Introduction:

Elective Director:  Petra J. Lewis, MD
E-mail: Petra.J.Lewis@hitchcock.org
Not here on Fridays

Elective Coordinator:  Brit K. Willey
E-mail: Brit.K.Willey@hitchcock.org
Phone: 603-650-7497 = x57497

Code of Conduct:

- 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 Luke prior to beginning of the elective.

- 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.

- 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.

- The PACS workstations are not to be used for e-mail 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.

- 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 exam at the end of your elective- this exam is pass fail. This will cover all basic general areas of radiology. E-value will be completed on all elective students and residents. Input is requested from all staff and residents.

Test and PACS login Info:

Test: Please go to: http://radiology.examweb.com/Login/radiology/createAccountStep1.cfm and select “Geisel School of Medicine at Dartmouth” and put in the course code below:

2WRADELECT This is for the 2 week course.
4WRADELECT This is for the 4 week course

Once you are signed up, you can click “TAKE EXAM” when you are ready to take either the practice test, or the actual exam.

* The Education coordinator will send you your PINCODE for the exam.

*To sign onto the computers/PACS use your windows Login/username- If you have trouble, call 5-2222 for support.
Student Schedule:

The recommended self-study resources should be completed prior to the appropriate clinical rotations.

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<thead>
<tr>
<th>2 WEEK FLEXI STUDENT (10 DAYS IN RADIOLOGY)</th>
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<td><strong>Week 1 Monday</strong></td>
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<th>4 WEEK FLEXI STUDENT (20 DAYS IN RADIOLOGY)</th>
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<td><strong>Week 1 Monday</strong></td>
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Resident Schedule:

Red indicates resident is not in radiology
The recommended self-study resources should be completed prior to the appropriate clinical rotations.

### 2 WEEK PRIMARY CARE RESIDENT (7 DAYS IN RADIOLOGY)

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<thead>
<tr>
<th>Week</th>
<th>AM Activity</th>
<th>PM Activity</th>
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<tbody>
<tr>
<td>Monday</td>
<td>Self-study-CXR anatomy, search systems. CORE 1, 2</td>
<td>Chest</td>
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<tr>
<td>Tuesday</td>
<td>Self-study - Chest CT anatomy, Lines and tubes, ICU module, CORE 3, 4</td>
<td>Chest</td>
</tr>
<tr>
<td>Wednesday</td>
<td>CLINIC</td>
<td>Chest</td>
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<tr>
<td>Thursday</td>
<td>Self-study – KUB and Abdo CT anatomy, CORE 5-7</td>
<td>CLINIC</td>
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<tr>
<td>Friday</td>
<td>DIDACTICS</td>
<td>CT</td>
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### 2 WEEK CATEGORICAL RESIDENT (9 DAYS IN RADIOLOGY)

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<th>Week</th>
<th>AM Activity</th>
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<tr>
<td>Monday</td>
<td>Self-study-CXR anatomy, search systems. CORE 1, 2</td>
<td>Chest</td>
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<tr>
<td>Tuesday</td>
<td>Self-study - Chest CT anatomy, Lines and tubes, ICU module, CORE 3, 4</td>
<td>Chest</td>
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<tr>
<td>Wednesday</td>
<td>CLINIC</td>
<td>Chest</td>
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<tr>
<td>Thursday</td>
<td>Self-study – KUB and Abdo CT anatomy, CORE 5-7</td>
<td>US</td>
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<td>Friday</td>
<td>CT</td>
<td>Neuro</td>
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### Self-Study Time and Resources:

The self-teaching room is available all week. The code for the door is: 135. To log into the computers use your windows login.

The self-study time will include (at minimum) a review of the following. Other resources are listed in the rotation specific resources and are optional.

**Note**: The rotation has been set up so that you will use self-study time to gain skills in an area of radiology BEFORE the clinical rotation (e.g. learning chest radiographic anatomy before you spend time in the chest reading room area.

**Oxford Textbook of Radiology**  
Chapters 1,2,3,4,7,11 (others as wish)  
**CORE cases**  
1-7, 9,10,13,15 (others as wish)

**PACS elective teaching folders**: (all preceded with “Elective-“) Pneumonia, Edema, Lines and Tubes, Atelectasis,
Radiology 503: Flexi-Elective Manual

Effusions, Pneumothorax, Free air, Obstruction, Fractures

Radiology- TEACHES:

Radiology-TEACHES was created by a group of Baylor faculty in conjunction with the American College of Radiology (ACR) and National Decision Support Company (NDSC) to assist in learning about evidence-based clinical decision support and appropriate utilization of imaging. The foundation of the program is the ACR Appropriateness Criteria.

- Case Based
- 3 Self-study modules
  - Pretest
  - Education
  - Posttest

Your login information for the Education Portal is as follows:

Username: Student email address
Password: Student last name (if your last name is less than six digits then a 9 will be used to add up to six digits ex. smith99)

The link to the Education Portal is: https://3s.acr.org/Institution/Home.aspx?Name=ACRSelect

Once logged on to the portal, navigate to the right side of the portal under “Activities” and click the “Assignments” radio button. Expand the selection by clicking the + icon to expand the General Radiology and then do the same for the Choosing Wisely topic. Click the title (link) for the Radiology TEACHES Pretest and educational module.

A short how-to-video is located here.

This is a requirement for the 4 week flexi elective and the modules need to be completed as follows:

- Pretest – Week one
- Education- Week two and three
- Posttest – Week four

Lines and Tubes module

Can be downloaded here
https://www.mededportal.org/publication/8399

CXR anatomy and review systems:
http://radiologymasterclass.co.uk/tutorials/chest/chest_home_anatomy/chest_anatomy_start.html
http://www.youtube.com/watch?v=HfNU8DGXFgk

AXR anatomy and review systems:
http://radiologymasterclass.co.uk/tutorials/abdo/abdomen_x-ray/anatomy_introduction.html
Radiology 503: Flexi-Elective Manual

**Common conditions on abdominal radiographs**
http://www.learningradiology.com/lectures/gilectures/Plain%20Films%20of%20the%20Abdomen/player.html

**Bone and joint anatomy and review system**
http://radiologymasterclass.co.uk/tutorials/musculoskeletal/principles/bones_joints_x-ray_start.html

For those on 4 week electives, the following additional resources should be reviewed:

CT anatomy and interpretation modules
http://www.med-ed.virginia.edu/courses/rad/CTAbdominalAnatomy/CTAnatomyoftheAbdomen.htm

MSK trauma modules
http://radiologymasterclass.co.uk/tutorials/tutorials.html
Recognizing and describing fractures from Learning Radiology

**Head CT module**
University Virginia Intro to Head CT module

**GENERAL LEARNING OBJECTIVES**

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

1. Correctly interpret the findings on chest and abdominal radiographs for commonly encountered emergency conditions.

2. Identify normal anatomy of the chest, abdomen and pelvis on CT, and describe the expected findings for common conditions such as appendicitis, diverticulitis, aneurysm, liver and kidney masses

3. Select appropriate imaging exam sequence for common diagnostic situations, (with an emphasis on those in your area of interest) using recommended imaging algorithms.

4. Describe the indications for, benefits and risks of image guided invasive procedures

5. Discuss the risks and benefits of imaging with patients and other practitioners, – particularly the risks associated with radiation exposure and contrast and awareness of the potential impact of unnecessary or repeat CT imaging in patients.

   This includes: understanding the concept of high risk groups (children, young especially female patients, and pregnant patients) for radiation exposure especially from CT scans and how to minimize the risk

6. Describe how radiologists used the appropriate clinical information to determine study appropriateness, protocol selection, and how it impacts interpretations.

**GENERAL EDUCATIONAL RESOURCES**

**TEXTBOOKS**
We also have other text books that we can loan you at your request, see Bailey for details.

**CORE CASES**
You are expected to review select 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, and MSK. They include multiple web-links to expand the learning experience. Your HITCHCOCK or DARTMOUTH email address will allow you to register.

**OTHER USEFUL GENERAL RADIOLOGY WEB RESOURCES**
- [www.learningradiology.com](http://www.learningradiology.com) (note, use the ppt links, some of the flash links go to adverts for his book)
- University Virginia radiology tutorials
- Beth Israel (Lieberman) web-tutorials (see list at bottom page)
- Brigham and Women’s guide to imaging in pregnant patients
- Dartmouth Anatomy web-course

**WEB SOURCES FOR RADIOLOGICAL IMAGES**
- [http://images.google.com/](http://images.google.com/)
- [http://goldminer.arrs.org/](http://goldminer.arrs.org/)

**MODALITY SPECIFIC GOALS, OBJECTIVES AND EDUCATIONAL RESOURCES**

**CHEST**
- Be able to identify normal CXR anatomy and become familiar with the range of normal appearances through seeing multiple examples of normal films
- Review a standardized search system for CXRs [http://www.youtube.com/watch?v=HfNU8DGXFgk](http://www.youtube.com/watch?v=HfNU8DGXFgk)
- 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)
- Identify common conditions on CXRs: Pneumonia, pneumothorax, pleural effusions, pulmonary edema, ARDS atelectasis, cardiomegaly, pulmonary masses, granulomas, hilar enlargement, COPD/emphysema, aortic rupture
- Identify correct and incorrect tube placements: Central lines, ETT, PICC, NG, Dobhoff
- Be able to discuss common indications for performing CXRs and when additional imaging with CT, MRI or nuclear medicine studies may be helpful
Specific recommendations

- Read chest chapter in Lewis and McNulty (provided)
- Review CXR anatomy
- Pre-read films (6-8 at a time) then review with radiologist who will dictate
- Review the Elective PACS collections

MSK

- 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
- Be able to briefly describe the procedure for an arthrogram to a patient

Specific recommendations

- Spend time part with primary and third listed MSK staff
- Observe one arthrogram
- Pre-read films (6-8 at a time) then review with radiologist who will dictate
- Review the Elective PACS collection

Additional reading

- Learningradiology.com (various modules)
- University Virginia CXR module
- University Virginia ICU chest film module
- Yale cardiothoracic imaging modules

CT/BODY

- Develop a method, or systematic approach to evaluate CT scans of the chest, abdomen and pelvis
- Review normal CT anatomy of the chest, abdomen and pelvis
- Describe different scanning protocols and understand why they are performed. Be familiar with some general protocol categories: CT angiography, multiphase imaging protocols, CT enterography
- Be able to identify patients at risk for contrast allergies, the contraindications to i.v contrast, and know how to access steroid pretreatment regimes.
- Observe diagnostic CTs and CT guided procedures being performed so that you can explain them to future patients
- Describe radiation risks of CT, including how those risks differ in different patient populations. Describe methods which can be used to reduce the risk: Dose reduction techniques, Limiting the region scanned, limiting repeat CTs
- Describe and identify CT findings of commonly encountered acute conditions: Diverticulitis, colitis, appendicitis, pancreatitis, renal stone disease, pulmonary embolism, aortic dissection, pneumoperitoneum, hemoperitoneum, aortic rupture and dissection.
- Describe and identify CT findings of commonly encountered chronic conditions: Solid organ tumors, metastases, ascites, lymphoma, aortic aneurysms
Specific recommendations

- 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.
- Observe or participate in a CT guided drainage. Review the patient history, learn the indication for the procedure, understand the technique used.

  CT anatomy from Wiki Radiology (this is comprehensive and good but adverts a bit irritating)
  CT chest anatomy from Geisel Anatomy
  CT abdominal-pelvic anatomy from Geisel Anatomy

NEUROIMAGING

- Compare the strengths, weaknesses and limitations of CT vs. MRI in the evaluation of patient’s with central neurologic symptoms and diseases
- Compare the strengths, weaknesses and indications of spine CT, MRI, and myelography in the evaluation of the spine and spinal cord
- 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
- Know some of the uses of contrast in MRI and CT
- Review basic neuroanatomy on head CT and MRI
- Know indications, process, and risks of common procedures done in neuroradiology, including the use of nerve root blocks for management of back pain and vertebroplasty for compression fractures, so can discuss these procedures with patients about to undergo these procedures.
- Be able to recognize the appearance of common pathological processes such as stroke, edema, herniation, subdural, epidural and subarachnoid hemorrhage on CT

Specific recommendations

- 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

  University Virginia Intro to Head CT module
  University Virginia Evaluation of the Cervical Spine
  SUNY Downstate brain MRI anatomy

FLUORO

Understand how fluoroscopy is used to image cavities and lumen

- Know differences between and indications for 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
Radiology 503: Flexi-Elective Manual

- See studies performed so that you can explain them to patients: Ba swallow, UGI, enema, VCUG, arthrogram, IVP
- Describe the advantages and limitations of fluoroscopy
- Describe some of the risks of fluoroscopy - radiation, contrast extravasation/aspiration, perforation
- Identify 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, illeus, abnormal calcifications (vascular, gallbladder, renal, bladder), large masses

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

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

- 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.
- Understand some of the limitations of breast imaging techniques including the effect of breast density.
- Know 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.
- 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. Rooney’s lecture and/or this lecture from U.Washington on screening or this one on diagnostic mammography/breast MRI
- For students/residents spending > 1 session in mammography should also aim to:
  - See image guided breast procedures performed, assist in basic patient care procedures where
possible
  o See some examples of breast MR studies

Current ACS guidelines for screening mammography
Breast Cancer Detective
Uptodate review of breast cancer screening

ULTRASOUND

- Learn the appropriate indications for the common ultrasound examinations
- See some of the limitations of ultrasound –
  o obesity, bowel gas etc
- Learn the classical appearances of common conditions:
  o RUQ: gallstones, acute cholecystitis, biliary obstruction
  o Abdominal aortic aneurysm
  o Renal: renal stones, hydronephrosis
  o Pelvic: Fibroids, endometrial thickening, ovarian cysts
  o Other: pleural fluid and ascites
- Students/residents should spend at least 50% of time with technologists watching scans
- 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. www.ultrasoundcases.info).

University of Virginia Emergency Ultrasound
Introduction to obstetrical ultrasound

NUCLEAR MED

- Understand the concept of physiological imaging
- Radioisotopes vs. radiotracers
- Describe some of the common indications for nuclear medicine studies
- See examples of common examinations:
  o PET-CT scans
  o Hepatobiliary studies
  o Cardiac perfusion scans
  o VQ scan
  o Thyroid scan
  o Renal Scans
  o Bone Scans
- Understand some of the limitations of nuclear medicine examinations
- 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 (e.g.I-131 therapy)
- 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.

Beth Israel nuclear medicine tutorial
INTERVENTIONAL/VASCULAR RAD

- 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.
- Introduce yourself to the staff of the day
- Attend the morning conference to discuss the day’s 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.

Vascular anatomy- see "vasculature" section in each learning module
DHMC angio survival manual