Radiology e-Rotation
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Adapted from:
An Internet-Based Radiology Course in Medical School. Andrew George Alexander, MD, Deborah Deas, MD, PhD, and Paul Eric Lyons, MD

A Vertically Integrated Online Radiology Curriculum Developed as a cognitive Apprenticeship: Impact on Student Performance and Learning. Jennifer E. Lim-Dunham, MD, David C. Ensminger, PhD, John A. McNulty, PhD, Amy E. Hoyt, MEd, Arcot Chandrasekhar, MD

Implementation of a new undergraduate radiology curriculum experience at the University of British Columbia. Lee JS1, Aldrich JE, Eftekhari A, Nicolaou S, Müller NL.

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Objective

Through independent required reading assignments, online modules, and on-line scenarios, students will learn to incorporate evidence-based strategies for imaging services, while experiencing the science, and diversity of modern imaging.

Materials and Learning Resources

NOTE: Some of the links may be blocked by institution firewall if not accessing from a personal device.

- **Required:** A Laptop computer capable of accessing the internet, some of the resources require Adobe Flash player installed on your laptop
- Device (Apple or Android) to download the UBC Radiology app [http://www.ubcradiologyapp.ca/](http://www.ubcradiologyapp.ca/)
- Geisle School of Medicine Human Anatomy Learning Modules: [http://www.dartmouth.edu/~anatomy/HAE/Radiology_Intro/rad/rad2/rad2a.html](http://www.dartmouth.edu/~anatomy/HAE/Radiology_Intro/rad/rad2/rad2a.html)
- Children’s Hospital Cleveland Clinic: [https://www.cchs.net/onlinelearning/cometvs10/pedrad/default.htm](https://www.cchs.net/onlinelearning/cometvs10/pedrad/default.htm) (requires creating a free account)
- Radiopaedia: [https://radiopaedia.org/](https://radiopaedia.org/)
- Radiopaedia Playlists: [https://radiopaedia.org/playlists/7314?lang=us](https://radiopaedia.org/playlists/7314?lang=us)
- Loyola Medical Student Radiology Curriculum: [http://www.stritch.luc.edu/lumen/MedEd/Radio/curriculum/Structure/image_list_g.htm](http://www.stritch.luc.edu/lumen/MedEd/Radio/curriculum/Structure/image_list_g.htm)
- Radiology Assistant: [https://radiologyassistant.nl/abdomen/lk-jg](https://radiologyassistant.nl/abdomen/lk-jg)
- Learningneuroradiology.com: [https://sites.google.com/a/wisc.edu/neuroradiology/home](https://sites.google.com/a/wisc.edu/neuroradiology/home)
- University of Wisconsin Neuroradiology Learning Module [http://cases.med.wisc.edu/neuroradiology/cases/home/Aquifer Radiology](http://cases.med.wisc.edu/neuroradiology/cases/home/Aquifer Radiology) [https://aquifer.org/courses/aquifer-radiology/](https://aquifer.org/courses/aquifer-radiology/)

Proposed Length of Course

2-week elective (9 day course with final exam)
Presentations
Each student will present an actual case history (with HIPAA information redacted) along with associated imaging studies. The student will lead the Problem-Based Learning discussion through the differential diagnosis to its conclusion, using ACR criteria for appropriateness, https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria, and actual images with interpretations. This will represent 20% of the final course grade. You will be involved in internet-based small group sessions with classmates and radiology specialists.

Final Examination
The final exam is a national shelf exam. It includes image-based questions, as well as questions without images regarding anatomy, appropriate ACR imaging management, and other general principles of diagnostic imaging. The final exam is based on material covered in modules, assigned links, chapters from Herring, and lectures.

Student Evaluations and grading
- Take final screen shots of completed modules or print certificates as available for your student records
- MRI and Radiation Safety Quiz (Passing is Mandatory)
- A 5-minute student presentation on a self-selected case history presentation during the second week (20%)
- Completion of online quizzes (measuring completion of required readings and modules) (30%)
- Completion of online modules (40%)
- Final examination consisting of NBME (or NMBE like) questions based on information and images covered in online material 30%
Radiology Rotation Goals and Objectives

1. **Knowledge for Practice**
   a. Know critical and high priority imaging findings and diagnoses and understand basic interpretive techniques in each subspecialty area.
   b. Know the indications for the most important imaging examinations in each of the Radiology subspecialty areas.
   c. Demonstrate knowledge of human anatomy by recognizing key structures on various imaging modalities in each of the Radiology subspecialty content areas.

2. **Patient Care (Problem Solving and Clinical Skills)**
   a. Regard the critical importance of useful clinical history in imaging interpretation
   b. Recognize the consequences of radiation in humans of different genders and ages
   c. Understand the effects of radiographic contrast on patients with kidney disease

3. **Practice-Based Learning and Improvement**
   a. Describe the common imaging findings of at least one pathologic entity, present an imaging
   b. Present differential diagnosis of these findings and demonstrate understanding of the appropriate imaging evaluation and involved pathophysiology.

4. **Systems-Based Practice**
   a. Understand the role of the radiologist in the care of patients undergoing imaging evaluation
      i. and/or image guided procedures for whom such evaluation or procedures are being considered.
   b. Know the relative costs associated with radiologic testing
   c. Understand the role that false positive and false negative results from mammography have on recommendations for screening

5. **Interpersonal and Communication Skills**
   a. Effectively advise patients and colleagues on the risks, benefits, limitations and indications of each of the most common imaging examinations.
   b. Demonstrate understanding of the important role of communication in radiology with specific emphasis on the radiology report, urgent or unexpected findings, recommendations for follow-up imaging or procedures, and doctor patient communication.

6. **Professionalism**
   a. Demonstrate understanding of the principles of mutual respect, honesty, and discretion in the use of patient clinical and imaging data, during lecture, as a part of the clinical radiology team, and when interacting with referring clinicians and non-radiology colleagues and support staff.

7. **Interprofessional Collaboration**
   a. Demonstrate the ability to engage in an Interprofessional team in a manner that optimizes safe, effective patient and population-centered care.

8. **Personal and Professional Development**
   a. Demonstrate trustworthiness that makes colleagues feel secure when one is responsible for the care of patients
Schedule

Day 1: Intro to Radiology, Imaging and Radiation

Remember to screen shot final pages for your records.

Pre-Course Assignments

1. Complete pre elective quiz
   [Link](http://undergrad.ubcradiology.ca/content/elective_pre/story_html5.html)

2. Screen shot the final quiz result for your records, passing is not required
Introduction

3. Read Chapters 1 and 2 in Learning Radiology: Recognizing the Basics by William Herring, MD, FACR.
   a. Recognizing Anything: An Introduction to Imaging Modalities
   b. Recognizing a Technically Adequate Chest Radiograph

4. Complete 5 of the 7 Introduction to Radiology modules (links below) including 2 of them that contain a quiz. Capture a screen shot of the quiz results.

http://www.dartmouth.edu/~anatomy/HAE/Radiology_Intro/rad_index.html

5. Day 2 prep online activities:
   a. Watch the videos on Chest Radiography Primer:
      https://www.youtube.com/watch?v=PDaRNPUNc10&feature=youtu.be
      https://www.youtube.com/watch?v=L6bnD2wOEmg
      https://www.youtube.com/watch?v=9J8rcmCVoes
      https://www.youtube.com/watch?v=bU0Nm7JFjtU
      https://www.youtube.com/watch?v=HfNU8DGXFgk
   b. Download the free UBC radiology app onto your device (iPad, tablet or smartphone)
      http://www.ubcradiologyapp.ca/ and complete “Approach for CXR”
      i. Open app and click the Get Started button
ii. On the menu select “Approaches”

iii. Select the Approach to Chest Radiographs

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**Day 2: Introduction (Continued) and Intro to Chest Radiology**

Remember to screen shot final pages for your records.

1. Read Chapters 3 and 4 in Learning Radiology: Recognizing the Basics by William Herring, MD, FACR
   a. Recognizing Normal Pulmonary Anatomy
   b. Recognizing Normal Cardiac Anatomy

2. On the UBC app complete the “Which Test”, a short 10 question quiz.
   a. Open the app
   b. Click Get Started to open the Menu
   c. “Which Test” is located under the Clinical Section
3. Complete the first 10 clinical cases on the UBC app located under the Clinical Cases section.

4. Review Chest CT anatomy found at (may take some time to load). Review the instructions on using the viewer here: [http://www.castlemountain.dk/atlas/index.php](http://www.castlemountain.dk/atlas/index.php)


   (or)

   Loyola PPT atlas of the Chest found at:
The Loyola Chest and Abdomen Atlas PPT located in the Resources folder.

5. On any page of the Loyola Site you have opened, click on PCM and complete all the modules on that subpage. Screen shot final pages for your records.

http://www.stritch.luc.edu/lumen/MedEd/Radio/curriculum/Structure/image_list_g.htm
6. On the Loyola site, start the self-evaluation modules listed below. Both self-evaluations should be completed by the end of the first week. Screen capture/print the certificates for the evaluations for your records.

http://www.stritch.luc.edu/lumen/MedEd/Radio/curriculum/Structure/image_list_g.htm

Day 3: Deep Dive into Pulmonary Embolism

Remember to screen shot final pages for your records.

1. Read Chapters 5 and 6 Learning Radiology: Recognizing the Basics by William Herring, MD, FACR
   a. Recognizing Airspace versus Interstitial Lung Disease
   b. Recognizing the Causes of Opacified Hemothorax

2. Complete short chest quiz under pre-clinical section, anatomy quiz of the UBC app.
   a. Open the app
   b. Click Get Started
   c. Under the Pre-clinical section, click Anatomy Quiz
d. Select the Chest Quiz

3. Read and familiarize yourself with the revised PIOPED and modified PIOPED criteria:
   https://radiopaedia.org/articles/revised-pioped-criteria-for-diagnosis-of-pulmonary-embolus
   https://radiopaedia.org/articles/modified-pioped-ii-criteria-for-diagnosis-of-pulmonary-embolus
4. Learn about the radiology of Pulmonary embolism here:  
https://radiopaedia.org/articles/pulmonary-embolism

5. Review the following lecture on CT of Pulmonary embolism (video):  
https://www.youtube.com/watch?v=Fvkj7qGs7Qo&feature=youtu.be

6. Review the following papers located in the resources folder or located on PubMed:

- CT in pregnancy Risks and benefits
- Imaging of acute pulmonary embolism an update
- Pregnancy-Adapted YEARS Algorithm for

A safe strategy to rule out pulmonary embolism: The combination of the Wells score and D-dimer test: One prospective study.

Computed tomography of acute pulmonary embolism: state-of-the-art.

Fetal radiation dose from CT pulmonary angiography in late pregnancy: a phantom study
S K DOSHI, MPhys, MSc, I S NEGUS, BSc, MSc and J M ODUKO, MSc, PhD, The British Journal of Radiology. 81 (2008), 653–658 https://www.ncbi.nlm.nih.gov/pubmed/18413302

Simplified diagnostic management of suspected pulmonary embolism (the YEARS study): a prospective, multicentre, cohort study

The Impact of Clinical Decision Rules on Computed Tomography Use and Yield for Pulmonary Embolism: A Systematic Review and Meta-analysis

Day 4: Ultrasound

Remember to screen shot final pages for your records.

1. Read chapters 19 and 20 in Learning Radiology Recognizing the Basics by William Herring, MD, FACR
   a. Ultrasonography: Understanding the Principles and Its Uses in Abdominal and Pelvic Imaging
   b. Vascular, Pediatric and Point-of-Care Ultrasound

2. Read Ultrasonography: Understanding the Principles and Its Uses in Abdominal and Pelvic Imaging, Peter Wang MD

4. Review the Radtorial on the Ultrasound of the Female Patient with Pelvic Pain:  

5. Complete the genitourinary modules 1, 3 and 5 in I.C.A.R.U.S platform. Screen capture the final image for each module for your records.  
http://www.icarus-rad.com/genitourinary
6. Compete gastrointestinal modules 1 and 4 in I.C.A.R.U.S platform. Screen capture the final image for each module for your records. 
http://www.icarus-rad.com/gastrointestinal

7. Complete the Ultrasound quiz under pre-clinical section of the UBC app
   a. Open the app
   b. Click Get Started
   c. Under the Pre-clinical section, click Ultrasound Quiz

Day 5: Nuclear Medicine

Remember to screen shot final pages for your records.
1. Chest case review – Game of Unknowns, Chest Edition. Screen capture the final slide. Who will sit on the Unknown Throne?

2. In the Learning Radiology Recognizing the Basics by William Herring, MS, FACR, under the Online-Only Appendixes section (check Table of Contents), read the Nuclear Medicine: Understanding the Principles and Recognizing the Basics
   a. Complete the online nuclear medicine module assessments and activities described in this section.
2. Complete the Loyola University modules located under Medicine and Nuclear Medicine
Nuclear medicine tests

- HIDA Scan
- Bone Scan
- Tagged RBC Scan
- Myocardial Perfusion and Function Scans
- Bone Densitometry Scan
- V/Q Scan
- MUGA Scan

a. After Hida Scan module, review: https://radiologyassistant.nl/abdomen/lk-jg
   i. **ACTIVITY:** Draw (either on your computer or pen & paper) a Hida Scan for a case of choledocholithiasis and a case of choledocholithiasis with CBD obstruction. **INCLUDE IN YOUR SCREEN CAPTURES FOR THE DAY**

b. After the Tagged RBC Scan (important to review the cine files [avi or animated gif] to understand the images), review the following cases on Gastric Bleed and Diverticular bleed (PDF version located in the Resources folder):
   i. http://gamma.wustl.edu/gi007te177.html
   ii. http://gamma.wustl.edu/gi009te177.html
Diagnosis: Gastric bleed

Brief history:
70 year old female with blood per rectum

Images:

Sequential anterior images of the abdomen and pelvis through 60 minutes. A cine file is available in AVI format.

Diagnosis: Diverticular bleed

Brief history:
71-year-old woman with maroon stools and decreasing hematocrit.

Images:

c. After Bone Scan, review the following cases on Metastatic prostate carcinoma and Left shoulder osteomyelitis (PDF version located in the Resources folder):
   i. http://gamma.wustl.edu/bs054te143.html
   ii. http://gamma.wustl.edu/bs131te142.html
Diagnosis: Metastatic prostate carcinoma

Brief history:

92-year old man with complaints of back pain

Images:

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Diagnosis: Left shoulder osteomyelitis

Brief history:

49-year-old woman with a history of breast cancer

Images:
3. Review the Radtorial module on oncologic imaging:

   a. Chapter 21: Lymphomas and Lymphoproliferative Disorders by Frederick D. Grant, Pages 479-496
   b. Chapter 26: Combined PET/MRI in Childhood by Thomas Pfluger, Wolfgang Peter Mueller. Pages 597-620
   c. ASSIGNMENT: Describe in one paragraph a disease you have seen or read about and how PET-CT or PET-MRI help in diagnosis, management or therapy, and what innovation you think would be useful in treatment of that disease. Creative thinking and science fiction encouraged!

Day 6: Pediatrics

Remember to screen shot final pages for your records.

1. Read Recognizing Pediatric Diseases chapter 28, pages 324-338 in Learning Radiology: Recognizing the Basics, by William Herring MD, FACR

2. Then please complete a minimum of 7 modules on the Children’s Hospital Cleveland Clinic website: https://www.cchs.net/onlinelearning/cometvs10/pedrad/default.htm You will need to register as a new user on the site using the menu located to the right.
3. Complete the Game of Unknowns Pediatric Edition:

4. Complete the 5-question online quiz and capture a screen shot of your final score on LearningRadiology.com site. Passing is not required but if you did not score 100%, please submit a 2-paragraph discussion on the entity you did not recognize including the clinical, radiologic and management of the condition. PDF version is available in the Resources folder named Chest Quiz 102.
   http://learningradiology.com/new/quizzes/quiz0102/index0102.htm
Day 7: Abdominal Imaging & Deep Dive on Appendicitis

Remember to screen shot final pages for your records.

1. Read Chapters 13-18 in Learning Radiology: Recognizing the Basics, by William Herring MD, FACR
   a. Recognizing the Normal Abdomen and Pelvis: Conventional Radiographs
   b. Recognizing the Normal Abdomen and Pelvis on Computed Tomography
   c. Recognizing Bowel Obstruction and Ileus
   d. Recognizing Extraluminal Gas in the Abdomen
   e. Recognizing Abnormal Calcifications and Their Causes
   f. Recognizing Gastrointestinal, Hepatobiliary, and Urinary Tract Abnormalities

2. Watch the video on reading CAT scan, what windowing does and other PACS usage tips. https://www.youtube.com/watch?v=rl8hpjlcDUY&feature=youtu.be
3. Review the anatomy of the abdomen using one of the resources:

   https://www.learnabdominal.com/how-to-read-ct

   (or)

4. View the C.R.E.A.T.E. Radcast lectures and complete the assignments:
   b. View: http://www.create-rad.com/abdominalradiographs
   https://www.learnabdominal.com/conferences/acute-care-gi-cases

6. On the same site, complete two cases:
   a. Complete either 1a or 1b and any other case 2-7.
   b. Using screen captures, make a PowerPoint of the two cases. The PowerPoint should include at least two images from the abdominal CT with arrows pointing to the findings/organs you think are abnormal. For example, if you choose a case of appendicitis screen capture 2 images from the CAT scan and annotate / point to the areas of abnormality.
   https://www.learnabdominal.com/conferences/acute-care-gi-cases
Day 8: Neuroradiology: Recognizing Some Common Causes of Intracranial Pathology

Remember to screen shot final pages for your records.

1. Read Chapter 27, pages 300-323 in Learning Radiology: Recognizing the Basics, 27, 300-323. William Herring MD, FACR
   a. Recognizing Some Common Causes of Intracranial Pathology

2. Review the CT Neuroradiology anatomy on the Learningneuroradiology.com site.
   https://sites.google.com/a/wisc.edu/neuroradiology/how-to-read-a-head-ct?authuser=0

3. Review the CT Neuroradiology terms on the Learningneuroradiology.com site.
   https://sites.google.com/a/wisc.edu/neuroradiology/image-acquisition/computed-tomography/ct-terminology?authuser=0
   
   http://www.create-rad.com/headct

5. Review the special discussion on contrast use on the Learningneuroradiology.com site.
   
   https://sites.google.com/a/wisc.edu/neuroradiology/image-acquisition/contrast?authuser=0

6. Review the Ratorial on Imaging Evaluation for the Stroke Patient
   
• Review the Stroke material on Learningneuroadiology.com site.

https://sites.google.com/a/wisc.edu/neuroradiology/pathology/stroke?authuser=0

7. Complete 3 cases on the University of Wisconsin Neuroradiology Learning Module. You may use resources (provided below) to complete the cases. Screen capture the last image from each case. Click on the ED Room Board to begin.

http://cases.med.wisc.edu/neuroradiology/cases/home/
All the resources you need for the cases are available somewhere on
https://sites.google.com/a/wisc.edu/neuroradiology/home?authuser=0 or you can use any resources you find.

Other optional resources:
https://sites.google.com/a/wisc.edu/neuroradiology/forward-curriculum/acute-care-seminar?authuser=0
Day 9: MRI

Remember to screen shot final pages for your records.

8. Read Chapter 21 in Learning Radiology: Recognizing the Basics, 27, 300-323. William Herring MD, FACR
   a. Magnetic Resonance Imaging: Understanding the Principles and Recognizing the Basics

2. Watch the videos on MRI Safety:
   https://www.youtube.com/watch?v=vU-PTCmbxQE
   https://www.youtube.com/watch?v=MJbo1ZwnOBM
3. Review the MRI PDF located in the Resources folder:

   - Magnetic Resonance Safety
   - Basic MRI Safety
   - UC DAvis Magnetic Resonance Safety

4. Complete the MRI Safety quiz located in the Resources folder.

Day 10: Radiology Exam