



RUTGERS

New Jersey Medical School

DEPARTMENT OF RADIOLOGY

RESIDENCY PROGRAM HANDBOOK



TABLE OF CONTENTS

Table of Contents

WELCOME	2
GOALS AND OBJECTIVES	3
DAILY RESPONSIBILITIES	115
CALL RESPONSIBILITIES	117
TRAVEL GUIDELINES	120
BOOK ALLOWANCE	122
FINGERPRINTING REIMBURSEMENT	123
HOLIDAY COMP DAY	123
EVALUATIONS	123

WELCOME

The faculty and staff here at the Department of Radiology, New Jersey Medical School welcome all of you as you embark on this important facet of your training. We are the longest running academic training program in New Jersey and have trained over 120 residents in the past 30 years. Our trainees have excelled in their chosen areas of practice and have contributed significantly both to patient care and the development of new knowledge in Radiology.

The Department of Radiology at Rutgers NJMS actively participates in the tripartite missions in patient care, education and research. We provide a full spectrum of services across Diagnostic and Interventional Radiology at teaching practice sites. Faculty members provide instruction and perform clinical work in gastrointestinal and genitourinary imaging, chest, breast, musculoskeletal, and pediatric radiology as well as in nuclear medicine, neuroimaging, and interventional radiology. The department is responsible for diagnostic imaging at University Hospital, the Doctors Office Center (DOC) and at our separate on-campus Advanced Imaging Center facility (ADMC Building 5), which houses our PET/CT unit. Residents also rotate at the VA Medical Center in East Orange, NJ.

The Department is committed to undergraduate and graduate training in Radiology and the education of our colleagues in other specialties. Over the years our residents have successfully secured excellent fellowships and excel in private and academic practice.

A majority of our faculty and residents are engaged in clinical investigations. Our Division of Radiation Research has 2 faculty members who have made considerable progress in understanding the biophysical parameters affecting radiation dose.

We wish you well and hope to see you excel during your training here at Rutgers NJMS as well as in your subsequent practice career.

GOALS AND OBJECTIVES

ABDOMINAL IMAGING - GI/GU (Ultrasound, Fluoroscopy, CT and MRI)

General Goals:

The specific goals include objectives required for every level of training with graduated levels of supervision and responsibility. Almost all aspects of abdominal imaging are incorporated into the residency, including fluoroscopy, radiography, CT, ultrasound, and MRI. During every training rotation, the resident will read the required literature in gastrointestinal and genitourinary radiology. Over time, the resident will become progressively more knowledgeable about normal radiographic anatomy and physiology of abdominal organs, and about imaging appearances of common pathologic entities involving gastrointestinal and genitourinary systems. The resident will also demonstrate a gradually increasing proficiency in diagnosing these conditions, along with improved understanding of their varied clinical presentations, differential diagnoses, and current modes of treatment. Ultimately, the resident will be able to demonstrate nearly independent and competent functioning in protocoling, diagnosing and consulting on various conditions encountered on these rotations.

Resident Daily Work Responsibilities

(OVERALL BENCHMARKS/OBJECTIVES for Self- Evaluation)

1. Residents assigned to the sections of abdominal imaging (GI, Ultrasound, DOC, or Body) will be available for consultations by fluoroscopy, CT and MR technologists, clinicians, and other health care providers, except during conference times, when the attending faculty will cover.
2. Resident questions will be referred to the supervising faculty covering abdominal radiology.
3. Resident review of cases with the supervising faculty will be conducted as many times in the day as necessary to keep an efficient workflow.
4. Residents will check and sign his/her reports prior to final verification by supervising faculty.
5. Residents will acquire an understanding of the proper preparation of patients for examinations and appropriate follow-up. At the start of every working day, the resident will be familiar with the patient schedule and anticipate the need for any procedures. The resident will check requisitions for the next working day to evaluate for appropriateness of the requested procedure

or if additional exams/protocols need to be performed. Requests with absent clinical indications or seemingly inappropriate requests will be clarified and discussed with the referring physician.

6. Residents will do in-depth reading and study to become knowledgeable about the normal anatomy and physiology of abdominal organs and the radiologic appearances of gastrointestinal and genitourinary diseases, and gain a general understanding of the disease entities, their clinical presentations, and certain modes of treatment.

7. Residents will serve as a secondary consultant to referring physicians regarding abdominal imaging. This will strengthen the confidence of the resident in the very important role every radiologist must perform throughout his/her career as a consultant to other physicians.

8. Residents will become prepared to pass the core examination of the American Board of Radiology.

9. Residents will teach and share knowledge to junior residents, radiology technologists and medical students, when appropriate.

10. Residents will participate in the preparation and presentation of imaging studies at divisional interesting case conferences.

Supervising Faculty Responsibilities:

1. Supervising faculty will be available at all times for any questions or consultations needed by the resident. While review in person and availability on-site are in general preferable, this decision will be left to the discretion of an attending radiologist covering the rotation due to concerns related to COVID pandemic.

2. Supervising faculty will review all studies with the residents before the end of the day, sometimes with multiple read-outs during the day.

3. Supervising faculty will provide the resident with constructive feedback on any problem areas encountered during the rotation.

4. Supervising faculty will verify resident-generated reports in a timely manner and inform the resident of any major changes made.

General Educational Goals and Expectations

While many of the educational goals, objectives and expectations on the rotations including, but not limited to professionalism, interpersonal relations and communication, and practice-based

learning are very similar for residents of all levels of training, some educational objectives pertaining to medical knowledge and patient care vary according to the residents' year of training. Therefore, where appropriate these differences and expectations will be outlined separately for residents of each year under rotation specific educational objectives. The general goals and objectives relevant to the residents of all years are summarized below.

Patient Care:

- Adequately explain each examination to the patient in order to ensure that the patient feels comfortable and to provide patient care that is compassionate, appropriate, and effective;
- Awareness of the basic principles of radiation protection in order to minimize the radiation dose to the patient and reduce exposure to healthcare providers;
- Understand the indications for, and contraindications of, intravenous and enteric radiographic contrast agents, and be able to monitor its administration;
- Recognize and treat reactions to intravenous and enteric contrast media;
- Understand the indications and contraindications to the different types of contrast material dosages, side effects, and their differences;
- Develop a knowledge of the preparation and aftercare required for the common examinations
- Use the PACS, voice recognition systems, and hospital information systems to become proficient in dictating reports in a concise and clear manner
- Demonstrate the ability to recommend additional imaging studies as appropriate to better assess findings on abdominal imaging studies

Medical Knowledge:

- Learn the basic physics and principles of radiography, ultrasound, fluoroscopy, CT, and MR, especially as it pertains to phases of enhancement of the liver and kidney
- Observe and learn the techniques to achieve high-quality diagnostic examinations of the gastrointestinal and genitourinary tract
- Perform an adequate upper gastrointestinal series, barium swallow, barium enema, voiding cystogram, retrograde urethrogram and cystogram study;
- Develop a knowledge of normal and abnormal anatomy of the gastrointestinal and genitourinary tracts as demonstrated on ultrasound and cross-sectional studies;
- List the risk factors for allergic reaction to intravenous contrast media
- State the proper assessment and treatment for allergic reactions to contrast media

- Recognize the more common abnormalities encountered in the GI tract, such as stricture, polyp, ulcer, and mass
- Develop a knowledge of the differential diagnoses of the more commonly encountered gastrointestinal and genitourinary abnormalities
- Demonstrate the ability to recognize and describe common medical conditions depicted on abdominal imaging studies
- Recognize critical findings on emergency CT evaluations of the abdomen and pelvis

Practice-Based Learning and Improvement:

- Show evidence of independent study using textbooks from the reading list
- Demonstrate appropriate follow up of interesting cases
- Research interesting cases, either as directed by faculty or self-directed
- Identify, rectify, and learn from personal errors
- Incorporate feedback into improved performance
- Efficiently use electronic and print sources to access information

Interpersonal and Communication Skills:

- Communicate with the patient at all times during the examination to ensure that patient remains comfortable
- Communicate effectively with all members of the health care team (technologists, medical students, fellows, residents, allied health providers, support staff, and attending physicians/radiologists)
- Call results to the referring physicians and show ability to interact with referring physicians
- Interact with clinicians show ability to provide preliminary readings, follow up with attending radiologists, formulate a plan of complex cases, and communicate any changes to referring clinicians
- Recognize necessity of communicating not only critical findings, but also of important findings, even if incidental, and make every effort to communicate the findings and document message delivery.

Professionalism:

- Demonstrate respect for patients, families, and all members of the healthcare team and be able to discuss significant radiology findings;
- Explain the impact of the radiology findings on patient care, including what imaging studies may/may not be appropriate;
- Respect patient confidentiality at all times;
- Present oneself as a professional in appearance, punctuality and communication;
- Demonstrate a responsible work ethic with regard to work assignments;
- Place needs of patients before own;

System-Based Practice:

- Able and willing to participate in multidisciplinary clinical conferences in which imaging studies are used to guide patient care/evaluations and be able to demonstrate understanding of how imaging relates to the clinical care of the patient
- Demonstrate knowledge of the ACR practice guidelines and technical standards for fluoroscopy, CT, and MR
- Demonstrate knowledge of ACR appropriateness criteria and cost-effective imaging evaluation of common disorders
- Show ability to interact with clinicians regarding cost effective and streamlined evaluation for different clinical entities.

ROTATION SPECIFIC GOALS AND OBJECTIVES:

ULTRASOUND: Welcome to your Ultrasound rotation!

General:

Ultrasound is one of the primary imaging modalities for rapid noninvasive evaluation of many regions of the human body, widely utilized in radiology and multiple other medical specialties. Due to its lack of ionizing radiation it remains the first modality of choice in imaging of pediatric and pregnant patients. Ultrasound can provide real time multiplanar assessment requiring that the radiologist plays an active role during the examination, especially as ultrasound is very user dependent; the image quality also greatly depends on the type of available equipment. Therefore, to become an expert in ultrasound and to minimize erroneous interpretation of the provided images, a radiologist must be sufficiently proficient in scanning to fully understand the complex anatomy and pathology as depicted by ultrasound. Awareness of the common “blind spots” and

limitations of ultrasound as well as thorough understanding of ultrasound artifacts and image optimization are key to acquiring proficiency and finesse in ultrasound interpretation. In Ultrasound, perhaps more than other service, a key component of your training will depend on your interaction with our dedicated US technologists. Please be respectful at all times, and be attentive to the fact that they are balancing their teaching and clinical responsibilities with a busy schedule. We ask that you do your best to cultivate a good relationship with the US technologists. If any issues arise, please do not hesitate to reach out to the chief of abdominal imaging section, residency program director, or one of the US attendings for guidance.

Patient care:

Please be aware and respectful that US exams may make patients feel exposed and uncomfortable, especially pelvic and scrotal exams, although similar concern may arise with abdominal imaging. Please introduce yourself at the beginning of the exam. If a patient is uncomfortable with you in the room, respect their decision and find an alternative exam. Please do not enter the room after the exam has begun.

Daily schedule:

When staffing permits, ideally a dedicated teaching sonographer will be assigned to a first or a second year resident to optimize teaching and provide extra time for the resident to scan. In general resident should check the daily schedule by 8 am and communicate with the chief US technologist to determine which cases they can scan that day. Some exams are not performed routinely (i.e. appendicitis, intussusception, and pyloric stenosis), and you will want to prioritize them to gain as much exposure to these cases as possible. It is the resident's responsibility to coordinate hands-on scanning opportunities that are focused on the competencies that the resident is trying to complete each year. Please maximize your scan time whenever you can. After the technologist has finished scanning, you will have several minutes to 'back scan' the patient. It is recommended that you focus on a specific skill for each patient (e.g. obtaining images of the common bile duct) as you will not, at least in the first two years, will have time to complete the exam.

Once you feel that you have the basics covered, start to change settings and patient position to modify the images and learn more about Doppler scanning and artifacts. During your third and fourth year rotations in US, you will spend more time in the reading room interpreting and dictating cases. You are also expected to back-scan as appropriate, and to focus on intermediate and advanced cases. The goal is that you will be able to "run" the section by the time you are a 4th year senior resident.

Below is the list of US Scanning Core competencies that you will be required to complete during residency:

- Scrotal, RUQ, Pelvis TA and TV Renal, 1st trimester viability, Liver transplant, Appendicitis, Abdomen, Vascular, Obstetric.

EXPECTATIONS FOR US ROTATIONS

For all rotations including your first one, please be proactive in filling your time efficiently and make it a priority to scan patients. Please make sure to keep the log of scanned cases irrespective of the rotation as at least 75 scanned cases are required by ACGME to demonstrate competencies in different areas. When things are quiet, make use of teaching files, reading material, and on-line resources that are listed in this guide.

The residents will be expected to arrive to their rotations prepared by having read the Educational Objectives and Expectations Guide prior to commencement of the rotation. It is also expected that while on the rotation the resident will be completing the assigned reading from Ultrasound Requisites regarding the expected competencies for that year and will actively read up on the cases that had been discussed the day before. It is also strongly suggested that the residents will supplement the Ultrasound Requisites by reading the articles suggested in this guide. Finally, in their down time the residents are highly encouraged to review available on-line resources, also listed below.

The day begins at 8:00 a.m. with pre-dictation of all cases performed after hours. The day ends at 4:30 pm or 4 pm on the days when a resident conference is scheduled. Priority reads should always be done for ER, observation unit, and inpatients, in that order. With the exception of upper and lower extremity venous Doppler to evaluate for deep venous thrombosis, we do not perform vascular Doppler in our department.

First Year Residents (Part I)

Daily work:

Check “Daily schedule” and check in with the chief ultrasound technologist/sonographers to best coordinate your scan time. Expect to spend at least half of the day scanning. Review the cases that you scanned with an attending and attempt to dictate at least 5 cases/day in the first part of the year.

Patient Care:

- Identify normal ultrasound anatomy and state the indications for examination of abdomen and renal ultrasound
- Be able to perform an ultrasound of the RUQ, including assessment of the liver, biliary tree, GB, and pancreas, and Renal Ultrasound.
- Be able to critique the technical quality of an RUQ and Renal ultrasound examinations

Medical Knowledge:

- Discuss the ultrasound features of the most common diseases involving the: liver (cysts, hemangiomas, metastases, cirrhosis, hepatitis, steatosis), gallbladder (cholelithiasis, acute cholecystitis, gallbladder polyps, adenomyomatosis, cholesterosis, gallbladder neoplasm), uterus, spleen (splenomegaly, cysts/pseudocysts), pancreas (pancreatic anatomy, pancreatitis, pancreatic cystic and solid masses), kidneys (hydronephrosis, medical renal disease, nephrolithiasis, pyelonephritis, simple and complex cystic masses, solid masses), bladder (ureteral jets, cystitis, bladder stones, ureteroceles, neoplasms).

First Year Residents (Part II)

Daily work:

Check “Daily schedule” and check in with the chief ultrasound technologist/sonographers to best coordinate your scan time. Expect to spend at least half of the day scanning. Review the cases that you scanned with an attending and attempt to dictate at least 10 cases/day in the second part of the year.

Patient Care:

In your second part of the first year ultrasound rotation :

- 1) Gain competencies in scanning and interpreting
 - Pelvic US TA and TV in assessment of the first trimester pregnancy (viability, ectopic pregnancy)
 - Pelvic US TA and TV for assessment of ovarian torsion and common solid and cystic adnexal masses (hemorrhagic cysts, tubo-ovarian abscesses, hydrosalpinx, dermoids, cystic ovarian neoplasms)
 - Scrotal Ultrasound (testicular torsion, trauma/fracture, neoplasms, varicoceles)
 - RLQ ultrasound (r/o appendicitis)

Medical Knowledge:

- Normal findings: gestational sac appearance, size, gestational sac growth, yolk sac, embryo, cardiac activity including normal embryonic heart rate, amnion, chorion, normal early fetal anatomy/growth, crown-rump length measurement, correlation with BHCG levels and menstrual dates,
- expected testicular size in pediatric and adult patients, anatomy of scrotum and its contents (epididymal head, body, tail appearance; tunica albuginea, rete testis, expected normal testicular vascularity)
- Pathology: spontaneous complete/incomplete abortion, ectopic pregnancy, blighted ovum, embryonic death, subchorionic hematoma, gestational trophoblastic disease, adnexal cystic and solid masses, , testicular torsion, epidimytis/orchitis, testicular microlithiasis, testicular and scrotal neoplasms, varicoceles, testicular fracture/trauma, hydroceles.

Competency in these five areas (RUQ US, Renal US, Pelvic US TA and TV; Ob First Trimester US for viability, Scrotal Ultrasound) is expected by the end of the first year. Scan other acute presentations such as appendix as they become available.

Please familiarize yourself with American Institute of Ultrasound in Medicine (AIUM) scanning protocols. These protocols can be found at: <https://www.aium.org/resources/training-guidelines>

Second Year Residents

Daily work:

Check “Daily schedule” and check in with the chief ultrasound technologist/sonographers to best coordinate your scan time. Focus on scanning cases of intermediate difficulty and begin focusing on Liver Doppler exams and other applications of Doppler and spectral sonography. Expect to spend at least half of the day scanning. Review the cases that you scanned with an attending and expect to dictate at least 10 cases/day in the second year.

Patient Care:

In your second year ultrasound rotation :

- 1) Refresh scanning techniques necessary for sonographic evaluation of
 - RUQ
 - Renal Ultrasound
 - Pelvic US TA and TV;
 - Ob First Trimester US for viability;
 - Scrotal Ultrasound
- 2) Gain additional competencies in
 - Pelvic US TA and TV (evaluation of gynecologic conditions: fibroids, adenomyosis, endometriosis, endometrial polyps, endometrial cancer, cystic and solid ovarian neoplasms), arteriovenous malformations + obstetric complications including retained products of conception, gestational trophoblastic disease,
 - Lower Extremity Ultrasound (DVT, Baker’s cyst)
- 3) Begin learning Liver Doppler assessment and other organ Doppler interrogation
 - Liver Doppler Evaluation (hepatic vasculature in normal and cirrhotic livers, TIPS evaluation, PV thrombosis, evaluation of liver transplants)
 - Thyroid ultrasound
 - Elastography

Medical Knowledge:

Normal findings:

- normal appearance and thickness of the endometrial stripe during various stages of menstrual cycle, uterine echotexture, normal appearance of the ovaries,
- normal appearance of the vascular anatomy of the lower extremities, normal appearance of the arteries and veins of the lower extremities, expected normal appearance of augmentation and respiratory phasicity of venous flow in the lower extremities;
- normal Doppler and spectral tracing of the portal and hepatic veins and its relationship to the cardiac cycle, expected spectral tracing of the hepatic arteries; normal vascular findings in portal hypertension, proper evaluation of TIPS patency, common immediate and delayed vascular complications after liver transplantation;
- Pathology: proper evaluation of fibroids relative to their location, myometrial cysts and other manifestations of adenomyosis, endometriomas, endometrial polyps, endometrial cancer, tubo-ovarian abscesses, follicular and luteal cysts, hyperstimulation syndrome, polycystic ovarian disease, serous and mucinous cystic ovarian neoplasms, retained products of conception, uterine AVM and AVF, gestational

trophoblastic disease; acute and chronic thrombosis of lower extremities veins, Doppler findings in CHF, portal vein thrombosis, hepatic artery stenosis and thrombosis, hepatic artery pseudoaneurysms)

Third Year Residents

Daily work:

Check “Daily schedule” and check in with the chief ultrasound technologist/sonographers to see if there are any unusual/rare cases scheduled to be scanned (multiple gestations, Doppler cases, etc) to coordinate your scan time. Focus on scanning cases of intermediate-high degree difficulty and further focus on Doppler and spectral sonography. Review the cases that you scanned with an attending and expect to dictate majority of the ultrasound list, at least 15-20 cases/day in the third year, depending on how many cases you scan.

1. Review studies and provide preliminary interpretation. Determine if additional images are needed to adequately answer the clinical question.
2. Consider scanning ED studies that are added on during the day if you feel that additional hands on scanning would be helpful. Practice additional Doppler interrogation of cases especially pertaining to Liver Doppler US
3. Gain competency in
 - Doppler US (liver transplant, renal artery stenosis, pelvic Doppler, lower extremity and carotid Doppler US)
 - Thyroid US
4. Gain knowledge in additional obstetric US topics via reading and doing on-line cases (multiple gestations, congenital fetal anomalies, gestational age measurements, placenta accreta spectrum, cervical incompetency).

Normal findings and Pathology:

Abdominal Doppler: Be familiar with the normal Doppler waveform for all of the major abdominal vessels (hepatic veins, hepatic artery, portal veins, splenic vein, superior mesenteric vein, renal artery, renal vein, iliac artery, iliac vein, IVC). Know the diagnostic criteria for hemodynamically significant stenosis (TIPS, renal artery). Understand the spectrum of vascular complications in transplants (liver, pancreas, and kidney).

Obstetric US: determine chorionicity/amnionicity in twins, vanishing twin sign, twin-twin transfusion, congenital anomalies in common triploidies (Trisomy 21,18 and 13), findings in Turner syndrome, additional common congenital anomalies including and not limited to diaphragmatic hernia, omphalocele and gastrochisis, renal hypoplasia, intracardiac defects, biliary atresia, duodenal atresia, normal and abnormal appearance of placenta (marginal and low-lying placenta, placenta previa, placenta accreta spectrum, placental abruption, circumvallate and succenturiate placenta), cervical incompetence;

Thyroid/parathyroid US: multinodular goiter, thyroiditis; thyroid nodule characterization; follow up of thyroid cancer resection, and parathyroid adenoma.

Vascular US :AVF, DVT of lower and upper extremities, pseudoaneurysms.

Fourth Year Residents

1. Be prepared to run the service independently as a junior faculty. Try to preview as many cases as possible for completeness and render preliminary interpretation before the attending reviews the case.
2. Focus on scanning cases of advanced difficulty and anything else you feel you have not had a chance to cover in sufficient detail.

READING LIST:

Ultrasound: The Requisites, 3rd edition. Hertzberg and Middleton. Elsevier, 2016 is the required textbook for ultrasound and constitutes the absolute minimum expected to be covered on the rotation. Note that ‘core exam prep’ type texts are not suitable for R1 and R2 and will not provide sufficient knowledge depth.

Two most comprehensive and standard reference texts for US Rotations, recommended for those wanting to go in greater depth or interested in Body Imaging Fellowship, are:

1. Rumack, Carrol and Levine, Deborah. Diagnostic Ultrasound, 2 volume set. 5 th edition.
2. Callen’s Ultrasonography in Obstetrics and Gynecology.

FIRST YEAR ROTATION (Part 1):

Radiology Handbook, Lewis and McNulty. Pgs 234-262, 276-280

US Requisites. Ch 1 practical physics

Ultrasound requisites: kidney (73-77)

Ultrasound requisites: normal anatomy and technique of:

liver (pgs 3-5)

gallbladder (35-38)

bile ducts (55-57)

Ultrasound of Focal Liver Masses. Tchelepi and Ralls. Ultrasound Quarterly 2004. Vol 20; 155-169

Detection and Characterization of Renal masses by Ultrasound. Heller et al. Ultrasound Quarterly, 2007: vol 23; 269—278

Imaging Evaluation for Acute Pain in the Right Upper Quadrant. Hanbridge et al. Radiographics 2004 24:4 1117-1135

FIRST YEAR ROTATION (Part 2):

US Requisites

pancreas (122-126)
spleen (142-143)
pelvis (359-368) adnexa (388-391)
scrotum (152-182)

Doubilet M, Benson C. et al. Diagnostic Criteria for Nonviable Pregnancy Early in the First Trimester. N Engl J Med 2013;369:1443-1451
Rodgers et al. “Normal and Abnormal US Findings in Early First Trimester Pregnancy: SRU consensus Recommendations” Radiographics 2015 35: 2135-2148
Maitray Patel “Rule out ectopic’ Asking the Right questions, getting the right answers. Ultrasound Quarterly June 2006
Dibble et al. Atypical Ectopics. AJR 2016; 207:1–13
Chang, Bhatt, and Dogra “Pearls and Pitfalls in Diagnosis of Ovarian Torsion”. Radiographics, 2008
“Management of Asymptomatic Ovarian Cysts Imaged by US. Consensus Statement Society of Radiologists in US”. US Quarterly 2010, vol 26; 121-131
Andreotti et al. “Ovarian-Adnexal Reporting Lexicon for Ultrasound: A White Paper of the ACR Ovarian-Adnexal Reporting and Data System Committee”. J Am Coll Radiol 2018 Oct;15 (10);1415-1429
Winter et al. “Evaluation of the Scrotal Mass.” US Quarterly 2009. Vol 25: 195-205

Laing et al. US of the Adnexa: Radiographics 2012; 32: 1621-1639
Gynecologic, Obstetric, and Scrotal Emergencies. In The Radiology of Emergency Medicine. Pope and Harris. 5th Ed. Pgs 707-747
Avery et al. Imaging of Penile and Scrotal Emergencies. RadioGraphics 2013; 33:721–740
Dogra et al. First trimester Bleeding Evaluation. US Quarterly 2005. Vol 21: 69-85
Revzin et al. Imaging Evaluation of Fallopian tubes and related disease. Radiographics 2020; 40: 1473-1501

SECOND YEAR ROTATIONS:

US requisites ch 12-21. OB
US Inguinal Canal. Revzin et al. RadioGraphics 2016; 36:0000–0000
US GI Tract. Muradali et al. RadioGraphics 2015; 35:50–70
Appendix visualization CT insights. Lin et al. AJR 2017; 209
US Requisites ch 9 and 10 (220-268). General Abdomen. Thyroid and Neck (including carotids)

Alan et al, first chapter: “Physics: principles, practice and artifacts” Clinical Doppler Ultrasound.
Baad et al . “US Artifacts”. Radiographics 2017; 37(5):1408-1423
ACR appropriateness criteria: https://acsearch.acr.org/list?_ga=2.226634718.2105403064.1606672446-1855451861.1606672446
McNaughton et al. “Doppler Ultrasound of the Liver Made Simple”. Radiographics 2011: vol 31: 161-188
Robinson et al. “Doppler Sonography of Portal Hypertension”. Ultrasound Quarterly 2009: vol 25: 3-13

Scheinfeld M. et al. "Understanding the spectral Doppler waveform of the hepatic veins in health and disease". Radiographics, 2009 Nov; 29(7): 2081-98.

Spectral Doppler Signature Waveforms in Ultrasonography. US Quarterly 2010; vol 26: 83-99

THIRD YEAR ROTATIONS:

O-RADS. Andreotti et al. J Am Coll Radiol 2018;15:1415-1429.

SRU Ovarian Cysts F/U. Levine et al, Radiology 2019; 00:1-13

ACR TIRADS: Tappouni et al. TIRADS pitfalls, solutions. Radiographics 2019; 39: 2040-2052

OPTIONAL BUT GOOD:

Dynamic US of Hernias of the Groin and anterior Abdominal Wall. Stavros et al. US Quarterly 2010; 26: 135- 169;

Additional Educational Resources:

- US artifact youtube links:

<https://www.youtube.com/watch?v=3k3L4ZNAZqk>

<https://www.youtube.com/watch?v=YVCugJe2IVw>

<https://www.youtube.com/watch?v=UuQtYuQ1ufE>

<https://www.youtube.com/watch?v=O74CeO6nRmo>

- SUSME Society of US on Med Ed:

<http://www.susme.org/learning-modules/>

accept disclaimer and will lead to U South Carolina modules. Excellent modules on physics, image optimization, abdominal and pelvic US

- Radprimer.com AIUM med ed portal: <http://meded.aium.org/>

Sound judgement series good articles evidence based

- Additional resources SAEM narrated US lectures

(TV pelvic US: <https://vimeo.com/channels/aeus/52830902>)

- Ultrasound Cases: 6000 online US cases by region:

<http://ultrasoundcases.info/>

- Need to register for FREE and will have access to many lectures

<https://sonoworld.com/>

- SRU consensus conference statements:

Levine et al: Asymptomatic adnexal cysts 2010:
<https://pubs.rsna.org/doi/10.1148/radiol.10100213> Levine et al: simple adnexal cysts updated 2019: <https://pubs.rsna.org/doi/full/10.1148/radiol.2019191354>

Rodgers et al: review of SRU 1st trimester 2015:
<https://pubs.rsna.org/doi/full/10.1148/rg.2015150092>

Needleman et al: SRU statement US DVT 2018: <https://pubmed.ncbi.nlm.nih.gov/29610129/>

US Lecture Curriculum

Core US ED1	Emergency Ultrasound
Core US ED2	Evaluating Acute Scrotal Pain/Trauma
Core US ED3	Acute Pelvic Pain in a Non-Pregnant Female
Core US ED4	Gallbladder and Biliary System
Core US N	Thyroid, Parathyroid & Neck & TI-RADS
Core US OB1	1st Trimester Pregnancy in ED
Core US OB2	Ectopic Pregnancy
Core US Ob3	Ultrasound of congenital fetal anomalies - a case-based approach
Core US Ob4	US of Multiple Gestation
Core US Ob5	First trimester US in genetic screening
Core US Ob6	2nd and 3rd trimester US Evaluation: Measurements, Umbilical Cord and Placenta
Core US Liv 1	Liver: normal anatomy, parenchymal disease and elastography
Core US Liv 2	Liver: common hepatic masses
Core US Liver 3	Liver - Parenchymal Disease, Portal HTN and TIPS Evaluation
Core US Gyn 4	Follow up of incidental ovarian cystic lesions: ACR Recommendations
Core USGU1	Scrotal Malignancies
Core US Gen 1	US Contrast: Principles and Applications
Core US Gen 2	Ultrasound Physics - Artifacts, Quality, Bioeffects
Core US Vasc 1	Introduction to Vascular US
Core US Vasc 2	Carotid US and Evaluation of LE and UE DVT on US
Core US Vasc 3	US of Liver Vasculature

Core US Vasc 4	Vascular ultrasound board review
Core US Renal 1	Renal - Parenchymal Disease, RAS, Transplant
Core US Renal 2	Renal nephrolithiasis, hydronephrosis and Evaluation of Cystic and Solid masses
Supplemental	Ectopic Pregnancy and its Mimics on CT and MRI
Supplemental	3D applications: pelvis

FLUOROSCOPY:

1. Residents must be familiar with the operation of all fluoroscopic equipment and be knowledgeable about radiation protection and ALARA (as low as reasonably achievable) principle of judicious radiation exposure to both patients and hospital personnel. To this end, residents are expected to review the relevant collated study materials before the assigned rotation to assure that these principles as well as basic operation of the equipment are understood. A brief quiz may be required to assure competence. In addition, the resident will be instructed and/or supervised (either by an attending or a senior resident) to ensure that safe practices are followed. Film badges must be worn at all times during fluoroscopic exams.

2. Residents will learn and become proficient in fluoroscopic techniques to perform high quality diagnostic examinations involving the gastrointestinal and genitourinary tracts. Examinations will be checked by the supervising faculty prior to beginning of the case and before the patient leaves the department.

3. Morning rounds will be informal, but required. Residents are expected to have a list of scheduled inpatients for each day which will be reviewed prior to presentation to the attending on service. Residents are expected to have a near complete history of relevant medical issues and surgical history for these patients. The plan for each case will be discussed and optimized for the submitted indication. Studies requested during the day will be discussed in a similar fashion as these consultations occur. Similarly, the images must be reviewed with an attending prior to patient's discharge from the Department. The following are helpful guidelines in approaching each case:

- Review the clinical indication on the exam request to see that it matches the test ordered.
- Take your own GI/clinical history to make sure you are imaging the appropriate area and further tailor the study to address the area of clinical interest.

- Obtain relevant GI/surgical history from the patient and, if necessary, search EPIC before beginning the exam. Review prior endoscopy report if available.
- Make sure you understand the patient's surgical anatomy BEFORE you begin the exam. If you are unfamiliar with the surgery, research it prior to performing the exam.
- Review prior GI fluoroscopy AND CT scan reports before beginning a study. If report is abnormal, review the images because it can help you tailor the exam and better locate or follow up pathology.
- Patients MUST be NPO since midnight prior to upper GI fluoroscopy exams. Help to reschedule the patient if they have had breakfast, including coffee or tea. Consult your attending before cancelling.
- Make sure patient took the bowel prep prior to a double contrast BE.
- Question female patients of child-bearing age to make sure they are not pregnant prior to the exam.

4. It is expected that the residents on Fluoroscopy rotation will supplement their practical experience and read-outs with a supervising faculty by appropriate reading with emphasis on the exams performed on that day. If a resident is aware of the fluoroscopy schedule for the next day, it is highly encouraged that he/she will prepare by reading appropriate sections in standard textbooks or pertaining suggested for each rotation at the end of this document.

5. The logistics and setup for each case will be discussed at morning rounds and will be considered the responsibility of the technologist and resident.

6. A faculty member will be generally available to advise, direct and assist performing whichever parts of the exam are warranted. For the first several months of the first year, first year residents will be paired with senior residents, who will help them to get oriented to proper fluoroscopic techniques for each examination and will assist them in performing cases. It is expected that by the end of the first year the residents are comfortable and proficient most common fluoroscopic exams independently.

7. All resident performed fluoroscopy examinations will be dictated by the end of every working day.

8. Keep in mind that the diagnoses and conditions encountered on the GI/GU fluoroscopy service are quite broad and cross over to many other areas of clinical service (Ultrasound, Body CT, Body MRI, PET). The residents are expected to read and study relevant material that covers the most commonly found diagnoses, surgical technique and its anatomic consideration and those topics generally considered relevant to the ABR licensing examination. Materials and suggested readings will be provided.

First Year Rotation:

Patient Care:

- Adequately explain each examination to the patient in order to ensure that the patient feels comfortable and to provide patient care that is compassionate, appropriate, and effective
- Familiarity with the operation of fluoroscopic equipment and awareness of the basic principles of radiation protection in order to minimize the radiation dose to the patient and reduce exposure to healthcare providers
- Understand the indications and contraindications to use of intravenous and enteric radiographic contrast, its side effects, and the differences and relative merits of single and double contrast studies
- Recognize and treat reactions to intravenous and enteric contrast media
- Develop knowledge of the preparation and aftercare required for the common fluoroscopic examinations
- Use the PACS, voice recognition systems, and hospital information systems to become proficient in dictating reports of significant fluoroscopic and radiographic findings in a concise and clear manner
- Demonstrate the ability to recommend additional imaging studies as appropriate to better assess findings on abdominal imaging studies

Medical Knowledge:

- Learn the basic physics and principles of fluoroscopy and become familiar with techniques available to minimize radiation exposure to patients and staff during fluoroscopic procedures;
- Observe and learn the techniques to achieve high-quality diagnostic fluoroscopic examinations of the gastrointestinal and genitourinary tract;
- Perform an adequate double contrast and single contrast upper gastrointestinal series, esophagram, barium swallow, barium enema, voiding cystogram, retrograde urethrogram and cystrogram study; during the first 4-6 months the first year residents are going to be actively learning proper performance of the fluoroscopic procedures and may be assisted by senior residents. By the end of the first year the residents are expected to be independent in performance of fluoroscopic procedures.
- Develop a knowledge of normal and abnormal anatomy of the gastrointestinal and genitourinary tracts as demonstrated on contrast studies
- Become knowledgeable about the different contrast agents available and begin to recognize abnormalities that are demonstrated on fluoroscopic studies of the alimentary and genitourinary tracts. Specifically learn which oral contrast agents should and should not be used in cases of suspected perforation, possible aspiration, possible obstruction.
- List the risk factors and become familiar with proper assessment and treatment for allergic reactions to contrast media.
- Recognize the more common abnormalities encountered in the GI tract in fluoroscopic studies, such as stricture, polyp, ulcer, and mass
- Develop a knowledge of the differential diagnoses and typical appearances of the more commonly encountered gastrointestinal and genitourinary abnormalities as seen on fluoroscopic studies;

Second Year Residents:

Patient Care:

- Understand the physics of radiation protection and be proficient in utilizing techniques available for minimizing radiation exposure during fluoroscopic studies.
- Continue to improve skills for performing fluoroscopic examinations, and tailor examinations to answer all questions being asked by the clinician; anticipate those questions that should have been asked, but were not;
- Demonstrate knowledge of indications for the examinations requested (when the reason for the examination is not clear, the resident will effectively communicate with the patient and referring physician until clarified)
- Be familiar with patient's history and available medical records prior to the procedure;
- Review all studies with the supervising faculty attending
- Provide preliminary reports to all referring clinicians if needed before the final review of cases (when there is a significant discrepancy between the preliminary reading and final reading, the resident will notify the referring clinician immediately)

Medical Knowledge:

- Develop a knowledge of the equipment and physics of fluoroscopy and be able to explain the function of each part of the imaging chain.
- Be familiar with techniques optimizing radiation dose reduction;
- Familiarity with the anatomy of the organs examined in every case;
- Familiarity with imaging findings of common acute and chronic diseases evaluated with fluoroscopy;
- Be able to list risk factors for allergic reactions to contrast media and be able to describe and treat, if needed, an allergic reaction to contrast media.
- Identify pathology in order to interpret routine fluoroscopy appropriate to the level of training when presenting to the attending;
- Detect abnormalities while the fluoroscopic procedures are in progress, such as 1) disease recognition skills will continue to increase on contrast studies, and 2) begin to develop meaningful differential diagnoses for the pathology that is found.

Third and Fourth Year Residents:

The above objectives as well as the following:

Patient Care:

- Thorough familiarity with the appropriateness of fluoroscopic studies of the GI and GU tracts and specific situations when each of these techniques can confer advantages over use of others modalities;

- Perfect fluoroscopic examination techniques and be very skilled and efficient in performing and interpreting all diagnostic procedures performed in the fluoroscopy suite
- Possess clear understanding of which type of contrast media is preferable or contraindicated for fluoroscopic examinations of different types
- Know the proper preparation of patients for diagnostic examinations

Medical Knowledge:

- Develop a thorough knowledge of the differential diagnosis of abnormalities encountered on fluoroscopic examinations of the GI or GU systems
- Relate the imaging findings to the clinical condition and its pathology
- Understand the clinical management of the conditions encountered
- Familiarity with the anatomy of the organs examined in every case
- Identify pathology and distinguish between normal and abnormal abdominal and pelvic anatomy in order to interpret fluoroscopy imaging studies with excellent accuracy appropriate to the level of training when presenting to the attending and demonstrate improvement compared to the prior rotation;
- Proficient in detecting abnormalities on fluoroscopic studies while in progress
- Development of appropriate differential diagnostic lists will be well advanced
- Act as a consultant in abdominal radiology to clinicians

Reading List

- **Textbook of Gastrointestinal Imaging (ExpertConsult Series); Gore, Levine [HERE](#) [AVAILABLE AT SMITH LIBRARY PERMANENT RESERVE AND ONLINE]**
- **Laufer I, Levine MS. Double Contrast Gastrointestinal Radiology, 2nd Edition. W. B. Saunders Co., Philadelphia, PA, 1992. [HERE](#) [AVAILABLE AT LIBRARY OF SCIENCE AND MEDICINE STACK]**
- **Mayo Clinic Gastrointestinal Imaging Review [HERE](#) [AVAILABLE ONLINE THROUGH SMITH LIBRARY]**
- **Davis M, Houston JD. Fundamentals of Gastrointestinal Radiology, W. B. Saunders Co., Philadelphia, Peabody I, 2002. [HERE](#) [AVAILABLE AT SMITH LIBRARY STACKS]**
- **Halpert RD. Gastrointestinal Imaging, 3rd Edition - The Requisites. Elsevier Mosby, St. Louis, MO, 2006. [HERE](#) [AVAILABLE ONLINE]**

- **Fundamentals of Body CT; Webb [HERE](#) [AVAILABLE AT SMITH LIBRARY AND ONLINE]**

BODY IMAGING (CT and MR)

Welcome to Body Imaging Rotation!

Currently the Body rotations are divided into the ED/Inpatient and DOC (outpatient CT/MRI) rotations. The learning experiences and roles of residents will vary depending on which rotation is being covered and on the resident's level of training.

The general expectations from residents on the ED/inpatient rotation will also depend on their level of training, but overall a resident or residents (if both a junior and a senior resident are assigned to the rotations) are expected to:

- Begin the day at 8 am and stay till 4:30 pm or until the last ED case scanned before 4:30 pm is read and the results are communicated, unless dismissed by the attending or excused for a 4 pm conference, which will be at the discretion of the covering attending.
- Be responsible for protocoling the ED and inpatient vases;
- Attend to the ED and inpatient lists and interpret corresponding CT and MRI studies in a timely fashion;
- Notify referring services regarding urgent, critical and unexpected results and document such communication;
- Provide consultations to referring services via telephone or in-person;
- Be available to answer questions and clarify protocols for CT and MRI technologists;
- Be able to instruct referring services regarding proper premedication regimens for patients allergic to contrast media;
- Be available and capable to treat allergic reactions experienced by the patients getting a CT or MRI scan in the hospital.
- Read each day on the conditions and pathologic entities that had been seen or discussed on the rotation during the previous day;
- Follow up on the interesting cases encountered in previous days;
- Preview the cases and be ready to present/discuss them to the attending having looked up patient's clinical history, labs and prior studies.
- Ensure follow up of the final reports and discuss any questions/ambiguity with an assigned attending

The general expectations from residents on the outpatient rotation (DOC) will also depend on their level of training, but overall residents are expected to:

- Begin the day at 8 am and read all outpatient cases performed till 2 pm on that day. The resident is expected to review with an attending once or several times a day, either in person or virtually (to be at the discretion of the covering attending) so that appropriate feedback can be received. Upon completion of the outpatient cases performed before 2 pm, a resident is expected to check in with an attending prior to dismissal, to see if any additional coverage is required on the Body service.
- Be available to protocol add-on cases and answer questions of CT and MR technologists regarding appropriateness and/or quality of performed studies prior to patient's dismissal;
- Notify referring services regarding urgent, critical and unexpected results and document such communication;
- Provide consultations to referring services via telephone or in-person;
- Be able to instruct referring services regarding proper premedication regimens for patients allergic to contrast media;
- Be available and capable to treat allergic reactions experienced by the patients getting a CT or MRI scan in the DOC.
- Read each day on the conditions and pathologic entities that had been encountered or discussed on the rotation during the day;
- Follow up on the interesting cases encountered in previous days;
- Preview the cases and be ready to present/discuss them to the attending having looked up patient's clinical history, labs and prior studies.
- Ensure follow up of the final reports and discuss any questions/ambiguity with an assigned attending.

Educational Goals and Objectives (First Year Residents):

Patient Care:

- Understand the indications for and contraindications to use of intravenous and enteric radiographic contrast, be aware of possible side effects and be able to monitor its administration
- Recognize and treat reactions to intravenous and enteric contrast media
- Use the PACS, voice recognition systems, and hospital information systems to become proficient in dictating reports a concise and clear manner.

- Be familiar with how to access electronic medical record to review relevant patient's history
- Preview studies and, during the review, pay attention to the attending's lexicon for description of the abnormalities.

Medical Knowledge:

- Learn the basic physics and principles of radiography, fluoroscopy, CT, and MR, especially as it pertains to phases of enhancement of the liver and kidney
- Learn the departmental CT protocols and develop understanding how different studies need to be protocolled depending on the specific question that needs to be answered.
- Be familiar with departmental contrast administration policy, cut-off values and recommendations for patients with chronic renal disease, diabetes and other conditions predisposing to contrast nephropathy .
- Recognize conceptual differences that exist between different types of CT exams depending on presence of intravenous contrast and timing of the contrast bolus.
- Develop and follow a consistent algorithm for examining CT of the abdomen, pelvis or abdomen and pelvis.
- Develop knowledge of normal anatomy as seen on CT of the abdomen, CT of the pelvis or CT of the abdomen and pelvis.
- Develop consistent habits in looking up patient's indication for a study, history, labs and prior imaging before evaluating each CT
- List the risk factors for allergic reaction to intravenous contrast media and state the proper assessment and treatment for allergic reactions to contrast media
- Begin recognizing abnormal appearances associated with common pathologic entities on CT studies of GI and GU tract(appendicitis, diverticulitis, liver and spleen laceration, small bowel obstruction, hydronephrosis, renal colic, acute cholecystitis, bowel ischemia)
- Develop knowledge of the differential diagnoses of the more commonly encountered gastrointestinal and genitourinary abnormalities
- Develop ability to recognize and vocabulary to describe common medical conditions depicted on abdominal imaging studies

- Recognize critical findings on emergency CT evaluations of the abdomen and pelvis (free air, ruptured/leaking aortic aneurysm, liver or spleen laceration, hemoperitoneum, closed loop obstruction, portal venous gas, distal colonic obstruction, ovarian torsion)

Educational Goals and Objectives (Second Year Residents):

The objectives above as well as the following:

Patient Care:

- Continue to improve skills for detecting abnormalities on CT, and MR examinations, and develop clear understanding how knowledge of the patient’s history may augment visual inspection of the images in arriving to the right diagnosis.
- Demonstrate knowledge of indications for the examinations requested and perfect understanding of the proper protocoling (when the reason for the examination or contrast need is not clear, the resident will effectively communicate with the patient and referring physician until clarified)
- Familiarity with available medical records and how to access them for the purposes of patient care
- Develop independent ability and clear understanding how to protocol studies, in consultation with the attending or senior resident, when necessary, to assure that the CT or MR examination is appropriate and of sufficient quality to address the clinical concerns of the patient and referring physician
- Preview studies and pre-dictate most prior to reviewing with the supervising faculty attending
- Provide preliminary reports to all referring clinicians if needed before the final review of cases (when there is a significant discrepancy between the preliminary reading and final reading, the resident will notify the referring clinician immediately)

Medical Knowledge:

- Recommend the appropriate study based on the clinical scenario and be able to offer correct protocol;
- Familiarity with the anatomy of the organs and imaging findings of common acute and chronic diseases
- Identify pathology in order to interpret abdominopelvic CT appropriate to the level of training when presenting to the attending; general accuracy in identifying common abnormalities such as appendicitis, colitis, diverticulitis, IBD, small bowel obstructions, including closed loop obstructions, bowel ischemia, hepatic, splenic lacerations, active contrast extravasations in cases of acute GI bleed, GSW, aortic rupture.
- Distinguish between normal and abnormal abdomen and pelvis anatomy appropriate to level of training when presenting to the attending and be able to generate appropriate differential diagnoses;
- Begin to learn different MRI sequences towards the second half of the second year

- Develop understanding for appropriate MRI utilization in evaluation of acute ED cases and recognize common pathologies (appendicitis in pregnancy, choledocholithiasis)

Educational Goals and Objectives (Third Year Residents):

The above objectives as well as the following:

Patient Care:

- Familiarity with the utility of contrast studies of the GI and GU tracts, and their relationship to other imaging modalities
- Familiarity with available medical records for the purposes of patient care
- Be proficient in independent protocoling of CT and MR cases
- Be able to deliver care for a patient experiencing an allergic reaction to contrast media in the department;
- Preview and pre-dictate studies independently before review with the supervising faculty attending
- Provide preliminary reports to all referring clinicians as needed before the final review of cases (when there is a significant discrepancy between the preliminary reading and final reading, the resident will notify the referring clinician immediately)

Medical Knowledge:

- Develop a thorough knowledge of the differential diagnosis of abnormalities encountered on CT and MR examinations of the GI or GU systems
- Be familiar with indications and increase level of comfort with more advanced/special CT examinations such as CT urogram, CT enterography, CTA aorta and lower extremity run-off, CT mesenteric ischemia, CT for Acute GI bleed, etc.
- Begin developing consistent algorithmic approach to interpreting MRIs abdomen and pelvis (focal liver mass, cirrhosis/HCC, cholecystitis, choledocholithiasis, biliary ductal dilatation/obstruction, pancreatic solid and cystic neoplasms, renal cysts and neoplasms, evaluation of common gynecologic conditions on MRI such as adenomyosis, fibroid vs ovarian mass, cystic ovarian mass)
- Relate the imaging findings to the clinical condition and its pathology and understand the clinical management of the conditions encountered

- Distinguish between normal and abnormal abdomen and pelvis anatomy with excellent accuracy according to the level of training when presenting to the attending and demonstrate improvement compared to the prior rotation
- Development of appropriate differential diagnostic lists will be well advanced
- Know the proper preparation of patients for diagnostic examinations
- Act as a consultant in abdominal radiology to the clinical services
- Obtain a broad understanding of abdominal and alimentary tract diseases, their clinical features, radiographic manifestations, and current modes of treatment

Educational Goals and Objectives (Fourth Year Residents):

The same objectives for Patient Care as above for the third year residents:

Medical Knowledge:

Same as for the Third year resident and as below:

- Become comfortable with interpreting basic MRI of the abdomen and pelvis as listed: (focal liver mass, cirrhosis/HCC, cholecystitis, choledocholithiasis, biliary ductal dilatation/obstruction, pancreatic solid and cystic neoplasms, renal cysts and neoplasms, evaluation of common gynecologic conditions on MRI such as adenomyosis, fibroid vs ovarian mass, cystic ovarian mass) ;
- Begin learning interpretation of more advanced MRI cases such as MRCP for delineation of anatomy for trasplants, structuring, PSC and cholangiocarcinomas; evaluation of HCC and follow up of treated HCC monitoring for recurrence; use of MRI in staging endometrial and cervical cancer; evaluating placenta accreta cases; staging of rectal cancer; evaluation of perianal fistulas;
- Develop proficiency and gain speed in evaluation of multiphasic CT for evaluation of HCC and its recurrence; systematic approach to evaluation of oncologic cases; evaluation of complex postsurgical cases, various CTAS and evaluations of aortic endografts
- Act as a consultant in abdominal radiology to the clinical services
- Obtain a broad understanding of abdominal and alimentary tract diseases, their clinical features, radiographic manifestations, and current modes of treatment

Monitoring and Assessment of Resident Performance

The resident's progress will be monitored by the faculty on the service. At the end of each rotation, the resident will receive an evaluation of performance from each attending. Deficiencies or substandard performance will be discussed personally and privately with the resident and will

be brought to the attention of the Residency Program Director by the attending radiologist. Resident performance is also evaluated through direct observation, multi-source professional evaluations, structured case discussion, and other performance evaluation methods as determined.

Reading List for CT/MR Body Rotation:

- **Morton Myers. Dynamic Radiology of the Abdomen, 4th edit. Springer 1996**
- **W. Richard Webb, William E. Brant, and Nancy Major. Fundamentals of Body CT, Elsevier,5th ed.** (Excellent for the first year CT rotation)
- **Textbook of Uroradiology. Dunnick, Sandler, Newhouse, Amis. 4th ed.** (all you need for for GU radiology)
- Davenport. Genitourinary Imaging: A Core Review. 2015
- **Evan S Siegelman. Body MRI. Elsevier Health Sciences, 2004.**
- Haaga J, Boll D. CT and MRI of the Whole Body, 2 vol set, 6th ed. 2016
- Brandt and Helms. Fundamental of Diagnostic Radiology. (fundamentals)
- Mandell, J. Core Radiology: A Visual Approach to Diagnostic Imaging.(fundamentals)

Other resources

- Johnson CD and GD Schmitt. Mayo Clinic Gastrointestinal Imaging Review. Mayo Clinic Scientific Press, Rochester MN, 2005.
- CTisus.com by Dr. Elliot Fishman is a great resource for body CT.

Some recommended articles on
Bowel Ischemia, Evaluation of Internal hernias, Bowel Complications after Bariatric Surgery:

<https://www.ajronline.org/doi/full/10.2214/ajr.176.5.1761105>

<https://pubs.rsna.org/doi/10.1148/radiographics.20.1.g00ja0629>

<https://pubs.rsna.org/doi/full/10.1148/radiol.2016160956>

<https://www.ajronline.org/doi/full/10.2214/ajr.176.5.1761105>

<https://pubs.rsna.org/doi/full/10.1148/rq.2018170148>

<https://www.ajronline.org/doi/full/10.2214/AJR.06.0541>

Lecture Code	Lecture Title	Body Imaging (CT/MR/Fluoro)
---------------------	----------------------	-------------------------------------

GI Lectures

Core L 1 (Liver)	Benign and Malignant Liver Masses	Mase Easy: Focused Algorithmic Approach
------------------	-----------------------------------	---

Core L2	Hepatocarcinogenesis and LI-RADS 2018: An Update on the Imaging Diagnosis of HCC
Core L3	MRI of The Liver Part I - Technique, contrast agents, Diffuse Liver Disease
Cover L4	MRI of The Liver Part II - Benign and Malignant Neoplasms
Core L5	Benign Liver Masses
Core L6	Malignant Liver Masses
Core L7	Hepatic Depositional, Vascular and Inflammatory Disease
Core L8	Rare Diffuse Liver disorders
Core L9	Loco-regional treatment of HCC:: Evaluation for Recurrence and Residual Disease
CoreL10	Liver Anatomy, Partial hepatectomy and Hepatic transplantation techniques
Core B1	Gallbladder: Imaging of the gallbladder
Core B2	Gallbladder Emergencies
Core B3	MRCP and Imaging of biliary disease
Core P1	Pancreas: Cystic pancreatic neoplasms
Core P2	Pancreas: Pancreatitis
Core P3	Pancreas: Pancreatic cancer diagnosis, structured reporting
Core P4	MRI of the Pancreas including secretin
Core P5	Neuroendocrine neoplasms: Emerging Concepts in Diagnosis and Treatment
Core S1	Spleen: CT and MR of Spleen:
Core Bow 1	Systematic approach to Small Bowel Obstruction
Core Bow 2	The Pearls of Bowel Imaging
Core Bow.3	Bowel Contents and their Complications
Core Bow 4	CT Duodenum
Core Bow 5	CT Small Bowel
Core Bow 6	CT Colonic Disease
Core Bow 7	Gastric Outlet and Duodenal Obstructions
Core Bow 8	Inflammatory Bowel Disease
Core Bow 9	Complications of Colonic Diverticular Disease
Core Bow 10	Imaging of Bariatric Surgery
Core Bow 11	Internal hernias; gastric bypass and beyond
Core Bow 12	Abdominal hernias

Core GI 1	Abdominal manifestations of lymphoma
Core GI 2	CT of the Peritoneum, Mesentery, & Omentum
Core GI 3	Anatomy: Peritoneal and retroperitoneal spaces
Core Gen1	Protocols and Contrast Part I -protocols, premedication policy & procedure
Core Gen 2	Protocols and Contrast Part II - contrast reactions, contrast nephropathy, NSF
Core Gen 3	On-call abdominal CT review
Core Gen 4	Using Laboratory Test Results in Emergency Radiology
Core Gen 5	Pneumoperitoneum and Pseudopneumoperitoneum
Core Gen 5	CT Of the Atraumatic Acute Abdomen
Core Gen 5	Introduction to Abdominal Radiograph
Core TR 1	Solid abdominal organ injury
Core TR2	Spleen: Splenic trauma and pathology
Core TR3	Hollow abdominal organ injury
Core ED 1	Evaluation of AAA and Endoleaks
Core ED 2	Emergency Complications of Cirrhosis and Hepatocellular Carcinoma
Core ED 3	MRI Imaging of Acute Abdomen and Pelvis in Pregnancy
Core ED 4	Approach to Oncologic Evaluation in ED setting
Core ED5	Emergencies of Benign Abdominal/Pelvic Lesions
Core F1	Introduction to fluoroscopy
Core F2	Radiologic evaluation of the esophagus
Core F3	Radiologic evaluation of the Stomach
Core F4	Radiologic evaluation of the colon
Core F5	Radiologic evaluation of small bowel obstruction
Core F6	Radiologic evaluation of bariatric surgery
Core F7	Radiologic evaluation of the post-operative GI tract
Core F8	Radiologic evaluation of the biliary tree
Core F9	Dysphagia evaluation and management
Core ADV1	Advanced pelvic MRI: imaging of rectal cancer and standardized reporting
Core AVD 2	Imaging of pancreatic transplants
Core ADV 3	CT Colonography: Pearls and Pitfalls

Core ADV4	MRI of the anal region; finding the tract
Core ADV 5	Introduction to CT/MR enterography
Core ADV 6	Lumen apposing stents: normal appearances and complications
Core ADV 7	ACR Abd/Pel Incidental Findings recommendations liver, pancreas and spleen
Core ADV 8	Vascular Diseases in the abdomen and pelvis
Core ADV 9	Principles and Applications of Dual Energy CT in Body Imaging

GU Lectures

Core R 1	Kidneys: Acute renal pathology (stones, infection, trauma)
Core R2	Kidneys: Cystic renal masses
Core R3	Renal Masses and Syndromes
Core R4	Urinary Tract: CT urography
Core R5	Renal and Ureteral Emergencies
Core R6	Renal Inflammatory and Vascular Disease
Core Adr 1	CT and MRI of Adrenal Diseases
Core Gyn 1	GYN: Acute GYN pathology on CT
Core Gyn 2	GYN: MRI of Female pelvis
Core Core Gyn 3	GYN: Benign uterine conditions I
Core Gyn 4	GYN: Benign and malignant ovaries
Core Gyn 5	GYN: Endometriosis and deep infiltrating endometriosis
Core Gyn 6	GYN: Systematic approach to GYN-ONC CT/MRI - Part 1 (Endometrial Cancer)
Core Gyn 7	GYN: Systematic approach to GYN-ONC CT/MRI - Part 2 (cervical Cancer)
Core Gyn 8	Imaging of Ovarian Cancer
Core Gyn 9	GYN: Role of Imaging in Work up of Female Infertility (US, HSG and MRI)
Core GU1	Diseases of the Retroperitoneum
Core GU 2	Male GU: Diseases of scrotum and penis
Core GU 3	GU Trauma:
Core GU 4	Cystourethrogram and Vesicourethrogram
Core GU Adv 1	OB: Role of US and MRI in evaluation of Placenta Accreta
Core GU Adv 2	Advanced pelvic MRI: Pelvic floor

Core GU Adv 3 Advanced pelvic MRI: Perineal and periurethral masses
Core GU Adv 4 MRI of Female urethra and Vagina
Core GU Adv 5 MRI of the Prostate

THORACIC AND CARDIAC RADIOLOGY

The information for the knowledge based portions of the curriculum for Thoracic and Cardiac Radiology will be distributed as pdf files to each resident as we progress through conferences.

Reading material will be assigned and distributed well in advance of conferences.

Demonstration of knowledge based objectives will be assessed with quizzes at conferences. Passing scores are as follows:

First Year Radiology Residents: Average \geq 50%

All other residents: Average \geq 60%

Residents will also be assessed by written evaluations after each rotation available on New Innovations.

Abbreviations:

PC = Patient Care

MK = Medical Knowledge

SBP = System based practice

PBLI = Practice based learning and improvement

P = Professionalism

ICS= Interpersonal Communication Skills

YEAR ONE

I. Goals

1. Demonstrate learning of the appropriate knowledge-based objectives.
2. Accurately and concisely dictate a chest radiograph report.
3. Communicate effectively with referring clinicians and supervisory staff.
4. Understand standard patient positioning in thoracic radiology.
5. Obtain pertinent patient information relative to radiologic examinations.

6. Demonstrate knowledge of the clinical indications for obtaining chest radiographs and when a chest CT or MR may be necessary.
7. Demonstrate a responsible work ethic.
8. Participate in quality improvement/quality assurance and other operational activities.

II. Objectives

A. Knowledge-based

At the end of the first year, the resident will demonstrate learning of at least one-third of the knowledge-based objectives (PC) (MK).

B. Technical, communication, and decision-making skills

By the end of the first year, the resident should have mastered the following technical, communication, and decision-making skills:

1. 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 (ICS)
2. Communicate with ordering physicians about all significant or unexpected radiologic findings and document who was called and the date and time of the call in the dictated report following departmental policies for communication for any urgent findings (IPC) (PC)(SBP)
3. Obtain relevant patient history from electronic records, dictated reports, or by communicating with referring clinicians (PC)(SBP)
4. Describe patient positioning and indications for posteroanterior (PA), anteroposterior (AP), lateral decubitus, and lordotic chest radiographs (PC) (MK)
5. When assisting referring clinicians with imaging interpretation and patient management, decide when it is appropriate to obtain help from supervisory faculty (P)
6. Arrive for the rotation assignment on time and prepared after reviewing recommended study materials (P)
7. Use appropriate chest radiograph, CT, and MRI nomenclature when dictating reports and consulting with health care professionals (ICS).
8. Demonstrate ability to locate appropriate guidelines for imaging management of incidental lung nodules and nodules on screening chest CT scans. (PBLI)

YEAR 2

I. Goals

In addition to those goals listed for Year 1, the resident will:

1. Demonstrate learning of the knowledge-based learning objectives.
2. Continue to build on chest radiograph interpretive skills.
3. Develop skills in protocoling, monitoring, and interpreting chest CT scans.
4. Demonstrate an understanding of Appropriateness Criteria and Practice Standards and Technical Guidelines for thoracic radiology.
5. Demonstrate an ability to generate and interpret multiplanar reformatted (MPR) or three-dimensional images of CT or MRI studies as appropriate.

II. Objectives

A. The resident will demonstrate learning of at least two-thirds of the knowledge-based objectives listed.

The resident should be able to identify the following structures on chest CT and chest MRI (MK).

- Lungs—right, left, right upper, middle, and lower lobes, left upper lobe (anteroposterior, anterior and lingular segments), and left lower lobe
- Pleura and extrapleural fat
- Airway—trachea, main bronchi, carina, and lobar 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—ascending, sinuses of Valsalva, arch, descending

- 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
- Gastrohepatic ligament, celiac axis
- Diaphragm
- Lungs—all lobes and segments; secondary pulmonary lobules
- Fissures—major, minor, azygos, accessory (superior and inferior)
- Airway—lobar and segmental bronchi
- Inferior pulmonary ligaments

B. At the end of the second year, the resident will demonstrate the following technical, communication, and decision-making skills, in addition to those listed for Year 1.

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 (PC)(SBP)
2. Monitor all chest CT examinations and determine if additional imaging is needed before the patient CT examination is completed (when necessary) (PC)

3. Demonstrate the ability to effectively present thoracic radiology cases to other residents in a conference setting by appropriately selecting cases, interacting with residents, and presenting a brief discussion of the diagnosis for each case (PBLI)
4. Demonstrate the ability to manage an intravenous contrast reaction that occurs during a chest CT examination (PC)(SBP)
5. Act as a consultant for referring clinicians and recommend the appropriate use of imaging studies (ICS)
6. Describe the principles of chest fluoroscopy, including the assessment of the diaphragm (PC)
7. Demonstrate knowledge of CT parameters contributing to patient radiation exposure and techniques that can be used to limit radiation exposure (PC).
8. Demonstrates ability to incorporate Fleischner Society Criteria and Lung-RADS guidelines into radiology reports. (PBLI)

YEARS 3–4

I. Goals

After completion of the third year, and in addition to the goals listed for Years 1 and 2, the resident will:

1. Demonstrate learning of the knowledge-based objectives.
2. Refine skills in interpretation of radiographs and chest CT scans.
3. Develop skills in protocoling, monitoring, and interpreting chest MR studies, including cardiovascular MRI.
4. Become a more autonomous consultant and teacher.
5. Correlate pathologic and clinical data with radiographic and chest CT findings.

II. Objectives

A. During the third and fourth years of radiology residency, the resident will demonstrate knowledge of all of the knowledge-based objectives introduced in Years 1 and 2 (MK).

B. Technical and communication skills:

The resident will demonstrate the following technical, communication, and decision-making skills, in addition to those listed for Years 1 and 2.

1. Dictate accurate, concise chest radiograph, CT scan, and MR reports; the reports will contain no major interpretive errors (ICS)

2. State the clinical indications for performing chest CT and MRI (MK) (PC)(SBP)

3. Describe a chest CT protocol optimized for evaluating each of the following (PC)(SBP):

- thoracic aorta and great vessels
- coronary calcium
- pulmonary vein anatomy
- suspected pulmonary embolism
- tracheobronchial tree
- suspected bronchiectasis
- lung cancer staging
- esophageal cancer staging
- suspected pulmonary metastases
- suspected pulmonary nodule on a radiograph
- shortness of breath
- hemoptysis
- cardiac mass
- coronary arteries
- suspected pericardial disease

4. Understand the technical principles of chest MRI exams and describe a protocol optimized for evaluating each of the following (MK) (PC)(SBP):

- thoracic aorta
- pulmonary arteries
- thoracic veins (superior vena cava, brachiocephalic veins)
- pericardium

- cardiomyopathy and cardiac and paracardiac masses, including tumors
 - ischemic heart disease, including function, viability and perfusion
 - valvular heart disease
 - right ventricular dysplasia
 - congenital heart disease in an adult
 - superior sulcus tumor
5. Present an interesting cardiothoracic imaging case to residents and faculty (MK) (ICS) (PBLI).
6. Work in the reading room independently, assisting clinicians with radiologic interpretation, and teaching other residents and medical students assigned to thoracic radiology (PC) (ICS) (P) (PBLI).
7. Locate and employ accepted criteria for diagnosing myocarditis and left ventricular noncompaction by MRI. (MK)(PBLI)

Knowledge-Based Objectives

Normal Anatomy.—

1. Define a secondary pulmonary lobule.
2. Define an acinus.
3. Name the lobar and segmental bronchi of both lungs.
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
 - Veins—superior vena cava, azygos, left superior intercostal (“aortic nipple”)

- Bones—spine, ribs, clavicles, scapulae, humeri
- Right paratracheal stripe
- Junction lines—anterior, posterior
- Aortopulmonary window
- Azygoesophageal recess
- Paraspinal lines
- 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, Leith brachiocephalic (innominate), pulmonary vein confluence
- Bones—spine, ribs, scapulae, humeri, sternum
- 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 (eg, a process involving the medial segment of the right middle lobe obscures the right heart border, a lingular process obscures the left heart border, a basilar segmental lower lobe process obscures the diaphragm)
- 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:

- 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. 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, enlarged heart and a pacemaker or defibrillator in a patient with prior sternotomy and ILD secondary to amiodarone drug toxicity).
3. Identify Kerley A and B lines on a chest radiograph and explain their etiology.
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.
5. Define the terms “asbestos-related pleural disease” and “asbestosis”; identify each on a chest radiograph and chest CT.
6. 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.
7. Describe the radiographic classification of sarcoidosis.
8. Recognize progressive massive fibrosis/conglomerate masses secondary to silicosis or coal worker’s pneumoconiosis on radiography and chest CT.
9. Recognize the typical appearance and upper lobe predominant distribution of irregular lung cysts or nodules on chest CT of a patient with Langerhans cell histiocytosis.
10. List causes of unilateral ILD.

11. List causes of lower lobe predominant ILD.
12. List causes of upper lobe predominant ILD.
13. Identify a secondary pulmonary lobule on CT.
15. Recognize findings of lymphangiomyomatosis on a chest radiograph and CT.
16. 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 causes of acute alveolar lung disease (ALD).
2. List causes of chronic ALD.
3. Name common pulmonary-renal syndromes.
4. List the most common causes of acute respiratory distress syndrome.
5. 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).
6. Recognize a pattern of peripheral ALD on radiography or chest CT and give an appropriate differential diagnosis, including a single most likely diagnosis when supported by associated radiologic findings or clinical information (eg, peripheral lung disease associated with paratracheal and bilateral hilar adenopathy in an asymptomatic patient with “alveolar” sarcoidosis, peripheral lung disease associated with a markedly elevated blood eosinophil count in a patient with eosinophilic pneumonia, peripheral opacities associated with multiple rib fractures and pneumothorax in a patient with acute thoracic trauma and pulmonary contusions).

Atelectasis, Airways, and Obstructive Lung Disease.—

1. Recognize partial or complete atelectasis of the following on a chest radiograph:
 - right upper lobe
 - right middle lobe
 - right lower lobe
 - right upper and middle lobe

- right middle and lower lobe
 - left upper lobe
 - left lower lobe.
2. Recognize complete collapse of the right or left lung on a chest radiograph and list an appropriate differential diagnosis for the etiology of the collapse.
 3. Distinguish lung collapse from massive pleural effusion on a frontal chest radiograph.
 4. Name the types of bronchiectasis and identify each type on a chest CT.
 5. Name common causes of bronchiectasis.
 6. Recognize the typical appearance of cystic fibrosis on chest radiography and CT.
 7. Name the important things to look for on a chest radiograph when the patient history is “asthma.”
 8. Define tracheomegaly.
 9. Recognize tracheal and bronchial stenosis on chest CT and name the most common causes.
 10. Name the three types of pulmonary emphysema and identify each type on a chest CT.
 11. Recognize alpha-1-antitrypsin deficiency on a chest radiograph and CT.
 12. Recognize Kartagener syndrome on a chest radiograph and name the three components of the syndrome.
 13. 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. Identify normal vessels or vascular abnormality on chest CT and chest MRI that may mimic a solid mass.
6. Name 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 important considerations in the evaluation of a solitary pulmonary nodule.
4. Name causes of cavitory pulmonary nodules.
5. Name causes of multiple pulmonary nodules.
6. Describe the indications for percutaneous biopsy of a solitary pulmonary nodule.
7. Describe the indications for percutaneous biopsy when there are multiple pulmonary nodules.
8. Describe the role of positron emission tomography in the evaluation of a solitary pulmonary nodule.
9. Describe an appropriate imaging algorithm to evaluate a solitary pulmonary nodule.

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.
5. Name the stages of non–small-cell lung cancer are potentially resectable.
6. Name the most common thoracic locations for adenoid cystic carcinoma and carcinoid tumors to occur.
7. Suggest the possibility of radiation change as a cause of new apical opacification on a chest radiograph of a patient with evidence of mastectomy or axillary node dissection.
8. 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.
9. State the role of MRI in lung cancer staging (eg, chest wall invasion, superior sulcus, Pancoast tumor).
10. Describe the role of positron emission tomography in lung cancer staging.
11. Describe the classification of lymphoma, the role of imaging in the staging of lymphoma and the
12. Describe typical and atypical imaging findings of thoracic lymphoma.
13. Define primary pulmonary lymphoma.
14. Describe the typical chest radiograph and chest CT appearances of Kaposi sarcoma.
15. Describe CT protocol for lung cancer screening and format for the radiology reports.
16. Be familiar with supportive evidence for lung cancer screening and related issues.

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.
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 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 cavitory 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 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. 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 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 intraperitoneal fluid on chest CT.

Infection and Immunity.—

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

15. Name the endemic mycoses and the specific geographic regions where they are found, and describe their radiographic manifestations.
16. Name the most common pulmonary infections seen after solid-organ (ie, liver, renal, lung, cardiac) and bone marrow transplantation.
17. 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
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 common causes of pulmonary arterial hypertension.
4. Recognize lobar and segmental pulmonary emboli on chest CT
5. Define the role of ventilation-perfusion scintigraphy, chest CT, 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
 - 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 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.

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.

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 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
- 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
- Congenitally corrected 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

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.

Topics for Didactic Conferences for Thoracic Imaging

Radiographic Anatomy and Mediastinal Lines
Thoracic Imaging for the Emergency Department
Solitary Pulmonary Nodule
Lung Cancer
Non-neoplastic Lung Masses
Multiple Nodules: Cavitory and Non-Cavitory
The Micronodular Pattern
Pulmonary Edema
Pneumonia, Tuberculosis and Atypical Mycobacterial Disease
Fungal Infections
Miscellaneous Infections, Acute Chest Syndrome Lipoid Pneumonia
Thoracic Complications of AIDS
Eosinophilic Lung Disease
Pulmonary Hemorrhage and Alveolar Proteinosis
Radiology of Interstitial Lung Disease: Part 1
Radiology of Interstitial Lung Disease: Part 2
Sarcoidosis
Bronchiectasis
Tracheal Abnormalities
Small Airway Disease
High Resolution Chest CT
Mediastinum Part 1: Anterior Mediastinum
Mediastinum Part 2: Middle and Posterior Mediastinum
Pleural Disease
Thoracic Vascular Abnormalities: Part 1 – Thoracic Aorta
Thoracic Vascular Abnormalities: Part 2 – Thoracic Veins, Pulmonary Hypertension, Pulmonary Embolism, Selected Cardiac Disorders
Signs You Must Know in Thoracic Radiology

Topics for Didactic Conferences in Cardiac Imaging

Normal Anatomy and Basic Physiology
Radiographic Anatomy and Specific Chamber Enlargement
Radiographic Approach to Adult Heart Disease
Cardiovascular Calcifications
Introduction to Cardiac MRI
Valvular Heart Disease
Imaging of Cardiomyopathies

Pericardial Disease
Cardiac and Pericardial Tumors
Coronary Arteries: Anatomy and Abnormalities
Coronary CT Angiography
Complications of Ischemic Heart Disease
Cardiac Pacemakers, Prosthetic Valves and Other Devices
Diseases of the Thoracic Aorta
Pulmonary Hypertension and Cor Pulmonale
Approach to Congenital Heart Disease
Congenital Heart Disease: Left to Right Shunts
Congenital Heart Disease: Admixture Lesions
Congenital Heart Disease: Right to Left Shunts
Congenital Heart Disease: Pulmonary Venous Hypertension
Congenital Heart Disease: Normal Pulmonary Vascularity
Surgery for Congenital Heart Disease
Aortic Arch Anomalies, Rings and Slings
Abnormalities of Situs and Cardiac Malposition

Revised November 2021 by Pierre Maldjian, MD

BREAST IMAGING

Reading list:

§ ACR BIRADS Lexicon Fifth Edition

§ Ikeda, Breast Imaging: The Requisites

Goals and Objectives:

1st Year

- The resident will learn the indications for screening mammography and diagnostic mammography.
- The resident will learn to review patient history forms and plan appropriate diagnostic workup algorithms tailored to each patient presenting with the symptoms related to the breast.
- The resident will demonstrate understanding of the indications and contraindications for different modalities including mammography, breast ultrasonography and MRI.
- The resident will learn the indications, contraindications, and potential complications of interventional procedures including stereotactic core biopsy, ultrasound, fine needle aspiration biopsy, MRI guided biopsy and preoperative wire localization.
- The resident will observe all image guided breast procedures including preoperative wire localizations, cyst aspirations, ultrasound guided biopsy, MRI guided biopsy and stereotactic biopsy.
- The resident will interpret screening mammograms under the supervision of the attending physician.

2nd Year

- The resident will learn to produce clear and concise mammographic reports and ultrasound reports according to ACR BI-RADS guidelines.
- The resident will interpret screening mammograms under the supervision of the attending physician.

- The resident will learn how to communicate findings on breast imaging studies to referring physicians, patients, and patients' families.
- The resident will successfully gain the skill to obtain written consent for interventional procedures.
- The resident will learn to supervise technologists in the performance of breast imaging studies to the satisfaction of the attending physician.
- The resident will continue to observe all image guided breast procedures including preoperative wire localizations, cyst aspirations, ultrasound guided biopsy, MRI guided biopsy and stereotactic biopsy and will be given gradual increase in participation of the procedures under direct attending supervision.

· 3rd Year

- The resident will gain enhanced skills in the production of clear and concise mammographic reports and ultrasound reports according to ACR guidelines as assessed by the attending.
- The resident will interpret screening mammograms under the supervision of the attending physician.
- The resident will learn about the interpretation of Breast MRI.
- The resident will learn how to communicate findings on breast imaging studies to referring physicians, to patients, and patients' families.
- The resident will attain facility in overseeing written consent for interventional procedures.
- The resident will supervise technologists in the performance of breast imaging studies as assessed by the attending.
- The resident will assist in all image guided breast procedures including preoperative wire localizations, cyst aspirations, ultrasound guided biopsy, and stereotactic biopsy and will be given gradual increase in participation of the procedures under direct attending supervision.

4th year

- The resident will be expected to produce clear and concise mammographic reports and ultrasound reports according to ACR guidelines as assessed by the attending.
- The resident will gain enhanced skills in the interpretation of breast MRI.
- The resident will communicate findings on breast imaging studies to referring physicians, to patients, and patients' families.
- The resident will obtain written consent for interventional procedures.
- The resident will supervise technologists in the performance of breast imaging studies as assessed by the attending.
- The resident must now interpret at least 250 mammographic exams under attending radiologist's supervision.
- The resident will assist in all image guided breast procedures including preoperative wire localizations, cyst aspirations, ultrasound guided biopsy, MRI guided biopsy and stereotactic biopsy and will be given gradual increase in participation of the procedures under direct attending supervision.

Dr. Salvador.

BREAST IMAGING LECTURES

Introduction to Breast Imaging

Breast Cancer: Statistic and Pathology

Breast Masses

Breast Calcifications

Benign Breast Lesions

Breast Asymmetries

Management of Palpable Breast Lesions

Breast MRI

Breast Implants

Imaging of Ductal Carcinoma in Situ

Imaging of Invasive Ductal Carcinoma

Imaging of Invasive Lobular Carcinoma

INTERVENTIONAL RADIOLOGY GOALS AND OBJECTIVES

Overall rotation goals and objectives:

The Interventional Radiology rotations involve performance and interpretation of diagnostic and therapeutic image-guided procedures. Radiology residents will spend 4--6 (4 core rotations required) months on the interventional radiology service during their residency. All aspects of interventional radiology will be taught during the residency. Specific responsibilities, goals and objectives for each rotation are described in this document. The interventional radiology faculty will provide residents with graded supervision using ACGME guidelines.

Resident responsibilities:

1. Complete competency check lists for basic IR procedures (see below)
2. Be knowledgeable of the daily interventional procedure schedule.
3. Be available to assist with procedures during the day, except during scheduled conferences.
4. Review previous radiology studies and discuss findings with faculty prior to each procedure.
5. Assist with completion of *outpatient* pre---procedure documentation.
6. Complete the post---procedure note after each procedure.
7. Act as liaison with referring clinicians: evaluate requisitions for appropriateness, discuss findings with referring clinicians.
8. Prepare inpatients for procedures by reviewing diet, coagulation, consent and allergies.
9. Consult supervising faculty when questions arise beyond the scope of the resident's current level of training.

Staff responsibilities:

1. Review the goals and objectives with the resident at the beginning of each rotation.
2. Sign off on resident competencies at the end of each rotation as appropriate.
3. Be available at all times for consultation by the resident.
4. Provide the resident with constructive feedback on their performance during the rotation.
5. Verify resident reports in a timely manner and inform the resident of any major

changes.

6. Faculty will complete resident and all program evaluations in a timely professional manner.

Residents are expected to present in the IR suite at 7:30 am every day and go over and prepare for the scheduled and add-on cases for the day in EPIC EMR. Residents are expected to review the clinical and imaging studies for the major cases. Self directed learning is strongly encouraged and expected.

SUGGESTED READING LIST

The Requisites.

Valji, K. Vascular and Interventional Radiology. W.B. Saunders Company.

Kandarpa, K, Aruny J., Handbook of Interventional Radiologic Procedures. 3rd edition Lippincott Williams & Wilkins.

Rogers, P. ed. Pocket Radiologist – Interventional 100. Amirsys, 2002. Small handbook of 100 common procedures.

Kadir, S. Teaching Atlas of Interventional Radiology Diagnostic and Therapeutic Angiography. Thieme, New York, 1999.

Baum, S and Pentecost, M. Abrams' Angiography 5th edition. Volume 1-3. Little, Brown and Co.

RadPrimer
SIR Clinical Practice Guidelines

First rotation

Medical

Knowledge:

- Vascular and non-vascular anatomy and physiology including some common variants
- Appropriate use of fluoroscopy, CT-Fluoroscopy and ultrasound equipment and technique including techniques to minimize radiation exposure
- Identify relevant anatomic structures on vascular studies
- Learn basic approach to drainage procedures (GI, GU, and abscess)
- Demonstrate understanding of Seldinger technique.

- Begin reading from books in the suggested list.
- Demonstrate mastery of approximately 1/3 of the Interventional Radiology curriculum from RadPrimer (see below)

Patient-Care Objectives:

Knowledge-based objectives:

- Learning appropriate indications and contraindications, risks and benefits to vascular and nonvascular procedures (mild to moderate complexity)
- Learning appropriate planning (reviewing imaging, pertinent labs, patient positioning, history and physical, consult write-ups) for vascular and nonvascular procedures (mild to moderate complexity)
- Appropriate work-up for emergency/on-call cases
- Medical management of patients admitted to the IR service
 - Gather clinical and radiological data on vascular and non-vascular patients, and write full consult on inpatients and outpatients
 - Develop diagnostic and treatment plan based on the clinical presentation and prior imaging
 - Consent patient and family for procedures
 - Participate in procedure safely and responsibly
 - Counsel patients concerning findings
 - Demonstrate basic knowledge of EPIC, Nuance, and Centricity PACS

Technical skills objectives:

- Venous access
- Simple CT guided procedures (Biopsies, abscess drainage, chest tube)
- Arterial access
- Basic abscess drainage and tube changes

Decision-making and value judgment skills:

- Work with the health care team in a professional manner to provide patient-centered care,
- Notify referring clinician for urgent, emergent, or unexpected findings, and document in dictation.
- Consistently perform pre-operative work ups on patients undergoing procedures.
- Diligent follow up and rounding on patients who have undergone procedures and management of any post operative complications.

Interpersonal and Communication Skills

Skills

- Provide a clear written consult, procedure note, and follow-up notes in the patient's
- medical record
- Provide an concise and accurate presentation of patients prior to procedure or on patients that the resident did a clinical consult
- Provide a clear dictated report
- Communicate directly with referring physicians, and document communication in
- report
- Demonstrate skills in obtaining informed consent, including effective communication to patients of the procedure, alternatives, and possible complications
- Demonstrate the verbal and non-verbal skills necessary for face to face

Education

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

Professionalism

Skills

- Mandatory and timely attendance at all IR rounds and lectures Daily rounds
- Active participation with faculty in patient workup and performing procedures
- Role modeling by faculty
- Preparation of cases for hepatobiliary conference
- Graduated responsibility in performing vascular and nonvascular

- Demonstrate excellence: perform responsibilities at the highest level and active learning throughout one's career
- Demonstrate honesty with patients and staff
- Demonstrate sensitivity without prejudice on the basis of religious, educational differences, and without employing sexual or other types of
- Demonstrate knowledge of issues of impairment

- Demonstrate positive work habits, including punctuality and professional
- Demonstrate the broad principles of biomedical ethics
- Demonstrate principles of confidentiality with all information transmitted patient encounter

Education

- Discussion of above issues during daily clinical work
- Role modeling by attending physician faculty
- Participation in hospital based educational activities

Practice Based Learning and Improvement

Skills

- Demonstrate the ability to use the Internet as an educational instrument
- Maintain a case log of all interventional procedures you perform
- Analyze and develop improvement plans in the clinical practice, including knowledge, observation, and procedural skills
- Demonstrate knowledge of and apply the principles of evidence-based medicine in practice
- Demonstrate critical assessment of the scientific literature
- Help teaching of medical students, peers and other health care professionals

Education

- Participate in Journal club, clinical conferences, and independent learning

Systems Based Practice

Skills

- Demonstrate ability to design cost-effective care plans
- Demonstrate knowledge of reimbursement methods

Education

- Review of literature, including ACR Appropriateness Criteria and SIR clinical practice guidelines
- Attendance and participation in multi-disciplinary conference
- Interaction with department administrators
- Membership and participation in local and national radiological societies

Second rotation

Medical

Knowledge:

- Fluoroscopic equipment and technique
- Digital subtraction angiography
- Angiographic interpretation
- Advanced patient management principles
- Complete Recommended Reading for second rotation (see below)
- Mastery of two-thirds of the RadPrimer Interventional Radiology curriculum

Patient care:

Technical skills objectives:

- Basic venous procedures including venograms, IVC filter placement, venoplasty and stenting,
- Basic arterial procedures including diagnostic aortograms and run-offs, mesenteric angiograms and pelvic angiograms
- Advanced drainage procedures, percutaneous biliary access and drainage, nephrostomy tube placement
- Basic chemoembolization techniques and patient management
- Basic RF ablation techniques and patient management
- Basic medical management of patients admitted to the IR service
 - Gather clinical and radiological data on vascular and non-vascular patients, and write full consult on inpatients and outpatients
 - Develop diagnostic and treatment plan based on the clinical presentation and prior imaging
 - Consent patient and family for procedures
 - Participate in procedure safely and responsibly
 - Counsel patients concerning findings
 - Demonstrate basic knowledge of EPIC, Nuance, and Centricity PACS

Decision-making and value judgment skills:

- Work with the health care team in a professional manner to provide patient-centered care
- Notify referring clinician for urgent, emergent, or unexpected findings, and document in dictation.

- Consistently perform pre-operative work ups on patients undergoing procedures.
- Diligent follow up and rounding on patients who have undergone procedures and management of any post-operative complications.

Interpersonal and Communication Skills

Skills

- Provide a clear written consult, procedure note, and follow-up notes in the patient's medical record
- Provide an concise and accurate presentation of patients prior to procedure or on patients that the resident did a clinical consult
- Provide a clear dictated report
- Communicate directly with referring physicians, and document communication in report
- Demonstrate skills in obtaining informed consent, including effective communication to patients of the procedure, alternatives, and possible complications
- Demonstrate the verbal and non-verbal skills necessary for face to face listening and speaking to physicians, families, and support personnel

Education

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

Professionalism

Skills

- Mandatory and timely attendance at all IR morning rounds and lectures
- Active participation with faculty in patient workup and performing procedures Role modeling by faculty members
- Attend Wednesday afternoon lectures Preparation of cases for hepatobiliary conference
- Graduated responsibility in performing vascular and nonvascular procedures
- Demonstrate compassion (be understanding and respectful of patient,

their families, and medical colleagues)

- Demonstrate excellence: perform responsibilities at the highest level and continue active learning throughout one's career
- Demonstrate honesty with patients and staff
- Demonstrate sensitivity without prejudice 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
- Demonstrate positive work habits, including punctuality and professional appearance
- Demonstrate the broad principles of biomedical ethics
- Demonstrate principles of confidentiality with all information transmitted during a patient encounter

Education

- Discussion of above issues during daily clinical work
- Role modeling by attending physician faculty
- Participation in hospital based educational activities

Practice Based Learning and Improvement

Skills

- Demonstrate the ability to use the Internet as an educational instrument
- Maintain a case log of all interventional procedures you perform

- Analyze and develop improvement plans in the clinical practice, including knowledge, observation, and procedural skills
- Demonstrate knowledge of and apply the principles of evidence-based medicine in practice
- Demonstrate critical assessment of the scientific literature
- Help teaching of medical students, peers and other health care professionals

Education

- Participate in Journal club, clinical conferences, and independent learning

Systems Based Practice

Skills

- Demonstrate ability to design cost-effective care plans
- Demonstrate knowledge of reimbursement methods

Education

- Review of literature, including ACR Appropriateness Criteria and SIR clinical practice guidelines
- Attendance and participation in multi-disciplinary conference
- Interaction with department administrators
- Membership and participation in local and national radiological societies

Third rotation

Medical

Knowledge:

- Fluoroscopic techniques
Arterial interventional
procedures TIPS
Arterial and venous thrombolysis
- Advanced patient management principles
- How to appropriately select patients for loco regional therapies (Chemoembolization and/or RF ablation)
- How to appropriately select patients for Uterine Fibroid Embolization (UFE)
- Complete Recommended Reading for Third Rotation (see below).

Patient Care:

Technical skills objectives:

- How to perform angiograms, runoffs, and basic arterial stents (renals, iliacs)
- How to perform TIPS
- How to perform chemoembolization and RF ablation

- How to perform UFE
- How to perform arterial and venous thrombolysis and follow up
- Medical management of patients admitted to the IR service
 - Gather clinical and radiological data on vascular and non-vascular patients, and write full consult on inpatients and outpatients
 - Develop diagnostic and treatment plan based on the clinical presentation and prior imaging
 - Consent patient and family for procedures
 - Participate in procedure safely and responsibly
 - Counsel patients concerning findings
 - Demonstrate basic knowledge of EPIC, Nuance, and Centricity PACS

Decision-making and value judgment skills:

- Work with the health care team in a professional manner to provide patient-centered care
- Notify referring clinician for urgent, emergent, or unexpected findings, and document in dictation.
- Consistently perform pre-operative work ups on patients undergoing procedures.
- Diligent follow up and rounding on patients who have undergone procedures and management of any post operative complications.

Interpersonal and Communication

Skills

- Provide a clear written consult, procedure note, and follow-up notes in medical record
- Provide an concise and accurate presentation of patients prior to procedure or on patients that the resident did a clinical consult
- Provide a clear dictated report
- Communicate directly with referring physicians, and document communication in report
- Demonstrate skills in obtaining informed consent, including effective communication to patients of the procedure, alternatives, and possible complications
- Demonstrate the verbal and non-verbal skills necessary for face to face listening and speaking to physicians, families, and support personnel

Education

- Participation as an active member of the radiology team by communicating with clinicians face to face, providing consults, answering phones, problem solving and decision-making
- Act as contact person for technologists and nurses in managing patient

Professionalism

Skills

- Mandatory and timely attendance at all IR morning rounds and lectures
- Active participation with faculty in patient workup and performing procedures
- Role modeling by faculty members

Practice Based Learning and Improvement

Skills

- Demonstrate the ability to use the Internet as an educational instrument
- Maintain a case log of all interventional procedures you perform
- Analyze and develop improvement plans in the clinical practice, including knowledge, observation, and procedural skills
- Demonstrate knowledge of and apply the principles of evidence-based medicine in practice
- Demonstrate critical assessment of the scientific literature
- Help teaching of medical students, peers and other health care professionals

Education

- Participate in Journal club, clinical conferences, and independent learning

Systems Based Practice

During each rotation it is mandatory that:

1. The resident attends and participates in morning rounds (see below)
2. In order to ensure continuing patient care residents might not leave the service to attend

noon conferences if there is a procedure in progress that the resident started earlier and is ongoing or if called for emergently.

3. Participate in all weekly IR conferences
4. All studies should be reviewed with an attending and dictated the same day
5. Residents can leave for the day only after notifying and approval from faculty on service.
6. Although 100% attendance is strongly recommended by the entire faculty, a maximum of 2 days per rotation of vacation/personal days/sick days will be allowed. Chief residents will be responsible for obtaining coverage for absent days. In the event of a sickness or an emergency, additional time will be granted on a case by case basis

Method of Assessment of Performance:

- Verbal feedback will be provided to the resident throughout the rotation
- Written evaluation of resident by faculty at the end of each rotation. Evaluations to be completed in New Innovations at the end of each rotation by at least 2 faculty members on service. Performance will be reported on a scale of 1-5, with 1 being deficient and 5 being exceptional. These grades/feedback will help them prepare for their subsequent rotations and help them identify deficiencies proactively
- In view of the educational requirements, any resident who fails to perform at the expected level by their final rotation (Rotation 3, PGY 4) will be required to do an additional 4 weeks of IR in their final year of residency to get them on par with their colleagues
- Interventional procedure case log—to be reviewed by program director at the end of each rotation
- ACR In-Training Service Exam
- ABR examinations

Recommended Reading

FIRST ROTATION

- *Interventional Radiology: The Requisites, Kaufman and Lee*
- *Handbook of Interventional Procedures, Kandarpa and Aruny*

SECOND and THIRD ROTATION

- *Interventional Radiology: The Requisites Kaufman and Lee*
- *Vascular And Interventional Radiology: Karim Valji*

ADDITIONAL READING

- *Teaching Atlas of Interventional Radiology: Diagnostic and Therapeutic Angiography: Sadoon Kadir*
- *Interventional Radiology Essentials: Jeanne M. Laberge*

- *Atlas of Normal and Variant Angiographic Anatomy: Sadoon Kadir*
- *Vascular Anatomy: Uflacker*

Core IR Lecture

Series Tools of the

Trade:

1. Pharmacology. Pre-procedural, procedural and post-procedural medications related to conscience sedation, renal insufficiency and allergic contrast reaction.
2. Basic Interventional Technique and Equipment. Needles, catheters, wires, sheaths, balloons, stents, embolic agents, retrieval devices, arterial access, closure devices, biopsy devices, drainage catheters, thrombolytic systems and percutaneous ablation devices.
3. Noninvasive Diagnostic Vascular Imaging. CT, US, MRI. Review of normal anatomy, discussion on modality specific appearance of pathology, and congenital/developmental anomalies.
4. Radiation Safety. Recognition of potential dangers of IR radiation exposure and steps to limit exposure.

Arterial Intervention

5. Endovascular Thoracic and Abdominal Aorta Aneurysmal Repair. Pre-procedural planning with CT/MRI. Stent graft placement. Endoleak classification and repair technique.
6. Peripheral Vascular Disease. Etiology, non-invasive and invasive evaluation, treatment of iliac, femoral, popliteal disease. Appreciation and treatment of complications.
7. Kidney and Adrenal Gland. Discuss uncontrolled HTN, atherosclerotic renal arterial disease, FMD, adrenal vein sampling.
8. Mesenteric Ischemia and GI Bleed. Including mesenteric vascular anatomy and anomalies; causes and treatment of acute and chronic ischemia; causes, evaluation and embolics used in GI bleed; and portal venous thrombosis.
9. Acute Hemorrhage. Diagnosis and treatment of a) traumatic vascular injury specific to spleen, liver, kidney, pelvis, peripheral vessels, b) bronchial artery embolization, c) obstetrical hemorrhage.
10. Vasculitis, Aneurysm and Pseudoaneurysm. Classification, common presentations, evaluation (CT/MRI/Angio) and treatment of vasculitis. Current techniques in treatment of aneurysm and pseudo aneurysm.
11. Gynecologic and Pelvic Intervention. Evaluation and treatment of uterine fibroids (UAE).
12. Carotid Artery Disease. Etiology, non-invasive and invasive evaluation, treatment carotid disease. Appreciation and treatment of complications.

13. Vascular Variant Anatomy. Commonly seen normal variants to arterial and venous anatomy, excluding cardiac anomalies.

Venous Intervention

14. IVC Filters. Indication for placement and retrieval. Venous anomalies affecting IVC filtration. Filter deployment and retrieval technique. Findings on pulmonary angiography.
15. Deep Venous Thrombosis and Post Thrombotic Syndrome. Venography, thrombolysis, infusion catheters, Trellis, PTA, stenting, recanalization.
16. Vascular Malformations. Etiology, evaluation (clinical and radiographic), treatment and follow-up related to the full range of vascular malformations and lymphatic malformations, with disease-specific discussion of HHT, PAVM, KTW.
17. Central Venous Access. Indications to place or remove CVL. Types and appropriate access locations of CVL, complications of CVL, central venous stenosis including SVC syndrome.
18. Portal Hypertension, TIPS & BRTO. Patient evaluation including MELD, procedural technique and complications, patient follow-up.
19. Hemodialysis. Clinical, non-invasive and radiographic evaluation of dialysis catheters, grafts and fistula. De-clot technique.
20. Gynecologic and Pelvic Intervention. Female pelvic congestion syndrome. Male varicocele.

Oncologic Intervention

- Trans arterial Chemoembolization and Radio embolization, Portal Vein Embolization. Indication for treatment, patient evaluation and exclusion criteria, tumor lysis syndrome, post-embolization symptoms, multidisciplinary approach.
21. Percutaneous Ablation Techniques. RFA, cryoablation, microwave, high-intensity ultrasound.

Non-vascular Intervention

22. Biopsy and Abscess Evaluation and Treatment Technique. Patient evaluation, drain follow-up, and advantages and disadvantages of CT, US, Fluoro, MRI assisted procedures.
23. Hepatobiliary Intervention. Biliary disease processes, radiologic evaluation (PTC) and treatment options including PBD/stents, cholecystostomy drains.
24. Nephroureteral Intervention. Nephroureteral obstruction, renal calculus disease, post-surgical urinary diversions.
25. Enteric Tubes. Indications and techniques for placement of gastrostomy,

- gastrojejunostomy, jejunostomy, and cecostomy tubes.
26. Pain Management. Vertebroplasty, kyphoplasty, RFA of osteoid osteoma, palliative celiac block and percutaneous ablation of metastatic disease.
 27. Unknown and Challenge Cases
 28. Senior Review and Mock Boards

Vascular and Interventional Radiology Curriculum, from RadPrimer:

Thorax

21	Thoracic Aortic Aneurysm	Dx
22	Mycotic Aneurysm	Dx
23	Post-Traumatic Pseudoaneurysm	Dx
24	Aortic Ulceration	Dx
25	Aortic Dissection	Dx
26	Takayasu Arteritis	Dx
27	Marfan Syndrome	Dx
28	Giant Cell Arteritis	Dx
29	Pseudo-Coarctation	Dx
30	Traumatic Aortic Laceration	Dx
31	Ductus Diverticulum	Dx
32	Bronchial Artery Pathology	Dx
33	Pulmonary Artery Aneurysm	Dx
34	Acute Pulmonary Embolism	Dx
		Multiple Choice
35	Acute Pulmonary Embolism (1765931844)	Question
36	Chronic Pulmonary Embolism	Dx
37	Hereditary Hemorrhagic Telangiectasia	Dx
	Superior Vena Cava Syndrome	Dx

Abdominal

Aorta

39	Abdominal Aortic Aneurysm	Dx
40	AAA with Rupture	Dx
41	Endoleak Post AAA Repair	Dx
42	Aortic Enteric Fistula	Dx
43	Infected Aortic Graft	Dx
44	Abdominal Aortic Occlusion	Dx
45	Abdominal Aortic Dissection	Dx
46	Abdominal Aortic Trauma	Dx

MUSCULOSKELETAL IMAGING GOALS AND OBJECTIVES

First year: To train the eye of the resident to look at bones properly, and introduce the resident to orthopedic terminology and fracture description

Competency:

A. Knowledge

1. Recognize and name normal anatomic structures, as well as normal variants as seen on radiography. Knowledge will be subject to verbal examination by attending.
2. Describe fractures in a systematic and comprehensive manner. Succinct and precise report dictation of radiographic findings in reports. All reports reviewed by radiology attending, critiqued where appropriate, and corrected by the resident. Appropriate choice of ICD-10 codes will be emphasized.
3. Describe and recognize basic benign bone lesions such as infarcts, osteochondromas, cysts and fibrous dysplasia. Digitized teaching file review of lesions with attending.
4. Recognize the radiographic signs of osteomyelitis/septic arthritis, and be able to competently discuss the appropriate imaging evaluation of osteomyelitis/septic arthritis. Extemporaneous discussions at the PACS workstation will highlight advantages and disadvantages of imaging modalities.
5. Recognize normal CT and MR cross-sectional anatomy of the extremities.
6. Each cross sectional imaging study to be reviewed with attending. Review of pertinent anatomy subject to verbal examination by attending, and additional resident review as deemed necessary.

B. Communications, practice-based learning and patient care:

1. Understand the indications for use of contrast in CT and MR imaging. Know the contraindications for use of contrast and learn appropriate screening questions to ask before injections are performed.
2. Learn hip aspiration/shoulder injection technique. Participation by observation and then fluoroscopy.
3. Learn to obtain informed consent and perform time out procedure. Emphasis on sterile technique and needle positioning under supervision. Respect and empathize with patient during the procedure.
4. Understand care of patients post-procedure. Dictate post-procedure note. Perform these functions under supervision. Resident will competently perform these procedures after a 3 month rotation; will do at least 2 of each under supervision of an attending (volume permitting).

C. Professionalism

1. To develop a professional rapport with consulting services. Communication of unexpected results to the clinical services will be monitored by attending physician for accuracy and politeness.
2. Attendance at all didactic lectures, and timely arrival each day on the rotation is expected.
3. Gain sensitivity to the demands of referring services, and responsiveness to the complaints of patients.

D. Systems-Based Practice

1. Recognize incorrectly positioned radiographs or radiographs performed using incorrect technique. Learn how positioning can influence the appearance of structures on radiographs and diagnosis.
2. Learn the required views for musculoskeletal system radiographic studies

Required reading includes “Fundamentals of Skeletal Radiology” by Clyde Helms, WB Saunders, The Requisites, by BJ Manaster, D May, D Disler Mosby, Orthopedic Radiology by B Weissman and C Sledge, WB Saunders

Evaluation will be done at the PACS system by the attending on a case by case basis. Approximately 200 cases reviewed per week with the resident. Questions on medical knowledge, radiographic evaluation, and findings to be answered by the resident as films are reviewed. At the end of each rotation, all residents will be evaluated by the attending using the comprehensive radiology evaluation form.

Second and third year rotations: Emphasis is placed on expanding basic knowledge and section responsibilities.

Competency:

A. Knowledge:

1. Develop a method of accurately describing the radiographic appearance of bone neoplasms and a complete differential diagnosis for musculoskeletal neoplasms. Review of current and teaching file cases to be done with attending to refine these points.
2. Develop a thorough knowledge of pediatric orthopedic problems as well as congenital dysplasias. Review of current and teaching file cases to be done with attending to refine these points.
3. Recognition of metabolic bone diseases and their causes. Review of current and teaching file cases to be done with attending to refine these points.

4. Know the radiographic characteristics of the arthropathies. Review of current cases and teaching file with attending.
5. Demonstrate satisfactory knowledge of commonly seen disorders such as neurofibromatosis, sickle cell anemia, avascular necrosis, fracture complications, developmental dysplasia of the hip.
6. Progression in ability to recognize abnormal CT and MR findings. By conclusion of 3rd year, competency in interpretation of shoulder and knee MR. Resident to begin dictating MR and CT Imaging in second year.
7. Areas of weakness are to be determined by the attending, and followed up by Individual study.
8. Try to interest resident in writing a case report or conducting research.

B. Communications, practice-based learning and patient care:

1. Continued performance of joint injection and aspiration procedures, with attending supervision.
2. Resident should be able to protocol all CT and MR studies by the conclusion of 2nd year. Will participate in annotating studies on EPIC. Appropriateness of imaging choices and radiation exposure will be emphasized.

C. Professionalism

1. Concise dictation of cross-sectional imaging studies to be reviewed and critiqued by the attending physician.
2. Residents should be able to discuss radiographic and cross-sectional imaging findings with consulting medical teams. Develop relationship with department of Orthopedics and pathology in order to foster research and rapid transmission of imaging findings to the clinician.
3. Attendance at all didactic lectures, and timely arrival each day on the rotation is expected. Residents should be able to teach junior residents and medical students.
4. Try to interest resident in writing a case report or conducting research.

D. Systems-based Practices:

1. While taking call, resident will supervise, protocol and monitor emergency bone and joint CT and MR emergency room cases. Appropriateness of imaging choices and radiation exposure will be emphasized.
2. Resident will notify section chief of any quality issues pertaining to adequate delivery of diagnostic studies on evening or overnight shifts

Reading list: “The Requisites”, by BJ Manaster, D May, D Disler Mosby, “Arthritis in Black and White” by Anne C Brower, “Pediatric Orthopedic Radiology” by M Ozonoff, “A Clinical Guide to Primary Bone Tumors” by J Levesque et al.

Evaluation will be done at the PACS workstation by the attending on a case by case basis. Approximately 200 cases reviewed per week. Appropriate response expected to all questions concerning the radiographic finding, as well as discussion on diseases or syndromes identified. At the end of each rotation, all residents will be evaluated by the attending using the comprehensive radiology evaluation form.

Fourth Year: Fine tuning the resident's exposure to all facets of musculoskeletal radiology.

Competency:

A. Knowledge:

1. Discuss current literature as it pertains to the radiologic evaluation of sports injuries, neoplasm, infection and arthropathies. Recognize and diagnose all pathology seen on radiographs.
2. Identify abnormal MR findings. Competency in interpretation of ankle, hip and wrist MR.
3. Run the musculoskeletal section efficiently in the event the attending is otherwise unavailable.
4. Residents should be able to function on a level adequate to pass their boards
5. All major texts and the syllabi should be read by now and their ability to interpret films should reflect their knowledge.
6. Areas of weakness are to be determined by the attending, and followed up by reading as well as further review at workstation

B. Communications, practice-based learning and patient care:

1. Residents should be able to supervise and teach junior residents during all procedures.
2. Residents should be able to protocol and interpret studies at a superior level. Appropriateness of imaging choices and radiation exposure will be emphasized.

C. Professionalism

1. Conduct of residents should reflect confidence in their ability, and a pleasant on-going relationship with clinicians.
2. Attendance at all didactic lectures, and timely arrival each day on the rotation is expected.

D. Systems based practice:

1. Residents must recognize a diagnostic cross-sectional imaging study, versus a

non-diagnostic one. Ability to critique radiography and imaging studies should be present. Knowledge on how to improve the study should be gained in final year.

2. Communicate CT or MR scan problems to the technologist while scan being done, and suggest imaging changes to optimize the scans. Be able to instruct technologist on correct slice orientation for both CT and MR.

All of the above done under the guidance of the attending, at the workstation, on a case by case basis. At least 250 cases reviewed per week. At the end of each rotation, all residents will be evaluated by the attending using the comprehensive radiology evaluation form.

Reading list: "Musculoskeletal MRI" by P. Kaplan et al, MRI-Essentials.com by Fischer, Guermazi et al.

Lecture Topics:

Orthopedic Trauma
Call Preparation
Arthritis (2 hours)
Bone Neoplasms (2 hours)
Soft Tissue tumors
Prosthesis and their Complications
Metabolic Bone Disease
Bone Marrow
Infection
MRI Ankle and Foot
MRI Knee (2 hours)
MRI Shoulder (2 hours)

Didactic lectures are followed by Case lectures to reinforce the discussed topics and show more examples of relevant pathology

Neuroradiology Curriculum with Goals and Objectives

Esther A Nimchinsky, MD, PhD

The resident rotations in neuroradiology during the four years of Radiology Residency program will vary depending upon the rotation schedule set up by the Department of Radiology. It is expected that residents will progressively develop their abilities to interpret imaging studies of the central nervous system. The objectives for the rotations during the years of training will be based upon principles in related to patient care, medical knowledge, practiced based learning and improvement, interpersonal and communication skills and professionalism.

Abbreviations:

PC = Patient Care

MK = Medical Knowledge

SBP = System based practice

PBLI = Practice based learning and improvement

P = Professionalism

ICS= Interpersonal Communication Skills

1st year rotations

I. Goals

1. Demonstrate learning of the appropriate knowledge-based objectives. (MK)
2. Demonstrate facility in accessing and understanding ACR appropriateness criteria for neuroimaging of the head, face and spine with CT. (SBP, PBLI)
3. Accurately and concisely dictate a report of noncontrast CT of the head, face and spine. (PBLI)
4. Recognize imaging findings of acute and life-threatening conditions that may manifest on CT of the head and spine. (MK, PC, PBLI)
5. Recognize and report imaging findings of acute stroke on neuroimaging, within Brain Attack Team (BAT) guidelines, in collaboration with a senior resident. (MK, PC, PBLI)
6. Learn the indications and techniques of neuroradiologic procedures. (PBLI)
7. Communicate effectively with referring clinicians and supervisory staff. (ICS)
8. Obtain pertinent patient information relative to radiologic examinations. (SPB, PBLI)
9. Demonstrate knowledge of the clinical indications for obtaining CT or MRI of the nervous system. (SPB, PBLI)
10. Demonstrate a responsible work ethic. (P)
11. Participate in quality improvement/quality assurance and other operational activities. (SPB, PBLI)

II. Objectives: By the end of the first year, the resident should have mastered the following technical, communication, and decision-making skills:

1. Demonstrate understanding of normal anatomy of the brain as assessed in a one-to-one evaluation session with the section chief at the end of the rotation. (MK)
2. Demonstrate understanding of the vascular anatomy of the head and neck as assessed in a one-to-one evaluation with the section chief in at the end of the session. (MK)
3. Demonstrate detailed understanding of the spinal canal, spinal cord and nerve roots and their spatial relations as assessed in a one-to-one evaluation session with the section chief at the end of the rotation. (MK)
4. Demonstrate the ability to identify and describe all forms of intracranial hemorrhage and understand their likely causes (MK).
5. Demonstrate the ability to identify and describe fractures of the skull base, calvarium, face and spine (MK).
6. Recognize and estimate the age of acute, subacute and chronic ischemic infarction on noncontrast CT (MK, PC).
7. Recognize abnormalities in the vasculature (arterial and venous) of the head and neck in the context of a BAT. Understand the role of CT perfusion and MRI in stroke imaging. (MK)
8. Become conversant with the clinical and radiologic finding in the most common neuroimaging-related emergencies and demonstrate that knowledge to supervising attendings and senior residents on call. (MK, PC)
9. Learn the indications and techniques of basic neuroradiologic procedures. Learn to perform a procedure consult in conjunction with the neuroradiology attending, and attend at least 3 procedures. including lumbar puncture/myelography/cisternography, or biopsy. (PC, ICS)
10. Obtain relevant patient history from electronic records, dictated reports, or by communicating with referring clinicians (PC)
11. Dictate accurate and concise neuro CT reports that include date of exam, date of comparison exam, type of exam, indication for exam, brief and concise description of the findings, and short impression (ICS)
12. Demonstrate basic comprehension of image acquisition techniques and variables in CT and MR imaging of the brain and spine. (MK, PBL)
13. Demonstrate basic comprehension of the indications and the limitations of the various modalities used in Neuroradiology, integrating ACR appropriateness criteria, including radiography, CT, MR, PET/CT, angiography and myelography, including long term consequences of neuroradiologic examinations to the satisfaction of the supervising attending with respect to dose deposition and cost, and appropriateness to the satisfaction of the program director. (MK, PC)
14. Attend all relevant tumor boards and clinical conferences as required (MK, PC)
15. Achieve a passing score on an examination testing minimal competency in the emergency setting. (PC)
16. Communicate with ordering physicians about all significant or unexpected radiologic findings and document who was called and the date and time of the call in the dictated

report following departmental policies for communication for any urgent findings (IPC) (PC)

17. When assisting referring clinicians with imaging interpretation and patient management, determine when it is appropriate to obtain help from supervisory faculty (P)
18. Arrive for the rotation assignment on time and prepared after reviewing recommended study materials (P)
19. Work diligently to complete the day's work as a member of the Neuroradiology team, and stay until the work is completed, unless dismissed by the supervising Neuroradiology attending (P)
20. Use appropriate nomenclature when dictating reports and consulting with health care professionals (ICS).

2nd year rotations

I. Goals: In addition to the Goals listed above for the 1st year rotations, by the end of their 2nd year, residents should have achieved the following goals:

1. Demonstrate learning of the appropriate knowledge-based objectives. (MK)
2. Demonstrate facility in accessing and familiarity with ACR appropriateness criteria for neuroimaging of the head and spine. (SPB, PBLI)
3. Accurately and concisely dictate a report of CT or CT angiogram of the head, neck, face or spine in the emergency or inpatient setting. (MK, PC)
4. Accurately and concisely dictate a report of MRI of the brain and spine in the emergency or inpatient setting. (MK, PC)
5. Recognize and report imaging findings of acute stroke on neuroimaging, within Brain Attack Team (BAT) guidelines, including critical evaluation of CT angiogram and CT perfusion, and MRI. (MK, PC)
6. Develop an understanding of the current classification of brain tumors. (MK)

II. Objectives: In addition to the Objectives listed above for the 1st year rotations, by the end of their 2nd year, residents should have mastered the following technical, communication, and decision-making skills:

1. Demonstrate knowledge of differential diagnoses of common imaging abnormalities of the brain. (MK)
2. Demonstrate familiarity with the current WHO classification of brain tumors (MK)
3. Demonstrate knowledge of differential diagnoses of common imaging abnormalities of the spine and spinal cord. (MK)
4. Demonstrate knowledge of the CT and MR features of traumatic brain injury. (MK)
5. Demonstrate knowledge of the CT and MR features of CNS infections. (MK)
6. Demonstrate knowledge of the CT and MR features of spine trauma. (MK)
7. Demonstrate knowledge of the role of the various MR imaging sequences and their pertinence to brain and spine abnormality detection and display that knowledge to the

division chief. Failure to achieve this goal at the end of the rotation will necessitate remediation through further reading assignments. (MK, PC)

8. Manage neuroradiology procedure consults, and perform at least 3 neuroradiologic procedures, including lumbar puncture/myelography/cisternography, or biopsy under supervision of the neuroradiology attending (PC).
9. Attend and participate in relevant Tumor Boards and other clinical conferences, including presenting cases following adequate preparation and review with the supervising neuroradiology attending. (MK, PC, ICS)
10. Gain skill in the art of radiologic consultation with referring physicians to the satisfaction of all faculty members and senior residents. (ICS, PC)
11. Demonstrate competence in collegial interactions, in the service of patients, with referring physicians in the context of after hours emergency duty to the satisfaction of the program director. (P, PC)

3rd year rotations

I. Goals: In addition to the Goals listed above for the 2nd year rotations, by the end of their 3rd year, residents should have achieved the following goals:

1. Demonstrate learning of the appropriate knowledge-based objectives. (MK)
2. Demonstrate familiarity with ACR appropriateness criteria for neuroimaging of the head and neck. (SBP, PBLI)
3. Accurately and concisely dictate a report of CT and MRI of the head and neck, brain or spine in the outpatient setting.
4. Recognize and report imaging findings of acute stroke on neuroimaging, within Brain Attack Team (BAT) guidelines, demonstrating the ability to manage the BAT as a senior staff member.
5. Recognize the role of development in the manifestation of disease in pediatric neuroimaging. (MK)
6. Further develop facility in advising the clinical team in, and performing, neuroradiologic procedures. (PC, SPB, PBLI)
7. Reinforce learning by communicating knowledge to junior residents on the neuroradiology rotation. (ICS)

II. Objectives: In addition to the Objectives listed above for the 2nd year rotations, by the end of their 3rd year, residents should have mastered the following technical, communication, and decision-making skills:

By the end of the third year, the resident should have mastered the following technical, communication, and decision-making skills:

1. Familiarity with common neurologic developmental abnormalities having anatomic manifestations. (MK)

2. Understanding of the unique imaging characteristics of the developing brain to improve interpretation of pediatric imaging (MK)
3. Familiarity with the detailed anatomy of the anatomy of the posterior fossa, orbits, face, temporal bone and neck. (MK)
4. Ability to dictate a comprehensive and accurate report for CT of the temporal bone, and MRI of the face, orbits, sellar region, craniocervical junction and posterior fossa (MK)
5. Conduct a Neuroradiology procedure consult and perform three imaging procedures, including lumbar puncture/myelography/cisternography, or biopsy under supervision of the neuroradiology attending, and demonstrate the technique to a junior resident (PC)
6. The resident will instruct the first year resident assigned with him or her in the operation of the Neuroradiology service. This function will be evaluated by the first year resident. (P, SBP)

4th year rotations

I. Goals: In addition to the Goals listed above for the 3rd year rotations, by the end of their 4th year, residents should have achieved the following goals:

1. Troubleshoot imaging artifacts in both CT and MRI. (SPB, PBLI)
2. Master the interpretation of specialized scans. (MK, PC)
3. Learn applications and performance of advanced imaging in neuroradiology. (MK, PC)
4. Learn postprocessing skills for advanced preoperative imaging. (MK, PC, PBLI)
5. Function at the level of a junior fellow or attending in the Neuroradiology service. (P)
6. Serve as liaison for the other clinical services. (ICS, P)

II. Objectives: In addition to the Objectives listed above for the 3rd year rotations, by the end of their 4th year, residents should have mastered the following technical, communication, and decision-making skills:

1. Ability to dictate a comprehensive and accurate report for CT of the parathyroid gland (4DCT), dual energy neck CT, dynamic TMJ, brachial plexus, sacral plexus (MK).
2. Ability to dictate a comprehensive and accurate report for CT myelogram or cisternogram. (MK, PC)
3. Learn applications and techniques for advanced imaging techniques including DECT, MR perfusion, DTI, CSF flow studies, and MR spectroscopy. (MK, PC, SBP)
4. Learn to perform postprocessing for diffusion tensor imaging (DTI), virtual bronchoscopy, curved planar reformats and 3D aneurysm rendering at the request of the surgical teams (MK, PC, SBP).
5. Present cases at Neurology work rounds. (PC)
6. Present complex cases at Neuropathology conference. (PC)

Lecture curriculum:

Lectures in Neuroradiology will consist of didactic and case based presentations. Didactic lectures will be given as an hour long and will be repeated twice during a four year cycle, with the exception of the general, "Boot Camp" series presented each summer for the benefit of the entering first year residents. Case conferences presenting unknown cases will be coordinated with the topics of didactic lectures being given in the same time period. All the defined didactic and case based presentations will be presented once a week during the lectures schedule. All the residents are expected to attend these conferences.

Rotating residents are required to attend the following Neuroradiology conferences with various departments: Tuesday Neurology (11:45-12:30 PM), Wednesday Head and Neck tumor board (8-9:30 AM), and monthly Orbit (Friday 6:30-8:00 AM). They are encouraged to attend the weekly Brain/Spine tumor board when not in conflict with Radiology lecture (Wednesday 12-1 PM), and Tuesday Cerebrovascular conference (4:30 -5:30 PM).

LECTURE TOPICS

General Neuroradiology/Boot camp

1. Principles of Neuroimaging (Lee)
2. Emergencies in Neuroradiology (Lee)
3. Ventricles and Sulci (Nimchinsky)
4. Head trauma (Nimchinsky)
5. Non traumatic intracranial hemorrhage (Lee)
6. Stroke (2-lecture series, Nimchinsky)
7. Blunt cerebrovascular injury (Nimchinsky)
8. Contrast media (Nimchinsky)
9. Case conference (Lebioda)

Brain

1. Aneurysms (Nimchinsky)
2. Recognition of enhancement patterns (Lee)
3. Infections of the brain (Lee)
4. Extra-axial brain tumors (Lebioda)
5. Gliomas (2-lecture series, Nimchinsky)
6. Sellar and Parasellar Disease (Lebioda)
7. Case conference (Lebioda)
8. White Matter disease (Nimchinsky)
9. Cranial nerves (Nimchinsky)
10. Degenerative brain disease (Lebioda)
11. Congenital brain abnormalities (Lee)
12. Metabolic disease of the brain and miscellaneous disorders (Lee)
13. Case conference (Lebioda)

Head and Neck

1. Base of skull (Lee)

2. Paranasal sinuses (Nimchinsky)
3. Facial trauma (Nimchinsky)
4. Orbit (2-lecture series, Nimchinsky)
5. Temporal bones (Lee)
6. Nasopharynx (Lee)
7. Oral cavity and oropharynx (Lee)
8. Larynx (Lee)
9. Lymph nodes and head and neck cancer (Nimchinsky)
10. Case conference (Lebioda)

Spine

1. Low back pain: Degenerative disease of the spine (Lebioda)
2. Spine trauma (Lee)
3. Congenital diseases of the spine (Lebioda)
4. Spine infections (Lee)
5. Spinal tumors (Lee)
6. Complications of spine fixation (Lebioda)
7. Non-discogenic causes of back pain (Nimchinsky)
8. Case conference (Lebioda)

Board review

Recommended Reading:

The Neuroradiology attendings recommend articles from the current literature throughout the rotations, and residents are expected to read and file them for future reference. The expectation is that by the end of the 4 years of residency, residents will have accrued a broad and valuable library of relevant and high-yield articles.

In addition, the following texts may be helpful for reference:

Osborne, Hedlund and Salzman, Osborne's Brain, 2nd Edition (2017) Elsevier.

Koch, Hamilton, Hudgins and Harnsberger, Diagnostic Imaging: Head and Neck, 3rd Edition (2016) Elsevier.

Nuclear Medicine: Curriculum Overview and Rotation Goals and Objectives

Part I, Curriculum Overview:

The nuclear medicine curriculum for radiology residents consists of a combination of clinical training/experience (or work experience) in the division of nuclear medicine and didactic classroom and laboratory instruction.

The clinical training and experience consist of 16week clinical rotations in the division under the direction of the nuclear medicine physicians (faculty), who are authorized users (AU). During these clinical rotations, the resident will observe, participate in, or manage all types of patient imaging performed in the division as appropriate to the resident's level of experience and medical knowledge. Training and experience will also include oral administration of I-131 (for which a written directive is required) for therapy of both benign and malignant thyroid diseases. The scope of patient imaging studies performed in the division is broad and includes evaluation of:

- Cardiovascular system,
- Respiratory system,
- Gastrointestinal/Hepatobiliary system
- Skeletal system
- Genitourinary system
- Endocrine system
- Cerebrovascular system
- Neoplastic diseases
- Infectious and inflammatory diseases

Therapy of benign and malignant thyroid disease as well as for palliative and supportive treatment for skeletal metastasis (from variety of malignancy) is also performed in the division. The clinical training is augmented by didactic classroom and laboratory training. Regularly scheduled classroom sessions cover a broad range of material as it relates to the practice of nuclear medicine including. The nuclear medicine faculty present these classroom sessions.

1. Introduction & History to Nuclear Medicine/Nuclear Cardiology & Molecular Imaging
2. The Lung/PIOPEd, and Pulmonary Imaging Update
3. Gastrointestinal Bleeding Assessment with Scintigraphy
4. Hepatobiliary Scintigraphy
5. Radionuclide Brain Death Studies
6. Nuclear Cardiology 1 - Intro, Indications, Radiopharmaceuticals, and Protocols
7. Nuclear Cardiology 2 - Stress Testing, and Image Review, MUGA Basics
8. Nuclear Cardiology 3 - PET Cardiac Perfusion Imaging and Viability
9. Gallium Scintigraphy
10. Functional Brain Imaging – SPECT
11. Renal Scintigraphy

12. Bone Scintigraphy
13. Nuclear Imaging and Therapy of Thyroid Disease
14. Infection Imaging
15. Positron Imaging Tomography - Introduction and Cases – oncology
16. PET Neuro imaging – Dementia, epilepsy & SPECT imaging –DAT scan
17. GI Nuclear Medicine- Gastric Emptying, Liver-spleen scan, liver hemangioma imaging
18. Somatoreceptor Imaging
19. Radioimmunotherapy -Zevalin & Bexxar & treatment with bone seeking radiotracers.
20. Pediatric Nuclear Medicine
21. Nuclear Renal Imaging
22. NRC

Part II, Rotation Goals and Objectives:

Although goals and objectives more specific to each of the nuclear medicine rotations are outlined below, there are also many general skills that will be continually developed during all rotations under the direction of the senior physician staff. These include:

- To gain skill in the art of radiologic consultation with referring physicians to the satisfaction of all faculty members.
- To practice competence in collegial interactions, in the service of patients and with referring physicians.
- To demonstrate compassion and humility in interaction with patients and staff members.
- To follow the appropriate dress code at all times and to be punctual for clinic assignments and conferences to the satisfaction of the faculty.
- To appropriately wear your film badges.

1st Year

Knowledge Based Objectives:

- The resident must understand the primary modes of radioactive decay and modes of interaction of ionization radiation with matter.
- The resident must be able to list the most common eight radionuclides relevant to nuclear medicine (Tc-99m, In-111, I-123, I-131, Ga-67, Tl-201, F-18, Mo-99), and describe their physical half-lives and major decay products.
- The resident must also recognize the basic biodistribution of each of the F.D.A.-approved radiopharmaceutical and their application to patient care, to the satisfaction of the reviewing attending.
- The resident must know the usual scan appearances of commonly encountered diseases and provide a differential diagnosis for commonly encountered scan patterns to the satisfaction of the attending physician as assessed in the faculty evaluation.
- The resident must understand the principles of operation of standard nuclear medicine equipment used for detecting and measuring radiation, including the gamma-camera, thyroid probe, PET Scanner, dose-calibrator, and well-counter.

Reading and Educational Assignments:

1. Mettler FA, Guiberteau MJ. Essentials of Nuclear Medicine Imaging, 5th Edition. Chapters 1-3, 7-9, and 14. Appendices D, E-1, G, and I.

2nd Year

-Observe at least one of each of the different scans routinely performed, as well as infrequently ordered studies.

-Knowledge Based Objectives—at the end of the 2nd year, the resident should be able to:

1. Demonstrate a thorough understanding of the clinical indications, general procedures (including radiopharmaceutical and dose), and scintigraphic findings for:
 - a. pulmonary (emboli) ventilation and perfusion imaging
 - b. hepatobiliary imaging and functional studies
 - c. gastrointestinal blood loss imaging
 - d. bone imaging
2. Discuss the basic physical principles of nuclear medicine imaging and instrumentation.
3. Identify the isotopes (including physical and chemical properties) that are used routinely in the compounding of radiopharmaceuticals for nuclear radiology procedures.
4. The resident should be able to review and dictate selected cases with senior physician staff.

-Decision-making and Value Judgment Skills- at the end of the 2nd year, the resident should be able to:

1. Review the pertinent clinical history of patients to be imaged each day to determine the relevance of the ordered study to the clinical question, to assess for any contraindications to the study, and to alert nuclear technologists about anticipated non-standard views or specific parameters of the study that require special attention.
2. Assist nuclear technologists in the determination of radiopharmaceutical or medication dosages when patient conditions do not fall within the criteria for the standard dose.
3. Make a preliminary review of obtained images and advice technologists when additional views or repeat views are needed.
- 4.

-Reading and Educational Assignments:

1. Mettler FA, Guiberteau MJ. Essentials of Nuclear Medicine Imaging, 5th Edition. Chapters 1-3, 7-9, and 14. Appendices D, E-1, G, and I.

3rd Year

-Knowledge Based Objectives—at the end of 3rd year, the resident should be able to:

1. Demonstrate a thorough knowledge of the clinical indications, general procedures (including radiopharmaceutical and dose) and scintigraphic findings in:
 - a. renal and urinary tract studies
 - b. liver/spleen imaging
 - c. gastrointestinal tract imaging and functional studies
 - d. thyroid imaging and functional studies
 - e. brain imaging and functional studies
 - f. tumor and abscess imaging
 - g. myocardial perfusion studies
 - h. gated cardiac blood pool (MUGA) studies
2. Identify and discuss indications for isotopes used for therapeutic purposes.
3. Describe the protocol for using I-131 in the treatment of hyperthyroidism and thyroid malignancies.
4. Describe accepted indications for and the role of PET/CT imaging.

-Decision-making and Value Judgment Skills—at the end of 3rd year, the resident should be able to:

1. Interpret and dictate studies under the guidance of the senior physician staff.
2. Review all scans as they are performed for any significant findings that require prompt attention, and make decisions regarding notification of the referring physician if the nuclear medicine faculty is not immediately available for consultation.

-Laboratory Sessions:

1. Schedule at least one session with head nuclear technologist; sessions typically in "hot lab," patient areas, and camera rooms.

-Reading and Educational Assignments:

1. Mettler FA, Guiberteau MJ. Essentials of Nuclear Medicine Imaging, 5th Edition. Chapters 4-6, 8, 10-13. Appendices E-1, E-2, F, H-1, and H-2.

4th Year

-Knowledge Based Objectives— at the end of the 4th year, the resident should be able to:

1. Identify normal and abnormal findings on all imaging and functional studies, including nuclear cardiology studies, and PET/CT imaging.
2. Discuss all aspects of nuclear studies, including indications, pathologies, protocols, correlative studies, radiopharmaceuticals used for each study, and various parameters that might interfere with the results of the procedure.

-Decision-making and Value Judgment Skills—at the end of the 4th year, the resident should be able to:

1. Make preliminary decisions on all matters of film interpretation and consultation
2. Comment on anatomical findings, scanning technique, and indications for performing the study to assist in the training of more junior residents or medical students.
3. Independently make a preliminary interpretation and dictate a report after review with the nuclear medicine faculty for all scans performed, including PET/CT.
4. Carry out the practice of nuclear medicine with a level of competence expected for an independently practicing radiologist, with due regard to quality control, quality assurance, and radiation safety for patients and personnel.

-Laboratory Sessions:

1. Schedule a session with the nuclear pharmacist at remote nuclear radiopharmacy. At the end of the session, the resident should have a proper understanding of:
 - Compounding radiopharmaceuticals from kits and do appropriate quality control procedures.
 - Eluting a generator and doing appropriate quality control procedures.
 - Calculating and safely preparing patient doses.
2. Schedule at least one session with head nuclear technologist; sessions typically in "hot lab," patient areas, and camera rooms. At the end of the session, the resident should have a proper understanding of:
 - Appropriate use of a survey meter to monitor radioactivity spills or other sources.
 - A wipe test.
 - Quality control procedures on cameras, well/uptake probes, and dose calibrators.
 - Procedures to handle radioactive sources according to the established guidelines.
 - Appropriate use of a survey meter to monitor radioactivity spills or other sources.

-Reading and Educational Assignments:

1. Mettler FA, Guiberteau MJ. Essentials of Nuclear Medicine Imaging, 5th Edition. Chapters 3 and 14 reviews. Appendices G, H-1, H-2, and I review.

2. Related textbooks/references, related current journal articles and online resources.

PET/CT Specific Goals and Objectives:

-Knowledge Based Objectives—Relative to the level of knowledge obtained during the required nuclear medicine rotations, at the end of the residency, the resident should be able to demonstrate a more thorough understanding of:

1. PET/CT radiopharmaceuticals.
2. Related physics.
3. Normal variants and image artifacts.
4. Accepted indications and the role of PET/CT in the evaluation of oncologic, neurologic, and cardiac diseases.
5. Proper patient preparation protocols and the variations in radiopharmaceutical biodistribution relating to proper versus improper patient preparation.
6. Limitations of PET/CT imaging.
7. Proper handling of PET radiopharmaceuticals and safety issues particular to these agents.

-Technical Skills—at the end of the rotation, the resident should be able to:

1. Independently assess image/diagnostic quality of an exam.
2. Independently operate the PET/CT workstation for complete image analysis.
3. Provide an interpretation of clinical images at the level expected of an independently practicing radiologist.

-Decision-making and Value Judgment Skills—

1. Consult with referring clinicians regarding the appropriateness and utility of PET/CT imaging for various patients and clinical questions.
2. Effectively integrate PET/CT imaging with other imaging modalities with goals of optimized clinical accuracy and cost-efficiency.

-Laboratory Sessions: At least one session will be scheduled with the nuclear technologists performing the PET/CT exams to gain experience with receiving patient doses from the supplier, safe handling of PET agents in the "hot lab," and safe administration of patient doses.

At the end of 4th Year, the residents are expected to have participated in interpretation and dictation of following number of cases:

NRC Training and Experience Requirements:

<https://www.theabr.org/diagnostic-radiology/initial-certification/abr-training-nuclear-medicine-compliance-nrc-regulations>

Candidates seeking certification for diagnostic radiology must meet the specific training and experience requirements described in 10 CFR 35.290 (c)(1)(i) and (c)(1)(ii); 10 CFR 35.392 (c)(1) and (c)(2); and 10 CFR 35.394 (c)(1), (c)(2), and (c)(3). Radiation safety, radionuclide handling and quality control, and related topics specified in 10 CFR 35.290, 10 CFR 35.392, and 10 CFR 35.394 must be covered. The detailed information regarding 10 CFR 35.290, 35.392, and 35.394 may be found via the NRC Electronic Reading Room, which provides access to the NRC Regulations, Frequently Asked Questions, and other pertinent references.

Specifically, each candidate for AU status through the ABR pathway must have completed a minimum of 700 hours of training and experience in imaging and localization studies, which must include 80 hours of classroom and laboratory training in basic radionuclide handling techniques applicable to both the medical use of unsealed byproduct material for imaging and localization studies and the medical use of sodium iodide ¹³¹I for procedures requiring a written directive. In addition, each candidate must also meet the training and experience requirements specified in §35.392 and §35.294 for medical uses of radioiodine ¹³¹I (≤ 33 mCi and > 33 mCi, respectively) requiring a written directive. The training and experience must include, at a minimum, the following:

Classroom and laboratory training (minimum of 80 hours) under the direction of an Authorized User in the following areas:

1. Radiation physics and instrumentation
2. Radiation protection
3. Mathematics pertaining to the use and measurement of radioactivity
4. Chemistry of by-product material for medical use
5. Radiation biology

Work experience for imaging and localization studies (§35.290) under the supervision of a preceptor AU who meets the requirements in §35.57, §35.290, or §35.290(c)(1)(ii)(G), or equivalent Agreement State requirements, involving the following:

1. Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys
2. Performing quality-control procedures on instruments used to determine the activity of dosages and performing checks for proper operation of survey meters
3. Calculating, measuring, and safely preparing patient or human research subject dosages

4. Using administrative controls to prevent a medical event involving the use of unsealed by-product materials
5. Using procedures to safely contain spilled radioactive material and using proper decontamination procedures
6. Administering dosages of radioactive drugs to patients or human research subjects
7. Eluting generator systems appropriate for preparation of radioactive drugs for imaging and localization studies, measuring and testing the eluate for radionuclidic purity, and processing the eluate with reagent kits to prepare labeled radioactive drugs
8. Residents must demonstrate hands-on work experience when they perform the supervised work experience requirements. Observation alone is not sufficient.

Work experience for the oral administration of sodium iodide 131I (§35.392 and §35.394), requiring a written directive: Experience under §35.392 must be obtained under the supervision of an AU who meets the requirements in §35.390, 35.392, 35.394, or equivalent Agreement State requirements. A supervising AU who meets the requirements in §35.390 (b) must also have experience in the oral administration of sodium iodide 131I, for which a written directive is required. This work experience must involve the following:

1. Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys
2. Performing quality control procedures on instruments used to determine the activity of dosages and performing checks for proper operation of survey meters
3. Calculating, measuring, and safely preparing patient or human research subject dosages
4. Using administrative controls to prevent a medical event involving the use of unsealed byproduct materials
5. Using procedures to safely contain spilled radioactive material and using proper decontamination procedures
6. **Administering to patients or human research subjects doses that include at least three cases involving the oral administration of $\leq 33\text{mCi}$ and three cases involving the administration of $>33\text{mCi}$ of sodium iodide 131I**

Authorized User (AU)-eligible Designation:

Iodide-131 case experience documentation

1. Regarding §35.392, the ABR requires that candidates must have completed a minimum of three cases that involve administration of $\leq 33\text{ mCi}$ of 131I for therapy under a preceptor Authorized User (AU) who meets the requirements in §35.390,

35.392, 35.394, or equivalent Agreement State requirements. A supervising AU who meets the requirements in §35.390 (b) must also have experience in the oral administration of sodium iodide 131I for which a written directive is required. A logbook of these therapies must be kept by the resident and submitted to the ABR in the format given below.

2. Regarding §35.394, the ABR requires that candidates must have completed a minimum of three cases that involve the administration of > 33 mCi of 131I for therapy under a preceptor AU who meets the requirements in §§35.57, 35.390, 35.394, or equivalent Agreement State requirements. A supervising AU who meets the requirements in §35.390(b) must also have experience in administering dosages as specified in §35.390(b)(1)(ii)(G)(2). A logbook of these therapies must be kept by the resident and submitted to the ABR in the format given below.

Forms to Be Submitted to the ABR

Two forms are available to document compliance with and completion of the required NRC training and experience. Both completed forms must be submitted on behalf of each candidate for the candidate to be eligible for an ABR Diagnostic Radiology Certificate with the Authorized User (AU)-eligible designation.

1. ABR Form A (Program Director Attestation)
2. ABR Form B (Candidate 131I Case Log)

Dr. Mathews Courses:

Nuclear Medicine: Total didactic hours NM: 20 hrs plus one hour intro didactic for new first years in first week of July. Pediatric NM and Emergency NM put in the organ-specific sections of the didactic course.

Intro to NM Skeletal

NM (1hr) Lung NM

(1hr) GI NM (1hr)

GU NM (1 hr)

Thyroid NM Dx (1hr) Thyroid

Rx (1hr)

Non-thyroid Rx and Lymphoscintigraphy (1 hr)

Neuroendocrine and non-PET tumor imaging (1 hr)

Infection/Inflammation (1hr)

PET Technical Aspects (1 hr) Body
PET and PET/CT (2 hrs) Nuclear
Cardiac Imaging (3 hrs) Nuclear
Neuroimaging (2 hrs) Practical Issues
and QC (3 hrs)
Case review sessions for Boards (6 hrs)

Vascular US: Total didactic hours Vascular US = 11 hours plus one hour intro didactic for new first years in first week of July.

Intro to Vascular US (1hr)
Intracranial US (1 hr) Extracranial
US (1 hr) Extremity Arteries US
(2 hrs) Extremity Venous US (1
hr) Aorto-Iliac US (2 hrs)
Mesenteric Vasc US (1 hr) Renal
Vasc US (1 hr) Hepatoportal Vasc
US (1 hr)
Transplant Vasc US and Dialysis Access (1 hr) Case
review sessions for Boards (3 hrs)

PEDIATRIC RADIOLOGY

GOALS AND OBJECTIVES

R1 year

Objectives:

- Be able to appreciate the differences between a technically adequate and inadequate study, especially as it refers to inspiratory/expiratory chest views, proper exposure technique and patient positioning to the satisfaction of the supervising attending. (Systems Based Practice)
- Be able to identify support lines and catheters including umbilical catheters, endotracheal and orogastric tubes, central and PICC lines and ventricular shunts. Be able to differentiate proper from improper placement. (System Based Practice, Practice-Based Learning)
- Learn to perform and interpret standard pediatric fluoroscopic examination including 2 voiding cysto-urethrograms, 2 upper GI and 2 modified barium swallow studies as assessed by the pediatric radiology faculty. (Practice-Based Learning, Patient Care)
- Learn the imaging characteristics of child abuse and be able to recognize suspicious radiographic findings and pass an examination on this subject. (Medical Knowledge, Practice-Based Learning)
- Learn the differential diagnosis for upper and lower GI obstruction and be able to recommend appropriate diagnostic workup to the satisfaction of the supervising attending. (Medical Knowledge, Practice Based Learning)
- Score above the 50th percentile on annual in-training exams. (Medical Knowledge)
- Recognize the normal appearance of pediatric radiographs and their differences compared with adult films, i.e. thymic shadow, unossified epiphyses and apophyses. Recognize pediatric normal variants to the satisfaction of the supervising attending and the Program Director at ER review (Medical Knowledge, Practice Based Learning)
- Recognize manifestations of pediatric skeletal trauma, and appreciate the differences from standard adult fractures. Be able to describe fractures and know Salter Harris classification. (Medical Knowledge)
- To learn the indications, limitations, daily and long term consequences of all major radiologic examinations in their specialty to the satisfaction of the supervising attending with respect to dose deposition and cost with the exception of US and appropriateness to the satisfaction of the program director and to gain a passing score on an examination. (Patient Care)

- To gain skill in the art of radiologic consultation with referring physicians to the satisfaction of all faculty members and senior residents. (Communication Skills, Patient Care)
- To practice competence in collegial interactions, in the service of patients, with referring physicians in the context of after hours emergency duty to the satisfaction of the program director. (Professionalism, Patient Care)
- To demonstrate compassion and humility in interaction with patients and staff members as revealed in 360° evaluations. (Professionalism)
- To follow the appropriate dress code at all times and to be punctual for clinic assignments and conferences to the satisfaction of the faculty. (Professionalism)
- To promptly look up information as suggested by the supervising physician in the course of daily education. (Practice-Based Learning)

R2 year

- Gain competence in the performance of all pediatric fluoroscopic examinations, including contrast enema. (Practice Based Learning)
- Name, describe and know the differential diagnosis of congenital thoracic, gastrointestinal and hepatobiliary abnormalities. Entities include congenital lobar hyperinflation, congenital pulmonary airway malformation, sequestration, bowel atresia, Hirschsprung's disease, choledochal cyst, etc. to the satisfaction of the supervising attending. (Medical Knowledge)
- Know the imaging findings and grading of vesicoureteral reflux as well as other congenital abnormalities of genitourinary tract, i.e. cloacal exstrophy and UPJ obstruction, as graded by the pediatric faculty. (Medical Knowledge)
- AS backup on call resident and during clinical rotations, be confident in reporting abnormal findings in a timely manner as well as in case consultations with referring clinicians. Know which studies to recommend which will provide the most information and least time and/or radiation exposure. (Systems-Based Practice, Communications, Practice Based Learning, Patient Care, Professionalism).
- Gain proficiency in performing ultrasound examination of the abdomen, retroperitoneum, pelvis, scrotum and limited evaluation of hips as assessed by the pediatric radiology attending. When on call, be able to generate a diagnostic exam to assess for: cholecystitis, hydronephrosis, ovarian or testicular torsion, appendicitis, ascites, abscess, hip effusion, etc. (Practice Based Learning, Medical Knowledge, Patient Care)

- Recognize metabolic bone diseases and their causes. Know how to assess a patient's skeletal maturity using knowledge of ossification centers and bone age evaluation. (Medical Knowledge).
- Score above 50th percentile on annual in-training examination. (Medical Knowledge)
- Know the differential diagnosis and imaging appearance of head and neck soft tissue abnormalities including congenital, neoplastic, infectious, endocrine and inflammatory. (Medical Knowledge)
- Recognize the imaging abnormalities and multi-system involvement of various pediatric diseases including: sickle cell disease, cystic fibrosis, autoimmune and metabolic diseases, heavy metal toxicity, etc. to the satisfaction of the attending as evaluated in their monthly review. (Medical Knowledge)
- To learn the indications, limitations, daily and long term consequences of all major radiologic examinations in their specialty to the satisfaction of the supervising attending with respect to dose deposition and cost with the exception of US and appropriateness to the satisfaction of the program director and to gain a passing score on an examination. (Patient Care)
- To gain skill in the art of radiologic consultation with referring physicians to the satisfaction of all faculty members and senior residents. (Communication Skills, Patient Care)
- To practice competence in collegial interactions, in the service of patients, with referring physicians in the context of after hours emergency duty to the satisfaction of the program director. (Professionalism, Patient Care)
- To demonstrate compassion and humility in interaction with patients and staff members as revealed in 360° evaluations. (Professionalism)
- To follow the appropriate dress code at all times and to be punctual for clinic assignments and conferences to the satisfaction of the faculty. (Professionalism)
- To promptly look up information as suggested by the supervising physician in the course of daily education. (Practice-Based Learning)

R3 year

Objectives: (in addition to those of the first and second years)

- Be able to confidently protocol all US, CT and MR examinations, tailored towards the patient's age. For MR, know how to optimize the study to reduce scanning time as evaluated by the supervising attending. (Systems Based Practice, Practice Based Learning)

- Be able to identify the characteristic features of congenital abnormalities of the brain. (Medical Knowledge)
- Residents should be able to teach junior residents and medical students as evaluated by medical student evaluation. (Practice Based Learning, Professionalism)
- Be competent in performing and interpreting neonatal ultrasound examination of the spine and brain. Know the sonographic findings of germinal matrix hemorrhage and their grading as well as hydrocephalus, periventricular leukomalacia and ischemia. (Practice based Learning, Patient Care)
- Be able to successfully perform a diagnostic quality dynamic hip ultrasound to assess for hip dysplasia. Know the differential diagnosis and imaging features of common pediatric hip disorders. (Medical Knowledge, Practice Based Learning, Patient Care)
- Score above 50th percentile on annual in-training examination. (Medical Knowledge)
- Know and identify the characteristic findings of congenital abnormalities involving the great vessels, such as vascular rings and slings. (Medical Knowledge)
- Prepare a short presentation on an area of residual weakness to be determined by the attending physician. (Medical Knowledge)
- Learn the differential diagnosis for common pediatric soft tissue and bone neoplasms, and their imaging characteristics. (Medical Knowledge)
- Be able to confidently hold consultations with referring clinicians in pediatric, surgical and emergency room departments as assessed by 360 degree review and attending review. (Professionalism, Communication Skills, Patient Care)
- To learn the indications, limitations, daily and long term consequences of all major radiologic examinations in their specialty to the satisfaction of the supervising attending with respect to dose deposition and cost with the exception of US and appropriateness to the satisfaction of the program director and to gain a passing score on an examination. (Patient Care)
- To gain skill in the art of radiologic consultation with referring physicians to the satisfaction of all faculty members and senior residents. (Communication Skills, Patient Care)
- To practice competence in collegial interactions, in the service of patients, with referring physicians in the context of after-hours emergency duty to the satisfaction of the program director. (Professionalism, Patient Care)
- To demonstrate compassion and humility in interaction with patients and staff members as revealed in 360° evaluations. (Professionalism)

- To follow the appropriate dress code at all times and to be punctual for clinic assignments and conferences to the satisfaction of the faculty. (Professionalism)
- To promptly look up information as suggested by the supervising physician in the course of daily education. (Practice-Based Learning)

LIST OF LECTURE TOPICS TO BE COVERED

Malrotation

Intussusception

Thymus imaging

Hip imaging

GI imaging

GU imaging

Neuro imaging

Non-accidental trauma

Scrotal imaging

Spine imaging

Necrotizing enterocolitis

Airway imaging

Board review

LIST OF LEARNING RESOURCES

Fundamentals of Pediatric Imaging (Fundamentals of Radiology) 2nd Edition

by Lane F. Donnelly MD (Editor)

Cleveland Clinic Pediatric Radiology Online Modules

<https://www.cchs.net/onlinelearning/cometvs10/pedrad/>

LAST EDITED BY DR. TEJ PHATAK ON 12/14/2021

Emergency & Trauma Radiology – Goals & Objectives

*Prepared by Joshua Dym, MD
November 2021*

Mission Statement:

To provide an educational pathway for residents to develop the image interpretation and administrative skills required to manage the provision of radiological services to the emergency department (ED).

General Goals:

1. To develop an understanding and appreciation for the appropriate use of CT, MR, radiography, and ultrasonography in the diagnosis and treatment of patients presenting to the ED. (Patient Care, Systems-Based Practice)
2. To learn and participate in the performance of the full range of emergency radiologic examinations. This includes:
 - a. Learn indications and contraindications for various types of contrast administration, and how to recognize and treat adverse contrast reactions. (Patient Care, Medical Knowledge)
 - b. Help guide emergency physicians to appropriate examinations with protocols tailored to the clinical indication. (Patient Care, Communication Skills, Systems-Based Practice)
 - c. Learn to dictate concise and appropriate reports for the full range of exams performed in the ED. (Patient Care, Communication Skills)
 - d. Serve as meaningful, valued consultants to referring emergency physicians. (Patient Care, Communication Skills, Practice-Based Learning)
 - e. Provide preliminary interpretations on inpatient radiology studies performed on acutely ill patients. (Patient Care)

3. As the primary contact person for all of radiology during off hours, the residents will demonstrate professional behavior towards other services and ancillary staff at all times, as befits their role as representatives of the department. (Professionalism, Communication Skills)

Workflow:

The following principles guide the nightly work routine for residents:

1. Residents will protocol examinations from the ED, as well as from the inpatient services, as requested. Residents are expected to communicate with the referring clinicians whenever there is uncertainty about the requested examination, or whenever it is possible that another examination may be more appropriate. Examinations that require special attention will be identified beforehand, and residents will communicate with technologists to monitor these exams as needed. (Patient Care, Communication Skills, Systems-Based Practice)
2. Residents will manage the phone line in a professional manner. (Professionalism, Communication Skills)
3. Residents will dictate reports for examinations performed in the ED, with priority to urgent trauma CTs and BAT examinations, adhering to all applicable departmental and section dictation policies. (Patient Care)
4. Residents should consult educational resources as well as the radiology attending for cases which they are uncertain about but will need urgent communication of results to clinicians. (Practice-Based Learning)
5. Residents will assess the quality of the imaging examinations as they review them, and will proactive in communicating with technologists to optimize the quality of the examinations. This will include joining the ultrasound technologists in the patient rooms to scan and/or guide image acquisition, as well as communicating with technologists in other modalities to address quality problems as they arise, including requests for image reconstructions or additional imaging as needed. (Patient Care, Systems-Based Practice)
6. Residents will provide preliminary interpretations for examinations performed on inpatients at the request of the referring services, documenting communication with the requesting clinician. Emergency radiology attendings will be available to provide assistance as necessary. (Patient Care)
7. Exams should be interpreted and reports released for viewing in an expeditious fashion, to enable referring physicians to be able to act quickly based on the results. (Patient Care)
8. Residents will provide the primary point of contact for interventional services, fielding requests from referring services and communicating with the interventional radiologists on call as per their divisional procedures. (Patient Care, Communication Skills)
9. Residents will determine the appropriateness, coordinate and provide preliminary interpretations on nuclear medicine studies, as needed. (Patient Care, Communication Skills, Systems-Based Practice)

Competency-Based Expectations:

During 1st year:

Residents should be gradually building up to the level of a 2nd year resident that can take call independently. The goals are the same as for the 2nd year (see below); however, a lower level of competency is expected for 1st years. Improvement should be seen over the course of the year.

1st year residents should initially focus on dictation of radiographs, beginning with learning how to properly dictate reports for these examinations, followed by increasing the accuracy and nuance of their reports. After becoming comfortable with reporting radiographs, 1st year residents should begin to report straightforward CT and ultrasound examinations with close senior resident or attending supervision.

By end of 2nd year, should be able to:

- 1) Recognize normal anatomy on CT, US, and MRI for common imaging studies. (Medical Knowledge)
- 2) Independently pre-dictate common radiographs, CT, US and MRI exams. (Patient Care)
- 3) Make core observations, confidently describe critical imaging findings and generate differential diagnoses. Examples of the diagnoses the resident is expected to be able to make at this stage are listed below. (Medical Knowledge, Patient Care, Communication Skills)
 - a) Abdomen and Pelvis CT:
 - i) Biliary ductal dilatation
 - ii) Pneumobilia vs portal venous gas.
 - iii) Liver lesions, with the ability to recognize obviously benign lesions including cysts and hemangiomas with classic features.
 - iv) Cholelithiasis/Cholecystitis
 - v) Hydronephrosis with or without ureteral obstruction
 - vi) Pyelonephritis
 - vii) PID
 - viii) Acute appendicitis
 - ix) Acute diverticulitis
 - x) Small and large bowel obstruction
 - xi) Colitis/enteritis
 - xii) Active GI bleeding
 - xiii) Retroperitoneal hemorrhage
 - xiv) Intraabdominal abscess
 - xv) Pneumoperitoneum
 - xvi) Ascites
 - xvii) Trauma: Injuries to liver, biliary tree, spleen, pancreas, kidneys, bladder, bowel, mesentery and vasculature; fractures of pelvis, acetabulum and hips
 - b) Chest CT
 - i) Acute pulmonary embolism
 - ii) Pneumonia and distinction from atelectasis
 - iii) Alveolar and interstitial edema

- iv) Pneumothorax
- v) Pericardial effusion
- vi) Pleural effusion: simple vs complex
- vii) Acute aortic syndromes: Dissection, intramural hematoma, penetrating ulcer
- viii) Aortic aneurysm and pseudoaneurysm
- ix) Pulmonary and mediastinal masses
- x) Trauma: Pulmonary contusion and laceration; traumatic aortic injury; airway injury; fractures of ribs, sternum and scapula; scapulothoracic dissociation
- c) Head CT
 - i) Parenchymal, subarachnoid, subdural, epidural, and intraventricular hemorrhage, with ability to distinguish these from each other.
 - ii) Acute territorial infarct and knowledge of the basic vascular territories.
 - iii) Distinction of cytotoxic and vasogenic edema
 - iv) Hydrocephalus: communicating vs non-communicating
 - v) Findings of brain herniation, including subfalcine, transtentorial, and cerebellar tonsillar herniation
 - vi) Recognition of the typical appearance of small vessel ischemic disease.
 - vii) Venous sinus thrombosis
 - viii) Skull fractures
- d) Neck CT
 - i) Abscess: Subperiosteal orbital, mastoid, masticator space, peritonsillar, retropharyngeal, prevertebral.
 - ii) Jugular vein thrombosis
 - iii) Foreign body vs physiologic calcification
 - iv) Adenopathy.
 - v) Cellulitis (including distinction of pre- and post-septal in the orbit)
- e) Facial CT
 - i) Identify facial fractures
- f) Spine CT
 - i) Fractures including odontoid fractures, spinous and transverse process fractures, burst fractures, extension and flexion teardrop fractures.
 - ii) Facet dislocation/subluxation
 - iii) Compression fracture
 - iv) Diskitis/Osteomyelitis
 - v) Metastasis and recognition of obviously benign lesions such as hemangiomas
- g) Ultrasound
 - i) General
 - (1) Recognize the ultrasound diagnostic criteria used to evaluate tissue characteristics, with the ability to recognize the appearances of a cyst, solid structure, fat, air, and calcification.
 - ii) Abdomen
 - (1) Liver - abnormal size, shape, echotexture, cyst, hemangioma, hepatocellular carcinoma, metastatic lesions
 - (2) Gallbladder/Bile Ducts – increased intra- & extra-hepatic duct size, gallstones, acute cholecystitis, biliary obstruction, duct stones

- (3) Pancreas - abnormal size, abnormal duct size, acute/chronic pancreatitis, pseudocyst
- (4) Spleen - abnormal anatomy/size, focal lesions (cyst/solid)
- (5) Kidneys - normal anatomy and size, cysts (simple/complex), cystic diseases, angiomyolipoma, hydronephrosis, stones, hydroureter +/- stones, renal transplant evaluation (including Doppler)
- (6) Peritoneal Cavity - localization/quantification of fluid
- (7) Gastrointestinal Tract – appendicitis
- (8) Retroperitoneum – aortic aneurysm, lymphadenopathy
- iii) Pelvis
 - (1) Urinary Bladder – abnormal filling, abnormal post void residual, stones, masses
 - (2) Uterus - physiologic variations, abnormal size or shape, abnormal echogenicity, abnormal endometrial thickness, leiomyoma, adenomyosis
 - (3) Ovary - physiologic variations, abnormal size or shape or echogenicity, physiologic variations (follicles, corpus luteum cyst) torsion, cystic/solid mass
 - (4) Fallopian Tube - dilated
- iv) Scrotum - normal size, shape, echogenicity of testis and epididymis, cystic/solid testicular and extra-testicular mass, torsion, epididymo-orchitis, varicocele, hydrocele, spermatocele, testicular carcinoma
- v) Obstetrics - spontaneous abortion, embryonic death, blighted ovum, ectopic pregnancy
- h) Pediatrics
 - i) Identify common acute traumatic injuries in children
 - (1) Growth plate injuries (salter-Harris classification system)
 - (2) Specific pediatric fractures
 - (a) Torus fracture
 - (b) Greenstick fracture
 - (c) Plastic bowing
 - (3) Elbow
 - (a) Radial head dislocation
 - (b) Supracondylar fracture
 - (4) Tibia, ankle, and foot
 - (a) Toddler fracture
 - (b) Triplane fracture
 - ii) Identify abnormalities specific for child abuse
 - iii) Ultrasound
 - (1) Intussusception
 - (2) Pyloric stenosis
 - (3) Appendicitis
 - (4) Female pelvis
 - (a) Ovarian cyst/solid mass, torsion, hydrosalpinx
 - (5) Scrotum
 - (a) Torsion, epididymo-orchitis, hydrocele
 - (6) Extremity
 - (a) Abscess
 - (7) Neck

(a) Suppurative adenitis

- 4) Generate reports that are free of dictation errors, using templates as appropriate. (Communication Skills)
- 5) Determine which findings require urgent communication (and documentation) with the ED and communicate those findings effectively over the phone. (Communication Skills, Patient Care)
- 6) Discriminate emergent from non-emergent clinical indications and triage case performance and dictation. (Medical Knowledge, Patient Care)
- 7) Protocol routine ED and inpatient exams; recognize the need for additional information and communicate with referring clinicians when necessary. (Patient Care, Communication Skills, Systems-Based Practice)
- 8) Provide independent preliminary interpretations on routine inpatient examinations upon request. (Patient Care)
- 9) It is understood that residents will sometimes struggle with the large volume of exams performed in the ED, especially on busy nights during their first weeks on the rotation. Residents should strive to be as efficient as possible while maintaining accuracy. To the extent possible, emergency radiology attendings will assist with the workload as needed.

By end of 3rd year, should be able to:

- 1) Generate clear and concise reports that do not require substantive faculty member corrections on routine cases. (Communication Skills)
- 2) Communicate findings clearly and concisely, and make recommendations for follow up or additional imaging for common abnormalities. (Communication Skills, Patient Care)
- 3) Select appropriate protocols and contrast agent/dose for intermediate level cases. (Systems-Based Practice)
- 4) Recognize sub-optimal imaging, and effectively manage the consequences, including communicating with the referring clinician and recommending additional or repeat imaging if necessary. (Systems-Based Practice, Communication Skills)
- 5) Make secondary observations, narrow the differential diagnosis, and describe management options. By this stage, residents are expected to be able to provide more specific and nuanced descriptions of the pathology they encounter. Residents should also demonstrate improved perceptive abilities, detecting more subtle or incidental findings. (Medical Knowledge, Patient Care, Communication Skills)

Examples for abdomen and pelvis CT would include but are not limited to:

- i) Distinction of perforated and non-perforated appendicitis, with the ability to recognize subtle signs of perforation.
- ii) Identify common complications of acute diverticulitis including intramural abscess, fistulas, and perforations.
- iii) Be more specific in descriptions of bowel obstructions, identifying important subtypes including closed-loop obstructions, and recognizing important complications of obstruction such as bowel ischemia.
- iv) Be more proficient in the distinction of benign and malignant lesions encountered on CT.

- v) Consistent evaluation of the vasculature, with the ability to make findings such as systemic or mesenteric vein thrombosis, severe stenosis/dissection/or aneurysm in vessels other than the aorta.
- 6) Residents are expected to be able function at a faster pace during their third year. While failure to make subtle or incidental findings may still occur, significant diagnostic errors should be rare. (Patient Care)
- 7) Independently pre-dictate MRI exams including brain, spine, abdomen, appendicitis in pediatric and pregnant patients. (Patient Care)
- 8) Provide independent preliminary interpretations on intermediate complexity inpatient examinations upon request, with attending assistance available as needed. (Patient Care)

By end of 4th year, should be able to:

- 1) Generate clear & concise reports that do not require substantive faculty member correction on common complex cases. (Communication Skills)
- 2) Able to provide effective verbal communication to the ED and inpatient services for complex cases. (Communication Skills)
- 3) Select appropriate protocols and contrast agent/dose for complex cases, with the ability to employ advanced imaging or adapt existing protocols to answer specific clinical questions. (Systems-Based Practice)
- 4) Provide accurate, focused, and efficient interpretations, appropriately narrowing the differential diagnosis. It is expected that the resident will provide a single, specific diagnosis when appropriate. (Communication Skills, Patient Care)
- 5) Residents should be able to handle busy ED volume. There should be no major diagnostic errors by this stage, and the resident's ability to make ancillary or subtle findings should have improved such that the majority of these findings are made by the resident. (Patient Care)
- 6) Able to recommend appropriate follow up/management of common complex conditions.
- 7) Provide independent preliminary interpretations on complex inpatient examinations upon request, with attending assistance available as needed. (Patient Care)

Medical Knowledge Objectives

To become familiar with the full range of emergency diagnoses as listed in the American Society of Emergency Radiology Core Curriculum Illustration Project:
<https://aser.org/core-curriculum/>

Suggested References & Learning Resources: (Practice-Based Learning)

American Society of Emergency Radiology Core Curriculum Illustration Project.
Please visit their website for list of topics, suggested readings by subject and some sample cases:
<https://aser.org/core-curriculum/>

Raby N. Accident and Emergency Radiology: A Survival Guide, Third Edition. Saunders 2015.

Free e-book available in Rutgers library online

Soto JA, Lucey B. Emergency Radiology: The Requisites, 2nd Edition, Elsevier, 2016

Free e-book available in Rutgers library online

Mirvis, SE. et al. Problem solving in emergency radiology. Elsevier/Saunders, 2014.

Free e-book available in Rutgers library online

Bittle M, et al. Trauma Radiology Companion, Second edition. Wolters Kuwer/Lippincott, 2012

Cornfeld D. One Night in the ED. 2005

<http://radiology.cornfeld.org/EDindex.php>

Teaching file with complete CT scans that you can scroll through as if at a PACS workstation. Each case is then discussed in an interactive format.

Professionalism Objectives:

The ED radiology attendings strive to provide an environment where residents can gain independence, synthesize information from various modalities, and ultimately produce coherent reports that have a meaningful impact on patient care.

Achieving these goals is dependent on adherence to certain standards of professionalism. As residents are the first line of contact, the manner in which they conduct themselves sets the tone for how the department is perceived by other services. The following are guidelines for how residents are expected to **A.C.T** in this setting:

- **Attitude.** This rotation is fast-paced and pressure-filled. However, a positive, courteous attitude will pay dividends by making interactions with people over the phone or in person more pleasant for all parties involved.
- **Communication.** Throughout the night, residents will have numerous interactions with clinical and support staff. The choice of words can make those encounters helpful and productive or unnecessarily antagonizing. It is important for residents to be mindful of how their communication will be received by the other party. It is prudent to err on the side of caution when in doubt. For example, speaking colloquially to a resident on the phone may be acceptable, whereas speaking to an attending in a similar manner may be perceived as unacceptable; therefore, residents are encouraged to err on the side of caution and extend the same high level of professionalism and courtesy to everyone.
- **Teamwork.** The ability to deliver excellent radiology services is dependent on the work of others. The clinical staff, technologists, and clerical staff are necessary for residents to do their job, and for patients to receive excellent care. Therefore, it is imperative that

residents do not alienate their team members, as this may ultimately interfere with patient care and the learning environment.

Keeping the above in mind, here are a few specific points that the residents will be required to adhere to:

1. Answer phones in a prompt manner. If a resident is busy with another consult and the caller will need to wait for a while, apologize and explain that things are busy. Feel free to ask the person to call back if possible, or ask the attending for help if needed.
2. Do not leave consulting clinicians, technologists, or support staff waiting for extended periods of time for your attention.
3. Our mindset should be to assist clinicians in answering their clinical question by facilitating performance and interpretation of the study that their patient needs. If a resident believes that a study is inappropriate and is getting “pushback,” ask the emergency radiology attending for assistance rather than risk conflict with the ED or other clinician.
4. When residents encounter situations that they are unsure how to manage, they should not hesitate to seek the assistance or guidance of the emergency radiology attending.

Evaluation and Feedback: (Practice-Based Learning)

Assessment of resident performance is performed at the end of the rotation by faculty members who have worked with the resident. Verbal feedback should be given by each attending at the end of their week. Written feedback may also be provided via formal evaluations. Feedback will also be offered throughout the rotation, particularly when the attending feels a resident can learn from a specific case. Feedback may reflect the quality of image interpretation, structure and content of imaging reports, quality of protocol selection, or content of clinical consultation. Feedback may also be offered regarding system-based practice and resident learning. Written feedback may include suggested areas for improvement as that is the purpose of residency training, but this should not be misinterpreted as negative criticism.

Emergency Radiology Lecture Curriculum

The lecture curricula for each subspecialty will include emergency topics for each of those areas. (Please refer to the individual curricula, particularly for Abdominal imaging, Ultrasound, Neuroradiology, Musculoskeletal Imaging, and Cardiothoracic Imaging.) Emergency radiology attendings will participate in the subspecialty curricula by providing some of the included lectures that are focused on emergency topics.

Additionally, the emergency radiology curriculum includes several lectures that are not included in the other curricula, either because they may span multiple subspecialties, or because they are unique and specific to the practice of emergency radiology. These lectures include the following:

- Emergency Department laboratory tests: their use to suggest appropriate imaging and provide an accurate differential diagnosis
- Reflex radiology: when recommending another study is required for a complete diagnosis
- Dictation of emergency radiology reports
- Contrast contraindications, controversies and confusion
- Appropriateness of Emergency Radiology examinations

DAILY RESPONSIBILITIES INCLUDING POLICIES ON SUPERVISION OF RESIDENTS

Hours of Duty of daily responsibilities and supervision: Residents are to report to their rotations at 8 am, with the exception of the MSK rotation which begins at 7:30 am. The day typically ends at 5 pm after conference, provided the work is completed. If you are unable to finish all assigned work before conference, you must attend conference on time then complete unfinished work. During daily work assignments, the resident must be in an area to allow for **Direct Supervision** by the attending responsible for that service. That is to say, the attending is **physically present** with the resident during patient care. At the discretion of the attending, **Indirect Supervision with Direct Supervision Immediately Available** may be used. That is to say, the attending is **physically within the hospital or other site of patient care and is immediately available to provide Direct Supervision**. This applies for all levels of training. On Call hours listed in the call section. Residents are required to sign in and out daily with the supervising attending at the EXACT times and are expected to comply with all ACGME regulations regarding duty hours.

For each daily assignment and on call assignment, the supervising attending must provide:

Oversight – The supervising physician is available to provide review of procedures/encounters with feedback provided after care is delivered. This applies to all levels of training.

Progressive authority and responsibility: At the discretion of the supervising attending, conditional independence and a supervisory role in patient care may be provided to the resident, unless a documented remediation plan has been developed for the resident by the program director. In that instance, the resident may only be given graduated responsibility within the framework of the remediation plan. Faculty members functioning as supervising physicians must delegate portions of care to residents based on the needs of the patient and the skills of each resident. Senior residents should serve in a supervisory role to junior residents, at the discretion of the supervising attending, in recognition of their progress toward independence, based on the needs of each patient and the skills of the individual resident. First year radiology residents (R1, PGY-2) may not be assigned on call without a supervising senior resident (R2, PGY-3 or greater).

Duty Hour Documentation: To assure compliance with the ACGME regulations regarding duty hours, residents are required to promptly record all duty hours in New Innovations daily. If hours are not logged on time, reminder emails will be sent daily. If there is continued noncompliance with recording duty hours, the program director will be notified.

Duty Types to Use

Clinical Duties – Any regularly scheduled assignment with patient care responsibilities including on weekday and weekend on call hours- NOT INCLUDING NIGHT FLOAT.

Night Float – This only applies to the night float rotation.

Day Off – This applies when you are off from any duties, including weekends and vacation.

Rotation Schedule: A yearly rotation schedule will be distributed to all residents at the beginning of each academic year. Any changes to this schedule must be approved by the chief residents.

Diagnostic Rotations: Responsibilities while on diagnostic rotations include reviewing and dictating cases with the attending, observing and/or assisting with any procedures, annotating studies, answering phone calls and assisting clinical teams in the reading room. Residents are required to sit in their assigned stations, unless directed to dictate elsewhere by their attending.

Interventional Rotation: Residents should report to the interventional radiology suite on C level at 8 am. Responsibilities include consulting with clinical teams, obtaining consents, reviewing relevant laboratory values and imaging prior to a case, assisting on cases, and postoperative checks. Residents should not leave the rotation until dismissed by the interventional attending. There is to be **Direct Supervision** by the attending responsible for that service. That is to say, the attending is **physically present** with the resident during patient care. At the discretion of the attending, **Indirect Supervision with Direct Supervision Immediately Available** may be used. That is to say, the attending is **physically within the hospital or other site of patient care and is immediately available to provide Direct Supervision**. This applies to all levels of training.

VA Rotation: Residents are to report to the East Orange VA at 8 am daily. Contact information (pager and/or cell phone) of the resident covering the VA for that day should be given to the front desk or the technologist. Residents should attend 12:00 and 4PM Conferences remotely. The covering VA attending should be made aware of any pending or incomplete cases before the resident leaves.

Lectures/Conferences: There are daily conferences at 12:00 PM and 4:00 PM (there is no 4:00PM lecture on Fridays). All residents are required to attend lecture except for the night float resident and the interventional resident. Attendance will be tracked.

Physics curriculum: Physics lectures will take place at noon on Wednesdays. All residents who have not passed the physics boards are required to attend.

Pagers: Residents should be available between the hours of 8 am and 5 pm daily and promptly answer all pages during this time.

Case Log: All residents are required to maintain ACGME Case log and cumulative case logs to be submitted on a regular basis (as requested) to the Program Coordinator. Procedure Log (Special Procedures such as biopsies, nuclear medicine therapies, interventional procedures, etc.) and Case Log (all studies interpreted in all rotations, including night float and short call, even if not dictated).

Nuclear Medicine: All residents are required to complete 16 weeks of Nuclear Medicine training. Strict documentation of I-131 Sodium Iodine treatment (small and large doses) should be maintained and submitted with the residents case logs.

Mammography: All residents are required to read 240 mammograms within a 6-month period during residency, as required by the FDA.

CALL RESPONSIBILITIES

Schedule:

Call hours are as follows:

Weekdays (M-F) 4:30PM – 10:30PM senior resident, 4:30 – 8:30 PM R1 resident

Weekends 8AM – 10PM

Night Float Hours: 10:30PM-8AM on weekdays (M-F) and 10:00 PM – 8:00 AM on weekends

Holidays are handled like weekends, so first call is from 8am - 10pm.

Attendance

The call resident is expected to be in the ER Radiology reading area during the aforementioned times. That means 4:30pm on weekdays and 8am **SHARP** on holidays and weekends.

If the on call resident will be more than 5 minutes late for a weekend call, he/she must inform the night float resident (973-972-4139) and let the senior resident know ASAP.

If a resident is unable to cover a call, he or she must find a substitution and notify the chief residents. If a resident is unable to cover a call due to illness the chief resident must be notified ASAP.

Call Responsibilities:

The junior and senior resident should work together on call to efficiently read out studies and prevent delays in interpretation. It is expected that the senior resident will dictate the more complicated imaging studies while the junior resident concentrates on radiographs and less complicated CT. Studies that must be dictated include:

- All ER studies will be listed under the worklist for titled “ED”.
 - 1) **ALL plain films** (chest, abdomen, MSK, peds, etc.)
 - 2) **ALL CTs** - except MSK CTs (i.e. CT Knee, etc.), CT angiograms of the extremities, CT Recon Thoracic Spine or CT Recon Lumbar Spine. If there is a CT Thoracic or CT Lumbar spine that is not a recon, it must be dictated.
 - 3) There are instances when a trauma patient will go straight to the OR and then get a CT afterwards. These cases are to be dictated
- The on call residents are also responsible for protocoling all studies that they are called about, whether the patient is from the ER, observation unit, inpatient, or outpatient.

- IR Procedure Requests: If someone (ER or inpatient) requests an IR procedure (i.e. TIPS, drainage, etc.) take down the patient's name, MRN, location, background info (current/working diagnosis, why they want the procedure), what type of procedure, which attending is requesting the procedure, pertinent labs (i.e. coags, hemoglobin/hematocrit, etc.), vitals (i.e. is the patient stable), if the patient consentable, when the patient is available for the procedure, etc. Then, before calling the IR attending, find out which nurse and technologist will be assisting the attending during the procedure. Then page the IR attending on call and let them know of the situation and above info you collected. He/she will decide if they are going to do the case, etc. Relay this information back to the requesting service (make sure you have a contact number or pager from the requesting service).
- Nuclear Medicine Requests: If requested to perform a nuclear medicine study obtain the patients name, MRN, location, background info (current/working diagnosis, why they want the study), which study and which attending is requesting the procedure. Make sure that the service requesting has already placed the order and then call Dr. Liu or Ghesani,
- GI/Flouro Studies: Occasionally someone (ER or inpatient) will call and ask for a GI/flouro study. The on call resident should let the chief technologist know that a flouro study is pending and when it should be completed.

Second Call (Senior Resident) Call responsibilities:

- Provide documented preliminary reports for all studies from the ED that are not required to be dictated by first call (i.e. CT recon thoracic and lumbar spines, all MSK CTs, CT angiogram of extremities, etc.)
- Dictate all ultrasounds and MRIs that are done through the ED at the discretion of the supervising attending.
- Provide documented preliminary reports for ALL inpatient body CTs within four hours of the exam.
- Provide documented preliminary reports for ALL inpatient chest CTs (especially PE protocol CTs)
- On weekends, dictate all plain films on the chest list until 6:30 PM.

Night Float Responsibilities:

- Everything outlined above as first and second call resident responsibilities.
- Performing any urgent ultrasounds if no ultrasound technologist is available.
- Certain attendings may require that the night float resident sign out the cases with them, please make sure the cases are signed out before leaving.

Attending Call Schedules

The main attending schedule is found on AMION (<http://www.amion.com>). The password is "deptrad" (case sensitive). The online schedule includes the Neuroradiology Attending Schedule, IR attending call schedule, and Nuclear medicine attending call schedule.

Who to Send Studies to, First/Second Call:

Monday - Friday:

Plain films - send to the attending listed as "evening shift body" for that day.

Body CT scans and US studies - send to the attending listed "evening shift body" for that day.

Neuroradiology studies (CT scans and MRI) – send to attending listed as “evening shift Neuro” for that day

Saturdays, Sundays, and Holidays:

Plain Films, Body, and Chest CTs - to "Weekend ER" attending listed on the same day.

Neuro CTs and MRI - whoever is listed as Neuroradiology on call that day.

Who to Send Studies to during Nightfloat:

- All plain films, ED Ultrasound cases, ED body CTs, and Neuro CTs except the aforementioned studies above are to be signed out with the overnight emergency radiology attending.

Important Phone Numbers:

PACS Window Presets:

Make sure "Num Lock" is on and use the numeric keypad.

- 1 - Soft Tissue
- 2 - Lung
- 4 - Bone
- 5 - Blood
- 6 - Liver / Subdural
- 7 - Kidneys / Angio

EVALUATIONS

Evaluation of your progress toward the goal of satisfactory completion of residency training is monitored in several ways.

1. At the conclusion of each subspecialty rotation, the responsible faculty will submit an electronic evaluation on New Innovations regarding your performance during that rotation. An example of this form is located with the residency coordinator. This evaluation is placed in your permanent file and is reviewed regularly by the Program Director.

You may review, and if necessary dispute, your evaluations upon request. Such a request should be made to either the Program Director or Program Coordinator. You will have a review of your rotational evaluations with the Program Director twice a year.

2. At least twice per year, each resident is responsible for submitting an electronic evaluation on New Innovations regarding the attending physician's performance. An example of this form is located with the program coordinator. Evaluation of faculty by residents is taken seriously. You should give constructive suggestions where applicable. Additionally, forms are sent at least once per year out to evaluate the various rotations. These evaluations are reviewed by the administration in the department.

3. Application to sit for the American Board of Radiology examination is possible only with the written confirmation of the Residency Program Director. This certification states that a resident has successfully completed the minimum requirements outlined by the Board and has satisfactorily completed the curriculum as outlined by the individual program.

The Clinical Competency Committee (CCC) for the Department of Radiology is comprised of members appointed by the Program Director.

The Chairman of the CCC is appointed by the Program Director.

Members of the CCC must be members of the residency faculty who work greater than 15 hours/week in the department.

The Clinical Competency Committee will meet at least twice per academic year.

The purpose of the CCC is to:

1. Review all resident evaluations semi-annually
2. Prepare and assure semi-annual reporting of the Milestone evaluations to the ACGME
3. Make recommendations to the Program Director for resident progress regarding promotion, remediation, or dismissal

The CCC will review all evaluations of all residents.

The CCC will review the data in each resident's portfolio regarding achievement and progress in the training program. This will include evaluations, updated CV, grades for exams or quizzes,

resident self-assessment, resident's learning plan, and procedure logs.

The CCC by consensus will prepare an evaluation for each resident semi-annually regarding achievement of milestones using the Diagnostic Radiology Milestones ACGME Report Worksheet.

The Program Director will then review performance assessment individually with each resident semi-annually.