of each monthly rotation, the Fellow must have reviewed and read 160 CT

30 Chest CTs Non Trauma

30 Abdominal CTs Non Trauma

40 Trauma CTs (Abdomen, chest, CNS)

30 MSK CTs (15 Trauma and 15 Non trauma)

30 CNS CTs

Preliminary interpretations should be provided within 30 minutes of request and final interpretations within 24 hours. Significant error rate for preliminary reports should be less than 10%

Body Imaging Fellowship Goals and Objectives (continued)

Monthly evaluation should have scores of (2) at level expected for training or (3) above level expected. If not, a remedial learning plan will be developed by the Program Director.

Every 2 weeks during his rotation, the fellow will meet with the Fellowship director to review the log book in which the Fellow will provide the Accession number and the name of the Faculty who reviewed the CT.

MAGNETIC RESONANCE IMAGING

Goals and Objectives

Practice-based Learning and Improvement

- Understand the basic physics of MR including TR, TE, T1W, T2W, Spin echo, Gradient Recall Echo imaging, and Inversion Recovery.
- Learn the basic principles of contrast distribution, particularly as applied to arterial and venous phase scanning
- Understand the principle of a saline chaser
- Learn to recognize and treat contrast reactions
- Develop skills in interpretation of MR pathology
- Understand the principles of Magnetic Resonance angiography
- Demonstrate ability to identify life-threatening findings, particularly with aortic aneurysms and grafts
- Provide emergent provisional interpretation as needed

Systems-Based Practice

- Demonstrate ability to direct the choice of imaging modality and protocol emergent studies
- Understand when referral to other imaging modalities is necessary
- Assist technical staff in performance of CT angiography and its interpretation

Patient Care

- Protocol and monitor MR studies. Modify protocols when appropriate

Interpersonal and Communication skills

- Learn the appropriate format for dictation of MR reports

Medical Knowledge

Identify the MR appearance of the following pathology:

- Liver cancer
- Benign liver lesions such as cysts and hemangioma
- Pancreas cancer
- Lymphoma
- Retroperitoneal adenopathy
- Aortic Aneurysm
- Aortic Dissection
- Adrenal adenoma and cancer
- Gallstones
- Choledocholithiasis
- Ascites
- Cirrhotic liver

Body Imaging Fellowship Goals and Objectives (continued)

- Pancreatitis with pseudocyst and necrosis
- Renal cystic disease
- Obstructive hydronephrosis due to ureteral calculus
- Active arterial extravasation
- Hepatic abscess
- Pancreatic abscess
- Renal abscess
- Groin pseudoaneurysm.
- Biliary cancer
- Budd-Chiari Syndrome
- Carcinomatosis with ascites
- Sequela of cryoablation
- Diaphragmatic hernia
- Focal nodular hyperplasia of the liver
- Hepatocellular carcinoma
- Islet cell tumor of the pancreas
- Renal oncocytoma
- Cystic pancreatic neoplasm
- Renal hypertension and varices
- Retroperitoneal fibrosis
- Von Hippel Lindau Syndrome
- MR angiography of liver transplant candidates
- Renal artery stenosis
- Accessory renal arteries.
- Thoracic outlet syndrome
- Uterine fibroids
- Uterine anomalies
- Ovarian cysts
- Ovarian cancer
- Pelvic abscess
- Cardiac MR imaging including functional cardiac assessment
- Arrhythmogenic right ventricular dysplasia
- Cardiac perfusion imaging
- Myocardial viability
- Adult congenital heart disease
- Pediatric congenital heart disease
- Valvular heart disease

Musculoskeletal MRI

- Congenital and Developmental Abnormalities
- Congenital Hip Dysplasia
- Avascular Necrosis
- Slipped Capital Head
- Trauma
- Joint Disorders
- Internal derangement of the joints
- MRI Arthrography
- Infection
- Osteomyelitis
- Septic Arthritis
- Soft tissue abscess
- Tumors and Tumor-Like Lesions
- Basic metabolic, systemic, and hematological disorders

Body Imaging Fellowship Goals and Objectives (continued)

Neuroradiology MRI

- Become familiar with the complex anatomy of the orbit, petrous bone, skull base and soft tissues of the neck (supra- and infra hyoid) as displayed on MRI. Have knowledge of established anatomic classification systems for each of these areas.
- Develop a greater understanding of the basic pathology and pathophysiology of disease of the brain, spine, and head & neck including neoplastic and inflammatory lesions
- Become familiar with the use of MR sequences (diffusion, perfusion, and MR spectroscopy) for the detection of these lesions
- Develop the ability to use imaging findings to differentiate different types of focal intracranial lesions based on anatomic location (e.g. intra- vs. extra-axial), contour, intensity and enhancement pattern
- Learn to identify and differentiate diffuse intracranial abnormalities (e.g. hydrocephalus and atrophy)
- Learn the vascular anatomy of the neck and head as displayed on MR angiography. Learn the indications, limitations, risks and benefits for each technique used for visualization of vascular anatomy
- Develop a more detailed understanding of causes of SIGNAL INTENSITY changes on MRI
- Become proficient at the assessment of the spine and contents of the spinal canal using MRI, myelography
 1. understand spinal anatomy as displayed on multiplanar
 2. be able to diagnose and differentiate degenerative spinal diseases including disc herniations, spinal stenosis, endplate changes, and facet joint disease
 3. be able to characterize traumatic lesions and identify signs of instability
- be able to identify spinal cord compression and the cause for the compression (e.g. neoplastic involvement of the vertebral body, infection, and trauma)
- Learn the imaging features that allow for spatial classification of spinal lesions (extradural, intra-dural extra-medullary, and intra-medullary)
- Learn the differential diagnosis for pathology in each of the intra-spinal spaces
- Be able to identify and characterize common inflammatory processes in the paranasal sinuses and mastoid bones
- Identify common inflammatory and neoplastic mass lesions of the soft tissues of the neck and have knowledge of criteria for identification and differentiation of causes of cervical adenopathy
- Develop the ability to accurately describe complex findings and generate comprehensive yet precise differential diagnoses of a variety of common and uncommon lesions of the brain, skull, and spine
- Learn the imaging features of post-operative and post-radiation exams

Body MR suggested Reading:

Body MRI:

1. Abdominal-Pelvic MRI. Semelka. Wiley-Liss. 2002
2. Body MRI. Siegelman. Saunders. 2005
3. Clinical Magnetic Resonance Imaging. Saunders. 3rd Edition. 2006
4. CT and MRI of the Abdomen and Pelvis: A Teaching File. Ros. Williams and Wilkins. 1997
5. Magnetic Imaging Review. Lippincott Williams. Wheeler. March 1996
6. Magnetic Resonance Imaging. Stark. Mosby. 1999
7. Magnetic Resonance Imaging of the Body. Higgins. November 1996
8. Pocket Atlas of MRI Body Anatomy. Berquist. August 1995
9. Primer on MR Imaging of the Abdomen and Pelvis. Martin. Wiley. 2005
10. Sectional Anatomy by MRI. 2nd Edition. El-Khoury. Churchill-Livingstone. 1995
11. Variants and Pitfalls in Body Imaging. Shirkhoda. Lippincott. 1999

Cardiac MRI:

1. Cardiac Imaging. The Requisites. Miller. Saunders. 2005
2. Cardiovascular Magnetic Resonance. Manning. Saunders. 2002
3. Cardiovascular MRI and MRA. Higgins. Lippincott Williams. Sept. 2002

Body Imaging Fellowship Goals and Objectives (continued)

4. Cardiovascular MR Imaging: Physical Principles to Practical Protocols. Lee. Lippincott Williams December 2005
5. Clinical Cardiac MRI. Bogaert. Springer. 2005
6. MRI and CT of the Cardiovascular System. Higgins. Oct 2005

MRI Physics:

1. How does MRI Work? Weishaupt. Springer.2003
2. Magnetic Resonance Imaging: Physical Principles and Sequence Design. Haacke. Wiley, 1999
3. MRI Principles. Mitchell and Cohen. Saunders. 2004
4. MRI: The Basics. Hashemi. Lippincott Williams. Sept 2003
5. Questions and Answers in Magnetic Resonance Imaging. Elster. Mosby. 2001

Neuroradiology Suggested Reading

General Texts

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- Head and Neck Imaging - Peter M. Som and Hugh D. Curtin, CV Mosby
- Pediatric Neuroimaging - A. James Barkovich, Raven Press

EVALUATION

At the end of each monthly rotation, the Fellow must have reviewed and read 80 MRIs.

- 10 Chest and Cardiac
- 10 Abdominal MRIs
- 30 CNS (15 Head; 15 Spine)
- 30 MSK MRIs (15 Trauma and 15 Non trauma)

Preliminary interpretations should be provided within 30 minutes of request and final interpretations within 24 hours. Significant error rate for preliminary reports should be less than 10%

Monthly evaluation should have scores of (2) at level expected for training or (3) above level expected. If not, a remedial learning plan will be developed by the Program Director.

Every 2 weeks during his rotation, the fellow will meet with the Fellowship director to review the log book in which the Fellow will provide the Accession number and the name of the Faculty who reviewed the MRIs.

Body Imaging Fellowship Goals and Objectives (continued)

ULTRASOUND

Each fellow will have 4 one-month rotations through ultrasound. In addition to observing, interpreting, and providing consultation on procedures, each fellow is expected to gain proficiency in performing US examinations. The fellow will keep a log of those examinations performed and review the log with the attending radiologist every 2 weeks during each rotation. Fellows are expected to perform at least 200 ultrasound examinations during their rotation.

Fellows are expected to read and dictate 240 ultrasound exams monthly:

- 50 Obstetric Ultrasounds
- 50 Abdominal Ultrasounds
- 50 Pelvic Ultrasounds
- 30 Scrotal Ultrasounds
- 30 Vascular Ultrasounds
- 30 Small Parts Ultrasounds (Salivary Gland, Thyroid, MSK, Superficial Soft Tissues)

Preliminary interpretations should be provided within 30 minutes of request and final interpretations within 24 hours. Significant error rate for preliminary reports should be less than 10%

The Log book with the accessions numbers and the name of the faculty member who reviewed the exams will be evaluated biweekly by the Fellowship supervisor.)

Practice-Based Learning and Improvement

- At the end of the rotations, the fellow should be able to:
- Discuss the ultrasound procedures and findings in
 - gallbladder/biliary tree ultrasound
 - o cholelithiasis
 - o cholecystitis
 - renal ultrasound
 - o obstruction
 - o renal failure
 - duplex Doppler
 - o venous thrombosis of extremities
- Understand anatomic relationships and be able to individually image intra-abdominal organs-liver, spleen, kidneys, gallbladder, biliary tree, aorta, IVC
- Be familiar with common intra-abdominal pathology
- Understand basic ultrasound physics and its clinical applications
- Demonstrate ability to turn on a machine, select the appropriate exam program and transducer, enter patient data and annotate images
- Understand basic Doppler and vascular principles to interpret extremity DVT studies and flow (i.e. portal vein thrombosis)
- Identify and localize fluid collections in the chest, abdomen and pelvis for aspiration
- Given an ultrasound case, make a preliminary review of the images and advise the sonographers when additional views or repeat views are needed
- Make preliminary decisions on all matters of interpretation and consultation and recognize the need to obtain assistance in situations that require immediate expertise of the faculty radiologist
- Decide on the appropriateness of procedures
- Schedule procedures
- Demonstrate ability to run the entire US service – QA all exams, supervise residents or medical students, sonographers; check exams for adequacy, appropriateness, add or subtract exams, etc.

Body Imaging Fellowship Goals and Objectives (continued)

Patient Care and Procedural Skills

- Perform basic abdominal ultrasound
 - Advise the sonographer about special views or specific parameters of the study that require special attention
 - Perform pelvic, scrotal, thyroid, and DVT (upper and lower extremity) exams
- Assist in interventional procedures guided by ultrasound; demonstrating appropriate patient interaction and knowledge of safety precautions
- Become adept at performance of doppler examinations, including carotids, extremities, abdomen, renal and liver transplants
 - Become proficient in endocavitary scanning (transvaginal, transrectal)
- Perform interventional procedures guided by ultrasound
- Become familiar with specialty US exams; transcranial doppler, penile doppler, shunt and fistulae exams, intra-operative US, endoluminal (GI)US, and contrast US exams

Medical Knowledge

- Demonstrate thorough knowledge of the ultrasound procedure through performing or assisting the sonographer with performance of the following studies:
 - liver/biliary tree
 - o biliary obstruction
 - o tumors
 - o transplant evaluation
 - pancreas
 - o inflammatory processes
 - o tumors
 - renal
 - o tumors
 - o inflammatory processes
 - pelvis
 - o uterine leiomyoma
 - o ovarian neoplastic disease
 - o non-neoplastic disease
 - small parts transducer scans
 - o thyroid, scrotal, etc.

Systems-Based Practice

- Learn basic US triage – which exams should be performed by US, and which by another modality, i.e. MRI, CT
- Review all scans as they are performed for significant findings that require prompt attention

Interpersonal and Communication Skills

- Assist with the preparation and presentation of cases for the ultrasound/imaging conference
- Discuss cases with the medical students and residents on rotation in ultrasound during the reading session
- Prepare cases for the monthly Quality Assurance (QA) and teaching file and present them at the Ultrasound

Quality Assurance Conference

- Demonstrate appropriate interactive skills with patients and staff.
- Provide preliminary reports on routine abdomen/pelvis/extremity cases
 - Make decisions in regard to notification of the referring physician, if the faculty radiologist is not available for consultation

Body Imaging Fellowship Goals and Objectives *(continued)*

- Discuss all aspects of ultrasound imaging, including indications, pathology, and correlative studies used for each examination
- Discuss with medical students and residents, anatomical findings, pathology and reasons for doing the study,
- Evaluate and read-out all US exams performed on service – pre-dictate routine cases

Professionalism

Demonstrate ability to interact appropriately with patients, staff, and referring physicians

Recommended Reading List

- Diagnostic Ultrasound by Carol M Rumack
 - o *Abdominal Ultrasound chapters*
- Ultrasound: The Requisites by Middleton
- Ultrasound Secrets by V Dogra, D Rubens
- Ultrasound Secrets by V Dogra, D Rubens
- Ultrasound in OB & Gynecology by Callen
- Vascular Ultrasound by Zweibel, et al
- Specific articles as needed from Radiology, AJR, JUM pertinent to topics

OBSTETRICAL AND PELVIC ULTRASOUND

In addition, following rotation in obstetrical and gynecological ultrasound, the fellow should understand and be able to discuss:

Basic physical principles of medical ultrasound:

1. Relevant principles of acoustics, attenuation, absorption, reflection and speed of ultrasound;
2. Biological, thermal and non-thermal effects of pulsed and continuous wave ultrasound beams;
3. Basic operating principles of ultrasound equipment, Doppler and color Doppler imaging and signal processing;
4. How to interpret and avoid artifacts;
5. The principles of measuring, storage and analysis of the ultrasound and Doppler data.

Behavioral Objectives

Gynecology and Human Reproduction:

Obstetrics:

1. Investigation of early pregnancy (measurement of the gestational sac, yolk sac, embryonic pole, crown-rump length of the fetus, detection of multiple pregnancy and evaluation of the chorionicity and amnionicity);
2. Evaluation of the fetal anatomy and embryonic-fetal biometry;
3. Detection of fetal viability;
4. Measurement of the nuchal translucency, detection of cystic hygroma;
5. Ultrasound features of early pregnancy failure, threatened abortion, missed abortion, anembryonic pregnancy, and chorionic trophoblastic disease (e.g. hydatidiform mole);
6. Ultrasound features of different sites of ectopic pregnancy; correlation of the biochemical and ultrasound data;
7. Assessment of the amniotic fluid (estimation of the amniotic fluid volume), umbilical cord (number of cord vessels, presence of the cysts, coiling) and placenta (location and morphology); evaluation of the cervix (length, shape);

Body Imaging Fellowship Goals and Objectives (continued)

8. Assessment of the fetal anatomy at 18 to 22 weeks (shape of the skull, assessment of the face and profile, brain structures – cerebral ventricles, cisterna magna, choroid plexus; longitudinal and transverse assessment of the fetal spine; evaluation of the head size and position, heart rate and rhythm, four chamber view; outflow tract; thorax (size and morphology of fetal lungs) and abdomen (with emphasis to outer shape and continuity of the abdominal wall); abdomen: visualization of the stomach, liver, kidneys, urinary bladder and umbilicus; limbs: femur, tibia, humerus, radius, ulna, hands, and feet, evaluation of bone echogenicity, shape and movement of the extremities;
9. Detection, evaluation, differential diagnosis, epidemiology and natural history of structural and functional fetal anomalies of the – skeletal system, central nervous system, cardiovascular system, anomalies of the intrathoracic cavity, renal and gastrointestinal system, abdominal wall and diaphragm.
10. Detection of the ultrasound markers of chromosomal abnormalities;
11. Detection of the functional abnormalities, such as amniotic fluid abnormalities (polyhydramnios, oligohydramnios, fetal hydrops)
12. Perform fetal biometry (assessment of the fetal size, including biparietal diameter, head circumference, abdominal circumference, and femur length);
13. Perform the measurements of the central nervous system to diagnose cranial anomalies; anterior/posterior horn of the lateral ventricle, transcerebellar diameter;
14. Estimation of the gestational age;
15. Assessment of the fetal growth and fetal weight estimation;
16. Perform and interpret biophysical profile; analysis of fetal body movements, fetal breathing, heart rate and rhythm, eye movements, breathing movements;
17. Use Doppler for assessment of the blood flow velocity measurements and waveform analysis of normal and complicated pregnancies (e.g. intrauterine growth retardation);
18. Clinical implications of Doppler studies in monitoring rhesus iso-immunization and diabetic pregnancy; detection and follow-up of twin-to-twin transfusion syndrome.

Research

The fellowship curriculum includes four weeks of equivalent time for imaging research. This may be obstetrical and pelvic ultrasound research under the supervision of Dr. Kupescic. During this time, they will learn:

- 1) effective means to peruse the scientific literature for background material,
- 2) methods to establish an hypothesis and research design,
- 3) means to pursue assistance in statistical analysis of results, and
- 4) development of an appropriate discussion and conclusion

If ultrasound research is selected, the fellow will learn advanced obstetrical and pelvic imaging skill in the use of Doppler and 3-D imaging

As a demonstration of completion of this research, the fellow is required to present the results in an assigned Grand Rounds session and is to prepare the research study for poster or paper presentation at a local, regional, or national meeting. Peer-reviewed publication is expected.

Evaluations

Evaluation and Competency of Fellow

- Evaluation is primarily based on the fellow's understanding of disease processes, anatomy, imaging and procedural skills, in keeping with the level of training
- Evaluation of the fellow will include, but is not limited to, attendance, number and quality of reports, performance at image interpretation sessions, participation in conferences, observation of technical skills, and feedback from staff, and residents
- Evaluations are based on the six competencies as required by the ACGME.
 - o Professionalism
 - o Medical Knowledge
 - o Patient Care

Body Imaging Fellowship Goals and Objectives (continued)

- o Interpersonal and Communication Skills
- o Practice-Based Learning and Improvements
- o System-Based Practice

Fellows are expected to participate in the 360 ° evaluation process via the currently used program. In this process, they are given the opportunity to evaluate residents on their service.

Monthly evaluation should have scores of (2) at level expected for training or (3) above level expected. If not, a remedial learning plan will be developed by the Program Director.

APPENDIX I

GENERAL COMPETENCIES IN RADIOLOGY TRAINING

DEFINITIONS, SKILLS, EDUCATION AND ASSESSMENT

Prepared by the Association of Program Directors in Radiology (APDR) Education Committee, January 2002

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Introduction

The Accreditation Council for Graduate Medical Education (ACGME) Outcome Project is a long-term initiative by which the ACGME is increasing emphasis on educational outcomes in the accreditation of residency programs (<http://www.acgme.org>). The impetus for this project is based on a system of medical education that relies heavily on public funding and is therefore accountable to the public in terms of meeting public needs and preparing well-qualified new physicians in the most cost-effective way possible. The current model of accreditation focuses on the potential of a residency program to educate residents (i.e. whether the program complies with the requirements, has established objectives and an organized curriculum, and evaluates the residents and it). However, measuring program quality by examining structure and process is not a direct or complete measure of the quality of the educational outcomes of a program. In the future, accreditation will focus on actual accomplishments of a program, through assessment of program outcomes (i.e. whether the residents achieve the learning objectives set by the program, whether the program provides evidence of this achievement, and whether the program demonstrates continuous improvement in its educational process). The ACGME Outcome Project Advisory Committee identified six general competencies that were subsequently endorsed by the ACGME in February 1999. They are patient care, medical knowledge, practice based-learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice. All Residency Review Committees (RRCs) must include minimum language regarding the general competencies and evaluation processes in their respective Program Requirements by July 2002. A major activity of the Outcome Project was the identification and development of measurement tools for programs to use as part of an overall evaluation system. The ACGME and the American Board of Medical Specialties (ABMS) collaborated on the development of a "Toolbox" (<http://www.acgme.org>) of assessment methods. The Toolbox (© Copyright 2000 Accreditation Council for Graduate Medical Education and American Board of Medical Specialties, Version 1.1, September 2000) includes descriptions of instruments recommended for use by programs as they assess the outcomes of their educational efforts. In addition to a description, the Toolbox includes information pertaining to the use, psychometric qualities, and feasibility/practicality of different assessment methods.

A radiology "quadric", composed of representatives from the Radiology RRC (including a resident member of the RRC), the American Board of Radiology, and the Association of Program Directors in Radiology (APDR) was formed in the spring of 2000 to interpret the six competencies as they relate to radiology, and choose evaluation methods from the ACGME/ABMS Toolbox that are most appropriate for evaluating radiology resident competence. As an extension of the work done by the quadric, the APDR Education Committee developed and adopted the following descriptions of the six competencies, outlining for each the definition of the competency, resident skills and education related to the competency and assessment of resident competence.

PATIENT CARE AND PROCEDURAL SKILLS: Provide patient care that is compassionate, appropriate and effective

Skills

- Gather essential and accurate information about patients
- Develop a diagnostic plan based upon the clinical question/s and relevant clinical, radiologic and pathologic information
- Oversee diagnostic imaging to ensure adequacy of studies performed
- Counsel patients concerning preparation for diagnostic testing
- Demonstrate a basic understanding of electronic patient information systems
- Demonstrate the ability to use the Internet as an educational instrument to expand medical knowledge
- Demonstrate knowledge of the levels of ionizing radiation related to specific imaging procedures and employ measures to minimize radiation dose to the patient
- Perform radiologic examinations appropriately and safely, assuring that the correct examination is ordered and performed

Education (with graduated faculty supervision and feedback)

- Practical experience in developing a differential diagnosis and management plan based upon clinical data, imaging findings and other medical test results
- Active participation in journal reviews to determine the effectiveness of diagnostic imaging for specific diagnostic questions
- Graduated responsibility in performing radiologic procedures
- Didactic instruction in radiation safety
- Preparation and presentation of radiologic cases to other members of the health care team

Assessment

- Global ratings by faculty
- 360 degree examination
- Procedure log

MEDICAL KNOWLEDGE: Residents must demonstrate knowledge about established and evolving biomedical and clinical sciences and the application of this knowledge to patient care.

Skills

- Demonstrate sufficient knowledge of medicine and apply this knowledge to radiological studies in a clinical context to generate meaningful differential diagnoses
- Demonstrate progressive acquisition of radiological knowledge
- Demonstrate knowledge of the principles of research design and implementation
- Generate a clinically appropriate diagnostic treatment plan
- Demonstrate the ability to use all relevant information resources to acquire evidence-based data
- Understand how radiologic equipment can be used to generate appropriate and diagnostic images

Education

- Didactic lectures and self-directed learning on the science and practice of radiology
- Participation in departmental and inter-departmental case conferences
- Participation in the clinical activities of the radiology department
- Departmental or institutional training programs on research design and implementation

Assessment

- Global ratings by faculty
 - Program-developed written examinations
 - ACR in-training examination
 - ABR Core (Qualifying) examination
 - RadExam examination
 - RadPrimer assignments
- Recall examinations

INTERPERSONAL AND COMMUNICATION SKILLS: Residents must demonstrate interpersonal and communication skills that result in effective information exchange with patients, patient family members, medical students, other residents, supervising faculty, referring physicians, technologists, nurses and other members of the health care team.

Skills

- Provide a clear and informative written radiologic report including a precise diagnosis whenever possible, a differential diagnosis when appropriate, and recommended follow-up or additional studies when appropriate
- Provide direct communication to the referring physician or appropriate clinical personnel when interpretation reveals an urgent or unexpected finding and document this communication in the radiologic report
- Demonstrate effective skills of face-to-face listening and speaking with physicians, patients, patients families and support personnel
- Demonstrate appropriate telephone communication skills
- Demonstrate skills in obtaining informed consent, including effective communication to patients of the procedure, alternatives and possible complications

Education (with graduated faculty supervision and feedback)

- Participation as an active member of the radiology team by communicating face-to-face with clinicians, answering the telephone, providing consults, problem solving and decision-making
- Act as the contact person for technologists and nurses in managing patient and imaging issues
- Active participation in preparing and moderating multi-disciplinary conferences
- Practical experience in dictating radiological reports

Assessment

- Global ratings by faculty
- 60° evaluations
- Record review (systematic evaluation of resident dictations)

PROFESSIONALISM: Demonstrate a commitment to carrying out professional responsibilities, adherence to ethical principles, and sensitivity to a diverse patient population.

Skills

- Demonstrate altruism (putting the interests of patients and others above own self-interest)
- Demonstrate compassion: be understanding and respectful of the patients, patient families, and staff and physicians caring for patients
- Demonstrate excellence: perform responsibilities at the highest level and continue active learning throughout one's career
- Be honest with patients and all members of the health care team
- Demonstrate honor and integrity: avoid conflicts of interest when accepting gifts from patients or vendors
- Interact with others without discriminating on the basis of religious, ethnic, sexual or educational differences and without employing sexual or other types of harassment
- Demonstrate knowledge of issues of impairment (i.e. physical, mental and alcohol and substance abuse), obligations for impaired physician reporting, and resources and options for care of self impairment or impaired colleagues
- Demonstrate positive work habits, including punctuality and professional appearance
- Demonstrate an understanding of broad principles of biomedical ethics
- Demonstrate principles of confidentiality with all information transmitted during a patient encounter
- Demonstrate knowledge of regulatory issues pertaining to the use of human subjects in research

Education

- Discussion of conflicts of interest and the ethics of conducting research during departmental or institutional conferences and daily clinical work
- Training programs (i.e. videotapes) on the issues of harassment and discrimination.
- Didactic presentations on the recognition and management of the "impaired physician"
- Participation in hospital-sponsored core curriculum educational activities (i.e. lectures, web-based programs)
- Didactic lecture/training program on the broad principles of medical ethics
- Institutional web-based self-directed learning and assessment programs on human subjects research guidelines

Assessment

- Global ratings by faculty
- 360° evaluations
- Conference attendance logs
- Resident self-assessment

PRACTICE-BASED LEARNING AND IMPROVEMENT: Residents must be able to investigate and evaluate their patient care practices, and appraise and assimilate scientific evidence in order to improve their radiologic practices.

Skills

- Analyze practice experience and perform practice-based improvement in cognitive knowledge, observational skills, formulating a synthesis and impression, and procedural skills
- Demonstrate critical assessment of the scientific literature
- Demonstrate knowledge of and apply the principles of evidence-based medicine in practice
- Use multiple sources, including information technology to optimize life-long learning and support patient care decisions
- Facilitate the learning of students, peers and other health care professionals

Education

- Participate in critical assessment of the scientific literature through journal clubs, clinical conferences and independent learning
- Didactic lectures on the assessment of scientific literature, study designs and statistical methods
- Teaching students, peers and other health care professionals, with graduated supervision and feedback from supervising faculty
- Active participation in departmental or institutional quality assurance (QA)/quality improvement (QI) activities with faculty supervision

Assessment

- Global ratings by faculty
- ACR in-service examination
- ABR Core examination
- QI/PI conference attendance
- Global ratings by students
- Procedure log

SYSTEMS-BASED PRACTICE: Demonstrate an awareness and responsiveness to the larger context and system of health care and the ability to effectively call on system resources to provide optimal care.

Skills

- Demonstrate the ability to design cost-effective care plans based on knowledge of best practices
- Demonstrate knowledge of the sources of financing for U.S. health care including Medicare, Medicaid, the Veteran's Affairs and Department of Defense, public health systems, employer-based private health plans, and patient's own funds
- Demonstrate knowledge of basic health care reimbursement methods
- Demonstrate knowledge of the regulatory environment including state licensing authority, state and local public health rules and regulations, and regulatory agencies such as Centers for Medicaid and Medicare Services (CMS) and Joint Commission for the Accreditation of Healthcare Organizations (JCAHO)
- Demonstrate knowledge of basic practice management principles such as budgeting, record keeping, medical records, and the recruitment, hiring, supervision and management of staff

Education

- Systematic review of appropriate literature, including current American College of Radiology (ACR) Appropriateness Criteria, to develop knowledge of evidence based indications for imaging procedures
- Attendance and active participation in departmental and multi-disciplinary conferences where there is discussion of the imaging evaluation of specific diseases and most appropriate and cost-effective methods for establishing a diagnosis
- Interaction with department administrators and knowledgeable faculty to gain an understanding of the costs of diagnostic examinations and the influence of the type of payer system on reimbursement
- ACR/APDR non-interpretive skills videotapes
- Membership and active participation in local and national radiological societies
- Departmental or institutional presentations on health care funding and regulation

Assessment

- Global ratings by faculty
- ABR Core examination
- ACR in-training examination
- Multi-disciplinary conference attendance
- Documented membership and participation in radiologic societies and other health care organizations

Appendix

Descriptions of Selected Assessment Methods

360° evaluation. 360° evaluations consist of measurement tools completed by multiple people in a person's sphere of influence. Evaluators can include superiors, peers, subordinates, patients, and patient families. Most 360° evaluation processes use a survey or questionnaire to gather information about an individual's performance on several topics (e.g. teamwork, communication, management skills, decision-making), and use rating scales to assess how frequently a behavior is performed. Reproducible results are most easily obtained when five to ten nurses rate a resident, while a greater number of faculty and patients are needed for the same degree of reliability.

Global ratings. Global rating forms are distinguished from other rating forms in that a rater judges general categories of ability (e.g. patient care skills, medical knowledge, interpersonal and communication skills) instead of specific skills, tasks or behaviors. The ratings are completed retrospectively based on general impressions collected over a period of time (e.g. at the end of a clinical rotation) derived from multiple sources of information (e.g. direct observations or interactions; input from other faculty, residents, or patients; review of work products or written materials). Typical rating scales consist of qualitative indicators and often include numeric values for each indicator. Written comments are important to allow evaluators to explain the ratings. Scores can be highly subjective when raters are not well trained. Sometimes all competencies are rated the same regardless of performance. Reproducibility is easier to achieve for ratings of knowledge and more difficult to achieve for patient care and interpersonal and communication skills.

Procedure case logs. Procedure logs document each patient encounter by medical conditions seen, procedure performed, and complications. Regular review of logs can be used to help residents track what cases or procedures must be completed in order to meet residency requirements or specific learning objectives. Logs documenting experience for the entire residency can serve as a summative report of that experience, but the numbers do not necessarily indicate competence.

Record review. Trained persons (e.g. radiology faculty members) perform a review of patient records produced by the resident (e.g. dictations). A checklist of predefined criteria can be used to abstract information from the records. The record review can provide evidence about observational, synthesis, management and communication skills.

Standardized oral examination. The standardized oral examination is a type of performance assessment using realistic radiologic cases with a trained radiologist questioning the examinee. Resident skills in observation, synthesis and management can be assessed. Fifteen of the 24 American Board of Medical Specialties (ABMS) Member Boards use standardized oral examinations as the final examination for initial certification. "mock orals", that use cases but with much less standardization compared to board oral examinations, are often used in residency training programs to help familiarize residents with the oral examinations conducted for board certification.

Standardized written examination. A written or computer-based examination is composed, usually, of multiple-choice questions (MCQ) to sample medical knowledge and understanding of a defined body of knowledge, not just factual or easily recalled information. The examination can include image interpretation items. Medical knowledge and understanding can be measured by MCQ examinations. Comparing the test scores on in-training examinations with national statistics can serve to identify strengths and limitations of individual residents to help them improve. Comparing test results aggregated for residents in each year of a program can be helpful to identify residency training experience that might be improved. All of the 24 ABMS Member Boards use MCQ examinations for initial certification.

ACGME GENERAL COMPETENCIES

PATIENT CARE AND PROCEDURAL SKILLS

COMPETENCY DEFINITION

PRACTICE PERFORMANCE MEASUREMENTS

Provide patient care through safe, efficient, appropriately utilized, quality-controlled diagnostic and/or interventional radiology techniques and effectively communicate results to the referring physician and/or other appropriate individuals in a timely manner.

- Global faculty evaluation (to include evaluation of knowledge about safety issues such as radiation dose, MRI safety, correct patient- exam-site verification, use of standard abbreviations)
- Case/procedure logs (to be included in the resident learning portfolio)
- OSCE (Objective Standardized Clinical Examination) or direct observation of selected procedures and other critical processes (such as obtaining informed consent)
- 360 degree evaluations

MEDICAL KNOWLEDGE

COMPETENCY DEFINITION

PRACTICE PERFORMANCE MEASUREMENTS

Engage in continuous learning using up to date evidence and apply appropriate state of the art diagnostic and/or interventional radiology techniques to meet the imaging needs of patients, referring physicians and the health care system

- Global faculty evaluation (which includes the 6 competencies)
- Yearly objective test (e.g., mock oral boards, ABR in-service test, ABR written examination)
- Resident learning portfolio (including documentation of conferences attended, courses attended, self-assessment modules completed, etc.)
- Journal club to evaluate skills in accessing, interpreting and applying best evidence in the radiology literature to patient care.

PRACTICE-BASED LEARNING AND IMPROVEMENT

COMPETENCY DEFINITION

PRACTICE PERFORMANCE MEASUREMENTS

Participation in evaluation of one's personal practice utilizing scientific evidence, "best practices" and self-assessment programs in order to optimize patient care through lifelong learning.

- Global faculty evaluation
- Resident learning portfolio (to include utilization of self-assessment modules)
- Documentation of participation in departmental QI/QA and regulatory activities

INTERPERSONAL AND COMMUNICATION SKILLS

COMPETENCY DEFINITION

PRACTICE PERFORMANCE MEASUREMENTS

Communicate effectively with patients, colleagues referring physicians and other members of the health care team concerning imaging appropriateness, informed consent, safety issues and results of imaging tests or procedures.

- Global faculty evaluation
- 360 degree evaluations
- Evaluation of quality of reports
- OSCE or direct observation of communication issues (e.g., informed consent, speaking with patients about adverse events or outcomes of imaging tests, consultation with referring clinicians)

PROFESSIONALISM

COMPETENCY DEFINITION

PRACTICE PERFORMANCE MEASUREMENTS

Commit to high standards of professional conduct, demonstrating altruism, compassion, honesty and integrity.

Follow principles of ethics and confidentiality and consider religious, ethnic, gender, educational and other differences in interacting with patients and other members of the health care team

- Global faculty evaluation
- 360 degree evaluations
- Verify status of medical license, if appropriate
- Documentation of compliance with institutional and departmental policies (e.g., conference attendance, HIPPA, JCAHO, dress code)

SYSTEMS-BASED PRACTICE

COMPETENCY DEFINITION PRACTICE PERFORMANCE MEASUREMENTS

Understand how the components of the local and national healthcare system function interdependently and how changes to improve the System, involve group and individual efforts.

Optimize coordination of patient care both within one's own practice and within the healthcare system. Consult with other healthcare professionals, and educate healthcare consumers, regarding the most appropriate utilization of imaging resources.

- Global faculty evaluation
- Documentation of resident participation in analysis of systems-based problem
- Resident learning portfolio (to include documentation of active participation in multidisciplinary conferences)

APPENDIX II

Diagnostic Imaging Services

RADIOLOGY CRITICAL/URGENT/IMPORTANT FINDINGS LIST

CRITICAL FINDINGS: Immediate life or limb threatening emergencies. Within 30 minutes of recognition the radiologist will communicate directly with the clinician and document the person, date, time and method of communication (phone or in person only) in the radiology report.

1. Tension pneumothorax
2. Large volume pulmonary embolus affecting several segmental branches, saddle pulmonary embolus, or any pulmonary embolus with right heart strain
3. Acute stroke
4. Acute subdural, epidural or subarachnoid hemorrhage
5. Brain herniation from any cause
6. Acute aortic dissection
7. Acute aortic or major vessel injury
8. Aortic rupture or impending aortic rupture
9. Pneumoperitoneum of unknown cause (not recently post-operative)
10. Unstable vertebral fracture
11. Large pericardial effusion
12. Ectopic pregnancy (visualized ectopic in adnexa)

URGENT FINDINGS: Within 4 hours of recognition the radiologist will communicate directly with the clinician and document the person, date, time and method of communication (phone or in person only) in the radiology report.

1. Acute appendicitis
2. Acute diverticulitis
3. Acute cholecystitis
4. Intrathoracic or intraabdominal abscess
5. Acute osteomyelitis
6. Impending proximal femur fracture
7. Deep venous thrombosis
8. Subchorionic hemorrhage > 50% of surface diameter for gestation > 23 weeks old.
9. Pregnancy of unknown location
10. Cord compression/cauda equina compression

IMPORTANT FINDINGS: Within 7 days of recognition the radiologist will communicate with the clinician and document the person, date, time and method of communication (if not direct communication there must be acknowledgement of receipt of the important finding by the clinician) in the radiology report.

1. Unsuspected malignant neoplasm at any location
2. Unexplained foreign body

APPENDIX III

Physician Short Stay Form (48 hours or less)

Chief Complaint	SUMMARY OF THERAPY/ TREATMENT	
Present Illness:		
Past History		
Social History:		
Family History		
Review of Systems:		
PHYSICAL EXAMINATION		
General Appearance: <input type="checkbox"/> Nutrition <input type="checkbox"/> Pallor		
Head, Eyes, Ears, Nose, Throat:		
Heart:		
Is murmur present?		
Lungs:		
Are respirations normal?		
Rales <input type="checkbox"/> Dullness <input type="checkbox"/>		
Abdomen:	DISCHARGE INSTRUCTIONS & DISPOSITION:	
Distension:		
Is spleen enlarged? <input type="checkbox"/> Is liver enlarged? <input type="checkbox"/>		
Adenopathy:		
Neck:		
Axilla: <input type="checkbox"/> Groin: <input type="checkbox"/>	FINAL DIAGNOSIS:	
Genitalia:		
Extremities		
Bones and Joints:		
Resident Printed Name:	Resident Printed Name:	
Signature: _____ Date/Time: _____	Signature: _____ Date/Time: _____	
Attending Printed Name:	Attending Printed Name:	
Signature: _____ Date/Time: _____	Signature: _____ Date/Time: _____	

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Physician Short Stay Form (48 Hours or Less)



768-001-04 (reviewed2/19) (b/w 8.5x11.#20w.5hpt)

Patient Information Sticker

History & Physical (H&P) Update Form

H & P Completed on _____ has been reviewed. I concur with the findings. I
(Date/Time)
confirm the necessity for the surgery/ procedure. I have examined the patient and there are:

- No changes in patient's condition since the last H & P was completed.
- Changes/additions/exceptions in the patient's condition since the last H&P was completed. Documentation on the patient's condition is noted below.

Assessment:

Physicians Signature

Printed Name

Date/Time

Attending Physicians Signature

Printed Name

Date/Time

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OF EL PASO

History & Physical



661-100-17

661-100-17(rev 12/17)(b/w, 8.5x11, #20archid, 5hpt)

Patient Identification Sticker

Resident-Faculty Mentoring Encounter

Resident Name:

Faculty Name:

Residency Year:

Date:

1. Resident perception of academic progress (including areas of perceived strength, weakness and areas for improvement):
2. Research and teaching participation (medical student lectures/workshops, journal club presentations, case reports, research abstracts, and articles):
3. Publications, presentations (planned, in progress, completed):
4. Reading/study habits:
5. Area of subspecialty interest? Fellowship plans? Postfellowship plans?
6. Goals for the next 6 months:
7. Goals for the next year:
8. Life issues (engagements, marriages, new children, illnesses, child or parent care, immigration, finances, social, emotional, spiritual, religious, psychological):

APPENDIX IV



Diagnostic Radiology Case Log Categories and Required Minimum Numbers

Review Committee for Radiology

Case Log Categories	Required Minimum Number	CPT Codes
Chest X-ray	1900	71045, 71046, 71047, 71048
CT Abd/Pel	600	72192, 72193, 72194, 74150, 74160, 74170, 74176, 74177, 74178
CTA/MRA	100	70496, 70498, 70544, 70545, 70546, 70547, 70548, 70549, 71275, 71555, 72159, 72191, 72198, 73206, 73225, 73725, 73706, 74174, 74175, 74185
Image Guided Bx/Drainage	25	20604, 20606, 20611, 32555, 32557, 49083, 49405, 49406, 49407, 77012, 76942, 77002, 77021
Mammography	300	77065, 77066, 77067
MRI Body	20	71550, 71551, 71552, 72195, 72196, 72197, 74181, 74182, 74183, 74712, 74713
MRI Brain	110	70551, 70552, 70553
MRI Lower Extremity Joints	20	73721, 73722, 73723
MRI Spine	60	72141, 72142, 72146, 72147, 72148, 72149, 72156, 72157, 72158,
PET	30	78459, 78491, 78492, 78608, 78609, 78811, 78812, 78813, 78814, 78815, 78816
US Abd/Pel	350	76700, 76705, 76706, 76770, 76775, 76830, 76856, 76857

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[Business of Radiology](#)

[Diversity, Equity & Inclusion Curriculum](#)

[Healthcare Disparities & Cultural Competencies](#)

[Ethics & Professionalism Modules](#)

[Well-Being Materials](#)

[Simulation Resources](#)

[Global Health](#)

[Art in Radiology](#)

APDR's Ten Procedures Expected of a General Radiologist Procedural Toolbox

Welcome to the APDR's Procedural Toolbox for the Ten Procedures Expected of a General Radiologist!

The ten procedures expected of a general radiologist, as determined by a joint APDR/APDR Task Force, are below:

- Image-guided core biopsy
- Image-guided abscess drainage
- Paracentesis
- Thoracentesis
- Lumbar Puncture
- Ultrasound-guided breast biopsy
- Ultrasound-guided venous access
- Over-the-wire tube exchange
- Thyroid fine-needle aspiration
- Joint procedures (Shoulder and Hip)

The toolbox continues to be developed to provide radiologists, trainees, and programs numerous resources to assist in education and assessment of these ten procedures.

Procedural Learning Modules

The procedural modules are meant to supplement hands-on procedural teaching in residency and fellowship and act as refresher and review material for both trainees and practicing radiologists. They are meant for all target audiences and may be used by medical students, radiology trainees, and practicing radiologists!

The modules take about 20 minutes each and ideally a module should be completed in a single session. For trainees who require proof of completion for the training program, a PDF certificate of completion is available once the module is complete.

- [Image-Guided Core Biopsy Module](#)
- [Image-Guided Abscess Drainage](#)
- [Lumbar Puncture](#)
- [Paracentesis](#)
- [Thoracentesis](#)
- [Joint Procedures](#)

Additional modules coming soon!

Thanks to the [APDR Procedural Toolbox Task Force](#) for their work in creating these modules.

Assessment Tools

The APDR is now engaging educators to collate learning assessment tools which will be made available for training programs to download. These assessment tools will provide educators a guide to observable actions during a procedure to assist in the observer's evaluation of the procedures performed.

Assessment tools are expected to be available by Summer 2025.

APPENDIX V

App Store Preview

This app is available only on the App Store for iPhone and iPad.



ACGME Case Logs 17+

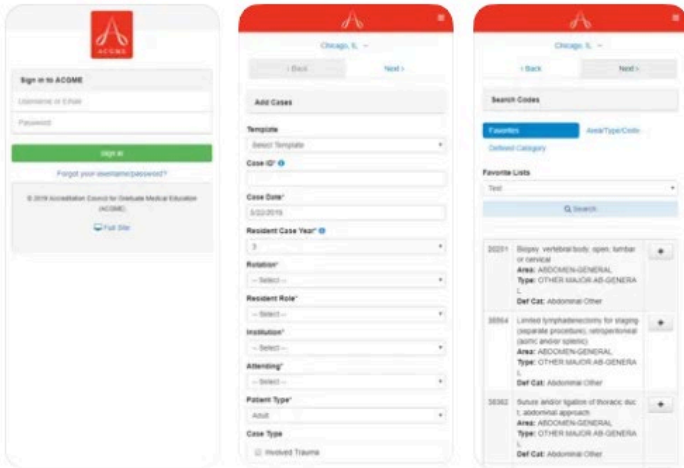
ACGME

#186 in Medical

★★★★ 3.0 • 2 Ratings

Free

Screenshots [iPhone](#) [iPad](#)



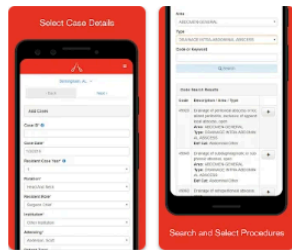
The ACGME Case Log app is designed for registered resident and fellow users in accredited programs to log their patient encounters in a secure, HIPAA compliant app. A system-generated login is required. Access must be enabled by your program.

ACGME Case Logs

ACGME

2.8★ 10 reviews | 5K+ Downloads | Everyone

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About this app →

The ACGME Case Log app is designed for registered resident and fellow users in accredited programs to log their patient encounters in a secure, HIPAA compliant app. A system-generated login is required. Access must be enabled by your program. <https://www.acgme.org/about/legal/hipaa-commitment-notice/>

Updated on
Oct 20, 2022

APPENDIX VI

ADULT

AMERICAN COLLEGE OF RADIOLOGY

CODE BLUE #:

EXAMPLE PREMEDICATION REGIMENS

Methylprednisolone 32 mg PO 12, 2 hrs prior +/- Benadryl 50 mg PO 1 hr prior.

OR

Prednisone 50 mg PO 13, 7, 1 hours prior +/- Benadryl 50 mg PO 1 hr prior.

OR

Hydrocortisone 200 mg IV 5 hrs and 1 hr prior and Benadryl 50 mg IV 1 hr prior. (urgent, NPO only, ER, inpatient)

CONTRAST EXTRAVASATION

Elevate arm (heart level), apply cool compress, remove rings. Observe. Consider surgical consultation for decreased perfusion, sensation, strength, active range of motion, or increasing pain.

Document reaction & monitor for return of symptoms post-treatment

HIVES/DIFFUSE ERYTHEMA

1. Observation; monitor vitals q 15 min. Preserve IV access.
2. If associated with hypotension or respiratory distress then considered **Anaphylaxis**:
 - O₂ 6-10 L/min by face mask
 - IVF 0.9% NS wide open; elevate legs > 60°
 - Epinephrine 0.3 mL of 1mg/mL IM (or auto-injector) OR Epinephrine 1 mL of 1mg/10mL (0.1 mg/mL) IV with slow flush or IV fluids
 - Call 911 or **CODE BLUE**
3. If **ONLY** skin findings but severe or progressive may consider Benadryl 50 mg PO, IM, IV but may cause or worsen hypotension.

ADULT

AMERICAN COLLEGE OF RADIOLOGY

CODE BLUE #:

HYPOTENSION WITH TACHYCARDIA (ANAPHYLAXIS)

1. Preserve IV access, monitor vitals q 15m
2. O₂ 6-10 L/min by face mask
3. Elevate legs > 60°
4. IVF 0.9% NS wide open
5. Epinephrine 0.3 mL of 1mg/mL IM (or auto-injector) OR Epinephrine 1 mL of 1mg/10mL (0.1 mg/mL) IV with slow flush or IV fluids
6. Call 911 or **CODE BLUE**

HYPOTENSION WITH BRADYCARDIA

1. Preserve IV access; monitor vitals
2. O₂ 6-10 L/min by face mask
3. Elevate legs > 60°
4. IVF 0.9% NS wide open
5. Atropine 0.6-1.0 mg IV if refractory
6. Consider calling 911 or **CODE BLUE**

LARYNGEAL EDEMA (INSPIRATORY STRIDOR)

1. Preserve IV access, monitor vitals
2. O₂ 6-10 L/min by face mask
3. Epinephrine 0.3 mL of 1mg/ mL IM (or auto-injector) OR Epinephrine 1 mL of 1mg/10mL (0.1 mg/mL) IV with slow flush or IV fluids
4. Call 911 or **CODE BLUE**

BRONCHOSPASM (EXPIRATORY WHEEZE)

1. Preserve IV access, monitor vitals
2. O₂ 6-10 L/min by face mask
3. Beta-2 agonist inhaler 2 puffs; repeat x 3
4. If not responding or severe, then use Epinephrine 0.3 mL of 1mg/ mL IM (or auto-injector) OR Epinephrine 1 mL of 1mg/10mL (0.1 mg/mL) IV with slow flush or IV fluids
5. Call 911 or **CODE BLUE**

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EXAMPLE PREMEDICATION REGIMENS

Prednisone 0.5-0.7 mg/kg PO (*Max 50 mg*) 13, 7 and 1 hr prior + Benadryl 1 mg/kg PO (*Max 50 mg*) 1 hr prior.

OR

Hydrocortisone 2 mg/kg IV (*Max 200 mg*) 5 hrs and 1 hr prior + Benadryl 1 mg/kg IV, IM, or PO (*Max 50 mg*) 1 hr prior.
(urgent, NPO only, ER, inpatient)

CONTRAST EXTRAVASATION

Elevate arm (heart level), apply cool compress, remove rings. Observe. Consider surgical consultation for decreased perfusion, sensation, strength, active range of motion, or increasing pain.

Document reaction & monitor for return of symptoms post-treatment

HIVES/DIFFUSE ERYTHEMA

1. Observation; monitor vitals q 15 min. Preserve IV access.
2. If associated with hypotension or respiratory distress then considered **Anaphylaxis**:
 - ◆ O₂ 6-10 L/min by face mask
 - ◆ IVF 0.9% NS 10-20 mL/kg (max 500-1000 mL); elevate legs > 60°
 - ◆ Epinephrine IV or IM or Auto-injector
 - ◆ **Call 911 or CODE BLUE**
3. If ONLY skin findings but severe or progressive, consider Benadryl PO, IM, IV 1 mg/kg (*max 50 mg*).

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HYPOTENSION WITH TACHYCARDIA (ANAPHYLAXIS)

1. Preserve IV access, monitor vitals q15m
2. O₂ 6-10 L/min by face mask
3. Elevate legs > 60°
4. IVF 0.9% NS 10-20 mL/kg (*Max 500-1000 mL*)
5. **Epinephrine IV, IM, or auto-injector***
6. Call 911 or CODE BLUE

HYPOTENSION WITH BRADYCARDIA

1. Preserve IV access; monitor vitals
2. O₂ 6-10 L/min by face mask
3. Elevate legs > 60°
4. IVF 0.9% NS 10-20 mL/kg (*Max 500-1000 mL*)
5. If refractory, Atropine 0.02 mg/kg IV (*Max 1 mg infants/children and 2 mg adolescents*)
6. Consider calling 911 or CODE BLUE

LARYNGEAL EDEMA (INSPIRATORY STRIDOR)

1. Preserve IV access, monitor vitals
2. O₂ 6-10 L/min by face mask
3. **Epinephrine IV, IM, or auto-injector***
4. Call 911 or CODE BLUE

BRONCHOSPASM (EXPIRATORY WHEEZE)

1. Preserve IV access, monitor vitals
2. O₂ 6-10 L/min by face mask
3. Beta-2 agonist inhaler 2 puffs or nebulizer, can repeat x 3
4. If not responding or severe, add **Epinephrine IV, IM, or auto-injector***
5. Call 911 or CODE BLUE

***EPINEPHRINE DOSING - PEDIATRIC (can repeat q5-15 min)**

IV 0.1 mL/kg of 1mg/10ml slowly into IVF (max 1 mL). IM 0.01 mL/kg of 1mg/mL (max 0.3 mL). If between 15-30 kg use pediatric (Jr) auto-injector; if >30 kg use adult auto-injector; if <15 kg follow institutional guidelines

APPENDIX VII

