
UNIVERSITY OF ROCHESTER MEDICAL CENTER

DEPARTMENT OF IMAGING SCIENCES



DIAGNOSTIC RADIOLOGY RESIDENCY PROGRAM

2006-2007

INTRODUCTION AND OVERVIEW	3
Letter from the Program Director	
Letter from the Chairman	
Radiology Faculty	
Radiology Residents	
Education Committee	
EDUCATIONAL PROGRAMS	9
General Diagnostic Radiology	
Resident Four-Year Curriculum	
Educational Goals and Objectives	
Vascular- Interventional Track	
Nuclear Medicine Residency Program	
Fellowship Programs	
Body Imaging (CT, US, MRI)	
Emergency Radiology	
Magnetic Resonance Imaging at UMI	
Musculoskeletal Radiology	
Neuroradiology	
Pediatric Radiology	
Vascular-Interventional Radiology	
CONFERENCES	64
Departmental	
Interdepartmental	
Core Curriculum	
Continuing Medical Education	
RESOURCES	66
Departmental library	
Teaching files	
RESIDENT DUTIES AND RESPONSIBILITIES	68
Night call and weekend duties	
Night float/ED rotation	
Night-call Qualifying Examination	
Vacations	
RESIDENT EVALUATION PROCESS	72
Evaluation of residents	
Resident evaluation form	
REQUIREMENTS FOR RESIDENT ADVANCEMENT	74
Promotion and Reappointment	
Disciplinary Action	
Remediation	
DEPARTMENT POLICIES	76
Resident work hours	
Moonlighting policy	
Resident supervision	
Resident teaching	
Paternity/ LOA	
Finance/ Purchasing Policies	
APPENDIX	81
Six General Competencies	
ACGME General Competencies	

LETTER FROM THE PROGRAM DIRECTOR

Vikram Dogra, M.D.
Radiology Residency Program Director



This manual describes the clinical, educational, and research opportunities for residents at the University of Rochester Medical Center during the 2006 academic year. It can be anticipated that your training experience will prepare you to become a most competent clinical practitioner and/or academician with outstanding credentials.

One of the strengths of our program is the magnitude and diversity of the clinical material. Most of your training will be within the film-less radiology department at Strong Memorial Hospital under the direct supervision of subspecialty-oriented faculty. However, we now have the added advantage of enhanced experience at the SMH musculoskeletal outpatient unit at Clinton Crossings and Highland Hospital's Radiology Department and Women's Center and PET Center also known as University Imaging at Science Park. Elective opportunities are available at the Armed Forces Institute of Pathology (AFIP) and our outpatient practice at University Medical Imaging (UMI).

Didactic training begins with a special lecture series for beginning residents in addition to our regular conference and grand rounds setting. Later in the year, you will participate in our comprehensive radiology physics course. These educational experiences are supplemented by electronic teaching aids within our library and a generous book allowance for educational support.

Faculty and resident research are another strong aspect of our department. Basic radiological research is available for pursuit of clinical applications and enhanced investigations. Health Services research, is supplemented by a NIH-funded training program. Our residents have been honored by the RSNA Roentgen Resident/Fellow Research Award and regularly are selected to attend the AUR/RSNA/ARRS Introduction to Research Program. During the past year our residents, were honored by, the Association of University Radiologists, the Association for Academic Women Radiologists and the RSNA Resident in Research Program for their research presentations. The department sponsors residents' presentations at national meetings and subsequent publications.

Perhaps the greatest strength of the program is the collegiality among the residents and good working relationships with the faculty and staff. This atmosphere provides mutual support in optimally caring for our patients and in effective preparation for future practice. However, you need to do your part in preparation for your future career. Your learning experience begins on the first day of your residency and continues through every day of each rotation. You need to stay focused and work hard throughout your residency so that you can be as successful as those that preceded you.

Welcome to the Radiology Residency Program for 2006-2007.

LETTER FROM THE CHAIRMAN

David L. Waldman, M.D., Ph.D.
Professor of Radiology and Chair



Welcome to Radiology!

On behalf of the faculty, I would like to welcome you to the Department of Imaging Sciences and the University of Rochester Residency Program in Diagnostic Radiology. The program has a distinguished history and has trained radiology residents for almost 50 years. During that time the department has undergone enormous growth and evolution. Currently, the department is divided into specialty radiology divisions. These include Neuroradiology, Vascular and Interventional Radiology, Musculoskeletal Radiology, Thoracic Radiology, Abdominal Imaging, Women's Imaging, Pediatrics, Nuclear Medicine and Community Radiology. The residents are exposed to each specialty area and work closely with faculty members who have established expertise in these disciplines.

The University of Rochester Hospital is a tertiary care facility and a Level I trauma center. Residents within the radiology residency training program are able to gain experience in both simple and complex medical problems. The department enjoys a warm and collegial relationship with other training programs within the hospital. Radiology residents interact with residents from other residency programs at many interdisciplinary conferences.

The specialty nature of the Department of Imaging Sciences provides advanced training in such modalities as interventional radiology and magnetic resonance imaging. The technology base of the department is "state of the art" with the latest CT, MR, PET and information systems technology. The training programs are designed to enable residents to acquire and demonstrate the knowledge, skills, and judgment necessary for competence in the practice of Radiology/Nuclear Medicine. This is primarily achieved by involvement in clinical case material under direct supervision and guidance of the faculty. More formal teaching supplements this educational process by providing lectures, demonstrations and conferences as well as electronic teaching aids.

Competency in radiology consists of the ability to plan appropriate and most cost effective sequences to be performed, obtaining these studies with utmost concern of patient care, and transferring necessary information to the referring clinician in a timely manner. Residents are to learn not only medical information and interpretation of radiological images but to obtain competency in transferring this information in an efficient and effective manner. This is based on having the resident obtain background knowledge of the patient including any treatment, which may modify radiographic appearance or examination requests. The core knowledge, which the resident radiologist must become familiar, (and which will require continuing study for the rest of one's professional life), concerns the variety of pathologic findings that may be detected on images due to disease and the differentiation of these from normal, normal variations and technical artifacts. The resident must also learn to direct support personnel in administrative matters such as information transfer, storage and retrieval in order to assume competent and responsive consultative services and quality patient care.

The orientation program, for new residents, consists of early rotations through the basic services of chest, musculoskeletal, CT, and abdominal radiology. Orientation also includes a series of special teaching sessions on common radiology practices and procedures. Further instruction is presented during regularly scheduled departmental conferences. Residents are to be concerned and involved with quality assurance and other non-imaging issues involving total patient management during the radiologic process and are required to participate in a monthly quality assurance conference.

FACULTY

Chair

Waldman, David L., M.D., Ph.D.

Chair

Professors

Adams, Mark J. M.D., M.B.A.

Burgener, Francis A., M.D.

Dogra, Vikram, M.D.

Ekholm, Sven, M.D., Ph.D.

Foster, Thomas H., Ph.D.

Meyers, Steven P., M.D., Ph.D.

Ning, Ruola, Ph.D.

Numaguchi, Yuji, M.D., Ph.D.

O'Mara, Robert E., M.D. (P-T) (Emeritus)

Rubens, Deborah J., M.D.

Skucas, Jovitas, M.D. (P-T)(Emeritus)

Smith, Edward M., Sc.D. (P-T)

Wandtke, John C., M.D.

Westesson, Per-Lennart, M.D., Ph.D., D.D.S.

Zhong, Jianhui, Ph.D.

Associate Chair; Abdominal Imaging

Co-Director: Musculoskeletal Radiology; General Radiology

Associate Chair of Education and Research; Head, Ultrasound; Director: Diagnostic Radiology Residency Program

Neuroradiology

Director: Physics Training Program; Radiologic Physics

Ambulatory Services; Neuroradiology

Radiology Physics and CT Research

Neuroradiology

Nuclear Medicine

Associate Chair, Special Imaging; Ultrasound;

Abdominal Imaging

Abdominal Imaging

Nuclear Medicine Physics; Continuing Education

Associate Chair; Director: General Radiology; Head,

Chest Radiology; Director: Emergency Radiology

Fellowship Program

Director: Neuroradiology, Neuroradiology Fellowship

Director: MR Research

Associate Professors

Bernstein, Allan, M.D.

Chengazi, Vaseem, M.D., Ph.D.

Fultz, Patrick J., M.D.

Hollenberg, Gary M., M.D.

Klionsky, Nina B., M.D. (GFT)

Kwok, Wing-chi E. Ph.D.

Lee, David E., M.D.

Monu, Johnny U. V., M.D.

O'Connell, Avice, M.D.

Shrier, David A., M.D.

Strang, John G., M.D.

Voci, Susan L., M.D.

Wang, Henry Z., M.D., Ph.D.

Weinberg, Eric P., M.D.

University Medical Imaging

Director: Nuclear Medicine, Director: Nuclear Medicine Residency Program

Director: Cross-sectional Imaging

Ambulatory Services; Abdominal Imaging

Head, Pediatric Radiology; Director: Pediatric Radiology Fellowship

MRI Physics and Research

Vascular-Interventional; Director: Vascular-Interventional Fellowship Program

Director: Emergency Radiology, Co-Director:

Musculoskeletal Radiology, Director: Musculoskeletal Radiology Fellowship Program

Clinical Imaging Sciences, Director: Women's Imaging

Associate Director: Neuroradiology, University Medical Imaging

Chief: Computed Tomography; Director: PET/CT Center

Ultrasound; Chief of Ultrasound

Neuroradiology

Ambulatory Services; Abdominal Imaging

Assistant Professors

Beitia, A. Oscar, M.D.

Davis, Delphine, Ph.D.

Dombroski, David, M.D.

Ambulatory Services; Neuroradiology

Coordinator: Radiology Research

Director: Cross-Sectional Imaging Fellowship; Medical

Student Teaching; Cross-sectional Imaging; Director:

MR Center

Assistant Professors (con't)

Elvey, Simone, M.D.	General Radiology, Highland Hospital
Holzwasser, Gerald R., M.D. (P-T)	General Radiology; Emergency Radiology
Jones, Luann T., M.D. (P-T)	Pediatric Radiology
Kitanosono, Takashi, M.D.	Vascular-Interventional Radiology
Klein, Deborah J. M.D. (P-T)	Pediatric Radiology
Kolodny, Leonard B., M.D.	General Radiology, Neuroradiology, Highland Hospital
Lee, Daniel, M.D.	Nuclear Medicine
Ormanoski, Margaret, D.O.	Cross-Sectional Imaging
Patel, Nikhil, M.D.	Head; Vascular-Interventional Radiology
Puri, Savita, M.D.	Nuclear Medicine
Saad, Wael E., M.D.	Vascular-Interventional Radiology
Sahler, Lawrence G., M.D.	Vascular-Interventional; GI/GU; Mammography
Sasson, Talia, M.D.	Vascular-Interventional Radiology
Seo, Gwy Suk, M.D.	Musculoskeletal Radiology
Somerville, Patricia, M.D.	General Radiology
Tan, Brian, M.D.	General Radiology, Highland Hospital
Tan, Raymond, M.D.	Chief, Radiology, Highland Hospital
Zayas, Vanessa, M.D.	UMI
Zynda-Weiss, Andrea, M.D.	UMI

Instructor

Kamalsky, Joan, M.D.	General Radiology
Wilson, Ian J., M.D.	Vascular-Interventional Radiology

Clinical Associate Professor

Chess, Mitchell A., M.D.	Cross-Sectional Imaging
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Clinical Instructor (Locum Tenens)

Weiss, Stan L., M.D.	Cross-Sectional Imaging
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Fellows

Basu, Arun, M.D.	Musculoskeletal
Bhatt, Shweta, M.D.	Cross-Sectional Imaging, Research
Cerniglia, Christopher, D.O.	UMI
Hiwatashi, Akio, M.D.	Neuroradiology
Hu, Rosa, M.D.	UMI
Jandzinski, Dana, MD, MPH	General Radiology
Kathuria, Sudhir, M.D.	Neuroradiology
Malhotra, Ajay, M.D.	Neuroradiology
Maragh, Marlon, M.D.	Musculoskeletal
Patel, Kalpesh, M.D.	Musculoskeletal
Shah, Waqar, M.D.	Vascular-Interventional
Sharma, Ashwani, M.D.	Neuroradiology
Sidhu, Ravinder, M.D.	Neuroradiology
Vilvendhan, Rajendran, M.D.	Neuroradiology
Vyas, Rajashree, M.D.	General Radiology
Wilson, Ian J, M.D.	Research
Yaroshevkiy, Arkadiy, M.D.	UMI

RESIDENTS

PGY 5 Residents in Radiology

Azodo, Uchendu, M.D.	SUNY @ Buffalo	2002
Farzanegan, Farhad, M.D. ²	Albany Medical College	2002
Hughes, Thomas, M.D.	Mt. Sinai School of Medicine	2002
Nyarko, Stanley, M.D.	Harvard Medical School	1999
Saad, Nael El Said, M.B.B.Ch. ¹	Ain Shams University	1997
Siddall, Kristina, M.D.	Case Western Reserve	2001
Takeyama, Peter, M.D.	University of Rochester	2002
Timberlake, Carmen, M.D.	University North Carolina	2001

PGY 4 Residents in Radiology

Chang, Hannah, M.D.	University of Vermont	2003
Christensen, Jared, M.D. ³	University of Vermont	2003
Lin, Edward, M.D.	University of Rochester	2003
Markhardt, B. Keegan, M.D.	University of Wisconsin	2003
Mikityansky, Igor, M.D., MPH	University of Rochester	2002
Patel, Gaurav, M.D. ¹	University of Virginia	2001
Sides, Corey, M.D.	Tufts University	2003
Shyu, Chandler, M.D., MPH	University of Rochester	2002
Wandtke, Ben, M.D. ³	University of Rochester	2003

PGY 3 Associates in Radiology

Barshay, Venamin, M.D.	University of Rochester	2003
Butani, Devang, M.D.	University of California @ Irvine	2004
Cesarz, Malin, M.D.	Medical College of Wisconsin	2004
Conde, Anthony, M.D., M.P.H.	Ponce School of Medicine	2001
El Shereif, Ahmed, M.D.	Drew/ UCLA	2004
Huang, Brady, M.D.	University of Rochester	2004
Klekers, A.R. (Albert), M.D.	Wake Forest	2004
Lee, Jerry, M.D.	University of Rochester	2002
Madoff, Samuel, M.D.	University of Rochester	2004
Mirza, Salman, D.O.	NY College of Osteopathic Medicine	2004
Mooney, Scott, M.D.	NY Medical College	2004

PGY 2 Assistants in Radiology

Cassar, Scott, M.D.	University of Rochester	2005
Camarena, Jacinto, M.D.	Howard University	2005
McCabe, Sam, M.D.	SUNY @ Buffalo	2005
Goldfeder, Sarah Ann, M.D.	University of Rochester	2005
Gong, Richard, M.D.	New York Medical College	2005
Majewski, Sara, M.D.	SUNY @ Buffalo	2005
Sorensen, Brian, M.D.	University of Vermont	2005

NUCLEAR MEDICINE RESIDENCY PROGRAM

Dockery, Keith, M.D.	University of Rochester	2004
Jethva, Chirag, M.D.	Medical University of Ohio	2004

¹Radiology, Interventional pathway

²Administrative chief residents

³Senior chief resident

EDUCATION COMMITTEE

This is a committee with faculty and resident representation that is charged with oversight of all issues related to the department's educational programs undergraduate medical education (UME), graduate medical education (GME), and continuing medical Evaluation (CME) programs. The committee meets monthly; more often as needed. Minutes are distributed to all members. The committee regularly evaluates the effectiveness of the residency program in meeting its goals and objectives, reviews resident benefits and requests, resident call and rotation schedules, and has input in choosing chief residents and resident award nominees. Residents who have issues to be addressed by the Education Committee should bring these to the attention of the chief residents who are members of the committee.

Chair: V. Dogra, M.D.

Members: D. Waldman, M.D., Ph.D.
J. Wandtke, M.D.
D. Dombroski, M.D.
L. (Teschmacher) Jones, M.D.
J. Monu, M.D.
N. Patel, M.D.
S. Puri, M.D.
D. Rubens, M.D.
H. Wang, M.D., Ph.D.
M. Maier
I. Mackey

Resident Representatives: F. Farzanegan, M.D.
J. Christensen, M.D.
B. Wandtke, M.D.

GENERAL DIAGNOSTIC RADIOLOGY

The University of Rochester/Strong Memorial Hospital residency program is a four-year [ACGME](#) accredited training period in diagnostic radiology. The program extends from PGY-2 through PGY-5 levels. An ACGME approved clinical PGY-1 is necessary before beginning radiology training.

This radiology program provides experience in general diagnostic radiology through sub-specialty areas of pulmonary, abdominal, emergency, neurological, musculoskeletal, and pediatric radiology. Special experience in ultrasonography, computed tomography, magnetic resonance imaging, and nuclear medicine is an important focus of the program. There is also training in women's imaging, vascular and interventional procedures, and radiation physics.

Specialty rotations are assigned at levels of increasing sophistication and experience. Appropriate responsibilities are available for procedures, film interpretations, teaching and consultation as the resident progresses through the program.

A [faculty](#) of full and part-time radiologists and PhDs with subspecialty expertise in their respective areas participates in supervision, teaching, and research.

Beginning with the July 1, 2006 batch, USMLE Steps 1, 2, 3 must be successfully completed in order to be approved to take the American Board of Radiology oral (final) examinations.

Residents are required to make application to take board examinations during the first year of residency. All residents are expected to appear for the physics and clinical written ABR examination at the beginning of the second year and beginning of the third year of residency, respectively, with no exception. Should a problem arise, prior written permission must be obtained from the Program Director.

CURRICULUM

REQUIRED MONTHS	General Radiology	Vascular Interventional
Abdominal Imaging: GI/GU ¹	6	4
Angio/Interventional	4	11
Chest	3	3
CT: Body	4	2
ED	5	5
MRI: Body	1	2
Musculoskeletal	4	3
Neuro: includes MRI	4	4
Nuclear Medicine	4	4
Peds	4	3
Ultrasound	4	4
Women's Imaging: Mammography/OB ultrasound	3	3
Total required	46	48
Electives: includes AFIP	6	4
Total	52	52

¹ includes Highland Hospital

RESIDENT GOALS AND OBJECTIVES BY ROTATION

The Department of Imaging Sciences follows the competency requirements as set by the Accreditation Council for Graduate Medical Education (ACGME) and follows its guidelines. Each rotation therefore, has incorporated these six competencies into its educational goals and objectives. These competencies are listed in **RED** at the beginning of each goal and/or objective. Residents receive these goals and objectives one day prior to the start of their rotations by way of the E*Value System and also have easy access via the printed version of the 2006 - 2007 Residency Manual and the Imaging Sciences website (.pdf format): <http://www.urmc.rochester.edu/smd/rad/rescorner.htm>

ABDOMINAL IMAGING

The radiology resident will rotate through GI and GU procedures and other abdominal imaging rotations will be completed within the first two years of radiology residency (PGY2 and 3). The final rotations will be completed within the third or fourth year of the radiology residency program.

The learning experience takes place in the following ways: one-on-one training during the clinical workday; Resident conferences given throughout the year, which will both be didactic and case conference in approach; weekly abdominal imaging conferences. General GI textbooks and specific articles are recommended to the resident throughout the year.

GASTROINTESTINAL RADIOLOGY

First Rotation

Goals

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

- The resident should begin to learn the skills of fluoroscopy:
 - He/she should become facile with the fluoroscope.
 - Begin to develop hand/eye coordination during the examination.
 - To become facile with a basic fluoroscopic procedures: upper GI-single and biphasic; barium enema-single and double contrast; esophagram-single and biphasic; small bowel exam-per oral and enterocolysis; swallow study; t-tube cholangiogram; NJ and NG tube placement under fluoroscopy.
 - Become familiar with radiation concerns during GI fluoroscopy: the various components of contribution of patient radiation during the exam; ways to decrease both patient and staff radiation exposure without compromise of diagnostic outcome; the differing radiographic techniques depending on contrast agent used.
 - To assess the adequacy of the various fluoroscopically obtained GI tract examinations.
- The resident should begin to understand the normal, normal variant, and pathologic states of the oral pharynx, esophagus, stomach, duodenum, mesenteric small bowel, and colon as examined with contrast. Plain image interpretation is also accomplished. ERCP's from the GI lab are interpreted.
- The resident will be made aware of the importance of patient/MD relationship during the GI examination.
- The resident will also be made aware the importance of communication with the referring clinician. Both in regards to a well crafted prompt report, as well as to make immediate contact when certain abnormal findings are found at examination.
- The resident will begin to learn of the appropriate use of various contrast agents related to the GI tract and the pancreaticobiliary tree.

Second Rotation

Goals

Medical Knowledge, Patient Care

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

- At this time the resident rotating through a second time will probably have undergone ultrasound and CT rotations of the abdomen. Thus, there will be increasing correlation between cross-sectional images obtained possibly prior or following the examination done in fluoroscopy. Also this resident should be made aware of the place of the various imaging techniques of the abdomen in order to structure an imaging approach to different clinical problems using fluoroscopy, plain film, and axial imaging studies.

Third Rotation

Goals

Patient Care, Professionalism, Interpersonal and Communication Skills

- The residents should now be comfortable with the basic fluoroscopic exams and will be encouraged to further modify the basic exam to answer specific questions at fluoroscopy and develop their own fluoroscopic pattern.
- During this rotation there will be brief reviews as needed in the following areas: radiation concerns, various contrast agents, patient/physician relationship, and the importance of reporting to the clinician.
- There will be a continued discussion of the various pathologies related to the GI tract. With further axial imaging studies, these discussions can be carried into both CT and ultrasound as well as contrast and plain film abnormalities related to the abdomen and GI tract.
- Along similar lines, the actual imaging studies that are associated with the case can also be better correlated with the present exam and again imaging strategies for order of examination.

GENITOURINARY RADIOLOGY

General Goals

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

Residents rotate through the section of Genitourinary Radiology during each of their four years of training. Residents will be taught the skills necessary to interpret plain films, fluoroscopy exams, US, CT and MRI. The training will include one-to-one training during the workday, resident conferences throughout the year, both didactic and case conferences. General GU textbooks and specific articles are recommended to the residents throughout the year.

The residents will receive an introduction in genitourinary anatomy and pathology. They will learn the value of each modality enabling them to optimize patient care and guiding referring physicians.

It is expected that residents will participate in the performance of examinations done in the section. They will obtain consents and perform infusion or injection of contrast media. The residents at all levels will be expected to show interesting cases in the GU conferences to their fellow residents.

The residents will learn to dictate concise and appropriate radiography reports and to serve as consults to referring physicians and house staff.

First Year GU Radiology Goals

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

- The resident should begin to learn the skills of fluoroscopy and intravenous exams.
 - He/she should become facile with the fluoroscope.
 - Begin to develop hand/eye coordination during the examination.
 - To become facile with basic fluoroscopic procedures: cystogram, voiding cystourethrogram, retrograde ureterogram, loop-o-gram, nephrostogram, hysterosalpingogram.
 - Become familiar with radiation concerns during GU fluoroscopy: the various components of patient radiation exposure during the exam; ways to decrease both patient and staff radiation exposure without compromise of the diagnostic outcome.

- The resident should begin to understand the normal, normal variant, and pathologic GU anatomy. Plain image interpretation and intravenous studies are also accomplished.
- The resident will be made aware of the importance of the patient/MD relationship during the GU examination.
- The resident will also be made aware of the importance of communication with the referring clinician. This includes a well-crafted prompt report, as well as to make immediate contact when certain abnormal findings are found at examination.
- The resident will begin to learn the appropriate use of various contrast agents related to the GU tract.

Second Year GU Radiology Goals

Patient Care, Medical Knowledge, Interpersonal and Communication Skills

- The residents will review their skill of fluoroscopy. Not only will the resident be instructed to become more facile with the fluoroscopic exam, he/she will also be taught nuances to facilitate the various GU examinations at fluoroscopic exam. The resident should continue to increase their efficiency of the basic examinations as stated under the first year rotation.
- Further detail will be given to the GU tract pathology as begun in the first rotation.
- By this time the resident will have undergone ultrasound, MRI and CT rotations of the abdomen. There will be increasing correlation between cross-sectional images obtained prior or following the examination done in fluoroscopy. The resident should be made aware of the place of various imaging techniques of the abdomen in order to structure an imaging approach to different clinical problems using fluoroscopy, plain film, and axial imaging studies.
- The residents should be able to assist in organizing the workday and working with the first rotation radiology residents.

Third Year GU Radiology Goals

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

- The residents should now be comfortable with the basic fluoroscopic exams and will be encouraged to further modify the basic exam to answer specific questions at fluoroscopy and develop their own fluoroscopic pattern.
- During this rotation there will be brief reviews as needed in the following areas: radiation concerns, various contrast agents, patient/physician relationship, and the importance of reporting to the clinician.
- There will be a continued discussion of the various pathologies related to the GU tract. With further axial imaging studies, these discussions can be carried into CT, MRI, and ultrasound as well as contrast and plain film abnormalities related to the abdomen and GU tract.

Fourth Year GU Radiology Goals

Professionalism, Interpersonal and Communication Skills

- The residents should be at a level to completely organize a day's schedule and supervise more junior residents.
- The fourth year resident is encouraged to write up for publication GU case reports or research experience in their prior years.
- The dictated reports will be refined, if needed, for clinical practice.

ANGIO

VASCULAR-INTERVENTIONAL RADIOLOGY

Throughout the four-year residency in Diagnostic Radiology Residency, each resident completes four one-month rotations in Vascular and Interventional Radiology. The residents in Diagnostic Radiology work closely with the resident (fellow) in Vascular-Interventional Radiology during each one-month rotation. The ensuing outline will detail the goals and objectives for each one-month rotation on the service.

First Rotation

Goals

Medical Knowledge

- Demonstrate the ability to obtain an informed consent.
- Demonstrate the ability to obtain pertinent patient information from the **PACS** system and the patient chart prior to the performance of an invasive procedure.
- Demonstrate timeliness and responsible work ethic.
- Demonstrate the ability to monitor and follow patients assigned to him/her during the rotation and have at hand pertinent clinical information i.e. chest tube output, abscess tube output, findings from follow-up chest/abdomen/pelvic CT scans.

Objectives

Medical Knowledge

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

Second Rotation

Goals

Medical Knowledge

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

Objectives

Medical Knowledge

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

Third Rotation

Goals

Medical Knowledge

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

Objectives: Decision-Making, Value Judgment Skills

Medical Knowledge, Interpersonal and Communication Skills

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

Fourth Rotation

Goals

Medical Knowledge

- Knowledge of the mechanism of angioplasty
- Knowledge of complications of angioplasty
- Knowledge of indications for vascular stent placement
- Knowledge of indications for renal angioplasty and stent placement
- Knowledge of indications for biliary stent placement
- Knowledge of indications and contraindications for TIPS placement
- Knowledge of indications of gastrostomy tube placement

Objectives: Decision-Making, Value Judgment Skills

Medical Knowledge, Interpersonal and Communication Skills

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

TECHNICAL SKILLS THAT SHOULD BE MASTERED DURING THE FOUR MONTHS ON VASCULAR-INTERVENTIONAL RADIOLOGY:

First Rotation

Technical Skills

Patient Care

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

Second Rotation

Technical Skills

Patient Care

- Manual dexterity in using pigtail catheter to go around the aortic bifurcation.
- Manual dexterity using the Omni Selective, Cobra, and S₀₈ Omni.
- Basic skills in suturing; interrupted, running, and subcuticular suturing techniques; knows when to use absorbable and nonabsorbable suture.
- Performance of ultrasound-guided puncture of the internal jugular vein.
- Ability to perform a tunneled dialysis catheter placement in the internal jugular vein.

Third Rotation

Technical Skills

Patient Care

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

Fourth Rotation

Technical Skills

Patient Care

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

CHEST

Year One: First, four-week rotation

Goals

Professionalism, Medical Knowledge, Interpersonal and Communication Skills, System-based Practice

After completion of the first chest rotation with resident will

- Demonstrate a responsible work ethic.
- Demonstrate learning of knowledge-based objectives.
- Accurately and concisely dictate a chest radiograph report.
- Communicate effectively with referring clinicians and supervisory staff.
- Understand standard patient positioning in chest radiology.
- Demonstrate knowledge of the “ACR Standards for Communication, Adult Chest”.
- Demonstrate the ability to obtain pertinent patient information relative to radiologic examinations.

Objectives

Medical Knowledge

At the end of the first chest rotation the resident will demonstrate learning of at least 50% of the following knowledge-based objectives

- Normal anatomy of the chest
- Interstitial lung disease
- Alveolar lung disease
- Monitoring and support devices – “tubes and lines”
- Mediastinal masses
- Solitary and multiple pulmonary nodules
- Acute chest trauma
- Chest wall, pleura and diaphragm
- Upper lung zone disease
- Atelectasis
- Peripheral lung disease
- Airways
- Unilateral hyperlucent lung
- Neoplasms of the lung
- Immunocompromised patient
- Cardiac and congenital lung disease

Technical, Communication and Decision-Making Skills

Interpersonal and Communication Skills, Professionalism

At the end of the first rotation, the resident will demonstrate

- Dictate understandable chest radiograph reports that include patient name, 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.
- Call ordering physicians about all significant or unexpected radiologic findings and document who called and the date and time of the call in the dictated report.
- Obtain relevant patient history from computer records, dictated reports, or by calling referring clinicians.
- Describe patient positioning and indications for a PA, lateral, decubitus and lordotic chest radiographic.
- Decide when it is appropriate to obtain help from supervisory faculty in interpreting radiographs or answering questions for referring clinicians.
- Arrive for the rotation assignment on time and prepared after reviewing recommended study materials.

- Utilize previous radiologic exams (e.g. prior chest radiographs and/or CT scans) in the interpretation of current studies.

Conferences and study materials

- Weekly resident chest conference.
- Residents are expected to place one case into the teach file, each rotation. The case should have references to indicate an understanding of evidence-based medicine.

Study materials

- Thoracic Radiology: The Requisites, by McCloud TC, Mosby, St. Louis, 1998.
- Chest Radiology: Plain Film Patterns and Differential Diagnoses, Reed, 5e, Mosby, St. Louis, '03

Year Two: Second, four-week rotation

Goals

Medical Knowledge, Systems-based Practice

After completion of the second chest rotation, the resident will

- Demonstrate learning of knowledge-based learning objectives
- Continue to build on chest radiograph interpretive skills.
- Demonstrate an understanding of “ACR Appropriateness Criteria” for chest radiology.

Objectives

Medical Knowledge

The resident will demonstrate learning of at least 75% of the knowledge-based objectives introduced in Year One.

At the end of the second chest rotation, the resident will demonstrate the following:

Technical, Communication and Decision-Making Skills:

Medical Knowledge, Patient Care, Interpersonal and Communication skills, Systems-based Practice

- Appropriately protocol all requests for chest CT, given the patient histories.
- Demonstrate the ability to effectively present interesting cases at the radiology case conference to other residents by choosing and showing appropriate interesting or quality assurance cases, interacting with residents and guiding them through the cases and being prepared to present a brief discussion of the diagnoses for each case.
- Demonstrate the ability to manage a patient contrast reaction that occurs during a chest CT examination.
- Acts as a consultant for referring clinicians, recommending appropriate imaging studies based on “ACR Appropriateness Criteria.

Conferences

- Same as for Year One.

Study Materials

- Chest- Diagnostic Imaging Series by Gurney. Amirsys, 2006
- Thoracic Imaging – Pulmonary and Cardiovascular, by Webb, Higgins, Lippicott, 2005

Years Three and Four: Third, four-week rotation

After completion of the third chest rotation, the resident will

Medical Knowledge, Interpersonal and Communication Skills

- Demonstrate learning of knowledge-based objectives.
- Refine skills in interpretation of radiographs and CT scans of the chest.
- Develop skills in protocoling, monitoring, and interpretation of HRCT scans.
- Become a more autonomous consultant and teacher.
- Correlate pathological and clinical data with radiographic and chest CT findings.

Objectives

Medical Knowledge

At the end of the third chest rotation, the resident will demonstrate knowledge of 100% of the knowledge-based objectives introduced in Year One, in addition to the objectives listed below:

- Identify a secondary pulmonary lobule on HRCT.
- Identify and give appropriate differential diagnoses when the patterns of septal thickening, perilymphatic nodules, bronchiolar opacities (“tree-in-bud”), air trapping, cysts and ground glass opacities are seen in HRCT.
- Identify the major anatomic structures of the chest and mediastinum on chest MRI.

Technical and Communication Skills

Medical knowledge, Interpersonal and Communication Skills, Professionalism

After completion of the third chest rotation, the resident will demonstrate the following technical, communication and decision-making skills:

- Dictate accurate, concise chest radiograph and CT scan reports with at least 75% accuracy; the reports will contain no major interpretive errors.
- Correctly protocol all HRCT exams, obtaining inspiratory, expiratory and prone images in collaboration with a pathologist, present an interesting cardiopulmonary case, with a confirmed diagnosis, correlating clinical history with pathology and radiologic imaging, to residents and faculty.
- In collaboration with a pathologist, present an interesting cardiopulmonary case, with a confirmed diagnosis, correlating clinical history with pathology and radiologic imaging, to residents and faculty.
- Work in the reading room independently, assisting clinicians with radiologic interpretation and teaching other residents and medical students assigned to chest radiology.

Conferences

- Same as for Year One.

Study Materials

- High Resolution CT of the Lung, Webb, Müller, Naidich, 3rd ed, Lippincott-Raven, Phila, 2000.
- ACR CD-ROM Chest Teaching File

CT - BODY

Through the four-year residency in diagnostic radiology, each resident completes four, four-week rotations in body CT. The following outline presents goals and objectives for each four-week rotation.

First Rotation

Goals

Medical Knowledge, Interpersonal and Communication Skills, Professionalism

- Understand the basic physics of CT including slice thickness, pitch, helical vs. multi-row scanners, effects of mA and kV.
- Learn the basic principles of contrast distribution particularly as applied to arterial and venous phase scanning.
- Protocol and monitor CT studies. Modify protocols when appropriate.
- Understand the principle of saline chaser.
- Learn to recognize and treat contrast reactions.
- Develop skills in interpretation of basic CT pathology.
- Learn the appropriate format for dictation of CT reports.
- Develop skills in consultation with house staff and referring physicians.

Objectives

Medical Knowledge

Identify the CT appearance of the following pathology

- Colon carcinoma
- Esophageal carcinoma
- Liver cancer
- Lung cancer
- Pancreas cancer
- Gastric cancer
- Lymphoma
- Retroperitoneal adenopathy
- Aortic aneurysm
- Aortic dissection
- Adrenal adenoma
- Gallstones
- Ascites
- Bowel perforation with free air
- Cavernous hemangioma of the liver
- Cirrhotic liver
- Liver metastases
- Pancreatitis with pseudocyst
- Renal cystic disease
- Obstructive hydronephrosis due to ureteral calculus
- Bowel obstruction
- Active arterial extravasation
- Shock bowel
- Splenic laceration
- Post traumatic urinary bladder leak
- CT artifacts

Second Rotation

Goals

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

- Refine interpretive skills with complex pathology.
- Understand the principles of computed tomographic angiography.
- Be able to identify life-threatening findings, particular in trauma patients.
- Provide emergent provisional interpretation as needed.
- Be able to direct the choice of imaging modality and protocol emergent studies.
- Understand when referral to other imaging modalities is necessary.

Objectives

Medical Knowledge

Identify the CT appearance of the following pathology:

- Hepatic abscess
- Pancreatic abscess
- Renal abscess
- Groin pseudoaneurysm
- Biliary cancer
- Budd Chiari Syndrome
- Carcinomatosis with ascites
- Sequela of cryoablation
- Diaphragmatic hernia
- Interloop abscess
- Focal nodular hyperplasia of the liver
- Hepatocellular carcinoma
- Islet cell tumor of the pancreas
- Renal oncocytoma
- Complications of renal transplantation
- Liver transplant complications
- Cystic pancreatic neoplasm
- Renal hypertension and varices
- Retroperitoneal fibrosis
- Von Hippel Lindau Syndrome

Third Rotation

Goals

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

- Continue to expand the knowledge of CT anatomy and pathology begun in the first two rotations.
- Assist fellows and technical staff in the performance of CT angiography and its interpretation.

Objectives

Medical Knowledge

Identify the CT appearance of the following pathology:

- CT angiography of endostent placement
- CT angiography of renal donor evaluation
- CT angiography of liver transplant candidate
- Renal artery stenosis
- Accessory renal arteries
- Virtual colonoscopy

- Thoracic outlet syndrome

Fourth Rotation

Goals

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

- Continue to expand the knowledge of CT anatomy and pathology begun in the first three rotations.
- Assist fellows and technical staff in the performance of CT angiography and its interpretation.
- Participate in CT guided biopsy procedures.

Objectives

Medical Knowledge

Identify the CT appearance of the following pathology:

- CT angiography of endostent placement
- CT angiography of renal donor evaluation
- CT angiography of liver transplant candidate
- Renal artery stenosis
- Accessory renal arteries
- Virtual colonoscopy
- Thoracic outlet syndrome

Body CT Suggested Reading:

- Fundamentals of Body CT. 2e. Webb WR, Brant WE, Helms CA. W.B. Saunders Phila, 1998.
- Spiral CT. Principles, Techniques, and Clinical Applications, 2e. Fishman EK, Jeffrey RB Jr. Lippincott-Raven. 1998.
- Computed Body Tomography with MRI Correlation, 3e. Lee and Sagel. Lippincott-Raven. 1998.
- Helical (Spiral) Computed Tomography. A Practical Approach to Clinical Protocols. Silverman PM. Lippincott-Raven. 1998.
- Understanding Helical Scanning. Blanck C. Williams & Wilkins. 1998.
- ACR Contrast Manual. 5.0, American College of Radiology.
- Categorical Course Syllabus: Cardiovascular Imaging. American Roentgen Ray Society (ARRS)

EMERGENCY RADIOLOGY

Emergency Radiology Curriculum

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

Objective:

To define the content, structure for residents in Emergency Radiology.

Medical Knowledge

Central Nervous System

Skull fractures

Brain

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

Face and Neck

Facial fractures

- Orbital fractures: blow-out fracture
- Zygoma , Isolated arch, zygomatic complex
- Nasal fractures, naso-orbital-ethmoid fractures
- Frontal fractures
- Maxillary fractures: dentoalveolar, maxillary sagittal, LeFort

Mandible fractures

Ocular injuries: rupture, cellulitis

Paranasal sinusitis

Spine

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

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

Concept and Assessment of Instability. Concept: Mechanism of injury, radiographic patterns, normal variants, frequently.

Cervical Trauma

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

- Facet dislocation with fracture

Thoraco-lumbar trauma

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

Chest

Chest trauma

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

Cardiovascular Emergencies

Myocardium and Pericardium

- Myocardial infarction, laceration, contusion
- Pericardial effusion. tamponade, pneumopericardium

Aorta laceration, dissection, aneurysm

Pulmonary edema, various etiologies

Pulmonary embolism

Abdomen

Abdominal Trauma

Hemoperitoneum and intraperitoneal fluid

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

Non-traumatic Abdominal Emergencies

Peritoneal cavity

- Ascities, peritonitis, abdominal abscess
- Liver and biliary tract
- Jaundice: obstructive and non-obstructive
- Cholecystitis, pancreatitis
- Urinary tract
- Urinary stones, infection
- Pyelonephritis, renal abscess
- Gastrointestinal tract
- Gastrointestinal hemorrhage
- Bowel obstruction, bowel infarction, bowel infection

- Appendicitis, diverticulitis, Infectious enteritis and colitis
- Inflammatory bowel disease: Crohn disease, ulcerative colitis

Male Genitourinary emergencies

Urethral and penile trauma, foreign bodies, stones

Scrotal and testicular trauma

Acute non-traumatic scrotal conditions

- Testicular torsion
- Epididymitis, Orchitis, Epididymo-orchitis
- Acute fluid collections (Hydrocele, hematocele, pyocele)
- Infarction, Fournier's Gangrene
- Abscess

Upper Extremity

Dislocations:

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

Fractures:

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

Pelvis and Hip

Pelvis

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

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

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

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

Insufficiency fractures, Stress fractures

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

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

Hip

Dislocation

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

Fractures (usually associated with dislocation).

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

Proximal femur

- Slipped capital femoral epiphysis (SCFE)
- Salter-Harris physeal injuries
- Fractures
 - Head - usually associated with hip dislocation

Neck - subcapital, transcervical, basicervical
Trochanteric, intertrochanteric
subtrochanteric, isolated fracture, greater trochanter

Avascular necrosis

Lower Extremity

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

Compartment syndrome

Goals

Patient Care, Professionalism, Interpersonal and Communication Skills

Radiology residents will rotate through the Emergency Section during each of their four years of training. Over this time it is expected that residents will progressively develop their abilities to interpret imaging studies of emergency patients. Residents will be taught the practical clinical skills necessary to interpret plain radiographs. The skills to interpret “after hours” Neuroradiology, Ultrasound, Body CT scans, Nuclear Medicine, GI/GU and MRI exams will be taught in each of those specific sections.

The residents will learn about Musculoskeletal, Chest and Abdominal conditions, which can be seen in an Emergency Radiology situation. The radiographic abnormalities will be taught with one-on-one teaching and in Radiology Conference presentations. A recommended reading list is provided to assist the radiology residents with their individual study efforts to learn about radiographic findings in these emergent conditions/diseases.

The residents will learn to dictate concise and appropriate radiographic reports and to serve as consultants to referring physicians.

During the day (Mon-Fri 8AM-5PM) , the resident will learn to provide prompt written or phone reports for Emergency patients, University Health Service, Occupational Medicine Clinic or other Out-patient Clinic patients which need a STAT report. During the evening and on weekends, the resident will also provide STAT verbal reports for inpatients in an efficient and professional manner.

First year Residents (PGY 2)

Day (8AM-5 PM), Evening (5-9 PM) & Weekends/ holidays (8 AM-5 PM)

Knowledge Based Objectives

Medical Knowledge

- Learn the basic principles of Musculoskeletal, chest and Abdominal radiology with an emphasis on normal anatomy and normal variants on plain film exams.
- Learn the types of injuries and Pathophysiology associated with acute trauma, and acute medical and surgical conditions.
- Develop skills in the interpretation plain films of the chest, musculoskeletal and abdomen diseases in the setting of acute trauma.
- Understand the basic physics of radiography and computed radiography.
- Learn the basic principles of interpreting the emergent Nuclear Medicine exams: eg. V/Q lung scans.

Decision-Making/Value Judgment Skills

Patient Care

- Learn how to promptly provide a preliminary interpretation of plain film examinations and then review the preliminary interpretations with an attending radiologist.
- If there are any changes from the preliminary, the radiology resident should contact the appropriate referring physician and give the final interpretation report.
- Learn when to request a Pediatric radiology consultation for a complex child case (such as intussusception or child abuse).
- Learn the basic principles of assessing a portable C-spine, T- spine or lumbar spine exam to “clear” it before the radiologic technologist performs a complete spine exam.

Interpersonal and Communication Skills

- Learn the appropriate format for dictation of reports, using PowerScribe.
- Develop skills in providing consultations for house staff and clinic physicians on routine emergent imaging studies.
- Learn how to interact professionally with the attending Radiologist and attending Emergency physicians on emergent radiologic exams.

Second Year Residents (PGY 3)

Day (8AM-5 PM), nights (9 PM- 8AM) & weekends/ holidays (5PM-8AM)

Knowledge Based Objectives

Medical Knowledge

- Develop a greater understanding of the basic pathology and pathophysiology of trauma, tumors, infections, and inflammatory diseases.
- Continue to develop skills in the interpretation of emergent studies begun in the first year.
- Learn the CT findings of acute/emergent diseases.

Decision-Making and Value Judgment Skills

Patient Care, Interpersonal and Communication Skills, Professionalism

- Direct the choice of imaging modality and protocol emergent studies.
- Be able to identify those cases that require the additional expertise in assessment of imaging studies. Learn when to call an attending radiologist to provide expertise for complex CT, US, or fluoroscopic exams.
- Consult on Level 1 and Level 2 Trauma Emergencies to coordinate emergency radiologic exams and interpretations.

Third & Fourth Year Residents (PGY 4)

Nights (9 PM- 8AM) & weekends/ holidays (5PM-8AM)

Knowledge Based Objectives

Medical Knowledge, Interpersonal and Communication Skills

- Continue to expand knowledge of the anatomy, especially on cross-sectional imaging modalities.
- Develop more detailed understanding of the basic pathology and pathophysiology of diseases of the chest, bones and abdomen.
- Learn to prepare and present cases in clinical conferences for QA, teaching, and management.

Decision-Making and Value Judgment Skills

Interpersonal and Communication Skills, Professionalism, Patient Care

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

Body MRI

Through the four year residency in diagnostic radiology, each resident competes three, four week rotations in body MR. The following outline presents the goals and objectives for each four-week rotation.

First Rotation

Goals

Medical Knowledge, Interpersonal and Communication skills, Professionalism.

- Understand the basic physics of MR including TR, TE, T1W, T2W, Spin echo, Gradient Recall Echo imaging, and Inversion Recovery.
- Learn the basic principles of contrast distribution, particularly as applied to arterial and venous phase scanning.
- Protocol and monitor MR studies. Modify protocols when appropriate.
- Understand the principle of a saline chaser.
- Learn to recognize and treat contrast reactions.
- Develop skills in interpretation of basic MR pathology.
- Learn the appropriate format for dictation of MR reports.

Objectives

Medical Knowledge

Identify the MR appearance of the following pathology:

- Liver cancer
- Benign liver lesions such as cysts and hemangioma
- Pancreas cancer
- Lymphoma
- Retroperitoneal adenopathy
- Aortic Aneurysm
- Aortic Dissection
- Adrenal adenoma and cancer
- Gallstones
- Choledocholithiasis
- Ascites
- Cirrhotic liver
- Pancreatitis with pseudocyst and necrosis
- Renal cystic disease
- Obstructive hydronephrosis due to ureteral calculus
- Active arterial extravasation

Second Rotation

Goals

Medical Knowledge, Interpersonal and Communication skills, Professionalism, Patient Care.

- Refine interpretive skills with complex pathology.
- Understand the principles of Magnetic Resonance angiography.
- Be able to identify life-threatening findings, particularly with aortic aneurysms and grafts.
- Provide emergent provisional interpretation as needed.
- Be able to direct the choice of imaging modality and protocol emergent studies.
- Understand when referral to other imaging modalities is necessary.

Objectives

Medical Knowledge

Identify the MR appearance of the following pathology.

- Hepatic abscess
- Pancreatic abscess
- Renal abscess
- Groin pseudoaneurysm.
- Biliary cancer
- Budd-Chiari Syndrome
- Carcinomatosis with ascites
- Sequela of cryoablation
- Diaphragmatic hernia
- Focal nodular hyperplasia of the liver
- Hepatocellular carcinoma
- Islet cell tumor of the pancreas
- Renal oncocytoma
- Complications of renal transplantation
- Liver transplant complications
- Cystic pancreatic neoplasm
- Renal hypertension and varices
- Retroperitoneal fibrosis
- Von Hippel Lindau Syndrome

Third Rotation

Goals

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

- Continue to expand the knowledge of MR anatomy and pathology begun in the first two rotations.
- Assist fellows and technical staff in performance of CT angiography and its interpretation.
- Become a more autonomous consultant and teacher.

Objectives

Medical Knowledge

Identify the MR appearance of the following pathology:

- MR angiography of renal donor evaluation
- MR angiography of liver transplant candidates
- Renal artery stenosis
- Accessory renal arteries.
- Thoracic outlet syndrome
- Uterine fibroids
- Uterine anomalies
- Ovarian cysts
- Ovarian cancer
- Pelvic abscess
- Cardiac MR imaging including functional cardiac assessment
- Learn how to use the cardiac workstation
- Arrhythmogenic right ventricular dysplasia
- Cardiac perfusion imaging
- Myocardial viability
- Adult congenital heart disease
- Pediatric congenital heart disease
- Valvular heart disease

Conferences

Weekly conference in Cross-Sectional Imaging.

Body MR suggested Reading:

Body MRI:

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

Cardiac MRI:

1. Cardiac Imaging. The Requisites. Miller. Saunders. 2005.
2. Cardiovascular Magnetic Resonance. Manning. Saunders. 2002
3. Cardiovascular MRI and MRA. Higgins. Lippincott Williams. Sept. 2002.
4. Cardiovascular MR Imaging:Physical Principles to Practical Protocols. Lee. Lippincott Williams. December 2005.
5. Clinical Cardiac MRI. Bogaert. Springer. 2005.
6. MRI and CT of the Cardiovascular System. Higgins. Oct 2005.

MRI Physics:

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

MUSCULOSKELETAL RADIOLOGY

The musculoskeletal radiology rotation includes (three) four-week rotations, based at Strong Memorial Hospital and the Clinton Crossings out-patient facility, during the 1st, 2nd and 3rd years of the program. During each rotation, the resident is actively involved in the management and interpretation of musculoskeletal plain films, MR and CT examinations from the emergency room, orthopedic surgery clinic, primary care clinics and in-patients. In addition, the resident has the opportunity to learn writing protocols for CT and MRI examinations of the spine and the extremities. Another (two) four-week rotations are spent in SMH doing MR imaging of the musculoskeletal system. These two rotations are integrated as in neuroradiology and body imaging.

The resident is expected to have an understanding of the underlying anatomy, physiology, and pathology of the musculoskeletal system. In addition, the resident will need to know the relative indications and advantages and disadvantages of different imaging modalities, such as plain films, CT scanning, radionuclide bone scanning, and MR scanning. During interpretation of the films, the resident is expected to recognize conditions that require urgent or emergency management. These cases need to be quickly reviewed with faculty, and then the appropriate clinical staff contacted with results of the study. When dealing with patients and technologists, the resident will be expected to demonstrate professional behavior in all situations.

The didactic material for the rotations will be drawn from the curriculum for musculoskeletal radiology developed by the Education Committee of the Society of Skeletal Radiology and the American Society of Musculoskeletal Radiology.

In addition, the resident will need to learn common orthopedic procedures used for treatment of spine and sports medicine pathology. They will also learn proper imaging parameters of MR Imaging and how to interpret in detail MR Imaging of the spine and extremities. In addition to these imaging skills, the resident will be expected to learn the techniques for fluoroscopic guided injections of peripheral joints as needed for arthrography.

First, four-week rotation

Goals

Professionalism, Medical Knowledge, Interpersonal and Communication Skills

After completion of the first musculoskeletal rotation, the resident will:

- Demonstrate a responsible work ethic
- Demonstrate learning of knowledge based objectives
- Accurately and concisely dictate a skeletal radiograph report
- Communicate effectively with referring clinicians and supervisory staff
- Understand standard patient positioning in skeletal radiology
- Demonstrate the ability to obtain pertinent patient information relative to radiologic examinations.

Objectives

Medical Knowledge, Interpersonal and Communication Skills

At the end of the first musculoskeletal rotation, the resident will demonstrate learning of the entities include in the congenital anomalies and trauma section of the musculoskeletal objective. *These objectives are outlined in detail and available upon request:*

- Congenital and Developmental Abnormalities
- Trauma
- Joint Disorders
- Infection
- Tumors and Tumor-Like Lesions
- Metabolic, systemic, and hematologic disorders (basic)

Second, four-week rotation

Goals

Medical Knowledge, Interpersonal and Communication Skills

After completion of the second musculoskeletal rotation, the resident will:

- Demonstrate knowledge-based learning objectives with emphasis on infections and joint disorders, neoplasms and arthritis.
- Continue to build on image interpretive skills
- Develop protocol skills, monitoring, and interpreting musculoskeletal CT scans
- Develop skills in interpretation of musculoskeletal MRI

Objectives

The resident will demonstrate learning of the tumors and arthritis section of the musculoskeletal objectives.

Third, four-week rotation

Goals

Medical Knowledge, Interpersonal and Communication Skills

After completion of the third musculoskeletal rotation, the resident will:

- Demonstrate learning of knowledge-based objectives with emphasis on congenital tumors by metabolic and hematologic disorders
- Refine skills in interpretation of imaging of the musculoskeletal system
- Develop skills in interpretation of musculoskeletal MRI
- Become a more autonomous consultant and teacher

Objectives

At the end of the third musculoskeletal rotation, the resident will demonstrate his knowledge of 90% of the **knowledge-based** musculoskeletal objectives listed above.

NEURORADIOLOGY

Goals

Residents rotate through the Section of Neuroradiology during each of their four years of training. Over this time it is expected that residents will progressively develop their abilities to perform and interpret imaging studies of the central nervous system. Residents will be taught the practical clinical skills necessary to interpret plain radiographs, neurovascular ultrasound exams, CT scans, and MRI exams of 1) brain and skull; 2) spinal cord and vertebral column and; 3) head and neck. They will be instructed in the performance and interpretation of invasive procedures including cerebral angiography, myelography/spinal canal puncture, and imaged guided biopsies of the spine and skull base. The main rotations include neuroangiography, procedures and the reading room, but there may be cross over during these assignments. The goals and objectives listed below are, therefore, outlined by level of training.

The residents will receive instruction in the science that underlies clinical neuroradiology, in particular neuroanatomy and neuropathology. They will learn the physical principles of CT, MR, plain radiography, and digital angiography. They will learn the relative value of each modality, enabling them to choose the appropriate study and the appropriate protocol for each patient.

It is expected that residents will participate in the performance of examinations done by the section. They will obtain consents and perform intravenous injections of contrast. In order to perform these duties, the residents will learn the indications and contraindications for contrast administration. They will learn to recognize and treat adverse reactions. Residents will protocol and monitor CT and MR exams after they have demonstrated a sufficient level of knowledge and experience to perform these tasks. Residents will aid in the performance of invasive procedures including angiograms, myelograms, spinal taps and vertebral biopsies. They will learn to explain these procedures to the patients and their families obtain pre-procedure consent and write pre- and post-procedure orders. They will learn techniques of arterial puncture, catheter choice and manipulation, and contrast dosage. They will learn to recognize and treat complications of these invasive procedures.

The residents will learn to dictate concise and appropriate radiographic reports and to serve as consultants to referring physicians.

First year Residents (PGY 2)

Knowledge Based Objectives

Medical Knowledge

- Learn the basic principles of neuroradiology with an emphasis on normal anatomy of the skull, brain, spine, contents of the spinal canal and head and neck as identified on plain radiographs, CT and MRI.
- Develop skills in the interpretation plain films of the skull, facial bones and spine in the setting of acute trauma. Learn to interpret CT scans of the brain, spine, and head and neck with a particular emphasis on studies performed on individuals presenting with acute or emergent clinical abnormalities.
 - Brain - Infarction, spontaneous intracranial hemorrhage, aneurysmal subarachnoid hemorrhage, traumatic brain injury, infection, hydrocephalus, types of brain edema, brain herniation.
 - Head and Neck - fractures (orbital, facial and petrous), infection (sinusitis, orbital cellulitis, neck abscess) and airway obstruction.
 - Spine - trauma (stable and unstable injuries), degenerative disease, infection, neoplasm (vertebral metastases), and cord compression.

- Understand the basic physics of computed tomography (CT). Be familiar with various standard CT imaging protocols and imaging techniques including:
 - Use of various window and level settings;
 - Use of soft tissue and bone algorithms;
- Options in selecting slice thickness, interslice gap, and helical / multi-row scanner imaging parameters.
- Learn the basic physical principles of MRI and be able recognize and understand the clinical value of commonly utilized pulse sequences.
- Recognize and understand common imaging artifacts.

Technical and Non-interpretive Objectives

Patient Care

Contrast administration - Learn to obtain informed consent, by explaining the risks and benefits of contrast enhanced CT/MR to the patient. Learn appropriate techniques for injection of contrast (including use of power injectors). Learn to recognize and treat contrast reactions.

Decision Making/Value Judgment Skills

Interpersonal and Communication Skills

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

Second Year Residents (PGY 3)

Knowledge Based Objectives

Medical Knowledge

- Continue to expand knowledge of the anatomy of the brain and spine. Become familiar with the complex anatomy of the orbit, petrous bone, skull base and soft tissues of the neck (supra- and infra hyoid) as displayed on plain radiographs CT and MR. Have knowledge of established anatomic classification systems for each of these areas.
- Become proficient at the interpretation of plain radiographs and CT scans of the brain, head and neck, and spine.
- Develop a greater understanding of the basic pathology and pathophysiology of disease of the brain, spine, and head & neck including neoplastic and inflammatory lesions.
- Continue to develop skills in the interpretation of emergent studies begun in the first year. Learn the imaging features CT and MR of hyperacute infarction. Become familiar with the use of new MR sequences (diffusion, perfusion, and MR spectroscopy) for the detection of these lesions
- Develop the ability to use imaging findings to differentiate different types of focal intracranial lesions based on anatomic location (e.g. intra- vs. extra-axial), contour, intensity and enhancement pattern.
- Learn to identify and differentiate diffuse intracranial abnormalities (e.g. hydrocephalus and atrophy).
- Learn the vascular anatomy of the neck and head as displayed on catheter, MR, and CT angiography. Learn the indications, limitations, risks and benefits for each technique used for visualization of vascular anatomy.
- Develop a more detailed understanding of causes of density changes on CT and intensity changes on MR in a variety of lesions (e.g. intracranial hemorrhage).
- Become proficient at the assessment of the spine and contents of the spinal canal using a variety of imaging techniques including plain radiographs, CT, MR and myelography. The resident must understand spinal anatomy as displayed on multiplanar images including reformatted helical CT scans and MR scans a. Be able to diagnose and differentiate degenerative spinal diseases including disc herniations, spinal stenosis, endplate changes, and facet joint disease. b. Be able to characterize traumatic lesions and identify signs of instability.

- Be able to identify spinal cord compression and the cause for the compression (e.g. neoplastic involvement of the vertebral body, infection, and trauma).
- Learn the imaging features that allow for spatial classification of spinal lesions (extradural, intra-dural extra-medullary, and intra-medullary).
- Learn the differential diagnosis for each intra-spinal space.
- Become proficient at the identification of common lesions of the orbit, petrous bones, skull base and soft tissues of the neck.
- Be able to identify and characterize common inflammatory processes in the paranasal sinuses and mastoid bones.
- Identify and classify traumatic lesions of the facial bones, petrous bones and orbits using established classification nomenclature.
- Identify common inflammatory and neoplastic mass lesions. Have knowledge of criteria for identification and differentiation of causes of cervical adenopathy.

Technical and Non-Interpretive Objectives

Patient Care, Interpersonal and Communication Skills

- Learn to obtain informed consent for invasive procedures for including myelography, angiography and image guided biopsies. The resident must understand and be able to explain the risks, benefits and complications of these procedures to patients and their families.
- Learn to perform fluoroscopically guided punctures of the lumbar spinal canal for the purpose of myelography, spinal fluid collection, and intrathecal injection of medications.
- Assist senior residents, fellows, and attendings in the performance of angiograms, myelograms, and biopsies.

Decision-Making and Value Judgment Skills

Patient Care, Interpersonal and Communication Skills, Professionalism

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

Third Year Residents (PGY 4)

Knowledge Based Objectives

Medical Knowledge, Interpersonal and Communication Skills

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

Technical and Non-Interpretive Objectives

Patient Care, Interpersonal and Communication Skills, Professionalism

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

Decision-Making and Value Judgment Skills

Interpersonal and Communication Skills, Professionalism, Patient Care

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

Fourth Year Residents (PGY 5)

Goals

Medical Knowledge, Interpersonal and Communication Skills, Professionalism

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

Responsibilities

Patient Care, Interpersonal and Communication Skills, Professionalism

- Participate in the general performance of tasks within the section (e.g. contrast injection, patient monitoring) -see above
- Interpret CT scans under the supervision of an attending at least twice a week.
- Interpret MR scans at least three times a week under the supervision of an attending.
- Provide emergent and/or provisional interpretations ("wet readings") for house staff and attending physicians.

- Monitor and protocol CT and MR exams.
- Perform invasive procedures (spinal punctures, myelograms, CT guided biopsies and angiograms under the guidance of fellows or attending radiologists (goal: 15 procedures per block).

Neuroradiology Suggested Reading

General Texts

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

Reference Texts

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

Journals

- American Journal of Neuroradiology (AJNR)
- Radiology
- American Journal of Roentgenology (AJR)
- Neuroimaging Clinics of North America

NUCLEAR MEDICINE

ROTATION I

Knowledge Based Objectives

Medical Knowledge

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

- Demonstrate a thorough knowledge of the clinical indications, general procedures (including radiopharmaceutical and dose), and scintigraphic findings in: pulmonary (emboli) ventilation and perfusion imaging
- Discuss the basic physical principles of nuclear medicine imaging and instrumentation.
- Identify the isotopes (including physical and chemical properties) that are used routinely in the compounding or radiopharmaceuticals for nuclear radiology procedures

Technical Skills

Practice Based Learning and Improvement

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

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

Decision-Making and Value Judgment Skills

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

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

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

Rotation II

Knowledge Based Objectives

Medical Knowledge, Interpersonal and Communication Skills, Professionalism

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

- Demonstrate a thorough knowledge of the clinical indications, general procedures (including radiopharmaceutical and dose) and scintigraphic findings in:
 - renal and urinary tract studies
 - liver/spleen imaging
 - GI tract imaging and functional studies
 - thyroid imaging and functional studies
 - brain imaging and functional studies
 - tumor and abscess imaging

- Identify and discuss indications for isotopes used for therapeutic purposes
- Describe the protocol for using I-131 for treatment of hyperthyroidism and thyroid malignances, including protocol for hospitalization and monitoring of patients who receive over 30 mCi of activity.

Technical Skills

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

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

- Read and/or dictate films with the assistance/review of the faculty radiologist.
- Assist with radioactive therapy treatments, making sure the consent form is completed properly and that the appropriate dose is administered, giving particular attention to radiation safety practices during the procedure.
- Assist with preparation/presentation of cases for biweekly resident noon film review.

Decision-Making and Value Judgment Skills

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

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

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

ROTATIONS III, IV

Knowledge Based Objectives

Medical Knowledge, Interpersonal and Communication Skills

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

- Identify normal and abnormal findings on all imaging and functional studies, other than nuclear cardiology studies.
- 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.

Technical Skills

Medical Knowledge, Interpersonal and Communication Skills

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

- Review and dictate with the faculty radiologist all scans performed.
- Review cases.

Decision-Making and Value Judgment Skills

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

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

- Make preliminary decisions on all matters of film interpretation and consultation, recognizing need for and obtaining assistance in situations that require the expertise of the faculty radiologist.
- Comment on anatomical findings, scanning technique, and reasons for doing the study to RAD 401 students in such a way that the students will be able to develop an appreciation for the value of nuclear radiology procedures in patient management.

ROTATION V

Knowledge Based Objectives

Medical Knowledge, Interpersonal and Communication Skills

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

- Demonstrate a thorough knowledge of the clinical indications, general procedures and findings in:
 - myocardial perfusion studies (rest and stress)
 - myocardial infarct imaging
 - multi-gated acquisition imaging and function studies
- Describe the radiopharmaceuticals used in cardiac nuclear studies, including the methods of red cell labeling, patient dosages and physical properties of the isotopes.
- Discuss patient conditions and patient monitoring requirements, particularly in relation to exercise and drug stress studies.
- Process computer data obtained in each of the different cardiac studies.
- Discuss the range of invasive and noninvasive tests, test characteristics and the prognostic value of tests used to evaluate cardiac disease.

Decision-Making and Value Judgment Skills

Medical Knowledge, Interpersonal and Communication Skills

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

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

ROTATION VI

Knowledge Based Objectives

Medical Knowledge, System Based Practice

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

- Discuss the following information regarding all radiopharmaceuticals used in nuclear radiology studies:
 - production of isotopes
 - physical properties of isotopes
 - general elution and quality control
 - compounding of radiopharmaceuticals
 - radiochemical quality control
 - bio-distribution and mechanisms of localization
- Calculate patient doses, using information related to decay factors, volume concentration, and patient parameters.

- Describe the procedures and rationale for instrument quality control in nuclear medicine.
- Discuss rules and regulations that apply to the practice of nuclear radiology as outlined in 10CFR20 and other appropriate sources.
- Describe the types of records that must be maintained in order to comply with federal/ state guidelines for radiation safety and radioisotope receipt/us/disposal.
- Demonstrate an in-depth understanding of the physics of nuclear radiology.

Technical Skills

Medical Knowledge, System Based Practice

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

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

Decision-Making and Value Judgment Skills

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

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

Carry out the practice of nuclear radiology with due regard to quality control, quality assurance, and radiation safety for the patient and personnel.

PHYSICS AND RADIOPHARMACY

Medical Knowledge, System Based Practice

Provisions will be made throughout the rotation to

- Discuss the following information regarding all radiopharmaceuticals used in nuclear radiology studies:
 - production of radionuclides
 - physical properties of radionuclides
 - generator elution and quality control of eluate
 - compounding of radiopharmaceuticals
 - quality control of radiopharmaceuticals
 - biodistribution and mechanisms of localization
- Calculate patient doses, using information related to decay factors, volume concentration, and patient parameters.
- Describe the rationale and procedures for instrument quality control in nuclear medicine.
- Discuss rules and regulations that apply to the practice of nuclear medicine as outlined in 10CFR20 and other appropriate sources.
- Describe the types of records that must be maintained in order to comply with federal/state guidelines for radiation safety and radionuclide receipt/use/disposal.
- Demonstrate an understanding of the physics of nuclear medicine.
- Observe the compounding of radiopharmaceuticals from kits and do appropriate quality control procedures.
- Observe the elution of a generator and do appropriate quality control procedures.
- Observe the calculating and drawing up of patient doses.

- Demonstrate appropriate use of a survey meter to monitor radioactivity spills or contamination, and radioactive sources.
- Observe the performance of a wipe test.
- Observe the performance of quality control procedures on cameras, well/uptake probes, and dose calibrators.
- Observe the handling of radioactive sources according to the established guidelines.
- Observe the practice of nuclear medicine with due regard to quality control, quality assurance, and radiation safety for the patient and personnel.

PEDIATRIC RADIOLOGY

Goals

Residents rotate through the section of pediatric imaging for at least three, four-week blocks during their four years of training. . At the University of Rochester the experience includes exposure to plain radiography, GI and GU fluoroscopic procedures, body and musculoskeletal CT and MR, as well as all ultrasound procedures on children.

Over this time it is expected that each resident will progressively develop the ability to perform, interpret, and report results of imaging studies of children. Residents will be taught the practical skills needed to supervise, perform, interpret, and report fluoroscopic procedures and ultrasound examinations, to supervise, interpret, and report plain radiographs and body CT scans in children.

What is taught and applied in the pediatric imaging section will complement and be supplemented by what is taught in the other rotations that the residents experience. As the section of Pediatric Imaging Science at University of Rochester is not at this time performing or interpreting pediatric interventional procedures, nuclear medicine examinations, musculoskeletal MR or CT examinations, or pediatric neuro-imaging examinations and procedures (except spine and brain ultrasound), training in these areas will be responsibility of the interventional imaging science section, nuclear medicine section, musculoskeletal, and neuro-imaging sections of the Imaging Sciences Department, respectively.

Competencies and expectations are tailored to the residents' level of expertise, usually related generally to his/her level of training. Because case-mix is not predictable, it is not always completely possible to limit types of cases based solely on level of training, and we expect that exceptional cases will be reviewed and discussed by all residents.

General Competencies

Patient Care: Provide pediatric imaging patient care through safe, efficient, appropriately utilized, quality-controlled diagnostic imaging techniques. Interpret procedure findings. Effectively communicate with the referring practitioner in a timely manner. This includes evaluating exam requests and relaying results (see communication skills below).

- The resident should learn to prioritize urgent work.
- Determine and describe appropriate procedures for investigation of a child with symptoms or signs of disease or congenital anomalies including:
- Identify and describe normal/abnormal airways and respiratory tract abnormalities on a chest x-ray of children of all ages.
- Identify and describe abnormalities associated with congenital heart disease on the chest radiograph of children of all ages.
- Identify and describe normal and abnormal skeletal structures, with special attention to extremity and skeletal findings in trauma (including child abuse), neoplastic disease, bone dysplasias, hematologic and metabolic disorders, bone ages, and congenital/acquired scoliosis.
- Determine, describe, perform, and interpret appropriate fluoroscopic examinations. Identify and describe normal and abnormal gastrointestinal tract, and genitourinary tract in fluoroscopic examinations including single and double contrast upper GI, single and double contrast lower GI, pharyngogram, pH probe placement, VCUG, feeding tube evaluation and placement or replacement (except interventional procedures), and other "sinogram" studies tract on children of all ages utilizing low dose radiation exposure techniques.
- Determine, describe, and define techniques and protocols for CT scan. Identify and describe normal and abnormal chest, abdomen and pelvis findings in disease or congenital anomalies on children of all ages by CT scan.
- Determine, describe, review and assess, and perform when needed, pediatric ultrasound examinations of the brain, spine, general abdomen, pylorus, kidneys, pelvis, scrotum, hips, superficial lesions, and vascular lesions on children of all ages.

- Produce concise yet thorough and grammatical dictated reports on studies reviewed.

Medical Knowledge (see also patient care above):

Continuously learn about the diseases, especially related to imaging findings and procedures using current evidence. Apply appropriate diagnostic techniques to meet the imaging needs of the patients, referring practitioners, and health care system (see systems practice below). Information, feedback, and guidance is available from the pediatric imaging attendings and other clinicians. Books are available in the pediatric radiology section and in the department and hospital libraries; journals are available in libraries or web-based. *This standard does not vary during the training.*

Practice Based Learning and Improvement

Assess self and review with pediatric imagers regarding technique and results.). Be able to ask for and accept help.

Interpersonal & Communication Skills (see also patient care above):

Effectively and appropriately communicate with patients, families, technical and clerical staff, other radiologists, clinicians concerning appropriateness of requested studies, consent if needed, safety issues, and results. Improvement is through monitoring practice based learning (above). Be able to ask for and accept help.

Safety issues include: radiation doses, IV contrast, allergies and latex precautions, respiratory stability, dangers of aspirated contrast (gastrografin), leaked contrast (barium), and hypertonic intestinal contrasts of diatrizoate meglumine with diatrizoate sodium (“Gastrografin”).

Other radiologist issues include coordinating multiple studies for one patient related to the timing and sequence of the studies, sharing of vascular contrast, timing of sedation.

Professionalism

Commit to high standards of professional conduct; demonstrate altruism, compassion, honesty, and integrity. Follow principles of ethics and confidentiality. Consider age, religious, ethnic, gender, educational, and other differences in interacting with patients and their parents or other caretakers and with other members of the health care team. *This standard does not vary by level of training.*

Systems Based Practice

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

Expected competence by level of training

A resident should not limit involvement to only a specific level of training, but should seek to learn from all exceptional cases that occur.

First rotation notes and emphases:

Patient Care 1

- In general, any resident whose first rotation in the Imaging Science Residency is in the pediatric section will need to learn the mechanics of dictation, the use of the fluoroscope, and basic radiographic interpretation principles.
- All first rotation residents should concentrate on interpreting plain films of chest, abdomen, and extremities and performing and interpreting common and uncomplicated fluoroscopic studies: upper GI, single contrast lower GI, pharyngogram, pH probe placement, VCUG. This will include studies from ED and from pediatric and neonatal intensive care patients.

Practice Based Learning and Improvement 1

- The resident will be able to learn from attending radiologists, pediatric imaging fellows, more senior residents, and experienced technologists.
- The resident will receive extensive support and feedback.
- The resident will be expected to recognize difficulties and to appropriately request help in planning, performing, and interpreting.

Interpersonal & Communication Skills 1

- Basic Patient safety: Immobilization may be needed. The patient should not be able to fall. Protect the patient from loose needles and other dangerous objects.
- The resident should seek to gain the most information with the least radiation. Low or no radiation examinations should be considered before high dose examinations.
- Consider risk of renal damage from iodine based vascular contrast.
- Learn the relative dangers in various body cavities of barium vs. water-soluble contrasts.
- Be aware that intestinal contrasts of diatrizoate meglumine with diatrizoate sodium ("Gastrografin") are hypertonic and the potential consequences.

The resident will need to interact professionally and pleasantly with patients, families, technical and clerical staff, other radiologists, including explaining examinations and results to families, sharing results with other clinicians.

Systems Based Practice 1

- Try to be aware of coordination of patient care.

Second Rotation General Competencies

Patient Care 2

- Residents should update the fluoroscopic skills previously learned; this will be particularly important in those residents whose initial pediatric imaging rotations were at the early in the residency.
- Thereafter, the resident should be able to perform the basic procedures with less minute direction from an attending, and should seek to learn studies with more potential for complications such as intussusception reduction and tube placements.
- Residents should become able to guide the technicians in procedure organization and to prioritize pending studies by urgency.

The resident should participate more in review of Neonatal ICU radiographs.

- By the second rotation, residents will generally have experience in general CT and ultrasound and add those modalities to the first rotation skills.
- In addition to general pediatric chest, abdomen, and pelvis CT, the resident should seek to learn how to coordinate studies involving multiple body parts (e.g. body with neuro imaging or with musculoskeletal, or CT with nuclear medicine or MRI), and to coordinate patients requiring sedation.
- In addition to understanding how pediatric ultrasound studies differ from adult ones, the resident will participate in ultrasound studies of hips, spine, and brain in infants.
- Nonetheless, a resident should not limit involvement to only these more complex studies but should seek to reinforce previously learned material and to share unusual cases with other imaging residents including those with less training.
- Interpersonal & Communication Skills 2: By the second rotation, but resident should be better able to give initial urgent preliminary readings and to work with the referring physician, evaluating the requests made by referring physicians, and explaining results.
- The second rotation resident should be able to demonstrate imaging basics to medical students and pediatric residents.

Systems Based Practice 2

By the second rotation, residents will generally have experience in multiple modalities, and should be able to start to optimize coordination of patient care, to consult with other healthcare professionals, and to educate healthcare consumers regarding the most appropriate utilization of imaging resources.

Third Rotation

More experience in all of the above. Should be able to substantially help more junior residents and consult on most cases, although attending backup will be easily available.

The third rotation resident should be able to

- Prioritize by urgency
- Become more familiar and comfortable with special ultrasound procedures such as hip ultrasound, brain ultrasound, and pyloric stenosis evaluation.
- Have exposure to the spectrum of pediatric imaging including pediatric plain films, fluoroscopy, ultrasound, body and musculoskeletal CT and MRI.
- Provide a thorough pertinent differential diagnosis of disease processes identified on imaging examination.
- Further build upon existing interpretation skills.
- Further hone skills with pediatric GI and GU fluoroscopic procedures, ultrasound procedures, and in prescribing protocols for performing and interpreting pediatric body CT and MRI evaluations.
- Consolidate reporting skills, encouraging brevity without loss of clarity or completeness.
- To accept the graded responsibility provided, including substantially help technicians and more junior residents.

Schedule, hours, and vacations are per department policy.

PHYSICS OF MEDICAL IMAGING

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

Conferences

The primary course consists of approximately 23 one-hour lectures that survey all of the topics listed above and provide exposure to the kinds of problems encountered on the written boards. A syllabus is attached. This course is given annually during the winter/spring. In preparation for the ABR written boards in September, approximately nine, two-hour weekly focused review sessions are offered every summer. The review course emphasizes problem solving. A syllabus for this review course is also attached.

Goal

Medical Knowledge

Understanding of the basic physics and technology related to the nature and production of radiation and its interactions with matter.

Knowledge Based Objectives

- Review of basic physics
- Nature of electromagnetic radiation including x-rays and gamma rays.
- Structure of the atom: its nucleus and electron cloud.
- Interaction of radiation with matter.
- X-ray production, x-ray tubes and generators.

Suggested Reading and Study Materials

- The Essential Physics of Medical Imaging, 2nd Edition by JT Bushberg et al.
- Review of Medical Physics by W Huda
- Christensen's Physics of Diagnostic Radiology, 4th Edition, T. S. Curry et al.
- Course class notes

Goal

Understanding of the nature and components of image quality and the physics and technology of fundamental imaging techniques (not requiring computer assistance).

Knowledge Based Objectives

Medical Knowledge

- Image Quality
- Screen Film Radiography
 - Film
 - Screen- Film systems
 - Film Processing and QA
 - Geometrical considerations in imaging
 - Conventional tomography and chest radiography
- Mammography
- Fluoroscopy

Suggested Reading and Study Materials

- Course Class notes

- The Essential Physics of Medical Imaging, 2nd Edition by JT Bushberg et al.
- Review of Medical Physics by W Huda

Goal

Understanding of the physics and technology of the more technically sophisticated methods of medical imaging evolved over the last 40 years (requiring computer assistance).

Knowledge Based Objectives

Medical Knowledge

- Computers in Medical Imaging
- Digital Radiography
- Digital Subtraction Angiography
- Computed Tomography
- Ultrasound Imaging
- Nuclear Medicine Imaging
 - Radioactivity and Nuclear Transformation
 - Radionuclide production and radiopharmaceuticals
 - Radiation detection and measurement
 - Nuclear imaging methods

Suggested Reading and Study Materials

- Course class notes
- The Essential Physics of Medical Imaging, 2nd Edition by JT Bushberg, et al.
- Review of Medical Physics by W Huda
- Nuclear Medicine Physics - the basics, 5th Edition by R Chandra
- Diagnostic Ultrasound, Principles and Instruments, 5th Edition, by F. W. Kremkau

Goal

- Understanding of radiation safety, dosimetry, and radiation biology
- Understanding the principles and technology of Nuclear Magnetic Resonance and Magnetic Resonance Imaging.

Knowledge Based Objectives

Medical Knowledge

- Radiation protection
- Radiation dosimetry
- Radiation biology
- Basics physics of NMR
- MR imaging pulse sequences
- MR image formation
- Parameters that affect MR imaging time and SNR
- MR imaging options
- MR imaging artifacts
- MR angiography

Suggested Reading and Study Materials

- Course class notes
- The Essential Physics of Medical Imaging, 2nd Edition by JT Bushberg et al.
- Review of Medical Physics by W Huda
- MRI the Basics by R Hashemi & W Bradley
- A Non-Mathematic Approach to Basic MRI by H-J Smith & F Ranallo
- Questions and Answers in Magnetic Resonance Imaging, by A. D. Elster

ULTRASOUND

Rotation I

Behavioral Objectives

Medical Knowledge, Interpersonal and Communication Skills

- At the end of the rotation, the resident should be able to
- Discuss thoroughly the ultrasound procedures and findings in
- gallbladder/biliary tree ultrasound
 - cholelithiasis
 - cholecystitis
- renal ultrasound
 - obstruction
 - renal failure
- duplex Doppler
 - venous thrombosis of extremities
- Understand anatomic relationships and be able to individually image intra-abdominal organs-liver, spleen, kidneys, gallbladder, biliary tree, aorta, IVC. Be familiar with common intra-abdominal pathology.
- Be able to turn on a machine, select the appropriate exam program and transducer, enter patient data and annotate images.
- Understand basic doppler and vascular principles to interpret extremity DVT studies and flow (i.e., R/O portal vein thrombosis).
- Identify fluid collections in the chest, abdomen and pelvis to localize.
- Learn basic US triage – which exams should be performed by US, and which by another modality, i.e. IVP, CT.

Technical and Performance Skills

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

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

- Perform basic abdominal ultrasound.
- Advise the technologist about special views or specific parameters of the study that require special attention.

Decision Making and Value Judgment Skills

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

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

- Given an ultrasound case, make a preliminary review of the images and advise the technologists when additional views or repeat views are needed.
- Provide preliminary reports on routine abdomen/pelvis/extremity cases.

Recommended Reading List

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

Rotation II

Behavioral Objectives

Medical Knowledge, Patient Care, Interpersonal and Communication Skills

Knowledge Based Objectives

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

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

Technical Skills

Interpersonal and Communication Skills, Patient Care, Professionalism

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

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

Decision Making and Value Judgment Skills

Patient Care, Professionalism, Interpersonal and Communication Skills

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

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

Recommended Reading List

- Diagnostic Ultrasound by C Rumack
Small Parts chapter
- Ultrasound: The Requisites by Middleton
- Ultrasound Secrets by V Dogra, D Rubens
Vascular, Pelvic and Small Parts chapters
- Ultrasound in OB & Gynecology by Callen

Rotation III

Behavioral Objectives

Knowledge Based Objectives

Medical Knowledge, Interpersonal and Communication Skills, Professionalism

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

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

Technical Skills

Patient Care, Medical Knowledge

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

- Become adept at performance of doppler examinations, including carotids, extremities, abdomen, renal and liver transplants.
- Become proficient in endocavitary scanning (transvaginal, transrectal)

Decision Making and Value Judgment Skills

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

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

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

Recommended Reading List

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

Rotation IV

Behavioral Objectives

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

Knowledge based objectives

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

- Be able to run the entire US service – QA all exams, supervise junior residents or medical students, sonographers; check exams for adequacy, appropriateness, add or subtract exams, etc.
- Become familiar with specialty US exams; transcranial doppler, penile doppler, shunt and fistulae exams, intra-operative US, endoluminal (GI) US. Contrast US exams.
- Participate in US/clinical research.

Technical Objectives

Medical Knowledge, Interpersonal and Communication Skills, Professionalism

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

- Refine all scanning skills to include some subspecialty exams.

Recommended Reading List

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

RESIDENT ROTATIONS IN WOMEN'S IMAGING

Introduction

Residents complete three four-week rotations in mammography, which includes breast ultrasound, breast interventional procedures, and breast MRI during their radiology residency. The first rotation is taken during the first two years of training, the second rotation during the third year, and the final rotation during the last year of residency. This schedule allows residents to be qualified to interpret mammograms independently after successful completion of their residency. Residents are instructed in breast anatomy, physiology, pathology, mammography interpretation and problem solving methodology, equipment and quality control issues, breast ultrasound, breast interventional procedures, mammographic reporting, and medicolegal aspects of mammography.

First Rotation

Goals

System Based Practice, Patient care, Interpersonal and Communication Skills

- Be able to dictate a mammogram report and be able to apply ACR lexicon and use BIRADS
- Understand basic mammographic positioning
- Be able to obtain pertinent patient information and determine if a mammogram is screening or diagnostic
- Begin to understand the work-up and evaluation process for breast masses and calcifications.

Objectives

Medical Knowledge, System Based Practice, Patient Care, Professionalism

At the end of the first rotation, the resident should demonstrate knowledge of the following:

- Normal breast anatomy
(identity normal breast structures including skin, Cooper's ligaments, pectoral muscle, inframammary fold, retromammary fat.)
- Be able to determine if the standard CC and MLO views are performed adequately by the ACR criteria
- Use ACR Lexicon for describing calcifications and masses
- Define TDLU
- Be able to evaluate calcifications as to benign or malignant depending on their morphology and distribution. Be able to recognize obviously benign calcifications such as, fat necrosis, secretory disease, dystrophic calcifications, indeterminate and malignant calcifications.
- Be able to evaluate breast masses as to benign or malignant depending on their morphology, density, margins. Be able to identify cysts, fibroadenomas, hematomas, phyllodes tumors, intramammary lymph nodes, malignancy
- Understand role of breast ultrasound in evaluating breast masses
- Understand the principles of and be able to discuss indications and contraindications and perform a stereotactic core biopsy.
- Be able to perform needle localizations under mammographic/ultrasound guidance, be able to describe principles, indications, contraindications for excisional biopsies
- Be able to evaluate specimen radiographs for adequacy of excisional biopsy
- Be able to localize lesion in the breast from the mammographic images and be able to apply the triangulation principle
- Select 4-5 mammography biopsy cases and present a mammo/path conference for faculty

Second Rotation

Goals

Medical knowledge, Patient Care, System Based Practice

- Continue to develop mammographic skills and start to develop problem-solving techniques
- Become familiar with breast MRI
- Expand knowledge base of pathologic processes of the breast.
- Demonstrate an understanding of breast physiology
- Demonstrate an understanding of basic mammographic QA.

Objectives

Interpersonal and Communication Skills, Medical Knowledge, Professionalism

By the end of the second mammography rotation the resident should be able to

- discuss indications and techniques to perform diagnostic mammographic views including spot compression views, magnifications views, 90 degree ML or LM views, rolled views, axillary tail, implant displaced views, tangential views, exaggerated CC views.
- describe the different subtypes of ductal carcinoma in situ
- define and identify breast implant ruptures both intra and extracapsular. Be able to discuss work-up of patients with suspected implant rupture and limitations and indications of mammography, US, and MRI.
- identify which part of the TDLU specific cancers arise from (ductal versus lobular)
- recognize physiologic changes from mammographic findings including weight changes, HRT, lactation, CHF, renal failure, venous or lymphatic obstruction, infection, radiation changes.
- discuss indications for performing FNA under US guidance and be able to perform these procedures
- perform mammo/path correlation on all FNA procedures performed
- describe daily (processor QC and sensitometry), weekly (phantom image testing), quarterly (fixer retention test, repeat analysis), semiannual (darkroom fog, screen-film contact test, compression device performance), and annually (AEC, focal spot condition, radiation output etc) QA Tests.
- describe indications and limitations of breast MRI (prelumpectomy patients, high risk patients, implant patients, post biopsy patients looking for recurrence, lesions only seen on one mammo view in a dense breast)

Third Rotation

Goals

Interpersonal and Communication Skills, Medical Knowledge, Professionalism, System Based Practice

- Expand on problem solving techniques for mammographic evaluation
- Expand on breast MRI knowledge base
- Be able to discuss screening mammography data and controversies; be familiar with most recent recommended screening guidelines and screening theory
- Learn requirements of mammography audit
- Familiarity with [ACR Mammography Quality Control Manual](#)
- Familiarity with ACR and FDA requirements for accreditation
- Familiarity with medicolegal problems of breast imaging.

Objectives

Interpersonal and Communication Skills, Medical Knowledge, Professionalism, System Based Practice

By the end of the third rotation the residents should be able to

- work-up breast problems using a combination of mammography, US, MRI, and interventional procedures
- discuss screening controversies, what current recommendations of the ACS, ACR, AMA are, what is lead-time bias, interval cancer rate, prevalence vs. incidence screening, definition of lead-time
- perform a mammography audit, know definition and desirable goals for PPV, percent node positivity, percent Stage 0 or 1 tumors, recall rates, sensitivity, specificity, false negative rate
- assist the radiologist in preparing for ACR/FDA site inspections, be familiar with requirements and implementation of the regulations
- evaluate screening mammograms for suitability to use as clinical images for ACR inspection, assess proper positioning, compression, exposure, contrast, sharpness, noise of images
- describe ACR Standards for stereotactic biopsy and image-guided breast biopsy accreditation programs
- describe ACR Standards for diagnosis and management of DCIS
- discuss medicolegal aspects of screening, problem-solving mammography, and interventional procedures
- recognize appearances and causes of multiple film artifacts including roller marks, grid lines, motion unsharpness, noise, dust, pick-off, poor film-screen contact
- recognize and be familiar with postoperative changes on mammography, US, and MRI.

Recommended Reading:

1. Breast Imaging: The Requisites by Debra Ikeda, James Thrall
2. Breast Imaging Companion by Gilda Cardenosa

References:

1. Breast Ultrasound by Stavros
2. Breast MRI, Diagnosis and Intervention by Elizabeth Morris and Laura Liberman

THE CLINICAL PATHWAY FOR VASCULAR AND INTERVENTIONAL RADIOLOGY

INTRODUCTION

The Society of Cardiovascular and Interventional Radiology recognizes the lack of training options for individuals interested in obtaining a broader clinical and research experience in the pursuit of a career in vascular and interventional radiology (VIR). To address this deficiency, a clinical pathway has been proposed for trainees interested in obtaining a more in-depth clinical and research experience in the field of VIR.

- The primary intent of this Pathway is to provide a broader and more in-depth experience in the clinical diagnosis and care of patients with diseases commonly treated by VIR.
- The secondary intent of the pathway is to allow the trainee an opportunity to become more familiar with and/or participate in research to further the field of VIR.

REQUIREMENTS

The Clinical Pathway is recommended for physicians who are planning a career that focuses primarily on the subspecialty field of VIR. Other physicians whose primary interest is not VIR should pursue the standard five years of training in Diagnostic Radiology. Entry into Clinical Pathway implies a commitment to its completion.

Because of the uniqueness of this program, the trainee must work closely with the radiology residency and the VIR fellowship program directors to design an appropriate training plan that provides adequate clinical radiology experience in order to meet both the ABR and CAQ requirements for Diagnostic Radiology and VIR, respectively, during a six year training period. Planning for this Pathway should occur either as a medical student or during the PGY-1 year. In special circumstances, exceptions can be made as late as the PGY-2 or the PGY-3 year.

Although it is preferable for the individual entering the Clinical Pathway to do all six years of training at one institution, in certain situations, it would be acceptable for the individual to obtain the PGY-1 year of training at one institution, The PGY-2 through 5 years of training at a second institution, and the PGY-6 year of training at a third institution (or any combination of the above), as long as all the training programs are ACGME-approved.

TRAINING

The total period of training is designed to comply with the normal six-year (combined) requirement for a Diagnostic Radiology residency and a VIR fellowship training program.

➤ **Clinical Patient Care Training**

A minimum of twelve months of direct patient care in the PGY-1 year is required in an ACGME-approved program in Internal Medicine or its subspecialty areas (i.e. cardiology, nephrology, pulmonary, critical care, gastroenterology, or hematology/oncology); Pediatrics; General, Cardiovascular, Pediatric, Thoracic, or Urological Surgery; Family Practice; Emergency Medicine; OB-GYN; or any combination of these specialty areas.

➤ **Clinical Radiology Training**

Thirty-two months of full-time clinical radiology is required including three months of VIR during the PGY-2 and/or PGY-3 year. Because of the attenuation of the traditional clinical radiology training, it will be imperative that the Radiology residency and VIR Fellowship program directors make annual evaluations regarding the resident's progress in clinical radiology. This diagnostic clinical radiology training will be obtained during the PGY-2, 3, and 5 years.

- **Vascular and Interventional Radiology Training**
Nine months of subspecialty training in VIR will be required during the PGY-4 year. These nine months could include training in the noninvasive peripheral vascular lab, MRA, CTA, neuroangiography, neuro-interventions, cardiac MRI or VIR. In addition, the individual will be required to spend the PGY-6 year in an ACGME-approved fellowship training program in VIR.
- **Research/VIR Clinical Training**
Seven months will be dedicated to research and clinical training in areas relevant to the practice of VIR (i.e. consult service for cardiology, nephrology, vascular surgery, oncology, gastroenterology). Of these seven months, the trainee shall have a minimum of 3 months dedicated to basic or clinical research activities.
- **Call Service**
During the VIR rotations in the PGY-4 year and non-radiology clinical training rotations during the PGY-2 through five years, call responsibility for the trainee, will be determined by the Residency, and Fellowship Program Directors.

**CLINICAL PATHWAY
VASCULAR AND INTERVENTIONAL RADIOLOGY**

YEAR	DESCRIPTION	DURATION
PGY-1	Transitional-clinical year	12 months
PGY-2, 3, 5	Clinical Radiology (<i>*includes 3 months VIR during PGY-2 and/or 3</i>)	32 months
PGY-4	*Vascular-Interventional Radiology	9 months
PGY-2-5	Clinical Training and Research	7 months
PGY-6	Vascular-Interventional Radiology Fellowship	12 months
Total Training		72 months

** Not to exceed 12 months total during PGY-2-5 years*

Trainees who leave this Pathway must complete the standard five years of training, including four years of clinical radiology.

- **Assessment of Training Quality**
The following are criteria that might be used to evaluate performance.
- **Clinical**
 - Quarterly evaluations while on the vascular and interventional radiology and clinical services
 - Participation in VIR, clinical, and multi-disciplinary conferences
 - Number of patients admitted and followed
 - Number of formal consultations done
 - Number and type of procedures participated
- **Research**
Participation in
 - Research
 - Seminars, journal clubs, etc.
 - Publications and patents
 - Presentations at scientific meetings
 - Grant proposals
 - Honors

➤ **Environment for Clinical Training**

An environment suitable for providing the trainee an opportunity to directly participate in inpatient and outpatient clinical care and follow-up of disease processes pertinent to the practice of VIR shall be available.

The trainee shall also have a clinical mentor who is either CAQ-certified or eligible in VIR. The mentor shall have experience in the management and care of patients frequently seen by a VIR service.

➤ **Environment for Research Training**

An environment suitable for a positive research experience should exist. This environment should include adequate space, equipment, clinical volume, funding, and a central mass of mentors and support personnel in VIR. The research mentor, who may be the same individual as the clinical mentor, must accept the responsibility for supervision or assignment of supervision of the trainee's research experience.

NUCLEAR MEDICINE RESIDENCY PROGRAM

Diagnostic radiology residents spend six months in Nuclear Medicine to fulfill the [American Board of Radiology \(ABR\)](#) requirements.

The department also offers a two-year training ACGME accredited program for the [American Board of Nuclear Medicine \(ABNM\)](#) in its Division of Nuclear Medicine. This will likely increase to a three-year program once the new RRC guidelines are implemented in 2007. The program currently accepts two candidates per year for training in the nuclear medicine residency program

The Division of Nuclear Medicine is located on the ground floor of the hospital, where it occupies approximately 3600 square feet of floor space. Within this space are offices for staff and residents, imaging and patient examining, injection rooms, radiopharmacy preparation, quality control and dispensing laboratories, *in-vitro* and counting laboratory, conference and reading room, staff lounge as well as waiting rooms. The Division has three dual headed SPECT cameras including one with a thick crystal for high energy imaging, one single head SPECT capable gamma camera, and two additional cameras for planar and portable imaging plus a thyroid uptake probe and a wet room for in-vitro studies. The PET CT Center, opened in 2005, is located at University Imaging at Science Park. It houses both clinical and research facilities.

All imaging systems are on the enterprise Ethernet and can communicate with each other via a state-of-the-art HERMES nuclear medicine PAC system that also interfaces with a department-wide PAC system. Studies are read directly from monitors. Cross-sectional data can be registered across different modalities using sophisticated software. The division has a large thyroid cancer clinic, and is actively involved in radioimmunotherapy with newer agents.

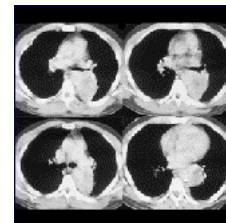
Residents are thus exposed to a very wide variety of diagnostic and therapeutic procedures in nuclear medicine. Perfusion imaging of the heart is further aided by rotations to the Nuclear Cardiology Laboratory of the Department of Cardiology, while other types of cardiology studies such as first pass, MUGA and PET viability studies are performed within the Division. There is active co-ordination with Endocrinology and Oncology in offering team care for patients. The total number of procedures is approaching 10,000 cases per year. There are two full-time and two part-time faculty available in the Division of Nuclear Medicine, in addition to the Radiology clinical and research faculty.

FELLOWSHIP PROGRAMS

The Department of Imaging Sciences offers one or two-year fellowships for further experience and training in several specialty areas.

Body Imaging Radiology

This one-year program is devoted to further training in non-neurologic ultrasound, CT, and MRI. Faculty expertise includes interventional ultrasound, spiral CT and CT angiography, MR, musculoskeletal MRI, and outcomes research. Fellows develop expertise in these fields, and participate in resident teaching and research projects.

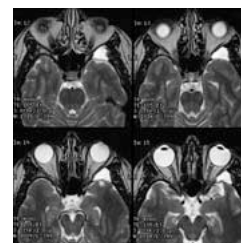


Emergency Radiology

This one-year fellowship provides specialized training in imaging of infants and children in the Emergency Department. Plain film interpretation is emphasized, but fluoroscopy, CT, MR, Nuclear Medicine and Ultrasound are included. There are about 90,000 Emergency Radiology exams performed each year. Clinical research opportunities are available. Close interactions with Emergency colleagues develops expertise as a consultant. Fellows assist in resident and student teaching.

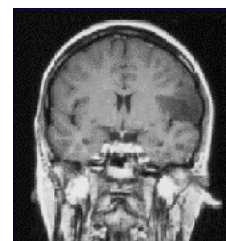
Magnetic Resonance Imaging at University Medical Imaging (UMI)

A one year fellowship program at the outpatient imaging center of the University of Rochester is available. The outpatient center performs over 10,000 MR exams per year using two 1.5 Tesla echoplanar magnets. This fellowship program offers training in neuro, musculoskeletal and body MRI. Fellows will receive an excellent clinical experience. They are required to perform research that culminates in publication.



Neuroradiology

This one or two-year fellowship provides training in interpretation of all aspects of neuroradiology: angiography, myelography, CT, MRI, and related procedures. Fellows may also participate in interventional neuroradiology procedures. During the second year of the two-year fellowship, a one month elective is offered in pediatric neuroradiology or interventional neuroradiology or other pertinent areas at an outside institution. Resident teaching and research is encouraged. There are three full-time faculty members.



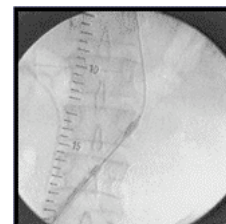
Pediatric Radiology

This one-year accredited fellowship provides specialized training in all imaging of infants and children. Plain film interpretation, fluoroscopy, CT, MRI, and ultrasound are stressed. There is a high volume of neonatal and oncology work. Teaching and research opportunities are available. Close association with pediatric colleagues develops expertise in consultative abilities. The fellowship is fully accredited by the ACGME.



Vascular-Interventional Radiology

A one-year accredited fellowship (ACGME) is offered in all aspects of vascular imaging and vascular and non-vascular interventional radiology. Over 6,000 examinations are performed annually. Fellows will develop technical skills for these procedures and will assume progressive responsibility for the clinical service. Fellows also participate in resident teaching and research.



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

Departmental

Two daily lectures or case conferences are given by faculty on Monday through Friday 11:45 – 12:30 pm and 12:30 pm – 1:15 pm. Grand Rounds, presented by a visiting professor, faculty, or resident, are held on Thursdays from 12:30 - 1:15 pm. **Residents are required to give Grand Rounds once during their residency during their second year.** Resident attendance at these conferences is required, and reported with each resident's semi-annual performance evaluation. Each resident is responsible for arriving at conference on time. A yearly conference schedule is distributed to all residents, fellows, and faculty.

The Education Committee has approved (**06/19/06**) the following policy on resident conference attendance:

- “Resident attendance at conference is **mandatory**, and will continue to be monitored, and incorporated into the six-month resident performance reviews.
- Residents **must initial** the sign-in sheet at every resident conference, Grand Rounds Conference, and required core curriculum conference provided by the hospital, and conferences given by outside speakers when residents are notified (via the conference schedule or other notification) to attend.
- Residents are excused from conference when post-call, sick, at an approved meeting (including any approved meeting time) or on vacation. **Delayed notification will not be acceptable.** A resident must attend at least 90% of required conferences, excluding those for which he/she is excused, to be eligible for elective study rotation. This 90% will be cumulative up to the time the resident wishes to take the elective (i.e. an 85% attendance record in one six-month interval and a 95% record in the following six-month interval results in a cumulative record of 90% attendance.).
- The noon-time conference held from 11:45 am to 1:15pm every working day of the week is mandatory for the radiology residents to attend, **including residents on the angio rotation**, exception is if the resident on the angio rotation is in the middle of a procedure. This policy takes effect immediately.”

Journal Club

Journal Club conference is held on a monthly basis and provides the resident an opportunity to discuss topics found in current medical literature. Powerpoint presentations are required and the presentation must be approved by the Program Director in advance.

Interdepartmental Conferences

There are numerous interdepartmental conferences and work rounds. At these, cases of interest to the relevant service are discussed primarily from a clinical point of view, but with varying degrees of radiological relevance. Either an attending radiologist or a fellow may present the case. Depending upon the clinical work situation, residents are encouraged to attend.

Senior residents organize Oral Boards review sessions with the faculty, and each year, over 50 one-hour sessions are provided. Sessions occur before 7:30 a.m. conference, between 12:00-1:00 p.m. (when no conference is scheduled), or after 4:30 p.m.

Numerous interdepartmental conferences with radiologist participation are held each week. Residents are required to attend many of these conferences as part of their responsibilities on assigned rotations.

Core Curriculum

Presentations on core curriculum topics are provided by both the institution throughout the year, and as a joint effort by the American College of Radiology (ACR) and the Association of Program Directors in Radiology (APDR). The ACR/APDR curriculum consists of a series of videotaped lectures on non-interpretive issues that are shown to residents throughout the year. Topics include: Job Search and Contracting Issues, Practical Business Issues in Radiology, Critical Thinking Skills, Ethics, ACR Standards, Accreditation Programs and Appropriateness Criteria, Service Orientation/Interpersonal Skills, and Medical Organizational Politics, Radiation Biology, Clinical Trials. Other items considered to be part of the core curriculum are Professionalism, Resident Fatigue and Impairment, Competency and Education in Legal Medicine

Continuing Medical Education

- *Angio Club*
Angio club is open to all the residents. This consists of case presentations and outside talks. CME credit is available for these conferences. Interested residents are also welcome to the Vascular Surgery Journal club. A monthly forum is provided to address hot topics in vascular surgery and interventional radiology.
- *Rochester Roentgen Ray*
Residents are welcome (free) to the monthly Rochester Roentgen Ray meeting where topics in general radiology are discussed. All the residents will be informed of the monthly meetings in their mailbox.
- **PACS**



PACS 2007 7th Annual Conference March 20-23, 2007

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- Advanced Visualization
- Information Systems
- Workflow and Productivity
- Impact of Digital Environment on Clinical Specialties
- Security and Risk Management
- Storage and Storage Management
- Advanced Technologies
- Implementing RIS, PACS, CPOE and EHR

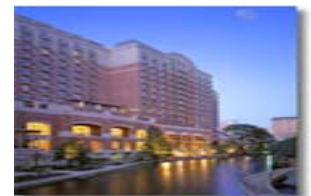
- ***Women's Imaging***



Women's Health 2007

January 22-24, 2007

- Mammography and CAD
- Managing Pelvic Disease
- Screening for Osteoporosis
- Approaches to Breast Biopsy
- Cardiac Evaluation in Post-Menopausal Women
- Implementing a Digital Environment
- Cardiac Evaluation in Post-Menopausal Women
- Using PET/CT to Diagnose and Manage Cancer in Women



Departmental Library

In addition to the medical school library (Edward G. Miner Library), there is a departmental library consisting of a suite of three rooms. It has been named in honor of Dr. George Ramsey, professor and head of the department from 1948-1960. It is furnished through contributions from a fund donated by previous residents and friends of Dr. Ramsey.

The main reading room is stocked with current periodicals, journals and books of interest to radiology. Periodicals and journals are also available through the chairman's office and other faculty. The library committee is always appreciative of information concerning books thought to be of value to the residents. Video presentations, and the computerized teaching files are now located in the main reading area along with the residents' computer equipped with CD ROM. The teaching files are an excellent teaching aid as one progress through the residency; they are especially helpful in the resident's later years for general review.

The middle room includes space for the librarian. The librarian's main duty is to assist departmental faculty and residents in literature searches and maintain teaching material sign-outs for books, periodicals and videos, and adding to this file. Additional teaching file materials and periodicals are available in many faculty offices.

Teaching file

Residents must place **two** cases into the teaching file annually to progress to the next year. These cases must be approved by the education committee and will be the beginning of the resident's portfolio in the evaluation of core competencies.

RESIDENT DUTIES AND RESPONSIBILITIES

Night Call and Weekend Duties

Call responsibilities are divided into junior (1st years) and senior (2-4th year) call divisions. Junior call is taken in addition to that resident's primary rotation. It extends from 5pm to 9pm Monday through Friday and 8am to 5pm Saturday and Sunday. This resident is expected to stay if needed to ensure a smooth transition between shifts. Junior call is taken directly with an attending. This resident is responsible for general activities including conventional radiography, nuclear medicine, and fluoroscopic procedures. The senior call pool provides in-house late night and overnight coverage. The CTSC (CT and senior call) resident works Monday through Friday from 12 pm to 9 pm, providing CT body support from 12 pm to 5 pm, and covering body CT, US, MRI, and Highland Hospital teleradiology from 5 pm to 9 pm. The designated first night float resident works Sunday through Friday from 9pm to 8am and is primarily responsible for plain films, nuclear medicine studies, fluoroscopic examinations, and teleradiology. The second night float resident works Sunday through Friday from 9pm to 8am with primary responsibility is of providing interpretation of CT/US/MRI examinations. However, both residents are encouraged to work as a team so that prompt accurate medical care is provided. These residents provide preliminary interpretation of conventional studies for both inpatients and emergency department patients and ensure that the information is accurately and efficiently conveyed to the referring physicians. These residents are representatives of the department and are responsible for ensuring the smooth operation of our services while on their shift. These residents need to be available for consultation with emergency department staff and resident physicians to demonstrate radiology's commitment to attentive, responsive medical service.

With regards to all night call, if ever a clinical problem arises with which the resident is uncomfortable in handling, the various subspecialty sections have faculty +/- fellows on call for immediate assistance including becoming available onsite. Vascular-Interventional Radiology call is delegated to the resident who rotates on that service.

The resident will be asked to make judgments as to whether imaging is indicated in a particular clinical setting, and if so, what sequence should be followed. Coordination with on-call technologists and physicians is necessary. It is expected that the resident will be able to expedite most problems. To do this effectively, the resident has to maintain a close liaison with clinical colleagues and be familiar with the patient. On duty residents are responsible for reviewing examinations with radiology faculty at the 7am review time and before going off duty at the end of the day as appropriate. As in regular daily work, follow-up of interesting patients can be very educational.

Similar responsibilities apply to weekends and holidays. The resident who is to be relieved has an obligation to stay and continue to function until an orderly transition is possible. The incoming resident should receive a verbal/written sign out regarding any problems or scheduled examinations still to be performed.

The Strong Memorial Hospital Imaging Sciences Department operates at nearly full service 24 hours a day, seven days per week. Supervision and timely interpretation of weekend and holiday procedures require additional weekend and holiday duty responsibilities for residents on most sub-specialized services (i.e., cross-sectional imaging, neuroradiology, and vascular interventional radiology). The resident performs these services with a fellow/faculty in attendance.

The chief resident(s) are in charge of resident daily schedules including conferences and handles on-call issues. Evening call rotation, weekends and holidays, are scheduled as evenly as possible, by the chief residents. Holiday coverage can usually be arranged so that no resident will be required to cover the same holiday more than once during a four-year period. In general, it is expected that the more junior residents will cover Christmas and New Years.

All residents are expected to share call. Absence due to illness will have to be "repaid" to the resident by a factor of two to the resident who was called to substitute in that resident's absence.

Night Float/ED Rotation

Six to eight, two-week emergency radiology night float rotations are assigned to each resident after approximately 12 to 18 months of initial supervised evening duty. This requirement is based on the curriculum established by the residency committee and occurs primarily in the PGY-3 and PGY-4 years, with limited overnight call in the PGY-5 year. Two residents are on each night from 9 p.m. to 8 a.m. the following morning. One resident (usually the more senior) covers Strong cross-sectional imaging (US, CT, and MR), while the other resident (usually the more junior) covers Strong plain film, nuclear medicine, fluoroscopy, and Highland teleradiology and cross-sectional imaging modalities.

Residents, between PGY4 and PGY5, will perform three to four two-week blocks of CT senior call (CTSC) providing CT body support from 12 pm to 5 pm, and covering body CT, US, MRI, and Highland Hospital teleradiology from 5 pm to 9 pm.

Residents also participate in daytime rotations in Emergency Radiology providing preliminary interpretation of conventional radiography exams for emergency department patients. Residents insure that the information is accurately and efficiently conveyed to the referring physicians. The resident needs to be available for consultation with the emergency department staff and resident physicians and needs to demonstrate radiology's commitment to be responsive in an appropriate manner.

Night Call Qualifying Examination

Before beginning emergency radiology rotations, every second year resident must pass a Night Call Qualifying Examination. The initial exam is given in the Spring; if necessary, repeat examination is offered before the resident is allowed to proceed to night duty rotations.

Vacations

Each resident is entitled to four calendar weeks (twenty weekdays) of vacation per year; these days must be used in the given academic year and do not roll-over. Leave request forms must be completed by the resident and signed by the appropriate section-chief prior to submission to the chief residents. No more than one week of vacation per rotation block is permitted. **Approval for more than one consecutive week of vacation must be scheduled before the beginning of the year, span two blocks (last week of one and first week of the other) and is *not* guaranteed.**

Every effort is made to allow residents to obtain vacation when they wish, provided service assignments can be adequately covered. Residents can expect to have *limited* vacation time available during July when fewer trained residents are on duty. The times of the year of the major radiological meetings (RSNA, ARRS, AUR) or American Board or in-service examination times are also not suitable for vacation.

Up to four academic days are allotted for job/fellowship interviews; any time away beyond four days is counted as vacation time. Please plan appropriately.

The proper procedure to request away time is:

- Complete an away request
- Obtain signature of the section chief for that rotation/time
- Return the signed request to your Chief Resident
- Once signed by the Chief Resident, the paperwork needs to be approved by the Program Director

Night Call and Weekend Duties

Residents participate in weekend call for Neuroradiology and Cross-Sectional Imaging (US, CT, and MR). Call is shared among residents rotating on these services. Residents on the Interventional Radiology rotation participate in a Q call system.

Emergency Radiology Call responsibilities are divided into junior (1st years) and senior (2-4th year) call divisions. Junior call coverage, is from 5pm to 9pm Monday through Friday and 8am to 5pm Saturday, Sunday, and holidays. This resident is expected to stay if needed to ensure a smooth transition between

shifts. Junior call is taken directly with an attending. This resident is responsible for general activities including conventional radiography, nuclear medicine, and fluoroscopic procedures.

The senior call pool provides in-house late night and overnight coverage. The CTSC (CT Senior Call) resident works Monday through Friday from 12 pm to 9 pm, providing CT body support from 12 pm to 5 pm, and covering body CT, US, MRI, and Highland Hospital teleradiology from 5 pm to 9 pm. The designated first night float resident works Sunday through Friday from 9pm to 8am and is primarily responsible for plain films, nuclear medicine studies, fluoroscopic examinations, and Highland teleradiology. The second night float resident works Sunday through Friday from 9pm to 8am providing interpretation of Strong US, CT, and MR examinations (Body, MSK, and Neuroradiology). However, both residents are encouraged to work as a team so that prompt accurate medical care is provided. These residents provide preliminary interpretation of conventional studies for both inpatients and emergency department patients and ensure that the information is accurately and efficiently conveyed to the referring physicians. These residents are representatives of the department and are responsible for ensuring the smooth operation of our services while on their shift. These residents need to be available for consultation with emergency department staff and resident physicians to demonstrate radiology's commitment to attentive, responsive medical service.

Similar call responsibilities apply to weekends and holidays. The resident who is to be relieved has an obligation to stay and continue to function until an orderly transition is possible. The incoming resident should receive a verbal/written sign out regarding any problems or scheduled examinations still to be performed.

With regards to all night call, if a clinical problem arises with which the resident is uncomfortable in handling, the various subspecialty sections have faculty +/- fellows on call for immediate assistance including becoming available onsite.

The resident will be asked to make judgments as to whether imaging is indicated in a particular clinical setting, and if so, what sequence should be followed. Coordination with on-call technologists and physicians is necessary. It is expected that the resident will be able to expedite most problems. To do this effectively, the resident must maintain a close working-relationship with clinical colleagues and be familiar with the patient. On duty residents are responsible for reviewing conventional radiography examinations with radiology faculty at the 7am review time and before going off duty at the end of the day as appropriate. As in regular daily work, follow-up of interesting patients is encouraged and is an important educational component of the night call system.

RESIDENT EVALUATION PROCESS

Evaluation and Competency of Residents

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

Residents are expected to participate in the 360⁰ evaluation process via the currently used program E*Value. Electronic evaluations are performed for faculty, program and rotation and peers. Assistance with login name and passwords is provided.

RESIDENT REQUIREMENTS FOR ADVANCEMENT

Resident Requirements for Advancement

Resident Promotion and Reappointment

- Successful completion of all clinical rotations. University of Rochester adheres to the ACGME standards of the six areas of clinical competency. Residents must be deemed competent or show consistent improvement in all the six areas of competency as defined in the following pages by the Association of Program Directors in Radiology (APDR).
- Resident attendance at conferences as defined in this manual.
- On-call examination will be given each year. Beginning second year residents are required to pass this examination prior to any night call rotations.
- A score above the 25% percentile on the in-service examination is required of all residents. A score below will place the resident on **temporary probation** and a makeup examination will be given in three months. If the resident does not pass this examination they will again be on probation. If the examination is again not passed this will be grounds for dismissal. Residents who pass the diagnostic written boards are exempt from this requirement.
- Two cases per resident will be placed in the teaching file annually. These cases will be used as the resident's portfolio. The cases should stress evidence-based medicine as defined by the clinical competencies. These cases are evaluated by, the Education Committee.
- Residents are expected to fill out monthly evaluations on the faculty involved with their instruction. They need to be completed online within two weeks of completing the rotation.
- Residents are expected to attend and participate in the monthly Quality Assurance/Improvement conferences.
- The department adheres to GME policies in regards to disability and sick time, but if that time is in excess of ten days per year, the committee will review the resident's activities to determine if additional days of training need to be added to that year before advancement to the next year or graduation from the program.

Disciplinary Actions

Standards, of academic performance and personal professional development, are the responsibility of the Program Director, Chairman and Education Committee. A resident experiencing difficulty with academic performance, impairment or professional misconduct may have disciplinary action taken in one of the following ways as outlined by the institution in the 2006 – 2007 GME Resident/Fellow Manual:

- Immediate Termination
- Termination After Appropriate Probation
- Non-Renewal of Contract After Appropriate Probation

§ 2006 – 2007 Resident/Fellow Manual for Medical and Dental Programs pp 26

Remediation

Educational difficulties are sometimes experienced and at the direction of the Program Director and the Education Committee, a resident may be recommended to seek remedial assistance to provide a good academic experience with the department. Departmental mentorship is offered to trainees.

DEPARTMENT POLICIES

The Department of Imaging Sciences aligns departmental policies to those of the institution as outlined in the [2006-2007 Office for Graduate Medical Education, Resident/Fellow Manual for Medical and Dental Programs](#).

Resident Work Hours

The maximum number of work hours is the same as required by New York State Law and the ACGME Resident Duty Hour Requirements. These hours are closely monitored and it is the responsibility of the resident to notify the Chief Resident and Section Chief immediately if any possible violations are perceived.

§ 2006 – 2007 *Resident/Fellow Manual for Medical and Dental Programs pp 33*.

All residents are responsible for clinical services Monday through Friday, generally from 7:30 a.m. to 5:00 p.m. Residents are on duty with faculty every weekday evening until 5:00 p.m. and weekend day until 5:00 p.m.

Senior residents (beyond 18 months of training) rotate on overnight duty. These are seven, four week rotations during the second, third and fourth years of training. These consist of two weeks of night duty and two weeks ED day or other rotation each. Friday evenings and holidays are covered by other residents, in the pool. Overnight duty is not anticipated to exceed 120 days in four years of training.

Residents have additional on-call responsibilities elsewhere in the department throughout their training.

Residents proceed to overnight duty after successfully passing a night-call qualifying examination in their second year of training.

Moonlighting Policy

There is no provision for moonlighting during the residency. However, our residents are free during vacation and relief time to moonlight subject to the following limitations:

- Any extra work must **not** interfere with appropriate study or residency duties within the Department.
- Each resident engaging in professional activities outside the training program must ensure that the hours devoted to that activity are added to the training program work hours.
- These hours must be reported on the Office for Graduate Medical Education Work Hour Survey performed twice per year and also on any Chairman/Program Director work hour surveys.
- The total hours must comply with the number of hours a trainee may work as outlined in New York State Health Care, Section §405.
- It is institutional **and departmental** policy that, all moonlighting by residents, **must** be approved by the Chairman/ Program Director.
- The resident should seek written assurance of malpractice and workers' compensation coverage from any outside employer. The professional liability insurance provided by the University's insurance program covers only those activities that are required by the training program. There is no coverage for professional activities outside the scope of this residency program.
- The residents must have a valid New York State medical license and federal DEA number.
- The moonlighting policies of the department are the same as those of the institution.
- **Those training with a J-1 visa are not eligible.**

§ 2006 – 2007 *Resident/Fellow Manual for Medical and Dental Programs pp39-40*.

Resident Supervision

“The following policy on resident supervision has been developed to conform to the New York State Health Code and Section MS 6.9/MS 6.9.1 of the Standards of the Joint Commission on Accreditation of Healthcare Organization (JCAHO)...Each training program may have additional supervision standards as dictated by their Residency Review Committees (ACGME) which may be **more restrictive than these outlined above. If so, the more restrictive standards will be followed.**”

§ 2006 – 2007 *Resident/Fellow Manual for Medical and Dental Programs pp51.*

The faculty is on-call in General Radiology and subspecialties: Cross-Sectional Imaging, Nuclear Medicine, Neuroradiology, Angiography and Pediatrics. The faculty is on-site: Weekdays from 7:00 a.m. to 9:00 p.m., Saturdays and Sundays from 8:00 a.m. to 11:00 a.m. and 3:00 p.m. to 5:00 p.m. Faculty are present during all interventional procedures throughout training.

There is a documented, supervised experience in interventional procedures as described by the ACGME Special Requirements for Core Residency Programs in Diagnostic Radiology. Data is entered into a database after each interventional procedure. A paper copy is given to each resident upon completion. Procedure documentation is also kept on file in the residency office for each resident during the entire residency training.

All studies preliminarily interpreted and/or performed by residents are promptly reviewed and edited by a faculty member before final reports are submitted.

Any significant difference between preliminary and final reports is called to the attention of the patient's physician.

Resident Teaching

After the first year, residents are encouraged to assume teaching responsibilities both for medical students and other residents. Any resident who has a special interest in teaching should make this known.

Residents are involved in medical student teaching in all four years of medical school. These include anatomy and pathology laboratories, pathology course, and the radiology electives in years two through four.

Sick Time

Residents are required to call the Residency Office to notify them of any sickness. If the resident is away for more than three consecutive days, a physician affirmation must be presented before returning to work. A resident is permitted a maximum of ten sick days a year. If this number is exceeded, the resident must extend the residency or use vacation days.

The department must be notified via phone call at the on-set of an illness. Phone calls may be placed to the residency coordinator at **585- 275-1128**, who will notify the chief residents and current rotation section chief in order to assure adequate coverage. Excessive use of sick time is serious cause for concern as it impacts patient care, resident education and workflow.

The Department of Imaging Sciences adheres to GME policies in regards to disability and sick time, but if that disability or sick time is in excess of ten days per year, the residency committee will review the resident's activities and determine if additional days of training need to be added to that year before advancement to the next year or graduation from the program. These determinations will be made and information will be relayed to the resident in a timely manner so that arrangements in the resident's personal schedule/commitments can be adjusted accordingly.

The Education Committee reserves the right to take action in excessive use of sick time and the resident might be required to undergo remedial action. ***Vacation days for the following year may not be used to make-up time lost.***

Leave of Absence

Should a resident need to request a Leave of Absence, discussion with the Program Director is the first step. The department adheres to the procedures as outlined by the institution in the [2006 – 2007 GME Residency Manual](#).

§ 2006 – 2007 *Resident/Fellow Manual for Medical and Dental Programs* pp 16-17.

Short Term Disability/ Maternity Leave

Those who need to apply for The Sick Leave Plan for Short-Term Disability (which includes sick days and maternity disability) need to make arrangements with the Program Director and Department Chair and must adhere to University guidelines as outlined in the GME Residency Manual.

§ 2006 – 2007 *Resident/Fellow Manual for Medical and Dental Programs* p 17.

Paternity Leave

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

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

§ 2006 – 2007 *Resident/Fellow Manual for Medical and Dental Programs* p17.

Declared Pregnancy and Radiation Safety

A resident who is pregnant, for her safety and that of the child, must notify the Program Director as quickly as possible, in order to insure that proper safety measures are taken in conjunction with guidelines as set by the Department of Radiation Safety at the University of Rochester. Radiation Safety guidelines and appropriate request form is made available through the radiology residency office.

Reimbursement and Purchasing Guidelines

The residents are permitted a \$2,500 professional allowance designed to cover radiology professional expenses over the four years that they are in residency. Residents may only use their "professional account money" to purchase radiology books on the recommended reading list. (If they purchase them through the URMC bookstore, using a requisition, they save the sales tax). Residents may use the professional account money to pay for a radiology "review course" – registration, housing, airfare. Residents may **NOT** use the "professional account money" for any other expenses, including: computers, cameras, ABR fees, USMLE fees, etc. Any all purchases and/or reimbursements must be approved in writing by the Program Director:

Books may be purchased in the following fashion:

- Book requests are presented to the residency coordinator for texts located at the Barnes & Noble Bookstore, located at the medical center by use of a requisition. The resident's balances are then checked to assure that there is an adequate balance to make the purchase. The requisition is then given to the Imaging Sciences Accounting Office for approval. Once approved, the requisition is returned to the residency office and given to the resident for the purchase. This is the preferred method of purchase by the department and radiology accounting office.
- Books paid for by credit card or an outside vendor, provided there is an adequate balance, may be reimbursed with the understanding that the University does NOT reimburse for sales tax. The Imaging Sciences Accounting office and the Department Chair reserve the right to refuse reimbursement with adequate explanation. It is best to inquire prior to purchase.
- Palm Pilots
- NOTE: iPods **are not** an allowable expense from the book fund.

Special Compensation

At times, residents maintain accounts arranged for special compensation situations at the discretion of the department Chair. Adherence to Imaging Sciences Accounting practices is mandatory. The following items are allowable expenses and vendors:

Travel and Conference

Residents are entitled to reimbursement for allowable expenses incurred for oral presentations where the resident is the first author for an oral presentation, scientific poster presentation or as an invited speaker at a national meeting with prior permission obtained from the program director.

- The resident must submit a copy of the abstract along with the verification letter or email from the society.
- Reimbursement up to \$1,500.00 and a total of four meeting days is allowed.

These are the allowable expenses with appropriate receipts:

- Airfare or travel – with original boarding passes, if the university has NOT paid for this travel in advance, then a credit card statement and/or bank statement is necessary for this claim.
- Hotel – Hotel check-out statement, along with credit card statement showing payment.
- Meals with receipts

These items are **not** allowed for reimbursement:

- Expenses for spouse or other person than the resident attending the conference
- Hotel expenses such as videos, spa, gym, gifts or alcoholic beverages.
- Food/groceries/meals while at AFIP
- Capital purchases in excess of \$1,000, including independent purchase of computer parts
- Residency purchases, i.e. textbooks purchased prior to the start of residency training.

**GENERAL COMPETENCIES IN RADIOLOGY RESIDENCY TRAINING:
DEFINITIONS, SKILLS, EDUCATION AND ASSESSMENT**

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

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Introduction

The Accreditation Council for Graduate Medical Education (ACGME) Outcome Project is a long-term initiative by which the ACGME is increasing emphasis on educational outcomes in the accreditation of residency programs (<http://www.acgme.org>). The impetus for this project is based on a system of medical education that relies heavily on public funding and is therefore accountable to the public in terms of meeting public needs and preparing well-qualified new physicians in the most cost-effective way possible. The current model of accreditation focuses on the potential of a residency program to educate residents (i.e. whether the program complies with the requirements, has established objectives and an organized curriculum, and evaluates the residents and itself). However, measuring program quality by examining structure and process is not a direct or complete measure of the quality of the educational outcomes of a program. In the future, accreditation will focus on actual accomplishments of a program, through assessment of program outcomes (i.e. whether the residents achieve the learning objectives set by the program, whether the program provides evidence of this achievement, and whether the program demonstrates continuous improvement in its educational process).

The ACGME Outcome Project Advisory Committee identified six general competencies that were subsequently endorsed by the ACGME in February 1999. They are patient care, medical knowledge, practice based-learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice. All Residency Review Committees (RRCs) must include minimum language regarding the general competencies and evaluation processes in their respective Program Requirements by July 2002.

A major activity of the Outcome Project was the identification and development of measurement tools for programs to use as part of an overall evaluation system. The ACGME and the American Board of Medical Specialties (ABMS) collaborated on the development of a "Toolbox" (<http://www.acgme.org>) of assessment methods. The Toolbox (© Copyright 2000 Accreditation Council for Graduate Medical Education and American Board of Medical Specialties, Version 1.1, September 2000) includes descriptions of instruments recommended for use by programs as they assess the outcomes of their educational efforts. In addition to a description, the Toolbox includes information pertaining to the use, psychometric qualities, and feasibility/practicality of different assessment methods.

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

PATIENT CARE: Provide patient care that is compassionate, appropriate and effective.

<p>Skills</p> <ul style="list-style-type: none"> • Gather essential and accurate information about patients • Develop a diagnostic plan based upon the clinical question/s and relevant clinical, radiologic and pathologic information • Oversee diagnostic imaging to ensure adequacy of studies performed • Counsel patients concerning preparation for diagnostic testing • Demonstrate a basic understanding of electronic patient information systems • Demonstrate the ability to use the Internet as an educational instrument to expand medical knowledge • Demonstrate knowledge of the levels of ionizing radiation related to specific imaging procedures and employ measures to minimize radiation dose to the patient • Perform radiologic examinations appropriately and safely, assuring that the correct examination is ordered and performed
<p>Education (with graduated faculty supervision and feedback)</p> <ul style="list-style-type: none"> • Practical experience in developing a differential diagnosis and management plan based upon clinical data, imaging findings and other medical test results • Active participation in journal reviews to determine the effectiveness of diagnostic imaging for specific diagnostic questions • Graduated responsibility in performing radiologic procedures • Didactic instruction in radiation safety • Preparation and presentation of radiologic cases to other members of the health care team
<p>Assessment</p> <ul style="list-style-type: none"> • Global ratings by faculty • 360 degree examination • Procedure log • Objective structured clinical examination

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

<p>Skills</p> <ul style="list-style-type: none"> • Demonstrate sufficient knowledge of medicine and apply this knowledge to radiological studies in a clinical context to generate meaningful differential diagnoses • Demonstrate progressive acquisition of radiological knowledge • Demonstrate knowledge of the principles of research design and implementation • Generate a clinically appropriate diagnostic treatment plan • Demonstrate the ability to use all relevant information resources to acquire evidence-based data • Understand how radiologic equipment can be used to generate appropriate and diagnostic images
<p>Education</p> <ul style="list-style-type: none"> • Didactic lectures and self-directed learning on the science and practice of radiology • Participation in departmental and inter-departmental case conferences • Participation in the clinical activities of the radiology department • Departmental or institutional training programs on research design and implementation
<p>Assessment</p> <ul style="list-style-type: none"> • Global ratings by faculty

- Program-developed written examinations
- ACR in-training examination
- Written ABR examination
- Oral ABR examination
- Raphex physics examination

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

Skills
<ul style="list-style-type: none"> • Provide a clear and informative written radiologic report including a precise diagnosis whenever possible, a differential diagnosis when appropriate, and recommended follow-up or additional studies when appropriate • Provide direct communication to the referring physician or appropriate clinical personnel when interpretation reveals an urgent or unexpected finding and document this communication in the radiologic report • Demonstrate effective skills of face-to-face listening and speaking with physicians, patients, patient's families and support personnel • Demonstrate appropriate telephone communication skills • Demonstrate skills in obtaining informed consent, including effective communication to patients of the procedure, alternatives and possible complications
Education (with graduated faculty supervision and feedback)
<ul style="list-style-type: none"> • Participation as an active member of the radiology team by communicating face-to-face with clinicians, answering the telephone, providing consults, problem solving and decision-making • Act as the contact person for technologists and nurses in managing patient and imaging issues • Active participation in preparing and moderating multi-disciplinary conferences • Practical experience in dictating radiological reports
Assessment
<ul style="list-style-type: none"> • Global ratings by faculty • 60° evaluations • Oral ABR examination • Record review (systematic evaluation of resident dictations)

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

Skills
<ul style="list-style-type: none"> • Demonstrate altruism (putting the interests of patients and others above own self-interest) • Demonstrate compassion: be understanding and respectful of the patients, patient families, and staff and physicians caring for patients • Demonstrate excellence: perform responsibilities at the highest level and continue active learning throughout one's career • Be honest with patients and all members of the health care team • Demonstrate honor and integrity: avoid conflicts of interest when accepting gifts from patients or

<p>vendors</p> <ul style="list-style-type: none"> • Interact with others without discriminating on the basis of religious, ethnic, sexual or educational differences and without employing sexual or other types of harassment • Demonstrate knowledge of issues of impairment (i.e. physical, mental and alcohol and substance abuse), obligations for impaired physician reporting, and resources and options for care of self-impairment or impaired colleagues • Demonstrate positive work habits, including punctuality and professional appearance • Demonstrate an understanding of broad principles of biomedical ethics • Demonstrate principles of confidentiality with all information transmitted during a patient encounter • Demonstrate knowledge of regulatory issues pertaining to the use of human subjects in research
<p>Education</p> <ul style="list-style-type: none"> • Discussion of conflicts of interest and the ethics of conducting research during departmental or institutional conferences and daily clinical work • Training programs (i.e. videotapes) on the issues of harassment and discrimination. • Didactic presentations on the recognition and management of the “impaired physician” • Participation in hospital-sponsored core curriculum educational activities (i.e. lectures, web-based programs) • Didactic lecture/training program on the broad principles of medical ethics • Institutional web-based self-directed learning and assessment programs on human subjects research guidelines
<p>Assessment</p> <ul style="list-style-type: none"> • Global ratings by faculty • 360° evaluations • Conference attendance logs • Resident self-assessment • Written ABR examination

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

<p>Skills</p> <ul style="list-style-type: none"> • Analyze practice experience and perform practice-based improvement in cognitive knowledge, observational skills, formulating a synthesis and impression, and procedural skills • Demonstrate critical assessment of the scientific literature • Demonstrate knowledge of and apply the principles of evidence-based medicine in practice • Use multiple sources, including information technology to optimize life-long learning and support patient care decisions • Facilitate the learning of students, peers and other health care professionals
<p>Education</p> <ul style="list-style-type: none"> • Participate in critical assessment of the scientific literature through journal clubs, clinical conferences and independent learning • Didactic lectures on the assessment of scientific literature, study designs and statistical methods • Teaching students, peers and other health care professionals, with graduated supervision and feedback from supervising faculty

<ul style="list-style-type: none"> • Active participation in departmental or institutional quality assurance (QA)/quality improvement (QI) activities with faculty supervision
Assessment
<ul style="list-style-type: none"> • Global ratings by faculty • ACR in-service examination • Written ABR examination • QA/QI conference attendance logs • Global ratings by students • Procedure log

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

Skills
<ul style="list-style-type: none"> • Demonstrate the ability to design cost-effective care plans based on knowledge of best practices • Demonstrate knowledge of the sources of financing for U.S. health care including Medicare, Medicaid, the Veteran’s Affairs and Department of Defense, public health systems, employer-based private health plans, and patient’s own funds • Demonstrate knowledge of basic health care reimbursement methods • Demonstrate knowledge of the regulatory environment including state licensing authority, state and local public health rules and regulations, and regulatory agencies such as Centers for Medicaid and Medicare Services (CMS) and Joint Commission for the Accreditation of Healthcare Organizations (JCAHO) • Demonstrate knowledge of basic practice management principles such as budgeting, record keeping, medical records, and the recruitment, hiring, supervision and management of staff
Education
<ul style="list-style-type: none"> • Systematic review of appropriate literature, including current American College of Radiology (ACR) Appropriateness Criteria, to develop knowledge of evidence based indications for imaging procedures • Attendance and active participation in departmental and multi-disciplinary conferences where there is discussion of the imaging evaluation of specific diseases and most appropriate and cost-effective methods for establishing a diagnosis • Interaction with department administrators and knowledgeable faculty to gain an understanding of the costs of diagnostic examinations and the influence of the type of payer system on reimbursement • ACR/APDR non-interpretive skills videotapes • Membership and active participation in local and national radiological societies • Departmental or institutional presentations on health care funding and regulation
Assessment
<ul style="list-style-type: none"> • Global ratings by faculty • Written ABR examination • ACR in-training examination • Multi-disciplinary conference attendance logs • Documented membership and participation in radiologic societies and other health care organizations

Appendix. Descriptions of Selected Assessment Methods

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

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

Objective structured clinical examination (OSCE). In an objective structured clinical examination (OSCE), one or more assessment tools are administered at 12 to 20 separate stations, each station lasting ten-fifteen minutes. All candidates move from station to station in sequence on the same schedule. Radiologic OSCEs include image interpretation and procedural exercises. OSCEs are only cost-effective when many candidates are examined at one administration.

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

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

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

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

ACGME GENERAL COMPETENCIES

PATIENT CARE

COMPETENCY DEFINITION	PRACTICE PERFORMANCE MEASUREMENTS
<p>Provide patient care through safe, efficient, appropriately utilized, quality-controlled diagnostic and/or interventional radiology techniques and effectively communicate results to the referring physician and/or other appropriate individuals in a timely manner.</p>	<ul style="list-style-type: none"> • Global faculty evaluation (to include evaluation of knowledge about safety issues such as radiation dose, MRI safety, correct patient- exam-site verification, use of standard abbreviations) • Case/procedure logs (to be included in the resident learning portfolio) • OSCE (Objective Standardized Clinical Examination) or direct observation of selected procedures and other critical processes (such as obtaining informed consent) • 360 degree evaluations

MEDICAL KNOWLEDGE

COMPETENCY DEFINITION	PRACTICE PERFORMANCE MEASUREMENTS
<p>Engage in continuous learning using up to date evidence and apply appropriate state of the art diagnostic and/or interventional radiology techniques to meet the imaging needs of patients, referring physicians and the health care system</p>	<ul style="list-style-type: none"> • Global faculty evaluation (which includes the 6 competencies) • Yearly objective test (e.g., mock oral boards, ABR in-service test, ABR written examination) • Resident learning portfolio (including documentation of conferences attended, courses attended, self-assessment modules completed, etc.) • Journal club to evaluate skills in accessing, interpreting and applying best evidence in the radiology literature to patient care.

PRACTICE BASED LEARNING AND IMPROVEMENT

COMPETENCY DEFINITION	PRACTICE PERFORMANCE MEASUREMENTS
<p>Participation in evaluation of one's personal practice utilizing scientific evidence, "best practices" and self-assessment programs in order to optimize patient care through lifelong learning.</p>	<ul style="list-style-type: none"> • Global faculty evaluation • Resident learning portfolio (to include utilization of self-assessment modules) • Documentation of participation in departmental QI/QA and regulatory activities

INTERPERSONAL AND COMMUNICATION SKILLS	
COMPETENCY DEFINITION	PRACTICE PERFORMANCE MEASUREMENTS
Communicate effectively with patients, colleagues, referring physicians and other members of the health care team concerning imaging appropriateness, informed consent, safety issues and results of imaging tests or procedures.	<ul style="list-style-type: none"> • Global faculty evaluation • 360 degree evaluations • Evaluation of quality of reports • OSCE or direct observation of communication issues (e.g., informed consent, speaking with patients about adverse events or outcomes of imaging tests, consultation with referring clinicians)

PROFESSIONALISM	
COMPETENCY DEFINITION	PRACTICE PERFORMANCE MEASUREMENTS
Commit to high standards of professional conduct, demonstrating altruism, compassion, honesty and integrity. Follow principles of ethics and confidentiality and consider religious, ethnic, gender, educational and other differences in interacting with patients and other members of the health care team	<ul style="list-style-type: none"> • Global faculty evaluation • 360 degree evaluations • Verify status of medical license, if appropriate • Documentation of compliance with institutional and departmental policies (e.g., conference attendance, HIPPA, JCAHO, dress code)

SYSTEM-BASED PRACTICE	
COMPETENCY DEFINITION	PRACTICE PERFORMANCE MEASUREMENTS
Understand how the components of the local and national healthcare system function interdependently and how changes to improve the System, involve group and individual efforts. Optimize coordination of patient care both within one's own practice and within the healthcare system. Consult with other healthcare professionals, and educate healthcare consumers, regarding the most appropriate utilization of imaging resources.	<ul style="list-style-type: none"> • Global faculty evaluation • Documentation of resident participation in analysis of systems-based problem • Resident learning portfolio (to include documentation of active participation in multi-disciplinary conferences)

