

INTERN/RESIDENT GENERAL ELECTIVE IN RADIOLOGY

ELECTIVE DIRECTOR

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Not available on Fridays

ELECTIVE CO'ORDINATOR

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INTRODUCTION

Welcome to radiology. This document is intended to provide you with some guidelines regarding your elective goals and objectives as well as some resources for study.

SCHEDULE

A preliminary schedule of your clinical rotations will be made prior to your elective and will be made available on googledocs™ with that link E-mailed to you. We will adjust that schedule according to your career interests, but generally for a 4 week elective you must spend a minimum of one half day in any one clinical area. For a two week elective we usually focus the time on 2-4 clinical areas. As we frequently have multiple learners in radiology, please consult with Dr. Lewis before changing your schedule. The clinical areas in radiology are:

Body imaging (CT/MRI)
Reading room (CXRs, KUBs, bone and pedi films)
Ultrasound
Neuroimaging
Fluoroscopy (Gis, VCUGs, arthrograms, IVPs etc)
Mammography
Nuclear medicine
Interventional radiology

CODE OF CONDUCT IN RADIOLOGY

1. You are expected to be in the assigned clinical area between 8-5p unless you have to be at a required learning activity by your department, post-call or covering clinic. If there is a conflicting required activity, this should be discussed with Dr. Lewis prior to beginning of the elective.

2. Please dress appropriately, as you would in a clinical area. In fluoroscopy and IR, as well as during procedures in CT, US and mammography, scrubs/white coats may be required.
3. The workstations are our offices and consulting rooms. Talking loudly, discussing personal matters, answering a cell phone and similar behaviors are unprofessional and distracting while we are reading studies. Any behavior that would be inappropriate during a clinical interaction is inappropriate in our reading rooms.
4. The PACS workstations are not to be used for email or activities unrelated to work. They can be used for accessing teaching resources but be prepared to make the workstation available if required by a member of radiology staff or resident. I would suggest that you bring your own laptop.
5. The presence of learners requires considerable time and effort by both radiology staff and residents. There are times when the number of learners or the workflow may require that staff ask you to utilize self-learning resources. Please be sensitive to this.

ASSESSMENT AND EVALUATION

You will be given a web-based quiz at the end of your elective. This will cover all basic general areas of radiology. E-value will be completed on all elective residents. Input is requested from all staff and residents. You will be given an E-value to complete of your elective.

GENERAL LEARNING OBJECTIVES

These will obviously depend on your career interests, but global learning objectives for this elective are for you to:

1. Develop basic image interpretation skills of chest and abdominal radiographs, with an emphasis on emergency findings
2. Develop basic interpretative skills in CT, including chest and abdominal anatomy
3. Learn appropriate imaging algorithms for common diagnostic situations, with an emphasis on those in your area of interest
4. Learn where image guided invasive procedures are beneficial
5. Understand some of the risks and benefits of imaging – particularly the risks associated with radiation exposure and awareness of the potential impact of unnecessary or repeat CT imaging in patients.
6. This includes: understanding the concept of high risk groups (children and young patients especially females, pregnant patients) for radiation exposure especially from CT scans and how to minimize the risk
7. Understand how to provide the appropriate clinical information to radiology so that the correct study, with the optimal protocol can be performed and the best interpretations be made of the data.

GENERAL EDUCATIONAL RESOURCES

The self teaching room is available all week outside of M,T,W 9-12p. The code for the door is: 135.

The computers in there have a login of radstudent/radstudent

TEXTBOOKS

We can lend you two textbooks at your request: Herrings: Learning Radiology and Felsons: CXR Workbook. The elective coordinator can lend you these, they must be returned at the end of the elective in the condition they were lent.

CDROMS

The coordinator has a set of teaching CDROMS including ones in OBGYN, general radiology, MSK, chest imaging and radiological anatomy that you can checkout.

PACS TEACHING FILMS

You can access the student teaching files on the PACS workstations by using your username and password which should be given to you on the first day. If you have not been given one, contact the coordinator. The instructions for logging in, configuring the PACS system and accessing these files is on a separate sheet that should have been in your packet.

There are also various other folders here such as neuro, body MRI, cardiac etc which you are welcome to look at if you wish.

CORE CASES

If you are a DMS student you will already have done some of the CORE cases. We highly recommend that you review these cases, which can take the place of textbook study for this course. These cases can all be accessed at <http://www.med-u.org/>. These are a series of interactive cases that are designed to teach the student curriculum in radiology. These include cases in chest, GI, GU, neuro, pediatrics and MSK. They include multiple web-links to expand the learning experience. Your HITCHCOCK or DARTMOUTH email address will allow you to register.

OTHER WEB RESOURCES

www.learningradiology.com (note, use the ppt links, some of the flash links go to adverts for his book)

[University Virginia radiology tutorials](#)

[BrighamRad teaching cases](#)

[Beth Israel \(Lieberman\) web-tutorials](#) (see list at bottom page)

[Harvard guide to imaging in pregnant patients](#)

[Dartmouth Anatomy web-course](#)

[Yale cardiothoracic imaging module](#)

[ACR appropriateness criteria](#)

[AMSER National Curriculum in Radiology for Medical Students](#)

WEB SOURCES OF RADIOLOGICAL IMAGES

<http://images.google.com/>

<http://www.yottalook.com/>

<http://goldminer.arrs.org/>

<http://www.e-anatomy.org/index.html>

MODALITY SPECIFIC GOALS, OBJECTIVES AND EDUCATIONAL RESOURCES

These goals, objectives and educational resources are specific for the individual areas and will depend on your career interests.

[Reading room](#)

[CT/Body imaging](#)

[Neuroimaging](#)

[Fluoroscopy](#)

[Mammography](#)

[Ultrasound](#)

[Interventional radiology](#)

[Nuclear medicine](#)

READING ROOM

Goals of rotation

- Learn normal CXR anatomy and become familiar with the range of normal appearances through seeing multiple examples of normal films
- Gain a familiarity with the interpretation of portable CXRs
- Identify the different CXR views and when they are helpful, as well as the limitations of each (PA, AP, lateral, supine, upright, decubitus, expiratory, lordotic)

- Learn to recognize [common conditions on CXRs](#): Pneumonia, pneumothorax, pleural effusions, pulmonary edema, ARDS atelectasis, cardiomegaly, pulmonary masses, granulomas, hilar enlargement, COPD/emphysema, aortic rupture
- Learn to identify correct and [incorrect tube placements](#): Central lines, ETT, PICC, NG, Dobhoff
- Learn the common indications for performing CXRs and when additional imaging with CT, MRI or nuclear medicine studies may be helpful
- Be able to recognize some of the [common plain film MSK abnormalities](#): Hip fracture, ankle fractures, scaphoid fracture, wrist fractures inc. buckle fractures, osteoarthritis, rheumatoid arthritis, knee and elbow effusions, spinal compression fracture, shoulder dislocation
- Understanding how we [describe fractures](#)
- Understand the importance of obtaining the appropriate views (scaphoid, radial head, shoulder internal and external rotation)
- Know some of the indications for and benefits of obtaining further imaging with MRI, CT or arthrography

Specific recommendations

- Read Felson CXR workbook (provided)
- Review [CXR anatomy](#)
- If in the RR in the morning, you should ensure that you sit in on the on-call resident readout
- Aim to spend your time in the reading room predominately split between the chest and float staff
- Those with an interest in pediatric imaging should spend time with Drs. Vaccaro and Sargent on M, T, Th pms
- Those with an interest in MSK imaging, should spend some time with Drs. Goodwin and Cheung in the MSK room - note, MSK plain films are also read by float radiologists
- Pre-read films (6-8 at a time) then review with radiologist who will dictate

Additional reading

[Learningradiology.com](http://learningradiology.com) (various modules)

[How to see abnormalities on CXRs](http://www.cxr.com) from www.cxr.com

[University Virginia CXR module](#)

[University Virginia ICU chest film module](#)

[UK Masterclass CXR tutorial](#) (aimed at students!. Also nice little basic radiological physics review.)

CT/BODY IMAGING

Goals of rotation

- Develop a method, or approach to evaluate CT scans of the chest, abdomen and pelvis
- Review normal CT anatomy of the chest, abdomen and pelvis

- Learn about the different scanning techniques and understand why they are performed. Be familiar with some general protocol categories: CT angiography, multiphase imaging protocols, CT enterography
- Learn about contrast allergies, the contraindications to iv contrast, and prevention of contrast reactions with steroids
- See CTs and CT guided procedures performed so that you can explain them to patients
- Learn the radiation risks of CT, understand how those risks differ in different patient populations, and understand methods which can be used to reduce the risk: Dose reduction techniques, Limiting the region scanned, limiting repeat CTs
- Learn the CT findings of commonly encountered acute conditions: Diverticulitis, colitis, appendicitis, pancreatitis, renal stone disease, pulmonary embolism, aortic dissection, pneumoperitoneum, hemoperitoneum, aortic rupture and dissection,
- Learn the CT findings of commonly encountered chronic conditions: Solid organ tumors, metastases, ascites, lymphoma, aortic aneurysms

Specific recommendations

- Read out the on-call CTs with on-call resident (if you are in the reading room this may occur during that rotation)
- If a workstation is available, pre-read appropriate CT scans (one at a time) before reviewing with staff radiologist
- Towards the end of the rotation, sit down with the resident who is doing the protocols and learn about how we choose which protocol to use.
- Spend time in the CT core area observing the technologists performing at least 2 scans; one of these should include an iv contrast injection.
- Observe or participate in a CT guided biopsy. Review the patient history, learn the indication for the procedure, understand the technique used, follow up on the pathology results.
- Observe or participate in a CT guided drainage. Review the patient history, learn the indication for the procedure, understand the technique used. If applicable, follow up on the microbiology results.

Additional reading

[CT/MRI/cadaver anatomy from Univ Aukland](#)

[CT abdomen and pelvis from WVU](#)

[CT chest anatomy from chestxray.com](#)

NEUROIMAGING

Goals of rotation

- Understand the strengths, weaknesses and limitations of CT vs. MRI in the evaluation of patient's with central neurologic symptoms and diseases

- Understand the strengths, weaknesses and indications of spine CT, MRI, and myelography in the evaluation of the spine and spinal cord
- Understand the indications for conventional carotid and cerebral angiography, its risks and benefits in comparison with CTA and MRA
- Understand the role of imaging (including MRI vs. CT) in the evaluation of common clinical complaints, including stroke, headache, trauma, mass lesions, back pain, radiculopathy and demyelinating disease
- See how different MR sequences are used to identify different pathophysiological processes.
- Understand the usual appearances of gray matter, white matter, fluid, edema, masses, blood, and fat on common MR sequences (T1, T2, FLAIR, STIR)
- Know some of the uses of contrast in MRI and CT
- Review basic neuroanatomy on head CT and MRI
- Develop a basic but comprehensive standard method to evaluate routine non-contrast head CTs
- Get an overview of common procedures done in neuroradiology, including the use of nerve root blocks for management of back pain and vertebroplasty for compression fractures
- Be able to recognize the appearance of common pathological processes such as stroke, edema, herniation, subdural, epidural and subarachnoid hemorrhage on CT

Specific recommendations

- Be involved in the morning readout of the call resident (usually around 8am)
- Accompany the neuroradiology fellow/resident during the workup and performance of nerve root blocks and vertebroplasties
- Become an active participant in the daily MR and CT reading including pre-reading studies when a workstation is available

Additional reading

[University Virginia Intro to Head CT module](#)

[University Virginia Evaluation of the Cervical Spine](#)

[SUNY Downstate brain MRI anatomy](#)

FLUOROSCOPY

Goals of rotation

Understand how fluoroscopy is used to image cavities and lumen

- Learn the difference between the different fluoroscopic tests and what structures they image: Modified swallow, single and double contrast swallow, UGI, small bowel follow through, single, air and double contrast enemas, IVP, VCUG

- Learn the common indications for fluoroscopic tests
- See studies performed so that you can explain them to patients: Ba swallow, UGI, enema, VCUG, arthrogram, IVP
- Understand the advantages and limitations of fluoroscopy
- Understand some of the risks of fluoroscopy - radiation, contrast extravasation/aspiration, perforation
- Understand the differences between the various contrast medias used in fluoroscopy
- Learn normal KUB anatomy and become more comfortable with the range of normal appearances
- Become familiar with [interpretation of common conditions](#) on plain abdominal radiographs: Obstruction, free air, ileus, abnormal calcifications (vascular, gallbladder, renal, bladder), large masses

Specific recommendations

Pre-read KUB studies and then review with radiologist

- Follow at least one patient through a study with the technologist,
- preferably one of the more complex studies such as an enema. You should have worked up this patient beforehand on CIS.

Be present at the 8am case discussion each morning. Watch the studies being performed with the resident/attending (in room with lead unless pregnant) and the interpretation afterwards Try to see as wide a variety of studies being performed as possible including pediatric studies

Additional reading

[University Virginia GI site](#) (this may be more detailed than you need but good sections)

[Learningradiology.com plain abdominal film interpretation](#)

[Learningradiology.com](#) (various other student modules)

[UK Masterclass Abdominal radiograph tutorial](#)

MAMMOGRAPHY

Goals of rotation

- See how mammograms and breast ultrasound are performed
- Be able to briefly describe mammographic procedures to patients
- See how we use different mammographic views and ultrasound for problem solving in diagnostic mammography

- Understand the differences between screening and diagnostic mammography
- Know the effect of screening mammography on survival rates Know the [current recommendations](#) for screening mammography and [MRI](#)
- Understand the management of screening 'call back' patients
- Understand the meaning of BIRADS 0-6 categories
- Know the indications for referral for diagnostic mammography and how to indicate the abnormality appropriately.
- Know the current indications for breast MRI.
- Understand some of the limitations of breast imaging techniques including the effect of breast density.
- See how ultrasound is used in the diagnostic setting and some of its limitations
- Know what the options are for [image guided procedures](#) in the breast.
- Understand how clinical examination and imaging are inter-related and how they affect management especially of palpable breast masses.
- Understand what a radiologist is looking for on a mammogram and what those terms mean:
 - Calcifications, Asymmetric densities, Architectural distortion, Masses.
- See some examples of benign and malignant processes in the breast on mammography and ultrasound

Specific recommendations

- Spend a minimum of one diagnostic session in mammography
- See at least one full mammographic series (CC, MLO) being obtained by a technologist
- Follow at least one patient through her diagnostic evaluation including additional mammo views and ultrasound, watching the tech performing the views as well the radiologist interpreting them.
- Perform a clinical breast examination on consenting women with palpable masses prior to the ultrasound
- Look up the [BIRADS](#) categories
- Go through [CORE](#) Women's Imaging Case 2 again
- Review Dr. Poplacks lecture and/or [this lecture](#) from U.Washington on screening or [this one](#) on diagnostic mammography/breast MRI
- For students spending > 1 session in mammography should also aim to:
 - See image guided breast procedures performed, assist in basic patient care procedures where possible
 - See some examples of breast MR studies

Additional reading

[ACS 2003 review and guidelines for screening mammography](#)

[Breast Cancer Detective](#)

[Beth Israel \(Lieberman\) breast imaging module](#)

ULTRASOUND

Goals of rotation

- Gain hands-on practice in using ultrasound imaging:
- Be able to find and recognize major intra-abdominal organs
- Gain basic familiarity with how moving the transducer changes the imaging plane
- See how altering scanning parameters such as gain, depth and focal zone affect our images
- See how different transducers are used for different purposes
- Learn the basic ultrasound imaging characteristics of tissues –
 - simple fluid, complex fluid, soft tissue, bone, air, fat
- See how the different types of Doppler ultrasound (m mode, pulsed, color and power) image motion
- Learn the appropriate indications for the common ultrasound examinations
- See some of the limitations of ultrasound –
 - obesity, bowel gas etc
- Learn the classical appearances of common conditions:
 - RUQ: gallstones, acute cholecystitis, biliary obstruction
 - Abdominal aortic aneurysm
 - Renal: renal stones, hydronephrosis
 - Pelvic: Fibroids, endometrial thickening, ovarian cysts, early pregnancy, normal 2nd trimester pregnancy
 - Other: pleural fluid and ascites

Specific recommendations

- Students should spend at least 50% of time with technologists watching scans
- Scan patients themselves (not transvaginally), with patient permission after tech leaves room.
- Remainder of time with attending/residents in reading room, helping with clinical workflow where possible.
- After they see an abnormal study: look up brief background on condition/additional images (e.g. <http://www.mypacs.net> (search under ultrasound), www.ultrasoundcases.info or the [Brigham teaching database](#)).

Additional reading

[University of Virginia Emergency Ultrasound](#)

[Introduction to obstetrical ultrasound](#)

INTERVENTIONAL RADIOLOGY

Goals of rotation

- Learn how different imaging modalities are used to guide procedures and begin to understand when each is used: ultrasonography, fluoroscopy, CT, MRI
- Be familiar with the indications and techniques of the following common IR procedures:
 - central vascular access, fluid aspiration and drain placement, angiography, percutaneous nephrostomy, percutaneous transhepatic cholangiography, gastrostomy tube placement, percutaneous angioplasty and stent placement
- Be able to describe to a patient the following procedures (observe any of these which occur the day you are on angio):
 - Vascular access, angiography, fluid aspiration and drainage, tube placement in stomach (gastrostomy), kidney (nephrostomy)
- Learn how we work up requests for IR procedures and the factors that go into determining if a procedure is necessary and indicated, safe, and able to be performed.

Specific recommendations

- Introduce yourself to the staff of the day
- Attend the morning conference to discuss the days cases. This begins at 7:15 am in the small reading room near angio; anyone in the angio suite can direct you
- If you are spending more than one day in angio, in the afternoon before an IR day:
 - Pick one case that you would like to be involved with from the board (check with the resident, fellow or NP/PA on the service) and participate in/do the patient work-up. Review the relevant patient history, allergies, medications, PMH, Labs and pertinent imaging studies. Understand the indications for the requested procedure and how it is performed. Write the pre-procedure note and have an attending review it and sign it
- Put your initials on the angio board next to the cases you wish to participate in
- Observe and/or participate in several additional IR cases from start to finish: Review the patient history, labs and relevant imaging, learn the indication for the procedure, [learn the pre-procedure work up and patient preparation](#).
- Follow the technologist and nurses as they set up the room, bring the patient in, position them and prep and drape the field. Understand the techniques used to perform the procedure.

Additional reading

[Vascular anatomy- see "vasculature" section in each learning module](#)

[DHMC angio survival manual](#)

NUCLEAR MEDICINE

Goals of rotation

- Understand the concept of physiological imaging
 - Radioisotopes vs. radiotracers
 - Learn some of the common indications for nuclear medicine studies
 - See examples of common examinations:
 - PET-CT scans
 - Bone scans
 - Renal scans
 - Hepatobiliary studies
 - Cardiac perfusion scans
 - VQ scan
 - Thyroid scan
 - Know the appearance of common conditions on these studies
 - PET-CT scans: lung cancer, metastatic disease
 - Bone scans: metastases, trauma, degenerative changes
 - Renal scans: obstruction
 - Hepatobiliary studies: acute cholecystitis, CBD obstruction
 - Cardiac perfusion scans (ischemia, infarction)
 - VQ scan: pulmonary emboli
 - Thyroid scan: Grave disease, hot and cold nodules
 - Understand some of the limitations of nuclear medicine examinations
 - Understand the difference between SPECT vs. PET
 - Know some of the important [patient preparations](#) for nuclear medicine studies (PET studies, thyroid, cardiac etc)
 - Know how common studies are performed to explain them to patients
- Know some of the therapeutic uses of nuclear medicine (I-131 therapy)

Specific recommendations

- Minimum 1/2 day in nuclear medicine
- Spend 30+ minutes watching techs performing exams in department
- The remainder of the time alternating between the attending reading PET-CT and conventional nuclear medicine studies
- Many PET-CT scans are shown in CTOP conference Tues 8 am.

Additional reading

[University Virginia Intro to PET-CT module](#)

[Intro to nuclear medicine ppt](#)

[Harvard teaching files](#)

[Mallinkrodt teaching files](#)

[Beth Israel nuclear medicine tutorial](#)