



**BROWN**  
Alpert Medical School

**DEPARTMENT OF DIAGNOSTIC IMAGING  
RHODE ISLAND HOSPITAL**

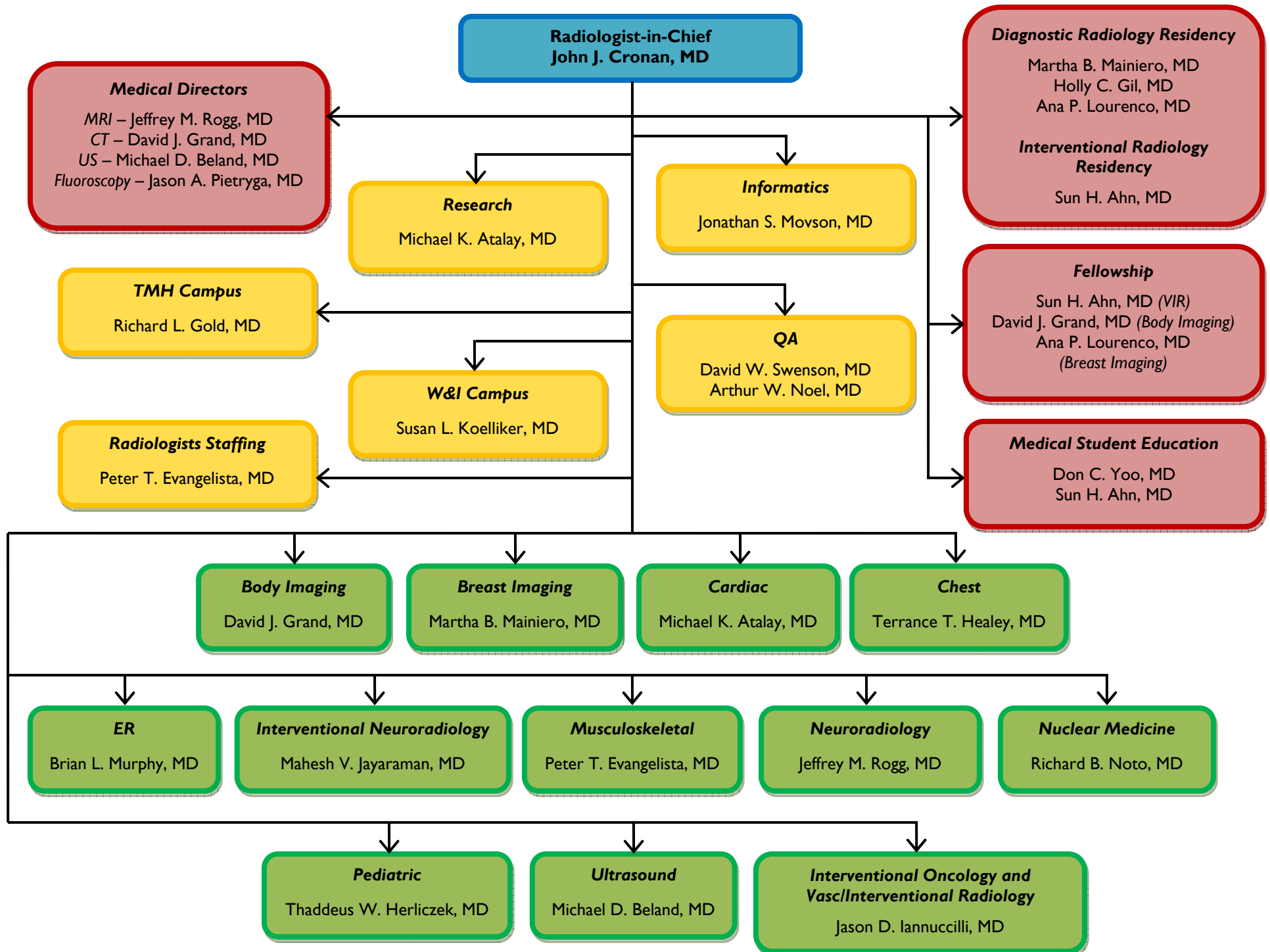
**RESIDENCY MANUAL**

**2017-2018**

## PHYSICIANS IN CHARGE OF SECTIONS

Chairman	John J. Cronan, M.D.
Program Director	Martha B. Mainiero, M.D.
Associate Program Directors	Holly Gil, M.D. Ana P. Lourenco, M.D.
<b>Physician in Charge</b>	
Body Imaging	David J. Grand, M.D.
Breast Imaging	Martha B. Mainiero, M.D.
Cardiac	Michael Atalay, M.D., Ph.D.
Emergency	Brian L. Murphy, M.D.
Fluoroscopy	Jason A. Pietryga, M.D.
Interventional	Jason Iannuccilli, M.D.
Musculoskeletal	Peter T. Evangelista, M.D.
Neurointerventional Radiology	Ryan A. McTaggart, M.D.
Neuroradiology	Jeffrey M. Rogg, M.D.
Nuclear Medicine	Richard B. Noto, M.D.
Pediatrics	Thaddeus W. Herliczek, M.D.
Physics	Richard B. Noto, M.D.
Research	Michael K. Atalay, M.D., Ph.D.
Thoracic	Terrance T. Healey, M.D.
Ultrasound	Michael D. Beland, M.D.
Women & Infants'	Susan L. Koelliker, M.D.

# Diagnostic Imaging Radiologist Organizational Chart



**BROWN DEPARTMENT OF DIAGNOSTIC IMAGING SUB-SPECIALTIES**

**JULY 2017**

**BODY IMAGING**

***David J. Grand***

Michael K. Atalay  
Michael D. Beland  
John J. Cronan  
Mary M. Hillstrom  
Adib Karam  
May M. Kassem  
Brian L. Murphy  
David P. Neumann  
John A. Pezzullo  
Jason A. Pietryga  
Mark S. Ridlen  
Julie H. Song

**BREAST IMAGING**

***Martha B. Mainiero***

Linda L. Donegan  
Mary M. Hillstrom  
Nneka T. Jimoh  
May M. Kassem  
Hanan I. Khalil  
Susan L. Koelliker  
Elizabeth Lazarus  
Ana P. Lourenco  
Robert C. Ward

**CARDIAC IMAGING**

***Michael K. Atalay***

David J. Grand

**CHEST IMAGING**

***Terrance T. Healey***

Saurabh Agarwal  
Michael K. Atalay  
Thomas K. Egglin

**COMMUNITY RADIOLOGY**

Srividya Anandan  
Vincent A. De Cesaris  
Mark A. Geist  
David K. Gunasti  
Gary R. Marecek  
Mark S. Ridlen  
Rahul A. Somvanshi  
Michael L. Viens

**EMERGENCY IMAGING**

***Brian L. Murphy, M.D.***

Saurabh Agarwal  
Michael D. Beland  
Peter T. Evangelista  
David J. Grand  
Terrance T. Healey  
Gaurav Jindal  
Jonathan S. Movson  
John A. Pezzullo  
Albert A. Scappaticci  
David W. Swenson  
Don C. Yoo

**MUSCULOSKELETAL  
IMAGING**

***Peter T. Evangelista***

Jeffrey M. Brody  
J. Elliott Brown  
Holly C. Gil  
Scott M. Levine  
Glenn A. Tung

**NEURORADIOLOGY**

***Jeffrey M. Rogg***

Jerrold L. Boxerman  
Jeffrey M. Brody  
Lawrence M. Davis  
Richard L. Gold  
Mahesh V. Jayaraman  
Glenn A. Tung

**NEUROINTERVENTIONAL  
RADIOLOGY**

***Mahesh V. Jayaraman***

Richard A. Haas  
Ryan A. McTaggart

**NUCLEAR MEDICINE**

***Richard B. Noto***

Jonathan S. Movson  
Arthur W. Noel  
Don C. Yoo

**PEDIATRIC IMAGING**

***Thaddeus W. Herliczek***

John A. Cassese  
Marcelle L. Piccoello  
Cassandra M. Sams  
David W. Swenson  
Michael T. Wallach

**VASCULAR**

**INTERVENTIONAL**

***Jason D. Iannuccilli***

Sun Ho Ahn  
Gregory J. Dubel  
Richard A. Haas  
Brian S. Jay  
Timothy P. Murphy  
Van T. Nguyen  
Ethan A. Prince  
Albert A. Scappaticci  
Gregory M. Soares

**WOMEN'S IMAGING  
at Women & Infants**

***Susan L. Koelliker***

Jeffrey M. Brody  
Linda I. Donegan  
David J. Grand  
Mary M. Hillstrom  
Hanan I. Khalil  
Elizabeth Lazarus  
Ana P. Lourenco  
Shruthi Ram  
Jana S. Rice  
Robert C. Ward

7/1/2017

## TABLE OF CONTENTS

<b><u>GENERAL INFORMATION</u></b>	Page 6
Welcome	Page 6
Resident Selection Policy	Page 6
Dress Code and Other Etiquette	Page 6
The Four-Year Curriculum	Page 7
Policy on Lines of Supervision	Page 7
Evaluation of Performance	Page 8
Resident Evaluation of Rotations, Program and Faculty	Page 8
Formal Grievance Procedures	Page 9
ABR Certification	Page 9
Suggested Curriculum	Page 10
Departmental Conferences	Page 11
Imaging Conference and Grand Rounds	Page 17
Interdepartmental Conferences	Page 18
Meeting Attendance	Page 18
Self-Study	Page 19
The Learning Portfolio	Page 20
Research	Page 22
Resident On-Call Responsibilities	Page 23
Duty Hour Policy	Page 24
Vacation Policy	Page 26
Interviewing for Fellowship	Page 26
Sick Time	Page 26
Religious Holidays	Page 26
Moonlighting Policy	Page 27
Travel Reimbursements	Page 28
The Use of Radiation Monitoring Badges	Page 31
Radiation Exposure and Pregnancy	Page 32
BCLS/ACLS Certification	Page 32
Leave of Absence Policy	Page 32
Responsibilities of the Chief Residents	Page 34
Academic Appointments	Page 35
<b><u>ROTATIONS: HOURS, GOALS, OBJECTIVES AND READING LISTS</u></b>	Page 39
Body Imaging	Page 40
Breast Imaging including Women & Infants Hospital Breast Imaging	Page 91
Cardiac MRI & CT	Page 98
Emergency Radiology	Page 107
Fluoroscopy/Gastrointestinal/Genitourinary	Page 120
Musculoskeletal Radiology	Page 129
Neuroradiology	Page 143
Nuclear Medicine	Page 153
Pediatric Radiology	Page 163
Thoracic Radiology	Page 172
Vascular & Interventional Radiology	Page 181
Ultrasound	Page 196
Women & Infants Body	Page 212

## **WELCOME!**

Welcome to the Department of Diagnostic Imaging! While we have tried to cover the essentials in this manual, there will certainly be times you have questions so do not hesitate to ask. In addition, you will need to refer back to this manual multiple times during the course of your residency. For instance, you should read the section for each rotation before you start that rotation to make sure you understand what is expected of you.

Jill Raczelowski is the Residency Program Coordinator and can assist you in many of the administrative tasks that you will be asked to complete during the program. You can find this manual and other necessary information on the department website on the Lifespan intranet : (Medical tab>Departments>Radiology >Brown Radiology)

## **RESIDENT SELECTION POLICY**

Resident applications are accepted through ERAS, and interviews are granted after review of medical school transcript, letters of recommendation, personal statement and USMLE scores. In order to be eligible, the applicant is expected to complete medical school, pass USMLE step I and II exams, and complete an accredited PGY-1 year in medicine, surgery, pediatrics or a transitional year prior to the expected date of entering radiology residency. The applicant must also be eligible for licensure in Rhode Island.

After receipt of the Dean's letter, interviews are conducted by three members of the education committee, and all interviewed applicants are discussed among and ranked by the members of the education committee. The rank list is then submitted to the NRMP. Decisions regarding selection for interview and rank order are made without regard to the applicant's race, sex, creed, ethnic background or national origin.

## **DRESS CODE AND OTHER ETIQUETTE**

At all times the residents should dress in a manner fitting the professional position he or she has attained. A collared shirt and tie for men is expected. Scrubs may be worn on interventional radiology, fluoroscopy, evening/weekend ED shifts, and weekend body imaging call only.

Much of the consultation between the radiology and other services is done over the phone, and each phone conversation is a professional interaction. You should clearly identify yourself (as a doctor) and the section in which you are working when you answer the phone. Remember at all times to be courteous, patient and helpful.

## **THE FOUR-YEAR CURRICULUM**

The four-year training program in diagnostic imaging is a competency-based curriculum with the goal to proportion residency training to conform to the contemporary practice of diagnostic imaging. The clinical program has been designed so that the resident will spend time optimally distributed through the areas involved in diagnostic and interventional radiology.

In the first year the resident's time is distributed in those areas in which s/he must become acquainted to become competent in basic radiology skills. These clinical rotations include fluoroscopy, emergency radiology, bone radiology, chest radiology, nuclear medicine, ultrasound, body imaging, pediatric radiology, vascular and interventional radiology, obstetrical sonography, and neuroradiology. These rotations continue in the second and third years with the addition of the breast imaging, cardiopulmonary and body MR rotations in the second and third years. A month at the American Institute of Radiologic Pathology (AIRP) or a month of pathology at RIH is offered in the second or third year. The fourth year will have up to 12 weeks of elective time available for the resident to choose to focus on one or more subspecialty areas depending upon availability of resources.

Upon completion of the program, the resident physician will be a competent, well-rounded diagnostic imager and will be competent in basic interventional techniques.

## **POLICY ON LINES OF SUPERVISION**

Upper level residents and fellows may at times supervise residents, but faculty members are ultimately responsible for the clinical care given to patients. During the four year curriculum, residents will be given increasing responsibility depending upon their knowledge, experience and manual skills, with appropriate levels of faculty supervision at all times.

Toward the end of the first year of training, residents will take an examination to assess competency for taking independent overnight call. Only after successful completion of the examination will 2<sup>nd</sup> year residents begin independent in house call duties. Fellows and attendings take call from home to assist the resident, including coming into the hospital to review cases and perform procedures when necessary. The weekly attending/fellow schedule lists who is on call for general radiology, pediatric radiology, IR, neuro and body imaging. Residents are expected to contact the fellow or attending staff at any time when assistance is needed. If the responsible individual cannot be reached for any reason, the resident should call any other faculty member necessary for assistance. All cases given a preliminary interpretation by the resident on call will be reviewed by a faculty member within 24 hours. In cases where the volume exceeds the residents' ability to provide adequate patient care or the resident is unable to safely provide patient care for any reason, back up is provided by the staff attending on call. For residents doing paid on call for TMH, the TMH attending is the back up to be called when needed.

All percutaneous invasive procedures done on rotation require direct faculty supervision. During normal working hours, procedures are supervised by the attending assigned to that service. Procedures done after hours require the resident to call in the fellow or attending for direct supervision with the exception of lumbar puncture. This procedure can be performed by the resident independently once the resident has been documented as being competent to perform the procedure. Interventional radiology provides oversight for these procedures and should be called prior to performing the procedure in case of any questions or problems that arise. When a procedure is performed independently, the resident must place a note in the patient's chart documenting the procedure. However, as there is no direct supervision, a bill is not generated and therefore the procedure should not be entered into the RIS.

### **EVALUATION OF PERFORMANCE**

Following the completion of each monthly rotation, the teaching faculty will complete an on-line evaluation form (E\*Value). The evaluation is based upon the ACGME milestones and assesses the resident's performance in achieving the stated goals and objectives in the six general competencies for that rotation at that specific level of training. These six general competencies are defined by the Accreditation Council for Graduate Medical Education (ACGME) as follows: medical knowledge, patient care, professionalism, interpersonal and communication skills, problem-based learning and systems-based practice. In addition, on services where there is interaction with the technical staff, the lead technologist will evaluate the residents on professionalism and interpersonal and communication skills. The resident will have electronic access to these evaluations as soon as they are completed.

Residents will be responsible for maintaining and up to date electronic portfolio of selected activities. At six-month intervals, i.e., in December and June, the Clinical Competence Committee will review the resident's rotation evaluations and portfolio and a global milestone evaluation will be compiled for each resident. This milestone report will be reviewed with the resident at a semi-annual review with the resident by the Program Director or Associate Program and submitted to the ACGME. Advancement to the next level of training will be contingent upon demonstration of competency. Unsatisfactory clinical performance and/or failure to score above the 25<sup>th</sup> percentile on the ACR in-service exam may necessitate academic remediation.

### **RESIDENT EVALUATION OF ROTATIONS, PROGRAM AND FACULTY**

After the completion of each rotation, the resident will complete an evaluation of the rotation. The evaluations are anonymous and are held until there are at least three evaluations before being released to the Section Director and Program Director to maintain anonymity. Additionally, once per year, the resident will complete an anonymous evaluation of each faculty member and of the entire Residency Program.



These evaluations will be reviewed by the Education Committee at the Annual Program Evaluation to assist in improving the program.

### **FORMAL GRIEVANCE PROCEDURES**

As defined in the Rhode Island Hospital (RIH) House Officer Agreement, the house officer agrees to participate in safe, effective, and compassionate patient care under supervision commensurate with his or her level of advancement. The resident also agrees to participate fully in the educational activities of the training program and to participate in other institutional programs and activities involving the medical staff. The residents are to involve themselves in a personal program of self-study and professional growth with guidance from the teaching staff.

Formal disciplinary action may be taken for due cause. Except under circumstances requiring an immediate emergency disciplinary action to preserve acceptable standards of care, safety or ethics, probation, suspension or termination from the training program will be recommended by the Program Director only after a period of counseling and remediation. The resident has the right to a review of any probation decision with the Director of Graduate Medical Education.

The House Officer Manual, which describes the residents' rights to due process, is available in Debbie Desjardins' office. The Graduate Medical Education Office is also a resource for any resident with concerns.

### **ABR CERTIFICATION**

The process of board certification in Diagnostic Radiology begins during residency and is a lifelong process. The American Board of Radiology (ABR) requires residents to register and pay for the examination well before the first examination occurs. While we will forward any communications received from the ABR, your best source of information about being eligible and registering examinations is the ABR website. You will be required to register on-line in order to begin and maintain board certification. In order to be eligible for board certification, during a four year residency, the resident must not be absent for more than 24 weeks (including vacation and family leave). Further details can be found at: [www.theabr.org](http://www.theabr.org)

**SUGGESTED CURRICULUM (weeks)**

**BREAKDOWN BY YEAR**

	FIRST	SECOND	THIRD	FOURTH
Fluroscopy	4	2	1	TBD
NUC MED	4	4	4	4
US	6	3	2	TBD
BODY	6	3	2	TBD
MR	0	2	2	
NEURO	4	4	4	TBD
ER	6	2	2	TBD
MSK	3	4	4	TBD
CHEST	4	6*	4	TBD
PEDI	4	4	4	TBD
VIR	4	4	4	TBD
W&I	2	4	2	TBD
Breast	0	4	4	4
NFL	0	3	2	2
NFS	0	2	3	2
Vacation	3	3	4	4
AIRP/Elective	0	0	4	TBD

\*Includes 2 weeks of Cardiac

## DEPARTMENTAL CONFERENCES

### **Departmental Noon Conference**

The daily noon conference is an integral part of resident education, and therefore, attendance is essential. Residents are excused from the clinical service during this time so that they may attend. Most of the noon conferences will be part of a formal educational curriculum covering the subspecialty areas of radiology, and this curriculum is planned as a two year cycle; each resident should see most conference material at least twice during their residency. The topics covered by each subspecialty area in the two-year curriculum are listed on the following pages. Physics will also be covered in the noon conference curriculum. In addition, occasional noon conferences will focus on non-interpretive issues such as ethics, research, and business practice.

### **Noon Conference Curriculum**

Subspecialty topics to be covered in a 2-year cycle:

#### **Nuclear Medicine**

Gastrointestinal/Hepatobiliary  
Nuclear Medicine Emergencies  
Bone  
Pharmaceutical Interventions in Nuclear Medicine  
Cardiac  
Neurology  
Nuclear Medicine Therapy  
Endocrine  
Lung  
Genitourinary  
PET  
    Intro  
    Head and Neck, Thyroid  
    Esophageal, Colon Cancer  
    Lymphoma  
    Gynecological Cancers  
    Breast Cancer, Melanoma  
    Lung Cancer

#### **Breast Imaging**

Calcifications  
Male Breast Disease  
Implants  
Asymmetries and Architectural Distortion  
Pre-Operative Evaluation of the Breast Cancer Patient  
Imaging the Post-Operative Breast

Screening Basics  
Nipple Discharge  
Pitfalls in Breast Imaging  
Axilla  
BIRADS and MQSA  
Breast Biopsy  
Masses – Cystic and Fat Containing  
Breast MRI  
A Logical Approach to Breast Imaging  
Radiology-Pathology Correlation

### **Pediatric Radiology**

Neonatal Abdomen  
Pediatric Chest  
Neck and Upper Airway  
Liver  
Fetal MRI  
Genitourinary Ultrasound  
NICU, X-Ray and Ultrasound  
Abdominal and Musculoskeletal Manifestations of Sickle Cell  
Child Abuse and Call Preparation  
Fluoroscopy  
Appendix MRI, Hip Infection and Gastrointestinal Fluoroscopy  
Renal Masses  
Biliary  
Musculoskeletal  
Pancreas  
Evaluation of the Plain Film of the Abdomen  
Gynecological Problems  
Catheters and Radiological Pitfalls  
Skull  
Cranial Ultrasound  
Spine  
Congenital Heart Disease  
Neonatal Chest  
Neonatal Surgical Disease  
Top 10 Malignancies  
Metabolic Bone Disease  
Emergencies  
Sports Medicine and Overuse Injuries  
On-Call Cases  
Knee  
Airways  
Ureteral, Bladder, Urethral Abnormalities  
Congenital Aortic Arch Anomalies

## **Musculoskeletal**

ABC's Bone  
MRI Shoulder  
Menisci  
Large Joint Arthropathy  
Surface Lesions of Bone  
Humeral/Glenohumeral Basics  
MRI Knee  
    Meniscus  
    ACL  
Humeral Basics  
Tumors, Infection, Metabolic  
Bone Tumors  
Bone Tumors and Systemic Disease Manifestations  
Facial Features  
CT Facial Features  
MRI Wrist/Hand  
Crystalline Arthropathy  
Emergencies  
Ultrasound  
RA and Seronegs  
Ankle  
Arthritis  
Infection/Tumor  
Cases for All  
Sports Injuries  
Sports Medicine  
Soft Tissue Tumors  
Elbow  
Metabolic Bone Disease  
Marrow Disorders

## **Ultrasound**

Abdominal US Protocol and Reporting  
Venous Disease, DVT  
Abdominal Vascular, Normal and Abnormal  
Gallbladder Disease  
Native and Tx Kidney  
Renal Emergencies  
Scrotal and Penile  
Atherosclerosis  
Diffuse Liver Disease  
Focal Liver Lesions  
Hyperparathyroidism  
Renal Masses

Testicular  
Thyroid Nodules for Radiologists  
Assessment of Renal Failure  
Ultrasound Turf: The Role of Handheld Ultrasound  
Pancreas and Spleen  
Musculoskeletal  
Pediatric Genitourinary and RP  
Techniques for Ultrasound Guided Intervention  
Pediatric Head and Spine  
Carotid  
Peripheral Arterial and Hemodialysis Grafts

### **GI/GU**

Contrast  
Pharynx and Esophagus  
Gallbladder, Biliary  
Pancreas  
Colon and Appendix  
Liver  
Duodenum and Small Bowel  
Multisystem (Acute Abdomen, Trauma, Hernias, Obstruction)  
Stomach  
Peritoneum and Retroperitoneum  
Spleen  
Renal Transplant  
Vascular  
Prostate and Seminal Vesical  
Trauma  
Stones  
Kidney  
Collecting System and Ureter  
Bladder  
Urethra

### **Chest**

ICU Films, Post-Operative Chest & Basic Concepts (atelectasis)  
Trauma  
Trauma: Non-vascular  
ILD: Nodules & Lines  
Lung Cancer Mimics  
Mediastinum: Malignant Lesions  
Pneumoconioses & Granulomatous Disease  
Trachea  
Pulmonary Vascular Disease

Vascular Congenital Anomalies  
COPD/Asthma  
Infection in the Immunocompromised Patient  
Non-Vascular Congenital Anomalies  
PVOD & PCH  
Sarcoid  
Interstitial Lung Disease: Organized Approach & Basic Review  
Infection: Tuberculosis  
Lung Cancer: Screening, Staging and Ablation  
Mediastinum: Benign Lesions  
Pleural Disease

## Neuro

Epidural Abscess  
Basics Head CT  
CN 1-12  
CT/MRI Orbit  
Phakomatoses  
Dural Sinus Thrombosis  
Head and Neck Cysts  
Spinal Epidural Abscess / Discitis and Osteomyelitis  
Temporal Bone  
Nasal/Orbit Masses  
Spine/Spinal Cord Tumors / Intramedullary Lesions  
Thalamus/BG  
Brain Tumor Pearls  
C Spine Trauma  
Cerebral Aneurysm Diagnosis and Management  
Stroke Rx  
White Matter Disease  
Acute Stroke Care: Imaging, Endovascular Therapy and Systems of Care  
Cerebral Angiography  
Cerebrovascular Emergencies Including Acute Stroke  
CTA Head and Neck  
CV Anatomy  
Epilepsy  
Intramedullary Cord Lesions  
Patterns of ICH  
Stroke  
Non-Neoplastic Cystic Brain Lesions  
Orbit  
Basics  
Congenital Spine  
CP Angle Path  
Intro to Neuroradiology  
Neonatal Brain

Pituitary/Para-Sellar  
Brain Hemorrhage  
CNS Infection  
Intro to Neuroanatomy  
Neuroanatomy  
Spine Approach  
MR Spine

## **Vascular and Interventional Radiology**

Trauma Interventions and Embolization  
Spinal Interventions: Vertebroplasty, Sacroplasty, LP  
Extracranial Carotid Vascular Disease and Upper Extremity Arterial  
Patient Care in IR  
    Drugs including anticoagulants and lytic agents  
    Conscious Sedation  
    Consent  
    Medico-legal issues in IR  
Aorto-Iliac disease/ Evaluation of Patient after Vascular Reconstruction/Bypass (also  
TPM)  
Central (Non-Coronary) MRA/MRV imaging  
Quality, Safety, and Reducing Occupational Hazards in IR  
Interventional Radiology Team and Basics and Equipment  
    Catheters and wires  
    Arterial access including femoral, brachial, radial  
    Fluoro guided needle placement  
    Foreign body retrieval  
UFE, Post-Partum Bleeding, Fallopian Tube interventions  
Intra-arterial Tx options for Liver Cancer  
    Yttrium, TACE, DEB  
Vasculopathies  
Portal HTN-Diagnosis, anatomy, and therapy including TIPSS, BORTO, etc  
Hepatobiliary-PTC, Int/Ext Drainage, Stent placement, stone removal, percutaneous  
cholangiostomy  
PAD: Femoro-Popliteal/Tibial disease  
VIR Tubes  
    PleuRx-Pleural and abdominal  
    G- and G-J Tubes  
    Chest Tube management  
CVAC/SVC Upper Extremity Venous (UE venous also EP in HD talk)  
    Ports, PICCs, Hickman placement and management of malfunctions  
    SVC Syndrome, anatomy, and management  
    Vascular diagnosis SVC/Up Ex Venous, inc Venous variations  
    Paget Schroetter  
Pelvic Venous Insufficiency: Pelvic Congestion and Varicocele  
Mesenteric Vascular



GI bleed  
Mesenteric Ischemia  
IVC Filter placement, retrieval, and IR therapy for Pulmonary Embolism  
Patient Care including CV Risk Factor reduction  
Research Methodology  
Claudication/PAD physical Exam/ Non-Invasive testing PAD  
Renal Vascular Disease  
Aorto-Iliac disease (also SHA)  
Non-Invasive Arterial Disease with CTA/MRA/Non-Invasive  
Imaging and Interventions for End Stage Renal Disease  
Pain Interventions  
AAA/Aortic Dissection/Endografting  
Prostate Artery Embolization+Pelvic Arterial anatomy  
Genitourinary Interventions  
    PCN, PCNU, PCNL, Stone retrieval  
    SP tubes  
Comprehensive Lower Extremity Venous Disease  
    Part 1. Comprehensive Superficial Venous Insufficiency: Clinical and Imaging  
    Evaluation, management, therapy, and follow-up  
    Part 2. DVT/PE evaluation and management: Iliofemoral/IVC clot management  
    including pharmacomechanical thrombolysis, LE/IVC/Iliac venous stenting  
    (include May-Thurner)  
Comprehensive Evaluation and Management of Vascular Malformations  
ELVO/Stroke Imaging/Stroke Interventions/ Cerebral vascular anatomy and disease  
Bronchial Arteriography and embolization

### **Non-Interpretive Topics in Radiology**

Professionalism and Ethics  
Political advocacy for radiology  
Research methodology and critical thinking skills  
Medical-legal issues in radiology  
Health care economics and the business of a radiology practice  
Dictation and billing issues for the radiologist  
Fatigue Management

### **IMAGING CONFERENCE AND GRAND ROUNDS**

Departmental noon conference stresses image interpretation and differential diagnosis. However, an effective radiologist must not only be able to interpret an imaging study but must serve as a consultant to the referring clinician. In order to be an effective consultant, the resident must be versed in the appropriate imaging evaluation of a variety of clinical conditions in order to be able to recommend the most useful, cost-effective studies. In the language of the ACGME, imaging conference addresses “systems-based practice, with emphasis on an awareness of and responsiveness to the larger context and system of

health care and the ability to effectively call on system resources to provide care that is of optimal value.” The cost of imaging, the components of billing, and the relative value units (RVU) of imaging will be included in these presentations to provide a forum for discussion and education on health care economics. This conference also provides a forum in which the resident refines his or her communication and teaching skills while conveying important imaging evaluation information to members of the department.

Imaging conference is held every 3 weeks September to June at 7:00 a.m. Each resident’s presentation should be no more than seven minutes long and should be a very brief presentation of an imaging case, followed by a succinct discussion of the relevant literature, any applicable ACR Appropriateness Criteria ( accessible online at the ACR website [www.acr.org](http://www.acr.org)), and the professional and technical reimbursement for the imaging modalities discussed. Third and fourth year residents should also include a discussion of the RVUs of each modality. First year residents should discuss the case they plan to present to an appropriate attending.

Grand rounds is held one day per month with the visiting professor lecturing at 12 noon in place of noon conference and at 5pm on the same day. Residents are expected to attend. The visiting professor also often gives a resident-specific conference at 3:30 that day.

### **INTERDEPARTMENTAL CONFERENCES**

Interdepartmental conferences within our institution will often require the participation of a radiologist and in most cases, necessitate the expertise of a staff radiologist. By the fourth year, the resident is expected to have gained sufficient expertise to be able to function as the primary radiologist at Medical Oncology Conference. Medical Oncology Conference is a working patient management conference, and the list of cases will be made available to the resident for the resident to have sufficient time to review the films. Participation in these conferences helps develop required skills of teaching and working in interdisciplinary teams.

### **MEETING ATTENDANCE**

The residents who are not assigned to specific rotations will be excused at 1:30 p.m. to attend the New England Roentgen Ray meeting, traditionally held from 3:00 pm to 6:45 pm one Friday per month in Boston, MA. The chief residents will determine the schedule of who will go to the meeting and who will cover services on these afternoons. There will be no noon conferences on these days.

It is the intent of the Department to encourage attendance at national meetings as well. The Department will pay for the attendance of any resident to a national meeting when a resident presents a scientific abstract. Three travel days will be provided to allow for travel to the meeting, day of presentation, and day of return travel. An additional day will

be provided for west coast meetings. Receipts for the meeting must be submitted and reasonable expenses related to the meeting will be reimbursed.

While education exhibits can be used to fulfill the residency requirements for scholarly activity, priority is given to paper presentations. A resident who is first author on an educational exhibit accepted to RSNA will be reimbursed a stipend of \$500 toward travel expenses for attendance at RSNA one time in residency only. Up to two days off of service will be allotted for meeting attendance and travel, depending schedule availability. Receipts must be submitted prior to reimbursement.

All presentations supported by the Department (paper, poster, etc.) should be presented to the Department at Imaging Conference. It is the responsibility of the resident to be placed on the Imaging Conference Schedule.

If a resident will be attending a conference, it is the resident's responsibility to inform the Chief Resident at least two weeks before the conference date for scheduling purposes.

During the second or third year of training, the Department will pay tuition only for residents to attend the AIRP course in Washington, D.C. If a resident chooses not to attend the AIRP, an alternate elective in radiologic-pathologic correlation will be provided at RIH.

In preparation for the core exam, residents will be provided time and tuition to attend the Huda Physics review course. Residents will be provided one week off of service to attend a general board review course but tuition will be the responsibility of the resident.

### **SELF-STUDY**

In addition to learning from supervised, progressive experience on service and didactic instruction in conferences, residents must develop self-study habits that will strengthen medical knowledge during residency and provide a foundation for life-long learning. The reading guide for each rotation can be found on the intranet. There is a collection of texts available which may be signed out through Jill Raczelowski. Any lost texts will be replaced by the resident who last signed out the book. In addition, there is an educational fund available of \$1500 per resident for books, ABR costs or educational travel. Book purchases must be placed through the Program Coordinator – the hospital requires purchasing through their own vendor. Please check with to make sure a purchase will be eligible for reimbursement before purchasing. Receipts should be given to Jill for reimbursement. Electronic equipment is not reimbursable but the department will provide an iPad to the resident so that the resident can regularly use the on-line resources StatDx and RadPrimer to learn in a case based format. If the iPad is lost or damaged, the resident will be expected to replace it.

## THE LEARNING PORTFOLIO

Each resident must maintain an electronic portfolio that demonstrates learning activities in the six core competencies. Each resident must become a member-in-training of the RSNA and use their RSNA portfolio to maintain their residency portfolio. This allows the program director electronic access to the portfolio for review. In addition, by continuing RSNA membership, the resident will have access to the portfolio beyond training.

The resident is responsible for ensuring that the following components are in the electronic portfolio before the CCC meeting every 6 months:

### Portfolio Requirements

Document	Frequency/Date due	Uploaded by
Dictation evaluation	Once by June first year	Dr. Gil to Jill
LP log	Once, by June first year	Resident to Jill
Procedure log	Updated every 6 months	Jill
USMLE 3	Once by June first year	Resident to Jill
ACGME case log	Updated every 6 months	Jill
Imaging Conference ppt	Every 6 months	Resident
Self assessment CME	2 per year by each June	Resident
Learning plan	Once per year by October	Resident
Peer Review sign in	Every 6 months	Jill
ACLS	Every 6 months check is valid and replace as necessary	Resident to Jill
1131 log	Once in residency by December 4th year	Resident to Jill
CV/Scholarly	Updated with scholarly activity. Once per year by June	Resident
PQI project write up	Once in residency	Resident

In order to complete the LP log, the resident should document 5 cases with attending signature during the IR rotation.

Activities with self assessment (SAM or CME with self assessment) are available on the ARRS or RSNA websites. The ACR case-in-point series and the RSNA physics modules can also be used for self assessment if documentation is uploaded to the portfolio.

At the beginning of each year, the resident should create an annual learning plan. The plan should be saved as a word document with the date in the title and added to the electronic portfolio by October. The annual learning plan should be in the following format:

**Learning Plan**

Date:

What I am doing well:

What areas I need to improve:

What I plan to do to improve areas of concern/weakness:

My short term goals for residency:

My long term goals for my career:

## RESEARCH

The ACGME (Accreditation Council for Graduate Medical Education) requires each resident to perform scholarly activity during radiology residency. During the four years of training in Diagnostic Radiology, there will be ample opportunities to participate in clinical research. Participation in research will deepen the resident's understanding of literature review, research study design, and statistical methodology. Quality research enhances the image of Rhode Island Hospital and the training program as well as the resident's stature within the radiology community. For those residents desiring fellowship training, participation in these activities enhances one's application to competitive fellowship programs.

Residents must first establish a basic knowledge base in radiology before committing time to research activities. First year-resident's first priority must be to establishing that base, and therefore research should not be undertaken during the first year until after the Program Director has evaluated the resident's performance at the 6-month review in December unless an exception is made by the program director

Many of the staff radiologists are excellent mentors for writing papers and/or preparing exhibits. Participation in these projects must be under the tutelage of an attending radiologist; no material should be submitted for publication or presentation without the supervision of a staff member. Residents may be given some academic time for critical portions of a research project. The staff radiologist working with the resident should make the request to the program director. After approval by the program director, the chief residents will allot the time when the schedule permits.

Prior to completion of the residency, an academic project must be completed. For the beginner, a case report submitted to an imaging journal or website, or an education exhibit will be an obvious starting place. For those residents interested in a specific area of radiology, a complete article could be undertaken. The national meetings of the Radiological Society of North America (RSNA), Association of University Radiologists (AUR) or the American Roentgen Ray Society (ARRS) are excellent arenas for abstract presentations. These national meetings allow 10-12 minute presentations on a concise topic, which can be submitted as a manuscript for publication. As with papers, staff guidance and supervision is mandatory. The ARRS and the AUR have annual competitions limited to residents for outstanding research and/or publications. In addition to prestige, these awards carry the additional bonus of a monetary award.

In summary, there are numerous avenues for the resident to become acquainted with the "academic" aspects of radiology. The requirement to participate in this area should be approached as an opportunity to evaluate possible career opportunities, demonstrate hidden talents, and to understand the unique opportunities available in diagnostic radiology.

## RESIDENT ON-CALL RESPONSIBILITIES

All radiology residents will share overnight call responsibilities. The resident assigned to Vascular and Interventional Radiology will be taking call in that section and will therefore be removed from the general call rotation.

1. First year residents will take in-house ER call at the beginning of October from 5:00 to 10:00 pm during the week. The first-year resident will provide plain film, CT, and Ultrasound interpretation and consultation under the direct supervision of an attending radiologist.
2. Weekend and Holiday call for the first-year residents will be from 8:00 am to 5:00 pm in the ER with an attending radiologist.
3. Second, third and fourth year residents will be scheduled for overnight “night float long” rotations from 10 pm until 8 am the next day Monday-Friday and 8pm-8am Saturday and Sunday. “Night float short” is a 5pm-2am rotation. An attending radiologist will be present in the ER until 12am and will return at 6am for morning readout of overnight cases.
4. During the week, the short night float covers the Body Reading Room to monitor contrast injections and assist referring physicians until 10 pm Monday-Friday, and then reports to the ER until 2am. On weekends and holidays, the short night float resident should report to the ER at 5pm for the entire shift.
5. The night float residents are responsible for handling all Hasbro, W&I, MRI, and inpatient requests. Additionally, the night float residents are responsible for entering preliminary reads in PACS for all Hasbro ER cases and all W&I ER studies/urgent studies.
6. Weekend and Holiday call for second, third, and fourth year residents will include a body call pool and a neuro call pool. Body call is from 8am until 5pm in the Body Reading Room and includes interpretation of inpatient and outpatient body imaging as well as any emergency CT, US, and Fluoroscopy procedures that arise. Neuro call is 8am-5pm on Saturday and 8am-3pm on Sunday and Holidays if all work is complete and the phones have been transferred to ring in the body reading room.

In general, body call is covered by second and third year residents and neuro call is covered by third and fourth year residents.

**GRADUATE MEDICAL EDUCATION TRAINING PROGRAM  
IN DIAGNOSTIC RADIOLOGY  
DUTY HOUR POLICY**

**PURPOSE:**

To establish a formal written program duty hours policy under the aegis of the Graduate Medical Education Committee governing resident/fellow duty hours that fosters education and facilitates the care of patients. The program policy must be consistent with the institutional policy and requirements as outlined in the ACGME's Common Program Requirements that apply to each program.

**POLICY:**

Duty Hours are defined as time spent on all clinical academic activities related to the residency program, including patient care at all duty sites (inpatient, outpatient, in the operating room and in the Emergency Department), administrative duties related to patient care, the provision for transfer of patient care, and include time spent in the hospital during on-call activities, as well as program scheduled activities such as conferences and on site meetings. Duty hours do not include reading and preparation time spent away from the duty site.

1. Duty hours must be limited to 80 hours per week, averaged over a four week period, inclusive of all in-house call activities and all moonlighting unless the ACGME and the GMCEC have granted an exception to that policy.
2. Residents must be scheduled for a minimum of one day free of duty every week (when averaged over four weeks). At-home call cannot be assigned on these free days.
3. Duty periods of PGY-2 house staff and above may be scheduled to a maximum of 24 hours of continuous duty in the hospital.
4. Residents must not be assigned additional clinical responsibilities after 24 hours of continuous in-house duty. It is essential, however, for patient safety and resident education that effective transitions in care occur. PG2 and above residents may be allowed to remain on-site in order to accomplish these tasks; however, this period of time must be no longer than an additional four hours.
5. In unusual circumstances, residents, on their own initiative, may remain beyond their scheduled period of duty to continue to provide care to a single patient. Justifications for such extensions of duty are limited to reasons of required continuity for a severely ill or unstable patient, academic importance of the events transpiring, or humanistic attention to the needs of a patient or family. Under those circumstances, the resident must:
  - a. Appropriately hand over the care of all other patients to the team responsible for their continuing care
  - b. Document the reasons for remaining to care for the patient in question and submit that documentation in every circumstance to the program director.
  - c. The program director must review each submission of additional service, and track both individual resident and program-wide episodes of additional duty.
6. First-year (PGY-2), second-year (PGY-3) and third year (PGY-4) residents are defined by the RC to be at the intermediate-level. Fourth year (PGY-5) residents are defined by the RC to be in the final years of education and must be prepared to enter the unsupervised practice of medicine and care for patients over irregular or extended periods.
  - a. This preparation must occur within the context of the 80-hour, maximum duty period length, and one-day-off-in seven standards. While it is desirable that residents in the final years of education have eight hours free of duty between scheduled duty periods, there may be circumstances when these residents must stay on duty to care for their patients or return to the hospital with fewer than eight hours free of duty.



- b. Circumstances of return-to-hospital activities with fewer than eight hours away from the hospital by residents in the final years of education must be monitored by the program director.
- 7. Residents must not be scheduled for more than six consecutive nights of night float.
- 8. PGY-2 residents and above must be scheduled for in-house call no more frequently than every-third-night when averaged over a four-week period.
- 9. Time spent in the hospital by residents on at-home call must count towards the 80-hour maximum weekly hour limit. The frequency of at-home call is not subject to the every-third-night limitation, but must satisfy the requirement for one-day-in-seven free of duty, when averaged over four weeks.
  - a. Residents are permitted to return to the hospital while on at-home call to care for new or established patients. Each episode of this type of care, while it must be included in the 80-hour weekly maximum, will not initiate a new “off-duty period”.
- 10. The Diagnostic Radiology program will monitor duty hours separately from semi-annual GMEC surveys. All residents will log daily duty hours, including moonlighting, for one consecutive 28 day period at least once per year. The time period will be assigned by the program director. The logs will be entered into the E\*Value system and reviewed by the program director.
- 11. Moonlighting is permitted only through approved moonlighting opportunities.
 

*The Program Director must approve any moonlighting activities before such activities are undertaken. Work hours, including moonlighting, must not exceed 80 hours per week, averaged over a 4-week period. Moonlighting is not permitted until the Program Director has determined that the resident’s educational program will not suffer. Therefore, each resident must have approval from the Program Director before engaging in any moonlighting activities. The Program Director will then monitor the number of hours worked outside the educational program. Moonlighting involving preliminary image interpretation is permitted only through internal moonlighting provided through the department at The Miriam Hospital (TMH). Faculty members of the department are able to monitor the resident’s performance and provide feedback to the resident and the Program Director. There is a limit on the number of hours of moonlighting permitted, and the moonlighting schedule at TMH will be reviewed to ensure compliance. The number of shifts allowed increases with resident experience, with a maximum of four shifts of weekday evening and four shifts of overnight call per month at the senior level. Second-year residents may begin moonlighting in the second half of the year. This will allow sufficient experience as “night float”, which provides the independent experience necessary for moonlighting. Second-year residents are permitted up to two shifts per month. It is not imperative that all shifts at TMH be filled. Moonlighting is completely voluntary, and each resident must decide if he or she will participate. The attending staff will cover any unfilled shifts. First year residents are not permitted to moonlight at TMH but may participate in contrast reaction coverage moonlighting through RIMI.*

\_\_\_\_\_  
 Martha Mainiero, MD  
 Diagnostic Radiology Program Director

\_\_\_\_\_  
 Date

Reviewed and approved by the Graduate Medical Education Committee on \_\_\_\_\_

\_\_\_\_\_  
 James Arrighi, M.D.  
 Director, Graduate Medical Education  
 Designated Institutional Official  
 Chair, Graduate Medical Education Committee

\_\_\_\_\_  
 Date

## **VACATION POLICY**

PGY 1-3 residents are entitled to three (3) weeks of paid vacation per year, and PGY 4-5 residents are entitled to four (4) weeks of vacation. All vacation requests should be directed to the chief resident. The number of residents permitted away per week will vary depending upon the schedule.

No more than two (2) consecutive weeks at a time can be taken. The resident will not be routinely allowed to take single vacation days. Only one week of terminal vacation (last week of residency) is permitted. Emergency request for absences will be evaluated on merit and charged against vacation time if needed. Unexplained absences will influence evaluation and may constitute grounds for dismissal.

No vacation is permitted during the week of the ABR core exam, the first week of July, and the last week of June (except fourth-year residents). During the RSNA, ARRS, SIR, ACR and AUR meetings, no time relieved from clinical duties is allowed except for those residents wishing to attend these important national meetings.

## **INTERVIEWING FOR FELLOWSHIP**

If more than 7 days, including travel are needed for fellowship interviews it will be required to be taken as vacation time.

## **SICK TIME**

The Chief Resident or resident on call must be informed regarding absences due to illness prior to 8:00 a.m. The attending on the involved service will be immediately notified so appropriate arrangements for clinical coverage can be provided.

## **RELIGIOUS HOLIDAYS**

Prior notification to the Director or Supervisor of the training program is necessary two weeks in advance. Based upon the number of residents desiring to be free of clinical responsibilities, a lottery may be necessary to maintain sufficient clinical coverage. Religious holidays will be counted as vacation time.

## MOONLIGHTING POLICY

The Accreditation Council for Graduate Medical Education (ACGME) requires the Residency Program Director to monitor resident work hours and progress. The Program Director must approve any moonlighting activities before such activities are undertaken. Work hours, including moonlighting, must not exceed 80 hours per week, averaged over a 4-week period. Moonlighting is not permitted until the Program Director has determined that the resident's educational program will not suffer. Therefore, each resident must have approval from the Program Director before engaging in any moonlighting activities. The Program Director must then monitor the number of hours worked outside the educational program.

In this program, there are two approved moonlighting opportunities:

### TMH

Moonlighting providing preliminary image interpretation is provided through the department at The Miriam Hospital (TMH). For the resident who has shown appropriate knowledge, professional skills and the capacity to function independently, this moonlighting activity can be a growth experience. Faculty members of the department are able to monitor the resident's performance and provide feedback to the resident and the Program Director.

Moonlighting must not interfere with the necessary educational and personal development that will allow the resident to mature into a well-rounded physician. There is a limit on the number of hours of moonlighting permitted, and the moonlighting schedule at TMH will be reviewed to ensure compliance. The number of shifts allowed increases with resident experience, with a maximum of four shifts of weekday evening and four shifts of overnight call per month at the senior level. First year residents are not permitted to moonlight. Second-year residents may begin moonlighting in the second half of the year. This will allow sufficient experience as "night float", which provides the independent experience necessary for moonlighting. Second-year residents are permitted up to two shifts per month.

It is not imperative that all shifts at TMH be filled. Moonlighting is completely voluntary, and each resident must decide if he or she will participate. The attending staff will cover any unfilled shifts.

### RIMI

Moonlighting providing contrast reaction coverage only is available through RIMI. This opportunity is permitted to residents at all levels of training but requires a full medical license. Once you obtain a full license from the state of RI you are no longer eligible to go back to having a training license, and you will therefore need to keep up your RI license for the rest of your training. Once you move to a full license, you must also have a RI controlled substance registration and a federal DEA license. Each of these is associated with an additional cost. The CSR and DEA license is a requirement of the hospital as you

will no longer be covered under the institution's DEA license once you are on a full license.

The GME office will reimburse \$169 per year toward the above costs (this is the amount of money they would have spent on your for a training license). There are times they may reimburse two years at a time (\$338) if you are going to be here for at least two more years. RIMI will reimburse the remainder. You should first submit to the GME office for reimbursement and then submit to RIMI for the remainder. In order to be reimbursed by RIH, an **original receipt** must be submitted along with the Employee expense reimbursement voucher at the link below.

The form to submit your expenses to the GME office are on the intranet, under employee tools tab: <http://intra.lifespan.org/accountspayable/documents/eerv.pdf>

Further procedural questions can be addressed to Kay Wagner in the GME office at 444-8450.

### **TRAVEL REIMBURSEMENTS**

Receipts are required for EVERYTHING for which you are asking to be reimbursed. (Airfare, lodging, meals, transportation and all other business travel expenses).

Proof of payment must be clear on the receipt; otherwise additional documentation is required (for example, a cancelled check image or copy of credit card/bank statement).

PLEASE NOTE: Travel expenses are reimbursed by your fellow radiologists at RIMI, which is a privilege that can be withdrawn at any time. Please make smart decisions during your travel.

#### **A. AIR TRAVEL**

1. Reimbursed at **coach class rates only**.
2. Seat upgrades from coach class are NOT reimbursable.
3. Acceptable forms of receipts are as follows:
  - a. Paper tickets: retain and submit "passenger receipt".
  - b. E-tickets: print and submit the flight itinerary/confirmation reflecting purchase price and form of payment.

#### **B. ACCOMMODATIONS**

1. Itemized hotel bills identifying dates of the stay and any ancillary charges and proof of payment must be submitted.
2. Pre-stay reservation itineraries are not acceptable.

#### **C. GROUND TRANSPORTATION**

1. Ground transportation is reimbursed based upon the least expensive means.

2. Automobile rental while on Lifespan business will be reimbursed when it is the only available mode of transportation or if it results in documented savings (written explanation required).
  - a. The employee must purchase a Bodily Injury and Physical Damage Comprehensive and Collision insurance policy from the car rental agency (if not provided by the employee's credit card company). Insurance premiums paid will be reimbursed.

#### D. PROOF OF ATTENDANCE

1. When attending a conference or seminar, the following items must be submitted:
  - a. A copy of the program schedule or agenda that includes the conference dates.
  - b. A copy of your name badge from the conference.

#### E. MEALS

1. The total allowable amount for meals is capped at \$90 per day and \$45 for partial travel days. This amount may not be combined over the duration of your trip.
2. An itemized receipt for all meals over \$25 must be provided, **including meals charged to the hotel room**. If you do not provide an itemized receipt for a meal over \$25, the total reimbursed will be reduced to \$25.
3. Tipping may not exceed 20%. Any tips over 20% will be reduced to the corresponding amount.
4. If a meal receipt indicates that there was more than one diner, the following rules apply:
  - a. The other diners must be identified on the receipt, i.e. "John Smith – Resident" or "Wife".
  - b. You must check off specifically what you ate. If the meal was split evenly, that also needs to be indicated.

#### F. ALCOHOL

1. Alcoholic beverages, as a general rule, should be limited to 2 per meal.
2. Alcohol-only receipts will not be reimbursed unless a meal receipt from the same establishment is also provided.
3. Alcoholic items must be marked as such on the receipt.
4. Even if an alcoholic reimbursement is approved by the department, the Finance Department may deem it unnecessary to reimburse.

#### G. NON-REIMBURSABLE EXPENSES

1. Non-reimbursable expenses include, but are not limited to:
  - a. Expenses incurred by a guest of the Lifespan employee
  - b. Entertainment including music, spectator, and sporting event costs
  - c. In-room movies, spa fees, and air club memberships
  - d. Laundry
  - e. Parking violations

#### H. NOTABLE ITEMS

1. The Employee Expense Reimbursement Voucher must be legibly signed by the employee seeking reimbursement and the employee's immediate supervisor or designee.

2. A travel advance may be obtained under extenuating circumstances.
  - a. Travel advances should be settled within 60 days from the date of return via submission of an Employee Expense Reimbursement Voucher to the Accounts Payable Department.
  - b. Future advances or reimbursements will not be processed until outstanding advances are settled.
3. International travel must be approved in advance by a Senior Vice President. Employee Expense Reimbursement Vouchers should be converted to U.S. dollars prior to submission to Finance.

**Please note this is the Diagnostic Imaging Department's travel policy. The Department is at liberty to approve or reject reimbursement requests at its discretion.**

**RHODE ISLAND HOSPITAL & THE MIRIAM HOSPITAL**  
**THE USE OF RADIATION MONITORING BADGES**

**To:** All Radiation Workers  
**From:** Radiation Safety Office

---

If you could be exposed to ionizing radiation from radioactive material or radiation producing devices such as x-ray tubes, you will be given one or more radiation monitoring badges. Badges are issued either monthly or quarterly and must be returned promptly after use.

Only the person whose name is on the badge should wear it. The badge **must** be worn when working with or in the vicinity of radiation sources.

**Radioactive Material Users**

- 1) **Whole body badges** must be worn at trunk level.
- 2) **Ring badges** must be worn under the glove with the name facing the palm.

**Radiation Generating Equipment Users (X-Ray, CT, Fluoro)**

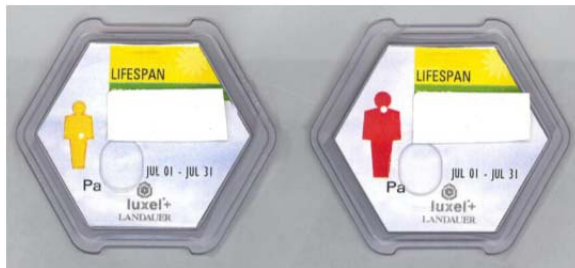
**One Badge System**

- a) For those not wearing lead aprons.  
Badges must be worn at trunk level.
- b) For those wearing lead aprons and using fluoro intermittently.  
Badge must be worn at collar level **OVER** the thyroid shield. This badge measures eye dose and whole body dose. The effective whole body dose = 0.3 x collar reading.

**Two Badge System**

**This is for those wearing lead aprons and using fluoro regularly.**

- a) Collar badge to be worn at collar level **OVER** the thyroid shield.
- b) Waist badge to be worn at waist level **UNDER** the lead apron on the scrubs.  
Effective whole body dose = 0.04 x collar reading + 1.5 x body badge reading.



**If you have any questions, please call the Radiation Safety Office at 4-5961.**

Rev. 05/07

## RADIATION EXPOSURE AND PREGNANCY

Any woman considering pregnancy or finding herself pregnant should discuss occupational exposure, monitoring and proper shielding with Sean Matthews in the physics department. The amount of radiation exposure expected from normal daily activities of radiology residency, including routine fluoroscopy and nuclear medicine injections such as sentinel lymph node studies, is well within the accepted range for occupational exposure to the pregnant worker by NCRP guidelines. However, in order to avoid the *potential* for an unintended larger dose of radiation, pregnant women should refrain from providing nuclear medicine therapy and should not handle radioactive iodine, even in diagnostic quantities.

## BCLS/ACLS CERTIFICATION

Basic Cardiac Life Support (BCLS) certification is required by the Accreditation Council for Graduate Medical Education (ACGME) and by the American Board of Radiology (ABR). Residents are also expected to be certified in Advanced Cardiac Life Support (ACLS). ACLS training is provided by the hospital during orientation. The department periodically organizes BCLS and ACLS classes, but it is the responsibility of the resident to sign up for the class when re-certification is due and to maintain a record of certification in his or her portfolio. The Graduate Medical Education office will pay the fee for the residents' recertification if it is due and necessary for the residency. The resident will be expected to pay for the class if recertification is not due or if the resident is graduating within six months.

## LEAVE OF ABSENCE POLICY

Graduate Medical Education Leave of Absence Policy

**SUBJECT:** Leave of Absence Policy

**REVISED:** October 20, 2005  
**February 14, 2008**

**Applicability:** This Policy is applicable to all House Officers (interns, residents and fellows) enrolled in any of the Rhode Island Hospital's GME programs and addresses any extended time away from the GME program.

**Policy:** All House Officers are afforded leaves of absence in accordance with the Lifespan System-wide policy on "Leave of Absence," which policy is included in the House Officer Manual. In addition, all House Officers are afforded the leave described in the Lifespan System-wide Leave of Absence Policy as of the commencement of their training program.

*Medical Leave of Absence:* In the event of a disabling illness or injury to a House Officer that lasts for more than 2 weeks (including illness or disability associated with pregnancy



and for a House Officer who gives birth to a child, beginning of the date of the birth of the child, the House Officer will be maintained at 100 percent of stipend for the 30 calendar days following the first day of the leave. Should the disability continue beyond that point, the House Officer will continue to receive disability benefits under the policies and procedures of the Hospital's Temporary Disability Policy and/or Long Term Disability Insurance Program, depending on the nature of the disability, as in effect at that time for salaried employees. House Officers are not required to, but may, use accrued vacation time during the unpaid portion of a medical leave of absence.

*Parental and Family Medical Leave:* House Officers are afforded unpaid leaves of absence in accordance with the House Officer's Leave of Absence Policy and the Lifespan System-wide Policy on "Leave of Absence", which are designed to be consistent with the state Parental and Family Medical Leave Act of 1990, and the federal Family & Medical Leave Act of 1993.

*Personal Leaves of Absence:* Personal and other unpaid leaves that are not considered Family and Medical Leaves under the Lifespan System-wide Policy, including School Involvement Leave as described in the Lifespan System-wide Policy, , may be granted by the Program Director. (See also Leave of Absence Policy in the House Officer's Handbook, and available at <http://www.lifespan.org/services/gme/amc/manual/5/leave-of-absence.pdf> as well as the Lifespan System-wide Leave of Absence policy available at [http://intra.lifespan.org/managers/lifespanwide/docs/2.0%20Employee%20Benefits/Complete\\_Signed\\_LOA\\_Policy\\_11\\_2007.pdf](http://intra.lifespan.org/managers/lifespanwide/docs/2.0%20Employee%20Benefits/Complete_Signed_LOA_Policy_11_2007.pdf).)

*Effect of Leaves on Training Requirements:* The granting of a leave of absence or other time away from the training program does not relieve the House Officer of the obligation to complete all program-specific reappointment requirements, ACGME Program Requirements or Specialty Board eligibility requirements. Therefore, the Program Director may require a House Officer to assume compensatory service and educational activities either during the appointment year or by extending the House Officer's appointment year in order to meet training requirements. The House Officer may receive a stipend during the extended time if approved by the Program Director.

**Procedure:**

Residents should discuss all requests for Leave of Absence, medical, family or personal, with the Program Director at the earliest possible opportunity. Such requests should be documented in the resident's file along with final arrangements. The Program Director will notify the GME Office in writing of the leave at the earliest opportunity. The GME Office will serve as a resource to residents and Program Directors, providing advice as well as interpretation of the overlapping Hospital, ACGME and Board policies and requirements. The Program Director, with support from the GME office, will advise the House Officer of any impact of the leave time on satisfying the completion of the requirements for training and board eligibility, and any impact of the leave time on pay and employee benefits, as discussed above.

## RESPONSIBILITIES OF THE CHIEF RESIDENT(S)

It is an honor and privilege to be selected as the Chief Resident. The major responsibilities of this position are typically accorded to a senior resident (with assumption of these duties beginning in January of the third year). These responsibilities consist of:

### **I. RESIDENT ASSIGNMENTS**

- A. Responsible for the resident rotation schedule, including the assignment of overnight call coverage and weekend/holiday coverage;
- B. Assigns coverage as needed for areas requiring physician supervision during routine hours when staff are otherwise occupied;
- C. Approve resident requests for vacation or meeting/conference time;
- D. Assigns resident coverage as needed in event of illness, approved leave of absence, or vacation;
- E. Arranges the noon conference schedule.

### **II. RESIDENT LIAISON**

- A. Attempts to represent the consensus resident viewpoint to the Program Director and Department Chairman when issues affecting the department arise;
- B. Communicates announcements to the resident group;
- C. Addresses issues affecting other resident groups and the radiology residents;
- D. Attempts to communicate departmental staff (technologists and secretaries) concerns to the residents.

### **III. GRAND ROUNDS**

- A. Assists with audiovisual needs.
- B. Collect resident sign in sheets and attending evaluations

### **IV. RESIDENT SELECTION**

- A. Participates in the interview process;
- B. Arranges resident applicant dinner and tours and oversees resident interactions with candidates.

### **V. MEMBER OF RADIOLOGY EDUCATION COMMITTEE**

### **VI. COORDINATES RESIDENT RESPONSIBILITIES TO BROWN AND OTHER VISITING MEDICAL STUDENTS**

**Brown Medical School**  
**Department of Diagnostic Imaging Academic Appointments**

<u><i>Name</i></u>	<u><i>Track</i></u>	<u><i>Appointment</i></u>
Gunjan Aeron, M.D.	Clinical	Clinical Instructor
Saurabh Agarwal, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Sun Ho Ahn, M.D.	Teaching Scholar	Associate Professor
Srividya Anandan, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
James A. Arrighi, M.D.	Teaching Scholar	Associate Professor of Medicine, Section of Medical Education and Diagnostic Imaging
Michael K. Atalay, M.D., PhD	Teaching Scholar	Associate Professor of Diagnostic Imaging and Medicine
Grayson L. Baird, PhD	Research Scholar	Assistant Professor
Michael D. Beland, M.D.	Teaching Scholar	Associate Professor
Jerrold L. Boxerman, M.D.	Teaching Scholar	Associate Professor of Diagnostic Imaging and Medicine
Jeffrey M. Brody, M.D.	Clinician Educator	Associate Professor, Clinician Educator
J. Elliott Brown, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Rachael L. Caiati, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
John A. Cassese, M.D.	Clinician Educator	Assistant Professor, Clinician Educator of Diagnostic Imaging and Pediatrics
Kevin J. Chang, M.D.	Teaching Scholar	Associate Professor
John J. Cronan, M.D.	Teaching Scholar	Professor
Lawrence M. Davis, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Allan Deutsch, M.D.	Emeritus	Clinical Associate Professor (Emeritus)

Daniel P. Dickstein, M.D.	Research Scholar	Associate Professor
Linda Donegan, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Gary J. Dorfman, M.D.	Emeritus	Professor (Emeritus)
Gregory J. Dubel, M.D.	Clinician Educator	Associate Professor, Clinician Educator
Thomas K. Egglin, M.D.	Teaching Scholar	Associate Professor
Matthew D. Ethier, M.D.	Clinical	Clinical Assistant Professor
Peter T. Evangelista, M.D.	Clinician Educator	Associate Professor, Clinician Educator
Holly Gil, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Richard L. Gold, M.D.	Clinician Educator	Associate Professor, Clinician Educator
David J. Grand, M.D.	Teaching Scholar	Associate Professor
Richard A. Haas, M.D.	Clinician Educator	Associate Professor, Clinician Educator of Diagnostic Imaging, Neurosurgery and Neurology
Terrance T. Healey, M.D.	Teaching Scholar	Assistant Professor
Thaddeus W. Herliczek, M.D.	Teaching Scholar	Assistant Professor
Mary M. Hillstrom, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Jason D. Iannuccilli, M.D.	Teaching Scholar	Assistant Professor
Bryan S. Jay, M.D.	Clinical	Clinical Assistant Professor
Mahesh V. Jayaraman, M.D.	Teaching Scholar	Associate Professor of Diagnostic Imaging, Neurology and Neurosurgery
Nneka T. Jimoh, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Gaurav Jindal, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Adib Karam, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
May M. Kassem, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Hanan I. Khalil, M.D.	Clinician Educator	Assistant Professor, Clinician Educator

Susan M. Koelliker, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Robert E. Lambiase, M.D.	Teaching Scholar	Associate Professor
Elizabeth Lazarus, M.D.	Teaching Scholar	Associate Professor
Scott M. Levine, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Ana P. Lourenco, M.D.	Teaching Scholar	Associate Professor
Martha B. Mainiero, M.D.	Teaching Scholar	Professor
Kathleen M. McCarten, M.D.	Emeritus	Professor, Clinician Educator of Diagnostic Imaging and Pediatrics (Emeritus)
Ryan A. McTaggart, M.D.	Clinician Educator	Assistant Professor, Clinician Educator of Diagnostic Imaging, Neurology and Neurosurgery
Derek Merck, MS, PhD	Research Scholar	Assistant Professor Diagnostic Imaging and Engineering
Lisa H. Merck, MD,MPH,FACEP	Teaching Scholar	Assistant Professor Emergency Medicine, Neurosurgery and Diagnostic Imaging
Jonathan S. Movson, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Brian Murphy, M.D.	Clinical	Clinical Associate Professor
Timothy P. Murphy, M.D.	Research Scholar	Professor
David P. Neumann, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Van T. Nguyen, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Arthur W. Noel, M.D.	Clinical	Clinical Assistant Professor
Richard B. Noto, M.D.	Clinician Educator	Professor, Clinician Educator
William K. Park, PhD	Research Scholar	Assistant Professor
John A. Pezzullo III, M.D.	Clinician Educator	Associate Professor, Clinician Educator

Marcelle L. Piccoello, M.D.	Clinician Educator	Assistant Professor, Clinician Educator of Diagnostic Imaging and Pediatrics
Jason A. Pietryga, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Ethan A. Prince, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Shruthi Ram, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Jana S. Rice, MD	Clinical	Clinical Assistant Professor
Mark S. Ridlen, M.D.	Clinician Educator	Associate Professor, Clinician Educator
Jeffrey M. Rogg, M.D.	Teaching Scholar	Associate Professor
Cassandra M. Sams, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Albert A. Scappaticci, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Barbara Schepps, M.D.	Emeritus	Professor (Emeritus)
Francis H. Scola, M.D.	Emeritus	Clinical Professor (Emeritus)
Bradley A. Shapiro, M.D.	Clinical	Clinical Assistant Professor
Gregory M. Soares, M.D.	Teaching Scholar	Associate Professor
Julie Song, M.D.	Clinician Educator	Associate Professor, Clinician Educator
Patricia K. Spencer, M.D.	Emeritus	Clinical Associate Professor (Emeritus)
David W. Swenson, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Glenn A. Tung, M.D.	Teaching Scholar	Professor
Michael T. Wallach, M.D.	Clinician Educator	Associate Professor, Clinician Educator of Diagnostic Imaging and Pediatrics
Robert C. Ward, M.D.	Clinician Educator	Assistant Professor, Clinician Educator
Don C. Yoo, M.D.	Clinician Educator	Associate Professor, Clinician Educator

**DEPARTMENT OF DIAGNOSTIC IMAGING  
RHODE ISLAND HOSPITAL**

**ROTATIONS**

**2017-2018**

## **BODY IMAGING AND INTERVENTION**

### **Table of Contents**

- I. General Description of the Body Division at Rhode Island Hospital
  - A. Overview
  - B. Body CT
    - 1. General
    - 2. CT Colonography
    - 3. Coronary CTA
  - C. CT Guided Interventional Procedures
    - 1. Biopsy and Drainages
    - 2. Tumor Ablation
  - D. Body MR
- II. Educational Goals and Objectives by Core Competency
- III. Body CT Resident Evaluation
- IV. Reference Sources
- V. Appendix



## I. GENERAL OVERVIEW AND DESCRIPTION OF BODY DIVISION

The Body Division at Rhode Island Hospital (RIH) interprets Body CT, Ultrasound and MR exams and also performs Image Guided Interventional procedures. The organizational structure of the Department of Diagnostic Imaging at Rhode Island Hospital includes Medical Directors of each *modality* as well as Physician directors of each Organ System/Area. The Medical directors of CT, MR and Ultrasound are Drs. Grand, Rogg, and Beland respectively.

The physician directors involved in the Body Division are as follows:

Director of Body Imaging & Intervention:	Dr. Grand
Director of Ultrasound	Dr. Beland
Director of Body MR:	Dr. Grand
Director of Fluoroscopy:	Dr. B Murphy
Director of CT Colonography:	Dr. Pietryga
Director of Cardiac Imaging (CT & MR)	Dr. Atalay

The Body CT, CT colonography and Body MR sections are included in this chapter. Ultrasound, fluoroscopy and Cardiac sections are reported in separate chapters.

### CT at Rhode Island Hospital

There are currently six helical CT scanners at Rhode Island Hospital which perform in excess of 85,000 examinations per year. The Main CT section has a 64 detector row scanner which performs diagnostic exams and cardiac imaging and a 16 detector wide bore scanner with CT fluoroscopy for CT guided interventional procedures. There are two multidetector scanners in the ER (64 and 128 detector rows). The Medical Office Center (MOC) has a 16 detector row scanner and the Pediatric Imaging Center has a 20 detector row scanner. In the body reading room, we also read CT exams performed in the morning at the MDIC (outpatient) imaging center where there is a 16 detector row CT. Many scanners have adaptive statistical iterative reconstruction software and hardware to help us perform low radiation dose CT exams. The department uses dual phase power injectors for every contrast enhanced examination.

### Body Rotation

Morning rounds begin promptly at 8 a.m. in the body reading room. The senior resident or fellow will briefly present:

1. Scheduled CT guided interventions for the day
2. Targeted ultrasound procedures for the day
3. Tube rounds on inpatients
4. Present 1-3 interesting cases from the day or week before

Before rounds begin, the tube patients are seen/assessed by the junior residents who will present them during tube rounds. Critical aspects of patient care to be presented are: Tmax, WBC, drain output, general assessment, current plan of admitting team.

The interesting body cases can be from the body CT, US, Body MR, ER, Miriam, or W&I. Interesting cases should be placed in the "Body Conf" folder and then deleted from the folder after being presented. Rounds should take approximately 35 minutes. The list of patients with tubes is on the 2<sup>nd</sup> flatscreen and their images are in the "Body Tube" folder.

All CT studies on the "Body CT" worklist should be read within 24 hours. This includes Abdomen and Pelvis exams, but will also include neck, chest, abdomen and pelvis exams if they are performed on the same patient at the same time. Dedicated chest exams are read in the Chest Division and dedicated neck exams, with the exception of 4DCT exams (for occult parathyroid adenomas), are read in the Neuro Division. The day concludes at approximately 5:00 p.m. or when the work is completed, whichever is later. The senior resident must stay until the nightfloat short resident is in the Body reading room.

Readout of Body CT and MR exams in the Meehan area is divided between the residents rotating in the section and the cross-sectional imaging fellow(s). The senior resident (or fellow) on the body rotation is responsible for performing the CT guided interventions for the day. Currently, the two NP's, Derek Tessier and Amy Doorley help obtain consent, discharge the patient and in general coordinate the calling of patients for CT guided interventions. When their duties require their presence elsewhere, these duties will be performed by the resident/fellow who is going to perform the procedure.

The resident/fellow should review the patient's electronic medical records and relevant prior exams on PACS to help with accurate interpretation of the current exam. The resident/fellow should then review the images and form their own impressions. The more history we have, the better our interpretation will be. In addition, for outpatient CT and MR exams, all outpatients answer a questionnaire which is scanned into the PACS system.

At mid-day and at the conclusion of the day the resident/fellow should review and sign all of their reports, making sure his or her queue is empty on the computer system before leaving work. Any unexpected or emergent findings should be communicated to the referring physician during the course of the day. All studies should be dictated within 24 hours of the exam.

As we sometime compare with RIMI exams, or are asked to perform a biopsy based on RIMI exams, all residents should have a password for login into the RIMI PACs system. Kyle Schuster is the contact person for this: 401-427-7871. RIMI cell 401-639-2968. RIMI PACs can be accessed via the Synapse program, located on the desktop of most standalone PCs in the Body reading room or on the Virtual Desktop on the PACs workstations.

Second, third, and fourth year residents are expected to be able to form basic interpretations of thoracic, abdominal, and pelvic examinations. These residents are expected to help referring physicians interpret studies performed at Rhode Island Hospital when they come to the Body section. When residents are having difficulty interpreting

these cases, the attending or fellow in the Body section should be consulted immediately.

### **Protocolling Cases**

Currently, Scott Collins protocols most CT cases, though residents/fellows should be familiar with the thought process. All of the available protocols can be found on the web at:

Please note that protocolling cases often requires looking up history in the EMR. The EMR is your friend.

Please do not hesitate to ask the attending any questions you might have re: protocolling. Once the correct images are acquired, the interpretation is often the easy part!

The resident/fellow on body MRI protocols all the body MRI cases. Once again, please do not hesitate to questions.

An incorrectly protocolled exam is often worse than no exam at all.

### **CT Intravenous Contrast**

#### **Evaluation of Serum Creatinine before IV contrast Administration:**

It is important to note that there is building evidence that contrast induced nephropathy (CIN) from IV injection of non-ionic contrast may not exist or may exist only in patients with acute renal failure. Unfortunately, the idea of CIN is deeply ingrained in practicing physicians. The pendulum is swinging toward the more liberal use of IV contrast in renal dysfunction, but the pendulum swings slowly.

It is the policy of the Rhode Island Hospital CT Scan Department to check the serum creatinine/eGFR on all inpatients. The Patient Screening/Consent Form is completed for all patients with the assistance of a technologist. All out patients must fill out the Patient Screening/Consent form. A serum creatinin/eGFR level is not needed for outpatients.

All Emergency Patients will be treated as outpatients; hence, a screening serum creatinine/eGFR is not necessary for the performance of a contrast CT study. If the Ordering Physician is concerned that the patient has renal failure, s/he should wait until the appropriate screening blood work has been returned from the laboratory before ordering the CT.

Women and Infants inpatients that are accompanied by the patient's chart will have the creatinine/eGFR level checked and Patient Screening/Consent form completed. Patients from Women and Infants Emergency Room are treated as outpatients.

Regarding administration of IV contrast in patients with compromised renal function, it is

up to the radiologist and referring physician to decide if intravenous contrast is required to establish a diagnosis (or another imaging test is more appropriate). **There is no "threshold" for EGFR below which IV contrast can not be given. Everything we do is a calculation of risk vs benefit.**

If a patient is found to have an eGFR of less than 40 or a serum Cr of greater than 1.6 the tech will contact the radiologist. The purpose of this contact is only to ensure that the study to be performed is necessary and that there is no viable non contrast alternative. No study should ever be cancelled simply because the eGFR is low. If the study is necessary, the patient will be hydrated according to the following protocol:

- A. For patients without a cardiac history, 500 mL of (0.9%) Normal Saline is administered intravenously over approximately one hour immediately before the CT exam and a second dose of 500 mL Normal saline is administered intravenously over approximately one hour immediately after the contrast-enhanced CT exam.
- B. For patients with a cardiac history, 500mL of (0.45%) half Normal Saline is administered before and after the contrast-enhanced CT exam at the rate described above.

From: Katzberg, R. Lecture at ARRS Boston, 2009. Approved by Drs Goh and Dworkin from Nephrology Service 6/09.

#### Contrast Types:

We routinely use low osmolar intravenous contrast agents at a concentration of 350- (omnipaque 350) in adults. The technologist notes the volume of the agent and rate of injection on the PACs screen in the lower left corner. The volume of the contrast agent should be included in the dictation. For routine body work, we administer 130 cc of 350mgI/cc (omnipaque 350). This is given in a split dose (30cc intravenously, then wait 5 minutes, then 100 cc at 3cc/sec followed by saline flush. The purpose of the split dose is to opacify the renal collecting system and bladder (the 30 cc delayed) while the second bolus allows us to acquire a portal venous phase.

#### Intravenous Catheter sizes and policy:

Intravenous catheters are started by the CT technologists or the IV team. The specific catheters to be used and the injection rates are summarized in the appendix. In general the injection rates depend on the type of contrast material and the catheter size.

Injection rate of up to 2.4cc/second: 22 gauge or larger

Injection rate of 2.5cc/sec to 4cc/second: 20 gauge or larger

Injection rate of 4.1cc/sec or greater: 18 gauge or larger

#### CTA Scan Peripheral Intravenous Access Policy

A 20 gauge or larger IV in an antecubital vein is preferred to perform a CTA study. Exceptions can be made at the discretion of the radiologist and technologist if a patient's

current iv access can yield a quality study without reducing the injection rate. The rationale is to prevent extravasation and poor quality exams from inadequate intravenous lines.

Central venous catheters can be injected depending on catheter type. Rates of injection also vary depending on catheter type. See appendix for details.

#### Acute Contrast Reactions:

Residents and fellows should be familiar with treatment of adverse contrast reactions and be able to treat the patient appropriately. The General Guidelines by Dr. B Murphy (6/09) are outlined below:

#### Bronchospasm – Mild

- Vital signs
- O<sub>2</sub> via mask
- IV line
- Albuterol via spacer 8 puffs
- Hydrocortisone 250mg IV

#### Bronchospasm – Severe

- Call code
- If no cardiac contraindication: Epi Pen 1:1000, 0.3mg subQ
- If circulatory collapse: Epinephrine 1:10,000, 3ml IV

#### Hypotension – systolic 60-80mmHg

- Vital signs, inc. pulse oximetry
- O<sub>2</sub> via mask
- IV Line
- Trendelenburg
- 1 liter N Saline IV in 15 min if normal heart rhythm
- 1 liter N Saline IV in 30 min if elderly/heart
- Atropine 1mg IV if bradycardia, x2 if needed
- CONSIDER CALLING CODE

#### Hypotension - systolic <60mmHg

- Follow same procedure as (systolic 60-80), If no response: Call code team - monitor rhythm
- Sinus rhythm: Epinephrine 1:10,000, 5ml IV (repeat if necessary)
- Hydrocortisone 250mg IV

#### Urticaria

- No Rx if mild and asymptomatic
- Benadryl (Diphenhydramine) 50mg IV, if symptomatic (patient will need ride

home.)

- Auscultate chest to detect bronchospasm

#### Severe Urticaria or Laryngeal Edema

- Secure airway
- Vital signs
- O<sub>2</sub> via mask
- IV Line
- Call code if intubation anticipated
- Epi Pen 1:1000, 0.3mg subQ
- Epinephrine 1:10,000, 1-5ml IV if vascular collapse

#### Seizures

- Protect patient from injury
- Vital signs
- O<sub>2</sub> via mask
- IV Line
- OP airway if >2 min
- Ativan (Lorazepam) 2mg IV
- Neuro consult / ER transfer

#### Prophylaxis for Intravenous Contrast Reactions:

If a patient has a history of a serious contrast reaction and is scheduled for a CT scan with contrast, then an alternative exam should be attempted (noncontrast CT, ultrasound, or MR). If contrast is required and there is a strong clinical indication, then the premedication regimen recommended by the American College of Radiology should be followed: **Methylprednisolone (Medrol) 32 mg, p.o. 12 hours and 2 hours before the contrast injection.** In addition, the patient should receive low osmolar contrast material. In general, H<sub>2</sub> blockers (cimetidine) are not recommended. The above assumes the patient does not have a contraindication to steroids (pediatric, pregnant, fungal infection, diabetes, immunocompromised patients, lymphoma, leukemia, peptic ulcer).

#### Metformin (Glucophage):

Metformin (Glucophage) is an oral hypoglycemic for which precautions should be taken when giving intravenous contrast. Our protocol for administering intravenous contrast in patients on Glucophage is approved by the ACR and is as follows: 1) patients undergoing intravenous contrast agents should stop taking Glucophage either before or at the time of the contrast examination. 2) Patients should remain off Glucophage for 48 hours after their contrast study and then have a serum creatinine drawn. If the creatinine is normal, the patient can resume medication. In the CT section, we will fill out a lab slip for creatinine to be drawn with the results to be sent to the patient's referring internist. The patient will be instructed to call their internist one day after the blood test to decide whether the medication can be restarted. This will save a step for the patient and the

internist as the decision to restart the medication can be made by phone call rather than a visit. 3) Patients with elevated creatinine (greater than 1.5) and on Glucophage should have the contrast administered only if there is a high diagnostic yield to be obtained from the contrast. 4) Note the patients do not need to be off Glucophage for 48 hours before the contrast examination is started.

#### Contrast Extravasation:

Our policy for contrast extravasation follows ACR guidelines and is listed below. Note this policy is the same for contrast extravasation of CT and MR contrast agents. When an extravasation occurs, the CT technologist will contact the radiologist who will evaluate the patient and fill out the data sheet listed below which will be scanned into PACS. In addition, the technologist will fill out a MERS report (Medical Event Reporting System) via the Lifespan intranet. The technologist should leave a note in PACs alerting the radiologists about the extravasation. For evening extravasations, the covering resident should also leave a note in PACS with 1. the exam findings and 2. course of action taken. We do **not** take radiographs of extravasated contrast.

#### Procedure:

- A Radiologist/physician should evaluate all extravasations.
- A cold pack should be applied to the site of extravasation.
- Evaluation should include a neurological exam of the affected extremity, documentation of presence of capillary refill, skin ulceration and documentation of presence of distal pulses and presence of pain. Documentation should be made on the attached IV extravasation fact sheet.
- The patient should be observed for a period of time at the Radiologist's discretion after the extravasation with the arm maintained in an elevated position above the heart.
- For outpatients, the attached discharge instructions should be completed by the Radiologist and given to the patient.
- If there are findings at the time of the exam (increased pain or swelling), decreased capillary refill, change in sensation or skin ulceration, a plastic surgery consult should be obtained at the discretion of examining Radiologist. **If urgent treatment is required, refer outpatients to Emergency Dept.**
- If a consult or ER referral is required, the patient's clinician should be contacted. For ED and in-house patients, a verbal communication should be given to the patient's nurse and/or in-house physician responsible for the patient's care.
- The extravasation, physical exam and steps taken in management should be documented in the final radiology report, and in the patient's chart if applicable.
- An addendum shall be dictated to the radiology report if the patient requires a follow-up visit.
- An electronic report should be entered in the Rhode Island Hospital MERS (medical event reporting system) by the lead technologist or manager and a note left in PACs.
- Both the IV extravasation fact sheet and the patient discharge instructions will be scanned into the Radiology Information System.

- For inpatients, the orders for patients who have had an extravasation are:  
Follow-up orders for inpatients have to be communicated and entered electronically like all other orders in the hospital. It is straight forward and self-explanatory (similar to post- procedure order sets for those who are familiar with electronic order). This is in compliance with ACR guideline/our policy although by necessity more detailed for nursing staff (with their input)



**DIAGNOSTIC IMAGING DEPARTMENT  
RHODE ISLAND HOSPITAL  
IV EXTRAVASATION FACT SHEET (to be scanned into PACs after completion)**

**DATE:** \_\_\_\_\_

**TIME:** \_\_\_\_\_

**PROCEDURE:** \_\_\_\_\_

**EXTRAVASATION SITE:** \_\_\_\_\_

**Estimated volume of extravasation:** \_\_\_\_\_

**Method of delivery: power injector or hand injection**

**Radiologist's assessment of extravasation site:**

*Follow up assessment*

*(if required)\**

• **Neurological exam within normal limits**      **Yes or No**

• **Capillary refill within normal limits**      **Yes or No**

• **Distal pulses within normal limits**      **Yes or No**

• **Skin ulceration**      **Yes or No**

• **Presence of pain**      **Yes or No**

Yes or No
Yes or No
Yes or No
Yes or No
Yes or No

**Radiologist's comments, treatment & discharge instructions:** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**I have reviewed and signed discharge instructions with the patient / legal guardian. Yes or No**

\_\_\_\_\_  
**Print Radiologist name**

\_\_\_\_\_  
**Radiologist signature**

**Technologists:** \_\_\_\_\_

\_\_\_\_\_

**\*(if required) FOLLOW UP INFORMATION:** \_\_\_\_\_

\_\_\_\_\_

**Radiologist:** \_\_\_\_\_ **49**      **Date:** \_\_\_\_\_

**DIAGNOTIC IMAGING DEPARTMENT  
RHODE ISLAND HOSPITAL  
DISCHARGE INSTRUCTIONS FOR IV EXTRAVASATION  
DIAGNOTIC IMAGING DEPARTMENT  
RHODE ISLAND HOSPITAL  
DISCHARGE INSTRUCTIONS FOR IV EXTRAVASATION**

During your exam you received an intravenous contrast injection or medication. At some point during that injection either some of the contrast and /or saline solution leaked outside of your vein causing swelling in that area. This fluid is routinely re-absorbed without any difficulty but for the next 24 hours you should check at or near the IV site for the following symptoms:

- **Prolonged stinging or burning at the site**
- **Increased swelling, tenderness or pain at the site**
- **Tingling or numbness**
- **Redness, warmth or blistering at or near the I.V. site**

If you experienced any of these symptoms or you have any questions or concerns, please call 401-444-8392  
Additional instructions given:

---

---

These instructions have been explained to me and I have had the opportunity to have my questions answered.

\_\_\_\_\_  
Patient /Legal Guardian signature

\_\_\_\_\_  
Radiologist signature

Date: \_\_\_\_\_

### Documentation of Contrast reactions and extravasations :

All contrast reaction should be described in the study report. If the person managing the contrast reaction will not be dictating the report, they should put a note in PACS.

### Contrast in Pregnant Patients:

The patient's referring physician or a radiologist needs to obtain informed consent before an intravenous contrast CT scan is performed in a pregnant patient.

### Contrast in Mothers who are Breast Feeding:

A very, very small amount of iodinated contrast is transiently excreted in breast milk. ACR guidelines conclude that continuing to breast feed normally before and after IV contrast is safe for breast-feeding mothers and their children. If the patient is nervous about this, however, they can pump prior to the scan and replace the first post-scan feeding with the previously obtained milk.

### Radiation Dose Reduction

We employ protocols tailored to maximize diagnostic yield and minimize radiation exposure. All CT units at RIH modulate mA to decrease dose. It is important to choose the correct protocol carefully as each protocol is designed to minimize exposure. For example, a Renal Stone protocol uses lower dose than a routine abdomen and pelvis because the calculi are radio-opaque and will be easily visualized at a lower mA.

### Scanning Pregnant Patients

All pregnant patients need an informed consent signed (by the patient and *referring* physician) before *any* CT exam is performed. This situation arises primarily in the ER and this policy has been approved by department chairs Drs. Cronan and Zink. A copy of the pregnancy consent form is attached at the end of this document.

### Scanner Weight Limits

Given the epidemic of obesity, residents are frequently asked about the weight limits of our scanners: Scanners in the department have a weight limit of 500 pounds.

### Dictations

Dictations are performed using the voice recognition software Powerscribe 360. Dictations in CT should include the relevant patient history, pertinent other studies and the CT technique. The CT dictation should include the volume of low osmolar contrast was administered. The body of the report should include the pertinent positive and negative findings given the clinical history. The conclusion should be short and have a new sentence for each important impression. Due to legal issues and appropriate

reimbursement, *multiple CT examinations in one patient should be dictated in separate paragraphs. For accuracy of communicating the aggregate results, the conclusion of the dictation should contain the results of all the CT examinations performed.* Dictations are performed using standardized templates for the exam in question. Residents should use these standardized templates for all body exams.

Regulations put forth by CMS (Center for Medicare/Medicaid Services) require that residents and fellows attest to the participation of attendings in the work product. For diagnostic imaging that product is the report. Included in the template is the following comment. "Dr. \_\_\_\_\_ has reviewed the report and all images related to this patient encounter."

**Important or unexpected clinical findings should be called to the referring physician at the time of the dictation. Physician to physician communication remains the gold standard for reporting of important results. Poor communication is one of the most common causes of patient harm involving radiology.**

If any of the following Critical Abnormal Results are discovered by the radiologist during the interpretation of an imaging exam, and it is not indicative of a known existing or improving condition, the result will be communicated within the shortest time possible to the ordering physician or covering LIP that can facilitate the appropriate course of therapy or treatment for the patient. For all telephonic reporting of these critical results, the person receiving the test result must "read-back" the complete result. Every attempt will be made to communicate the results within one hour of detection.

As part of the reporting process the radiologist will dictate the exam as soon as the abnormal result is discovered and in the impression include the abnormal result, the name of the ordering physician or LIP that was contacted and who read back the result, and the time the call was placed. The final impression must contain the words RED RESULT in the first 320 characters. The Radiology System will then be searched for all reports with critical values for Quality Assurance purposes. Results of Quality Assurance monitoring will be reported monthly in the aggregate. The results of any individual retrospective case reviews will be non-discoverable pursuant to the Rhode Island Medical Malpractice Act, section 23-17-25 and such laws which supplement or replace it.

**RED Critical Abnormal Result List:**

- 1) Tension Pneumothorax
- 2) Unsuspected significant hemorrhage
- 3) Critically misplaced tube or catheter
- 4) Acute pulmonary Embolism
- 5) Infection related soft tissue gas
- 6) Unexplained pneumoperitoneum
- 7) Ischemic bowel

- 8) Ectopic pregnancy
- 9) Midgut volvulus
- 10) Testicular/ovarian torsion
- 11) Acute Intracranial Process
- 12) Acute cord compression
- 13) Acute DVT
- 14) Epidural process (includes mass, hematoma, and abscess)
- 15) Acute aortic dissection
- 16) Acute cholecystitis
- 17) Any diagnosis deemed clinically urgent by the Radiologist

### **Access to RIMI Images via Synapse:**

Often, we are asked to review images from RIMI or WI, particularly to book a patient for a biopsy. Residents should each have their own access code to the RIMI system, Synapse. To get your RIMI account password, contact Kyle Schuster at RIMI cell 401-639-2968.

### **Diagnostic Body CT Exams**

#### **General Protocol Information:**

We are routinely performing 5mm coronal reconstructions for neck, chest and abdomen on all MDCT exams. This offers more diagnostic information from routine scans without need to use the 3D workstation or archive large data sets. As residents review the studies, they should also consider if additional reconstructed images in other planes, or thinner slices through a certain region, could be beneficial in the interpretation of a study in slices through a pulmonary hamartoma, or sagittal images for a skull base lesion, etc.) Residents can ask the technologist to reconstruct such images and forward them to PACs prior to attending readout.

Alternatively, the raw data from each CT is sent to a thin-client called Terra-Recon which can be used to make ones' own reconstructions. This is accessible from each PACS workstation under the arrows at the bottom of the screen. To login, use your lifespan email credentials.

### **CT Colonography Protocol, Post-Processing, & Reporting**

Kevin J. Chang, MD

*Updated 6/10/13*

#### **Indications:**

1. **Incomplete or failed colonoscopy:** This may be secondary to a variety of factors including colonic tortuosity, nonvisualization of the colon proximal to an

obstructing lesion, colonic spasm, diverticulitis, extrinsic compression, aberrant anatomy or scarring related to prior surgery. The reason for the failed colonoscopy should be mentioned in the dictation to get reimbursed.

- a. DO NOT SCAN SAME-DAY FAILED COLONOSCOPY PATIENTS IF THE REASON FOR FAILURE IS “INADEQUATE BOWEL PREP.”

These patients will need to be re-prepped to perform the exam on another day.

2. **Contraindication to colonoscopy:** e.g. Anticoagulation which cannot be discontinued, significant medical/surgical complications from previous colonoscopy, contraindication to conscious sedation. When in doubt, get preauthorization.
3. **Screening:** Not yet covered by Medicare. Covered by many private insurers (including all insurers in RI). Referring physicians will need to confirm coverage and obtain preauthorization.

**CPT codes:** Category I (confirmed for 2010)

**74261** — Computed tomographic (CT) colonography, diagnostic, including image postprocessing; without contrast material

**74262** — ... with contrast material(s) including noncontrast images, if performed **74263** — Computed tomographic (CT) colonography, screening, including image postprocessing.

Ga

**ICD9 code:** Use **v643** (Traditional exam, ie. conventional colonoscopy, not carried out for other reasons) as the **primary code** to get reimbursed for indications 1 and 2 above. Other codes that may be used: v1000, v1005, v1006, v103, v160, v1272.

---

### **Patient preparation:**

The most crucial aspect of performing a high-quality CT colonography exam involves a thorough colon prep. The prep protocol used differs from traditional colonoscopy preps in that instead of high volume “wet” preps involving agents such as GoLytely, a “drier” prep is used which leaves less residual fluid in the colon allowing much better visualization of the colon wall by CT. The only exception to this prep protocol would be a patient coming to CTC on the same day as an incomplete colonoscopy (already prepped for traditional colonoscopy). In general, these “dry” bowel preps are better tolerated by patients than the GoLytely prep.

There is **no need for IV contrast unless the cause of incomplete colonoscopy is an obstructing neoplasm which has not yet been staged** with a prior contrast-enhanced CT of the abdomen and pelvis. In the latter case, following colonic insufflation and scout topograms, perform the usual noncontrast low-radiation dose supine scan followed by a **prone scan using the routine IV contrast injection dose, injection rate, post-injection delay, and radiation dose that we use for a typical single-phase abdomen/pelvis CT.** This scan volume should include the whole liver.

“Dry” bowel prep:

Patient to pick up **two 10 oz. bottles of Magnesium Citrate from any local pharmacy** and **60 cc of Gastroview or Gastrografin from Radiology** prior to the day before the exam.

1. **24 hours prior to exam: Clear liquid diet only.** Avoid milk or dairy products. Patient may take regular medications.

Diet recommendations:

	<b>ALLOWED</b>	<b>PLEASE AVOID</b>
Fruit/Fruit Juices	clear fruit juices, canned fruits (no seeds, skin or membranes)	fresh fruits, raisins, dried fruits, prunes, prune juice, skins.
Beverages	decaffeinated: coffee (limited), fruit flavored drinks, tea, carbonated drinks	all others
Soup	bouillon/broth, strained soups	all others
Dessert	gelatin, fruit ice, popsicle (no red color)	coconut, nuts, seeds, hard clear candies, fruits that are <i>not allowed</i> on this list
Miscellaneous	salt, pepper, jelly, sugar, honey, syrup	cloves, garlic, seed spices, chili sauce, Bar-B-Q sauce, any strong flavored spice or sauce, mustard, jam, peanut butter, mayonnaise, marmalade

2. Bowel Preparation: **Magnesium Citrate** may be picked up over the counter at any local pharmacy.

Starting the night prior to the exam:

**5PM:** Drink first 10 oz bottle of Mg-citrate + four 5 mg Dulcolax (bisacodyl) tabs

**8PM:** Drink second 10 oz bottle of Mg-citrate

**Before bed** (at least 1 hr later): Drink 30 cc of oral contrast (Gastroview or Gastrografin). This may be mixed with 8 oz of clear fruit juice or a carbonated beverage over ice.

**Upon waking up** the morning of the exam: Drink another 30 cc of oral contrast as above.

The patient should be near a restroom after taking the above medications as bowel movements will become more frequent.

If the patient has not taken the oral contrast the night before or had a same-day incomplete colonoscopy, the patient may drink one **30 cc bottle of oral contrast (Gastroview or Gastrografin) at least 2 hours** prior to the CT scan. The patient will need easy access to the restroom as this agent also acts as a laxative. If the patient is not

able to wait 2 hours or Gastroview/Gastrografin is not available, the exam may be performed immediately without fluid tagging (however, fluid tagging greatly aids in visualization of polyps otherwise obscured by retained fluid in the colon).

---

### GE VCT Protocol:

The most crucial technical aspect of this study lies in adequate gaseous distension of the entire colon. In general, a thin-collimation low-dose technique is employed in both supine and prone positions following scout topogram confirmation of adequate colonic insufflation.

1. Allow **patient to use the restroom immediately prior** to positioning on the CT table to empty bowel one last time.
2. Position patient in **lateral decubitus** position for placement of silicone rectal catheter.
3. Radiologist, nurse, or technologist to **insert rectal catheter prior to connecting to insufflator**. *Lightly* inflate balloon tip (~15-30 cc air using syringe) in order not to distort mucosal anatomy of the rectal vault. Gently pull back balloon cuff flush with the anal sphincter. If there is any residual fluid present in the rectum, allow it to drain into the collection bag prior to attaching tubing to the insufflator.
4. **Attach tubing to automated CO<sub>2</sub> insufflator. Set PRESSURE to 25 mm Hg.** Hit "FLOW STOP/RUN" button to begin inflation. Inflation will ramp up slowly. If the patient experiences discomfort, hit the FLOW STOP/RUN button to temporarily pause inflation until discomfort passes then resume inflation by hitting the FLOW STOP/RUN button again. General guideline for positioning the patient is left decubitus until 1 liter, then supine until 2 liters, then right decubitus until 3 liters, then supine. Scout when rate of increase in total CO<sub>2</sub> volume stabilizes and pressure remains 25 mm Hg +/- 2 mm Hg.

Generally, colonic distension requires at least 2-4 L of CO<sub>2</sub> with more needed depending on the redundancy of colon and presence of small bowel reflux. If >

4.0 L of CO<sub>2</sub> has been administered (which is quite common), the FLOW STOP/RUN button will have to be restarted to continue insufflation. FLOW STOP/RUN will also reset at every 2 L interval thereafter (safety feature).

*There is an excellent Bracco CO<sub>2</sub> inflation video tutorial available on the Bracco website.*

5. Position patient **supine** on CT table and perform end-expiratory **CT scout topogram**. Evaluate scout for adequacy of colon insufflation. If not completely inflated, roll patient to try to redistribute gas while continuing insufflation. Then repeat scout.
6. **Scan** abdomen and pelvis from above the colon to lesser trochanters using a single



- end-expiratory breath-hold with **noise index of 50** at **1.25 mm** collimation and a 350 mAs maximum (may need to scan lower if there is a large hernia).
7. **Confirm the colon prep and distension is adequate** on axial images before moving on to prone positioning. If the prep is inadequate, the exam should be terminated and the patient should be rescheduled for another day following a more thorough colon prep. Any colonic segments that are incompletely distended should be rechecked on prone images to insure an adequate exam.
  8. Flip patient over **prone** while CO<sub>2</sub> insufflator is still on. Position pillow(s) beneath the patient's chest and pelvis to relieve pressure on the abdomen and permit better distension.
  9. When prone insufflation is complete (see criteria in Step 4), perform end-expiratory **prone CT scout topogram** to determine adequacy of colonic distension (especially sigmoid). If not completely inflated, roll patient to try to redistribute gas while continuing insufflation. Then repeat scout.
  10. Perform **prone scan** using the same parameters as supine in a single end-expiratory breath-hold.
  11. **Check** adequacy of supine and prone axial images prior to removing catheter and discharging patient. On occasion, lateral decubitus positioning may be necessary for limited re-scanning of the cecum or sigmoid in cases of inadequate distention on both supine and prone datasets.
  12. **Remove rectal catheter and have patient go to restroom** to decompress colon prior to discharge to home. No specific instructions are necessary as the patient may return immediately to regular activity.
  13. **Reconstruct supine and prone** datasets to 1.25 mm collimation with 0.625 mm overlap (**1.25 x 0.625 mm**) to send to **GE Advantage Workstation** and **GE PACS**.

---

#### **Post-Processing on the GE Advantage Workstation:**

1. Choose patient from local database list and open supine and prone 1.25 x 0.625 mm datasets simultaneously using **CTC Auto-Dissection** plugin.
2. **Edit lumen tracking** for both supine and prone datasets if necessary.
3. Use **Virtual Dissection 360 views** for initial 3D screen.
4. Use **3D VR endoluminal views** for correlation (shift-LMB on target).
5. **2D read for confirmation and to evaluate colonic surfaces beneath tagged fluid:** review axial images at "near-lung windows" (narrow windows enough to differentiate fat from soft-tissue density) on supine and prone volumes. Use coronal and sagittal MPR as necessary to follow colonic lumen. Evaluate ALL surfaces of colon on both supine and prone.

6. Placing bookmarks for the **Reporting Tool** aids in generating multiple reformatted images to send back to PACS (“DCBE” colon map, MPRs, 3D VR endoluminal views).

---

## **Reporting:**

We will be following the CT Colonography Reporting and Data System (C-RADS, Working Group of the 5<sup>th</sup> International Symposium on Virtual Colonoscopy, October 2004)<sup>1</sup> for CTC reporting and management recommendations.

## **Colonic Findings**

Co: Inadequate study/awaiting prior comparisons. Use this category in cases of inadequate prep or insufflation (ie. collapsed segments on both supine and prone views), or when the image can't be read because of excess fluid or feces.

C1: Normal colon or benign lesion. Use this category for cases of no polyp greater than 6 mm, and continue routine screening (Every 5 years per American Cancer Society screening guidelines).

C2: Indeterminate lesion. Use this category for cases of fewer than three polyps 6–9 mm. Recommend follow-up CTC in 3 years vs. consideration of colonoscopy.

C3: Polyp, possibly advanced adenoma. Use this category for cases of three or more polyps 6–9 mm or any polyp 10 mm or larger. A follow-up colonoscopy is recommended.

C4: Colonic mass, likely malignant. Use this category when a lesion compromises the bowel lumen, or there is evidence of extracolonic invasion. Surgical consultation is recommended.

---

<sup>1</sup> Zalis ME, Barish MA, Choi JR, et al. Working Group on Virtual Colonoscopy. CT colonography reporting and data system: a consensus proposal. *Radiology* 2005;236:3-9.

## **Extracolonic Findings**

E0: Limited exam. Use this category when an exam is compromised by an artifact so that evaluation of extracolonic soft tissues is limited.

E1: Normal exam or anatomic variant. Use this category when no extracolonic abnormalities are visible, or if there is an anatomic variant, eg. retroaortic left renal vein.

E2: Clinically unimportant finding. Use this category when no work-up is indicated, eg. simple renal or hepatic cysts, cholelithiasis without cholecystitis, vertebral hemangioma,

E3: Likely unimportant finding, incompletely characterized. Use this category when a work-up may be needed, based on practice and patient preference. eg. minimally complex renal cyst.

E4: Potentially important finding. Communicate the details to the referring physician. eg. solid renal mass, lymphadenopathy, aortic aneurysm, pulmonary nodule > 1 cm

The full proposal can be found in *Radiology* at

<http://radiology.rsna.org/content/236/1/3.full>

**Polyps** are defined as homogeneously soft-tissue attenuation structures arising from the colonic mucosa demonstrating a fixed point of attachment to the bowel wall. A **colonic mass** is defined as a similar structure measuring greater than 3 cm in largest dimension.

We will only report polyps 6 mm or greater in size. No polyps less than 6 mm should be reported (in the body or impression of the report) as the specificity of CTC is limited at this size (many of these represent adherent stool) and the clinical significance of polyps of this size is also limited (most true polyps of this size are hyperplastic and do not increase risk for developing colon cancer).

**Polyp descriptors:**

1. Size: in mm
2. Morphology: pedunculated, sessile (broad-based, width > height), flat (< 3 mm elevated above colonic mucosa)
3. Location: rectum, sigmoid, descending, transverse, ascending, cecum; relationship to adjacent haustral folds
4. Attenuation (i.e. fat = lipoma)

**Extracolonic findings:**

For a standard non-contrast CTC exam: "Limited non-contrast evaluation demonstrates no significant extracolonic findings..."

**Impression and Management recommendations:**

1. Normal or Benign findings (i.e. lipoma, diverticulosis; no polyps  $\geq$  6 mm): routine screening (5 year follow-up CTC/endoscopy).
2. Polyps 6-9 mm, < 3 in number: 3 year follow-up CTC versus consideration of endoscopy (or repeat focused endoscopy).
3. Polyps 6-9 mm,  $\geq$  3 in number: Endoscopy.
4. Polyp  $\geq$  10 mm; Endoscopy.
5. Colonic Mass, likely malignant (compromises lumen or shows extracolonic invasion): Surgical consultation.

A repeat directed endoscopy is often successful even when the initial endoscopy was incomplete.

These guidelines are subject to consideration of the patient's history/presentation and local practice preference.

Do not hesitate to call the referring physicians with the results of the CTC, as we need all the good PR we can get. If the patient asks to be called with the results, I will not hesitate to give them a call as well since satisfied patients will recommend this study to others as well as relate positive experiences to their own physicians.

Questions, additional suggestions? Feel free to page me at 350-5841. -Kevin

### Cardiac CT Angiography:

The cardiac CT information and protocols are contained in the cardiac section of the resident manual.

### **CT Guided Interventional Procedures**

The residents and fellows are responsible for performing interventional procedures in Ultrasound and CT. Interventional procedures include lung, abdominal, and bone biopsies, and abscess drainages. General guidelines for performing procedures is as follows. Procedure booking sheets (see end of this document) should be filled out for all patients when taking the request, and the person filling out the sheet should print their name legibly.

Lifespan images (RIH, TMH, Newport) can be reviewed on PACs and RIMI exams can be accessed via the web on a computer in CT. Women and Infants and images from Kent hospital can be viewed on the Woman and Infants PACS in the body reading room. If the images are from outside, have the CT secretary call that institution to fax the report at the time of the booking. Outside studies should be uploaded by the secretaries into LifeImage and PACS (if possible).

Please approach each request with same degree of care and thoughtfulness you would if you were doing the requested procedure yourself, that day. Review all relevant imaging including all priors for comparison. Ask yourself if you agree that the procedure is indicated and safe. Document your (and the attending's) thought process thoroughly. Don't force the team to recreate the wheel on procedure day.

When the procedure sheet is completed, it is brought to the CT secretary who then books the case and can call either the patient or the booking doctor's office with the time.

Two days before the procedure, the secretary in the radiology recovery room calls all patients at home to confirm the date and time of their exam to minimize no-shows.

On the evening before the procedure, the fellow and resident should review upcoming cases for the following day to assure that all films and laboratories are in order. If the relevant films are not present, they can be retrieved or restored. Good residents will look at all procedures for the upcoming week to know what is happening, rather than have a "surprise" each morning at 7:30.

On the morning of the procedure, the cases will be reviewed with the attending in the body reading room with the lead CT technologist, Mid Level, and charge nurse to decide the appropriate approach to a lesion. The plan for the procedure (patient position, side of lesion, area to be scanned and collimation) will be entered in the biopsy book by the attending and given to the lead interventional technologist after morning rounds.

When the patient arrives for the procedure, one of the nurse practitioners if available (Derek Tessier or Amy Doorley) will obtain consent from the patient in the radiology

recovery room. Informed consent includes 1) an explanation of the procedure, 2) expected benefits of the procedure, 3) risks of the procedure and 4) alternatives to the procedure. Pre-procedure assessments are also now completed by the NPs and the appropriate documentation completed in the Radiology holding area before the procedure. The NP's also discharge the patients home with a responsible adult after the procedure. Assessment before the procedure includes review of the indications for the procedure, relevant blood work and a brief physical exam. **In the event that one of the NPs are not available, the resident performing procedure will obtain consent and review appropriate discharge instructions.** We function best when we function as a team. *The patient is told before the procedure that they will need to spend the night with another person (relative/ friend) in their apartment/house in the event they need to call for help.*

All procedures are performed with the attending present. After the procedure, outpatients are observed in the holding area and inpatients are returned to the floor. A procedure note should be left in the EMR.

Orders for monitoring of vital signs and catheter irrigation should be entered using inpatient electronic medical record order templates. Biopsy specimens for pathology are generally placed in formalin and cytology specimens in Cytolite. Specimens for microbiology should be placed in a sterilized white top tube. This tube can be used for aerobic cultures, anaerobic cultures and gram stains. Blood culture bottles are not used for cultures of aspiration specimens.

Pre-operative blood work is not necessary or essential in most cases. A routine bleeding history should be obtained from the referring physician and from the patient. Has the patient had any difficulty with bleeding in the past, with dental extractions or prior surgery? If the patient is on any anticoagulants or drugs which could affect coagulation, this should be noted. When blood work is deemed necessary because of an underlying bleeding history or drug history, baseline INR and platelet count should be obtained. Patients with a history suggesting the potential for coagulopathy such as those with liver disease, sepsis, or poor nutritional status should be screened.

The department policy on use of anticoagulants and indications for transfusion have recently been modified and are outlined below.

	Low Risk	Intermediate Risk	High Risk
Procedures	Non-tunneled catheter, fistulography & intervention, central line removal, IVC filter insertion, venography, catheter exchange, Thyroid biopsy, joint injection/aspiration,	Angio intervention (< 7Fr), venous intervention, chemo/radioembolization, UFE, transjugular liver biopsy, tunneled catheter, port, abscess drainage, biopsy (non-superficial, non-renal), cholecystostomy, G-tube,	TIPS, renal biopsy, thermal ablation, fresh nephrostomy, fresh biliary.

	<p>superficial aspiration/drainage/biopsy, LP, epidural.</p> <p><b>Note:</b> Paracentesis and thoracentesis should be performed at any INR and do not give FFP.</p>	Vertebroplasty/Kyphoplasty/Osteoplasty	
Pre-procedure labs	<p>Check labs: <b>INR ONLY</b> if possibility of abnormality e.g. warfarin, NOACs, severe liver ds, DIC. <b>PLTs ONLY</b> if liver ds or h/o thrombocytopenia. <b>INR &lt; 2.5: proceed</b>  <b>INR &gt; 2.5: Liver ds:</b> cryoprecipitate (2 pools) if fibrinogen &lt; 100mg/dL; check aPTT: &lt; 40 seconds-no FFP; if &gt; 40 seconds-xfuse FFP at 10mls/Kg.  <b>DIC:</b> FFP at 15 mls/Kg – xfuse 4 hours pre-procedure  <b>Platelets &gt; 30K: proceed</b>            PLTs &lt; 30K: administer 1 adult U PLT txfusion 1-3 hrs before the procedure.</p>	<p>Check labs: <b>INR ONLY</b> if possibility of abnormality e.g. warfarin, NOACs, severe liver ds, DIC. <b>PLTs ONLY</b> if liver ds or h/o thrombocytopenia. <b>*CrCl ONLY</b> if Renal Ds.  <b>INR &lt; 2.0: proceed</b>  <b>INR &gt; 2.0: Liver ds:</b> cryoprecipitate (2 pools) if fibrinogen &lt; 100mg/dL; check aPTT: &lt; 40 seconds-no FFP; if &gt; 40 seconds-xfuse FFP at 10mls/Kg.  <b>DIC:</b> FFP at 15 mls/Kg – xfuse 4 hours pre-procedure  <b>Platelets &gt; 50K: proceed</b>            PLTs &lt; 50K: administer 1 adult U PLT txfusion 1-3 hrs before the procedure.</p>	<p>Check labs: <b>INR ONLY</b> if possibility of abnormality e.g. warfarin, NOACs, severe liver ds, DIC. <b>PLTs ONLY</b> if liver ds or h/o thrombocytopenia. <b>*CrCl ONLY</b> if Renal Ds.  <b>INR &lt; 1.5: proceed</b>  <b>INR &gt; 1.5: Liver ds:</b> cryoprecipitate (2 pools) if fibrinogen &lt; 100mg/dL; check aPTT: &lt; 40 seconds-no FFP; if &gt; 40 seconds-xfuse FFP at 15mls/Kg.  <b>DIC:</b> FFP at 15 mls/Kg – xfuse 4 hours pre-procedure  <b>Platelets &gt; 50K: proceed</b>            PLTs &lt; 50K: administer 1 adult U PLT txfusion 1-3 hrs before the procedure.</p>
Management of anticoagulants	<p><b>Warfarin:</b> hold 5 days &amp; check INR 24 hrs prior to procedure. <b>INR &gt; 2.5:</b> consider 5mg IV vitamin K if non-urgent or Kcentra (25 U/kg) if the procedure is urgent or immediate. Restart warfarin evening of</p>	<p><b>Warfarin:</b> hold 5 days &amp; check INR 24 hrs prior to procedure. <b>INR &gt; 2.0:</b> consider 5 mg IV vitamin K if non-urgent or Kcentra (25 U/kg) if the procedure is urgent or immediate. Restart warfarin evening of procedure. <b>Heparin:</b> hold for 4 hrs. Restart 4 hrs after procedure.</p>	<p><b>Warfarin:</b> hold 5 days &amp; check INR 24 hrs prior to procedure. <b>INR &gt; 1.5:</b> consider 5mg IV vitamin K if non-urgent or Kcentra (25 U/kg) if the procedure is urgent or immediate.</p>

Management of Anticoagulants Continued	<p>procedure. <b>Heparin:</b> hold for 4 hrs. Restart 2 hrs after procedure.</p> <p><b>Prophylactic LMWH:</b> do not hold. <b>Therapeutic LMWH:</b> hold one dose. Restart 4 hours after procedure. <b>NOACS:</b> dabigatran (Pradaxa); Rivaroxaban (Xarelto); apixaban (Eliquis); Edixaba (Savaysa); betrixaban: Hold for 24 hrs.</p>	<p><b>Therapeutic/Prophylactic LMWH:</b> hold one dose. Restart 4 hours after procedure. <b>*(If CrCl ≤ 50mL/min hold Fondaparinux for 2-3 days)</b> <b>NOACS:</b> dabigatran (Pradaxa); Rivaroxaban (Xarelto); apixaba (Eliquis); Edixaba (Savaysa); betrixaban: Hold for 48 hrs.</p>	<p>Restart 24 hours after procedure. <b>Heparin:</b> hold for 4 hrs. Restart 6 hrs after procedure.</p> <p><b>Therapeutic/Prophylactic LMWH:</b> hold one dose. Restart 4 hours after procedure. <b>*(If CrCl ≤ 50mL/min hold Fondaparinux for 2-3 days)</b> <b>NOACS:</b> dabigatran (Pradaxa); Rivaroxaban (Xarelto); apixaba (Eliquis); Edixaba (Savaysa); betrixaban: Hold for 48 hrs.</p>
Management of antiplatelets	<p><b>ASA:</b> do not hold Clopidogrel (Plavix); Prasugrel (Effient); Ticlopidine (Ticlid); Ticagrelor (Brilinta). Hold for 3 days.</p>	<p><b>ASA:</b> do not hold Clopidogrel (Plavix); Prasugrel (Effient); Ticlopidine (Ticlid); Ticagrelor (Brilinta). Hold for 5 days.  <b>*CrCl &lt;30mL/min:</b> DDAVP 0.4mcg/Kg IV 30 min before procedure</p>	<p><b>ASA:</b> do not hold Clopidogrel (Plavix); Prasugrel (Effient); Ticlopidine (Ticlid); Ticagrelor (Brilinta). Hold for 5 days.  <b>*CrCl &lt;30mL/min;</b> DDAVP 0.4mcg/Kg IV 30 min before procedure</p>
Management of NSAIDS	<b>Do not hold</b>	<b>Do Not Hold</b>	<b>Do Not Hold</b>
Management of Glycoprotein IIb/IIIa inhibitors	<p>Abciximab (Reopro): Hold 24 hrs  Eptifibatide (Integrilin); Tirofiban (Aggrastat): Hold 4 hours</p>	<p>Abciximab (Reopro): Hold 24 hrs  Eptifibatide (Integrilin); Tirofiban (Aggrastat): Hold 4 hours</p>	<p>Abciximab (Reopro): Hold 24 hrs  Eptifibatide (Integrilin); Tirofiban (Aggrastat): Hold 4 hours</p>

<b>Note: Restarting anticoagulants should also take into account state of hemostasis post-procedure</b>			
Heparin Bridging Recommendations			
	Low Thrombotic Risk	Moderate Thrombotic Risk	High Thrombotic Risk
Bridge?	No	Consider	Yes
	Bileaf AV without afib or stroke, CHADS <sub>2</sub> 0-2, VTE>12 mo prior	Bileaf AV with afib, stroke/TIA, HTN,DM,CHF, CHADS <sub>2</sub> 3-4, VTE 3-12 mo prior, recurrent VTE, Cancer, mild thrombophilia	MV, ball/cage or tilting disc valve, CHADS <sub>2</sub> 5-6, Stroke/TIA/VTE within 3 months, Rheumatic heart, severe thrombophilia, Bare coronary stents < 6 weeks, drug eluting stents < 6 months

As the regulatory world becomes more complex, we need to fill out several forms when performing interventional procedures in CT and ultrasound. The following is a summary on these procedures from Marie Kelley RN, nursing director of the radiology recovery area:

When doing invasive procedures in all areas of diagnostic imaging, the following documentation is required:

1. A pre-procedure note indicating the planned procedure, diagnosis/indication for study, allergies and current meds
2. Patient history
3. Review of systems
4. Physical exam
5. Completion of the one page procedure verification form which includes patient verification, site marking and time out.
6. Post procedure note
7. Signed procedure orders
8. Discharge instructions

Pre procedure notes and history and physical must be either documented in the patient's chart or filled out on page 1 of the "sedation, invasive procedure & monitoring record." Post procedure notes are either documented in the patient's chart or on page 2 of the "ambulatory surgery record".

For all procedures or exams requiring sedation the following information **must** be



documented on the lower portion of page 1 of the “sedation, invasive procedure & monitoring record.”

1. ASAclass
2. History of complications with sedation
3. Sedation plan and sedation meds intended
4. Mallampati airway class
5. Verification of NPⓄtatus
6. Consent received for administration of sedation
7. Availability of resuscitative equipment

Documentation compliance is reported monthly to the DI and RIH QA committees.  
Dictation of Procedures:

Standardized interventional procedure dictation templates are in Powerscribe and should be used for CT guided interventions. These include "CT Lung Biopsy", "CT Abdomen Biopsy", and "CT Drainage". These templates include a brief history and indication for the procedure, the findings on the localizing CT images, the type and amount of anesthesia used and note of the follow-up period in the radiology holding area. In addition the dictation should include that the patient was discharged home in the care of his/her wife, family member etc with printed discharge instructions. Each procedure CT should include a brief diagnostic portion of the exam with imaging findings. The size and number of lesions, the type and gauge of needle (or catheter) and number of passes made should be included in the dictation. The resident should dictate that the attending radiologist was present during the entire procedure for all interventional cases. Face to face sedation time needs to be documented in all cases. **All interventional procedures are dictated at the conclusion of the procedure, these should never be dictated on the following day.**

---

#### Sedation for Procedures:

In general, biopsies are performed with local anesthesia (lidocaine). Lorazepam (Ativan) 1mg IV is useful to decrease patient anxiety and is now used in advance of most CT guided biopsies performed without conscious sedation. Due to its safety profile, lorazepam can be given without the need for continuous monitoring of vitals signs by nurses. Lorazepam may cause confusion in elderly patients so is not generally administered in patients over 75 years. If a patient is particularly anxious, conscious sedation can be administered for biopsies.

Abscess drainages are performed using conscious sedation (versed and fentanyl) administered by dedicated nursing personnel under the direction of the attending.

For booking general anesthesia cases for pediatric *interventional* procedures, the referring doctor and or radiologist should contact the pediatric sedation service or pediatric

anesthesia.

### Lung Biopsy:

CT guided lung biopsies are booked in a standard fashion using the CT booking sheet. It is the responsibility of the fellow and attending performing the procedure to review all relevant films before performing the actual procedure. Occasionally, patients with a lung lesion will have other intra-abdominal lesions such as an adrenal mass can be approached more safely. In general, you should strive to perform lung biopsies in the morning as the patient can be discharged even if a pneumothorax develops if there is adequate observation period in the afternoon. If the patient has a chest tube placed, please contact pathology and ask them to tell us diagnostic/non-diagnostic as quickly as possible. If the findings are nondiagnostic, it is best to re-biopsy the patient with a chest tube still in to obtain an adequate sample.

### Management of Pneumothoraces

Most pneumothoraces occur within the first hour while a small percentage can be delayed. We therefore routinely obtain a chest radiograph two hours after the procedure. If a small pneumothorax is detected on the immediate post biopsy CT images, I obtain a chest x-ray (PA only) immediately after the CT and at two hours. This way, I can compare chest x-ray to chest x-ray to assess for interval change. If the patient is asymptomatic, hemodynamically stable, the pneumothorax is stable and the patient is reliable and lives near Rhode Island Hospital, s/he may be sent home with instructions to return to the CT area the following morning. The patient should be given a stamped requisition, told to have a chest x-ray performed the following morning in the General Radiology area, and to bring the chest x-ray to the CT suite and contact the responsible fellow. In general, if the patient remains asymptomatic the following day and the pneumothorax is stable, the patient does not need follow-up. Obviously if the pneumothorax is bigger or the patient is symptomatic, then a chest tube should be placed.

- For a patient who develops a pneumothorax post-procedure and becomes symptomatic, a chest tube should be placed either in the recovery room or in VIR. If a chest tube is placed in the recovery room, I prefer using a 10 French drainage catheter inserted along the anterior axillary line at the level of the nipples. A chest x-ray should then be performed to assure resolution of the pneumothorax. If the patient is reliable, asymptomatic and there is no air leak, s/he may be sent home with a Heimlich valve with instructions to return if symptomatic. As stated above, these patient should be given a chest x-ray requisition and instructed to have a chest x-ray performed in the Main Department and to bring the radiograph to the CT suite.

### Abscess Drainage:

Abscess drainages should be performed with antibiotic coverage. It is the recommendation of the Infectious Diseases Division that 3 grams of Zosyn (which is a

combination of 2 drugs: piperacillin and tazobactam) be given intravenously for broad spectrum coverage of abdominal abscess drainages. Piperacillin is a penicillin-type antibiotic that works by stopping the growth of bacteria. Tazobactam is an enzyme inhibitor (beta-lactamase inhibitor) that helps the piperacillin work better. Alternatively, 1 gram of Ancef and 80 mg of Gentamicin may be given intravenously at the time of procedure. Outpatients undergoing an abscess drainage generally should be admitted for overnight observation as patients may experience transient bacteremia.

Inpatients and outpatients who have tubes placed in CT/US are followed by the residents, fellows and attendings in the CT /US area. A tube data system has been incorporated into EPIC. In addition, the patient should be entered into the "Body Tube" folder in the Body Worklist of PACs for review on a daily basis.

- radiology recovery room. Admitting orders will be submitted by NP. The following day, Nurse Practitioner will round and discharge patient from hospital and perform all necessary documentation in POM.
- b. Admitting under Teaching Service (Med onc/surgery/medicine)
  - Nurse Practitioner/resident will contact referring physician who has admitting privileges to Rhode Island Hospital. Patient will be admitted under their service. Radiology will act as consulting specialty.
- c. Admitting under Non-Admitting physician
  - Nurse Practitioner will determine whether patient is Coastal Medicine by contacting patient PCP office.
  - Nurse Practitioner will determine whether patient is UMA/IMIS/Hospitalist service by either contacting PCP office or contacting hospital operator.
  - Radiology will act as consulting specialty.
- d. Admitting patient from out of network referring physician
  - Coordinate admission with Medical Admitting resident (350-0113) and/or Medical Consult resident (350-2365) and/or IMIS/unassigned medical admission (UMA) 350-0944, who will evaluate patient in Radiology Recovery Room and admit to teaching services.
  - Radiology will act as consulting specialty.
  - Nurse Practitioner will contact referring physician to update on current clinical situation/admission.

\*\* In cases of ablation patients, where a VIR resident has performed the procedure, the VIR on-call resident should be contacted.

\*\* Cases performed by radiology residents during the daytime should be addressed to the night float short and long resident. Include a note for nursing to contact 4- 4123(CT) until 10pm and 4-2727 (ER) after 10pm with acute issues. The resident who performed the procedure should "sign-out" the procedure to the NFS resident at 5pm. In certain circumstances, the NP will take night on the responsibility of night call coverage.

Post Procedure Observation Patients who have undergone Image Guided Intervention:

Patients are observed in the radiology holding area or on the floor for inpatients. Inpatient lung biopsy patients are observed in radiology recovery until their 2 hour post biopsy CXR. For inpatients, follow-up orders for vital sign monitoring and catheter irrigation should be made in POM. A form regarding the history, physical, procedure and observation care should be filled out on each patient. A pulse oximeter is utilized whenever conscious sedation is given and vital signs recorded. The hospital mandate for conscious sedation does indicate that patients must have basic monitoring with pulse oximeter if they are medicated with intravenous sedation.

#### Discharge of Patient:

All patients undergoing a CT guided procedure should be discharged home with another person to care for them overnight. Patients who have undergone a biopsy are told to contact their referring physician for the results of their biopsy. Following conscious sedation the patient must be alert and awake prior to discharge. Type and amount of sedation administered should be dictated in all interventional cases. A discharge form is available in the department that should be given to each patient documenting the instructions you have given them.

#### Rounding on Inpatients Treated by CT Radiology:

Inpatients and outpatients who have tubes placed in CT/US are followed by the residents, fellows and attendings in the CT /US area

Each morning a resident and or fellow rounds on all patients and gather information on:

1. Overall patient status; 2. fever; 3. white count; 4. tube drainage; and 5. irrigation. Residents and fellows will irrigate the tubes on the floor themselves if there is not drainage. A radiology progress note should be written in the chart. At 8 in the morning, we will have "tube rounds" with the residents, fellows and either the CT or US attending to decide on a plan. The person coordinating who will see each patient is the CT fellow/senior resident. Who sees which patient should be set up the afternoon before. Decisions on patient management, tube pulling, flushing, changing etc. will be made during tube rounds and communicated in the chart and with the appropriate referring service. In addition, the patient should be entered into the "Body Tube" folder in the Body Worklist of PACs for review on a daily basis.

#### Needlestick injuries:

Should the resident suffer from a needlestick injury, s/he should notify their attending and be evaluated immediately at employee health at Rhode Island Hospital. Employee health is open from 7:15 am – 4:00 pm Monday through Friday. In the event of a needlestick injury outside of those hours, the resident should be evaluated at the Rhode Island Hospital emergency department.

## **Body MR**

Welcome to Body MR. MR is a dynamic, exciting modality. The residents and fellows are critical to the success of our division. The following is intended to serve not only as an introduction to the service but also as a resource for protocolling studies and for basic study interpretation. Please consult it early and often. The utility of MR for evaluation of the chest, abdomen and pelvis has dramatically increased in the past decade due to more powerful scanners with faster gradients, faster pulse sequences and improved coils. Within the abdomen, MR has quickly become the test of choice for the evaluation of focal and geographic liver disease and the biliary tree. It is also used as a problem solving modality for lesions of the kidneys, adrenal glands and more recently the small bowel. With unparalleled soft tissue resolution, MR is the gold-standard imaging exam for evaluation of the female pelvis and is also useful for the staging of pelvic malignancies in either gender.

Currently, the RIH/TMH/WI MR division has six 1.5 Tesla MR scanners and a 3T scanner.

RIH Room 1: Siemens Verio 3T. This 3T scanner was installed in 6/2010 and is truly the prince of protons. At 3T it is high-field and has a bore as wide as the Espree (see below) for claustrophobic or obese patients. Although many people believe a good 1.5T is as good as 3T for body imaging, I must say, I've been very impressed with this magnet. There is one exception. Ascites. **IF A PATIENT HAS KNOWN ASCITES, do not image on the 3T.** It can cause significant degradation of the images due to dielectric effects.

RIH Room 2: Siemens Symphony: 444-3931. Installed in 2003, the majority of the body and all of the cardiac imaging is performed on this scanner.

RIH Room 3: Siemens Espree: 444-6403. Installed in 2007, and located in the pediatric imaging center in the basement of Hasbro, this scanner is not just for pediatric patients. It is not an "open" magnet, but does feature a wider bore than conventional scanners which is intended to ease claustrophobia.

RIH ED: Siemens Aera: 444-8168. Although there are currently few indications for emergent body MR, they are increasing...also, routine inpatients may be scanned here as well.

RIH trailer: Siemens Avanto. That's right. It's in a trailer.

TMH MRI: Siemens Aera. 793-4475. Identical to room #2 at RIH.

W + I: Siemens symphony. 274-1122 ext 1875. The identical scanner to room 2 at RIH, except for hardware and software upgrade in 2010.

There are also currently 5 scanners in the RIMI system (three 3T's, two 1.5T's ) from which we may read if there is no body reader in the RIMI offices on a given day. (More below).

## **PROTOCOLLING STUDIES:**

Residents/Fellows are expected to check the protocol list in Epic and protocol studies at least twice/day. Do not hesitate to discuss with an attending. These can be very interesting/educational discussions.

### **BODY MR PROTOCOLLING AND INTERPRETATION:**

MR is fundamentally used as a problem-solving modality.

Examinations are therefore targeted to a specific diagnostic problem/lesion. The goal of MR interpretation is to put this diagnostic issue to rest.

It is critical that all previous imaging studies as well as laboratory data and clinic notes be thoroughly reviewed before protocolling and interpreting MR studies.

**It is unacceptable to perform an MR incorrectly because the purpose of the examination was not known when it was protocolled.**

If the purpose of an examination cannot be determined from all available data, the referring clinician should be contacted. When discussing cases with referring physicians, it is imperative to be friendly and to explain that we are contacting them to optimally image their patient with the goal of performing the final study necessary to answer their clinical question. When put this way, clinicians will (almost) always be happy to discuss the case. We can provide the best answer to the clinical question when we have all the data. When we attempt to interpret studies in a vacuum, everyone loses.

Please do not hesitate to discuss protocolling questions with the attending on service or myself...anytime (David Grand). Cell: 524-0548.

### **WORKFLOW**

The body MR rotation is a terrific opportunity to be exposed to a high volume of a wide-variety of different types of body MR's from multiple locations.

To that end, we have the opportunity to read the Body MRI from RIH and TMH (found on the centricity Body MRI worklist), as well as abdominal MRI from W+I and RIMI when there is NOT a body reader at the offices. An updated listed of body readers can be found posted by the RIMI workstation.

It is the job of the resident or fellow assigned to body MRI to look at the attending schedule each day, determine if there is a body reader at RIMI and notify the RIH body attending appropriately.

There is a lot of good MRI done at TMH, W+I and RIMI. They are all patients who need our help. The more MRI you see in residency the more confident you will be in practice. Read as many as you can get your hands on. Your future colleagues and patients will thank you.

## **IV. CONTRAST USED IN BODY MR:**

### **A. Intravenous Contrast Agents**

All intravenous MRI contrast agents available in the USA are chelates of gadolinium. They function by increasing the T<sub>1</sub>-relaxivity of blood and tissue rendering them bright on T<sub>1</sub> weighted images. They are typically power-injected and imaging may be performed dynamically, ie in multiple phases. Practically, there are two categories of gadolinium-agents.

Extracellular, Non-specific -- These are the most commonly used agents. They are used for all types of MR imaging. Obviously the pharmaceutical companies would disagree, but they are essentially interchangeable. We most commonly use Dotarem because we believe it has the lowest risk of NSF.

Liver specific – There are currently two agents which are considered liver specific. Of the two, Multihance (Gd-BOPTA) and Eovist (Gadoxate Disodium), Eovist is better due to more efficacious hepatic uptake. It is taken up by functioning hepatocytes in the liver and approximately half is excreted through the biliary tree as opposed to the renal only excretion of the non-specific agents. Delayed images of the liver performed with these agents have been shown to be exquisitely sensitive for detection of small metastatic lesions against the bright background of the (still) enhancing liver.

Another use is distinguishing FNH (focal nodular hyperplasia) from hepatic adenoma. The imaging features of these two lesions often overlap when using non-specific gadolinium agents. Both are hypervascular on arterial phase imaging and are essentially isointense to liver parenchyma on portal venous and delayed phase imaging. Despite all the textbook chatter regarding central scars in FNH and heterogeneity due to internal blood and fat within adenomas, these features may only be found in 50% of lesions (as is typical of appearances described as “classic”). On delayed images, FNH will retain these liver specific agents and be hyperintense compared to liver whereas adenomas will be isointense.

Like most explanations, the following is postulated rather than known, but it makes us feel better and gives us something official sounding to tell the referring clinicians. Both FNH and adenomas have functioning hepatocytes, however whereas FNH has abnormal, blind ending bile ducts, adenomas have no ducts at all. FNH will therefore take up the contrast hoping to excrete it but its ducts are abnormal and the contrast has nowhere to go. Because adenomas have no ducts at all, biliary metabolism is blocked entirely and its hepatocytes will neither take up nor excrete the contrast. Currently, we use Eovist to characterize focal liver lesions (as many of them will turn out to be FNH) and to r/o mets as small mets will be black on the delayed Eovist image (no hepatocytes).

Because these agents are excreted through the biliary tree (in addition to renal excretion) it is possible to use them to make very pretty T<sub>1</sub>-weighted MRCPs. While interesting in principle, this technique has not proven particularly useful.

The dosing of intravenous contrast agents should be determined by weight. A standard or

“single” dose of a conventional, nonspecific gadolinium agent is 0.1 mmol/kg.<sup>2</sup> A “double” dose is 0.2 mmol/kg. Traditionally, MRA’s and cardiac exams are performed with a double dose, although this is changing with better scanners, better contrast agents, and fear of NSF (nephrogenic systemic fibrosis – more below). At the time of writing, the optimal dose of Eovist (Gadoxate Disodium) is controversial. We use 10 cc regardless of weight (it comes in a 10 cc vial). Intravenous contrast agents are typically power-injected at 2 cc/sec followed by a 20 cc saline “chaser” to flush the contrast from the tubing into the vasculature.

## B. Oral Contrast Agents

Oral contrast is currently used for two indications. First, we use a barium sulfate suspension (0.1% w/v, VoLumen) which is a low-concentration barium and sorbitol solution to distend the small bowel for MR enterography examinations. Small bowel distension is critical to the utility of these studies, and because of the sorbitol this contrast agent cannot be absorbed in the bowel. Secondly, we routinely use pineapple juice for MRCP’s. It is cheap, delicious, turns the contents of the intestines black (and contains vitamin C!). Bright fluid signal within the duodenum could otherwise obscure the ductal anatomy on MRCP images (which are heavily T2-weighted).

## **MR Contrast Use (Gadolinium) in Patients with Renal Dysfunction**

During my MR fellowship, elevated creatinine (poor renal function) was probably the single most common indication for performing MRI. Times have changed. Recently, a small number of patients with decreased renal function who received gadolinium for an MRI exam acquired a potentially fatal disease, Nephrogenic Systemic Fibrosis. Although gadolinium contrast agents have always been thought to be innocuous, the gadolinium ion itself is known to be quite toxic. By binding it into a larger molecule, it is rendered inert. Remember that all or nearly all of the excretion of these agents is renal. It is thought that patients with poor renal function may not excrete all of the contrast agent before the gadolinium ion manages to dissociate itself from its larger molecule. It is then free to wreak havoc.<sup>3</sup>

Recent studies have linked a serious group of diseases known as Nephrogenic Systemic Fibrosis/Nephrogenic Fibrosing Dermopathy (NSF/NFD) to the administration of gadolinium-based contrast agents in dialysis-dependent patients and those with severe renal failure. Use of gadolinium in patients with moderately reduced renal function has also recently been cautioned by the FDA.

---

<sup>2</sup> The manufacturers have actually done us a favor here. The concentrations of all listed IV contrast agents except Eovist (Gadoxate Disodium) are such that the standard dose of 0.1 mmol/kg is roughly equal in cc’s to the patient’s weight in pounds divided by ten. Hence, a single dose of gadolinium for a 150 lb person is 15 cc’s. A double dose would be 30 cc’s.

<sup>3</sup> This is also why we NEVER, NEVER, NEVER give gadolinium to a pregnant patient.



The contrast agent can diffuse into the amniotic fluid and stay there – with plenty of time for the gadolinium ions to disassociate and cause trouble. (Although this has been the teaching, recent evidence suggests IV gadolinium may not be nearly as dangerous for a fetus as previously thought.)

Gadolinium-chelate compounds, may pose a risk for NSF/NFD in patients with moderate renal failure, estimated Glomerular Filtration Rate (eGFR) of 30-60ml/min, and therefore should only be used if necessary for diagnosis, limiting dose to minimum required. Recent FDA advisory states that “the risk, if any, for developing NSF among patients with mild to moderate renal insufficiency or normal renal function is unknown”.

In patients with severe renal failure (eGFR < 30) exposure to gadolinium containing contrast agents increases the risk for NSF (estimated to be 3-7%). Significant risk is also present for patients with acute renal insufficiency of any severity, or renal insufficiency due to hepato-renal syndrome. A recent study identified a small group of patients with eGFR between 30-40ml/min who developed NSF. These patients were later found to have had undetected ATN at the time of Gd administration. Extreme caution should be exercised in all patients with acute renal insufficiency related to recent major surgery/vascular procedures, sepsis or in the peri-transplantation period. Acidosis and elevated serum Ca, Fe, P have also been associated with increased risk. High dose erythropoietin therapy and immunosuppression may be linked to NSF/NFD.

Among the factors that may increase the risk for NSF are repeated or higher than recommended doses of gadolinium containing contrast agents. Although this is a rapidly evolving topic these guidelines provide an initial framework for the care of patients who may be at risk for gadolinium associated NSF/NFD.

(Because NSF is a fatal disease we must be cautious. However, it is also important to understand that the actual risk of a patient contracting NSF is essentially nil. Nearly all of the cases of NSF reported have been with a single gadolinium agent which is no longer used. If you look critically at the number of cases of NSF worldwide compared to the number of gadolinium enhanced MRI's performed – statistically speaking, NSF essentially doesn't exist. That being said, our guidelines for contrast administration are based on the current recommendations of the experts and the FDA.)

#### OUR CURRENT GUIDELINES:

*Guidelines are established to define procedures which reflect appropriate care practices for providing imaging and interventional procedures. These guidelines shall be used routinely; however, actual practice may be altered to fit specific patient conditions which may be recognized. Altered practices from these guidelines must first be approved by a Radiologist as he/she evaluates the patient's condition and clinical circumstances against the imaging or intervention services being requested.*

- A. Procedure: Guidelines for Patient Screening:  
Adult Patient screening shall be performed for assessment of moderate or severe renal disease by obtaining serum creatinine and calculating eGFR (using the

MDRD Study equation Modification of Diet in Renal Disease: located at <http://mdrd.com> or eGFR calculators available at each MR unit. For patients under 18 years of age the Schwartz Formula should be used to calculate eGFR: located at [http://nephron.com/cgi-bin/peds\\_nic.cgi](http://nephron.com/cgi-bin/peds_nic.cgi)), when **any** of the following risk factors are present:

- I. Inpatient/ER Patient: Creatinine value obtained during current hospitalization prior to MRI.
  - II. Creatinine value must be obtained within 24 hours prior to MRI when:
    - a. Active renal disease / acute tubular necrosis
    - b. Hepato-Renal Syndrome/Liver Transplant Recipient/ other recent transplant
    - c. Any recent major surgery/vascular procedures/sepsis
    - d. Following recent CT when pre-CT eGFR less than 60 or diabetes/hypertension.
  - III. Outpatient: Creatinine value must be obtained within 6 weeks of MRI examination when:
    - a. Known or suspected renal disease
    - b. Diabetes/Hypertension
    - c. Liver transplant/other transplant surgery
    - d. Age greater than 60 (exception may be when creatinine value is obtained within one year prior to MRI; patient is followed by a physician, has eGFR greater than 60 and has no additional risk factors).
- B. Guidelines for Performance of Gadolinium Enhanced MRI Examinations based on patient risk category and examination type:**

**Inpatient/Outpatient**

- I. No risk factors - standard dose gadolinium agent (Gadavist/Magnevist//Eovist)
- II. No risk factors MRA- Standard dose Gadavist/Magnevist.
- III. Risk factors HTN or Diabetes/No Creatinine Available within 6weeks- Contrast may be administered per above guidelines if eGFR is greater than 60ml/min calculated from creatinine obtained within one year if the patient is followed by a physician for this condition and reports no recent change in condition, reason for exam does not include assessment of urinary tract, and there are no additional risk factors. Patients who have had a recent CE CT scan must have documentation of stable post CT renal function. If creatinine cannot be obtained then non-contrast examination performed when appropriate. If gadolinium is recommended following Radiologist review of non-contrast study, referring physician is notified. If upon discussion with referring physician the decision is made to proceed

with CE portion of MRI examination, creatinine must be obtained, and reported to MRI at the time of limited CE examination scheduling. If eGFR >60, proceed with examination as described above, if <60 see below. All patients with <60 eGFR, needs an “eGFR evaluation patient sheet” (form A) completed and scanned into PACS/ Novius.

- a. **eGFR less than 60ml/min, greater than 30ml/min** (moderate renal failure)- Non- contrast examination should be performed. If this is not diagnostic or based on clinical history there is a diagnostic imperative for gadolinium administration (i.e. rule out metastatic breast cancer for pre treatment staging) and gadolinium is indicated, consideration of risk benefit analysis documented by Radiologist in the patient record. Radiologist prescription of amount & type of gadolinium given must be recorded.

**Limited Gadolinium dose is recommended which should be tailored to the specific examination requirement.**

**Gadavist dose should be tailored to limit total gadolinium exposure and take advantage of the increased T<sub>1</sub> relaxivity of this agent to reduce overall contrast volume. (I.e. double dose exams may be performed using single dose Gadavist, and single dose studies may at times be performed with a reduced dose).**

**eGFR=30-40, creatinine obtained within 24 hrs, ensure no risk for ATN (stable Cr), Assess prior Gadolinium administration (cumulative dose over preceding year may present risk) or recent CT contrast exposure (ATN risk-stable post CT Cr must be recorded), no additional risk factors for NSF. If Gd required recommend ½ dose Gadavist. It should be remembered that risk for NSF relative to eGFR is a continuum. As eGFR levels approach 30, risk may approach that of severe (Gr 4, 5) renal disease.**

**eGFR=40-50, creatinine obtained within 6 weeks, Assess prior Gadolinium administration (cumulative dose over preceding year may present risk) or recent CT contrast exposure (ATN risk-stable post CT Cr must be recorded), no additional risk factors for NSF. If Gd required recommend minimum necessary Gadavist dose, not to exceed single dose.**

**eGFR=50-60, creatinine obtained within 6 weeks, Assess prior gadolinium administration (cumulative dose over preceding year may present risk) or recent CT contrast exposure (ATN risk-stable post CT Cr must be recorded), no additional risk factors for NSF. If Gd required recommend single dose Gadavist.)**

- b. **eGFR less than or equal to 30ml/min** (severe renal failure) or acute renal insufficiency of any severity due to the hepato-renal syndrome or in the peri- operative transplantation period, recent major surgery, sepsis, major vascular procedures. Prudent to not administer gadolinium compound if previous gadolinium administration within preceding year. Non-contrast examination

should be performed. If this is not diagnostic, Radiologist review of gadolinium indication is required in consultation with the Referring Physician and **Nephrologist**. If gadolinium is indicated, consultation and consideration of alternative examinations should be documented in the patient record.

**Patient/Guardian informed consent should be obtained with estimated risk clearly stated (estimated risk of NSF/NFD 3-7%).**

**Limit dose necessary for MR procedure, half dose Gadavist is recommended.**

**If patient receives hemodialysis, follow-up dialysis treatment must be performed within 2 hours and again within 24 hours of gadolinium administration. It is unknown however if hemodialysis prevents NSF.**

**Peritoneal Dialysis is not believed to be effective in clearing gadolinium. Patients undergoing peritoneal dialysis may not receive gadolinium unless Nephrology is consulted and hemodialysis is planned.**

**Patients receiving gadolinium who are at risk for NSF require clinical follow-up and long term monitoring for the disease.**

Fundamentally, like everything else we do in medicine, this is a calculation of risk/benefit. We tend to lose sight of this calculation, inherent in all medical tests and procedures, because radiology tests and procedures are typically quite safe. However, there is risk to the patient in everything we do, and our willingness to perform a test/procedure implies that after careful consideration we believe the benefit of the test/procedure to outweigh the risk. It is important to remember that to date not a single person with normal renal function has acquired NSF. NSF has certainly increased the risk in the risk/benefit equation, however we should use our judgment in addition to the above guidelines to calculate the risk/benefit ratio for each patient at risk.

## II. BODY CT EDUCATIONAL GOALS AND OBJECTIVES

### PGY 2

#### Medical Knowledge

1. Describe the basic physics of computerized tomography
2. Describe Hounsfield units, window and level settings
3. Describe proper CT protocols for specific disease processes
4. Describe dynamic vs. equilibrium phase imaging and differentiate between these entities
5. Describe normal thoracic parenchymal, mediastinal and vascular anatomy
6. Describe normal abdominal and pelvic anatomy

7. State indications for aortic dissection CT and the protocol to be followed with this examination
8. Describe the differences between axial CT, helical CT, and MDCT
9. Describe indications for body MR exams

Patient Care:

1. Become familiar with CT protocols
2. Be able to manage contrast reactions

Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors
2. Incorporate feedback into improved performance
3. Efficiently use electronic resources (Lifelinks) to access information
4. Schedule exams appropriately

Communication and Interpersonal Skills:

1. Appropriately communicate and document in the patient record urgent or unexpected radiologic findings
2. Produce radiologic reports that are accurate, concise and grammatically correct
3. Communicate effectively with all members of the health care team

Professionalism:

1. Demonstrate respect for patients and all members of the health care team
2. Serve as a role model for medical students
3. Respect patient confidentiality
4. Present oneself as a professional in appearance and communication.

System-based Practice:

1. Demonstrate knowledge of how radiologic information is integrated with the other parts of the health care system in the treatment of the patient
2. Demonstrate knowledge of ACR standards and appropriateness criteria
3. Demonstrate knowledge of cost-effective imaging practices

**PGY 3**

**Medical Knowledge**

1. Describe the basic physics of computerized tomography
2. Describe Hounsfield units, window and level settings
3. Describe proper CT protocols for specific disease processes
4. Describe dynamic vs. equilibrium phase imaging and differentiate between these entities
5. Describe normal thoracic parenchymal, mediastinal and vascular anatomy
6. Describe normal abdominal and pelvic anatomy
7. State indications for aortic dissection CT and the protocol to be followed with this examination
8. Describe the differences between axial CT, helical CT, and MDCT
9. Describe indications for body MR exams

#### Patient Care:

1. Become familiar with body CT and MR protocols for patients
2. Be able to manage contrast reactions
3. Demonstrate proper technique in planning and performing CT procedures

#### Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors
2. Incorporate feedback into improved performance
3. Efficiently use electronic resources (Lifelinks) to access information
4. Schedule exams appropriately

#### Communication and Interpersonal Skills:

1. Appropriately obtain informed consent for CT guided interventional procedures
2. Appropriately communicate and document in the patient record urgent or unexpected radiologic findings
3. Produce radiologic reports that are accurate, concise and grammatically correct
4. Communicate effectively with all members of the health care team

#### Professionalism:

1. Demonstrate respect for patients and all members of the health care team
2. Serve as a role model for medical students
3. Respect patient confidentiality
4. Present oneself as a professional in appearance and communication.

#### System-based Practice:

1. Demonstrate knowledge of how radiologic information is integrated with the other parts of the health care system in the treatment of the patient
2. Demonstrate knowledge of ACR standards and appropriateness criteria
3. Demonstrate knowledge of cost-effective imaging practices

### **PGY 4**

#### Medical Knowledge:

1. Respond logically and with competence as a Body Radiology consultant.
2. Prescribe and interpret CT/MR exams in the chest and abdomen.
3. Describe radiation dose reduction principles in CT
4. Describe volume, doses and administration rates of contrast for CT examinations.
5. Provide a differential diagnosis for
  - a. thoracic, abdominal and pelvic pathology
6. Indications for CT-guided chest, abdominal and pelvic CT interventions
7. Indication and techniques of CT-guided abscess drainages and biopsies.
8. Orient and supervise the proper imaging investigation of a patient or of a specific disease.

#### Patient Care:

1. Develop a management plan based upon CT, US and or MR findings and clinical

- information.
2. Demonstrate proper technique in planning and performing CT procedures
  3. Know the appropriate indications for body CT and MR examinations and alternatives depending on the suspected diagnosis.
  4. Appropriately protocol CT and body MR cases based upon the indication for the examination.
  5. Minimize adverse reactions to iodinated contrast through appropriate patient selection and medication.

Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors
2. Incorporate feedback into improved performance
3. Efficiently use electronic resources (Lifelinks) to access information
4. Schedule procedures appropriately
5. Use appropriate protocols and techniques for radiation dose reduction in CT

Communication and Interpersonal Skills:

1. Appropriately obtain informed consent
2. Appropriately communicate and document in the patient record urgent or unexpected radiologic findings
3. Produce radiologic reports that are accurate, concise and grammatically correct
4. Effectively teach junior residents and medical students
5. Communicate effectively with all members of the health care team

Professionalism:

1. Demonstrate respect for patients and all members of the health care team
2. Serve as a role model for junior residents and medical students
3. Respect patient confidentiality
4. Present oneself as a professional in appearance and communication.
5. Demonstrate a responsible work ethic with regard to work assignments

Systems-based Practice:

1. Demonstrate knowledge of how radiologic information is integrated with the other parts of the health care system in the treatment of the patient
2. Demonstrate knowledge of ACR practice guidelines for CT examinations
3. Demonstrate knowledge of cost-effective imaging practices
4. Understand treatment implicated by findings on CT or MR (e.g. what is the next treatment that should occur based on the CT/MR findings).

**PGY 5**

Medical Knowledge:

1. Respond logically and with competence as a Body Radiology consultant.
2. Prescribe and interpret CT/MR exams in the chest and abdomen.
3. Describe radiation dose reduction principles in CT and the ALARA (as low as
4. Describe volume, doses and administration rates of contrast reasonably achievable principles) for CT examinations.

5. Provide a differential diagnosis for
  - a. thoracic, abdominal and pelvic pathology
6. Indications for CT-guided chest, abdominal and pelvic CT interventions
7. Indication and techniques of CT-guided abscess drainages and biopsies.
8. Indications for image guided tumor ablation.
9. Orient and supervise the proper imaging investigation of a patient or of a specific disease.

#### Patient Care:

1. Develop a management plan based upon CT, US and or MR findings and clinical information.
2. Demonstrate proper technique in planning and performing CT procedures
3. Know the appropriate indications for body CT and MR examinations and alternatives depending on the suspected diagnosis.
4. Appropriately protocol CT and body MR cases based upon the indication for the examination
5. Minimize adverse reactions to iodinated contrast through appropriate patient selection and medication.

#### Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors
2. Incorporate feedback into improved performance
3. Efficiently use electronic resources (Lifelinks) to access information
4. Schedule procedures appropriately
5. Use appropriate protocols and techniques for radiation dose reduction in CT

#### Communication and Interpersonal Skills:

1. Appropriately obtain informed consent
2. Appropriately communicate and document in the patient record urgent or unexpected radiologic findings
3. Produce radiologic reports that are accurate, concise and grammatically correct
4. Effectively teach junior residents and medical students
5. Communicate effectively with all members of the health care team

#### Professionalism:

1. Demonstrate respect for patients and all members of the health care team
2. Serve as a role model for junior residents and medical students
3. Respect patient confidentiality
4. Present oneself as a professional in appearance and communication.
5. Demonstrate a responsible work ethic with regard to work assignments

#### Systems-based Practice:

1. Demonstrate knowledge of how radiologic information is integrated with the other parts of the health care system in the treatment of the patient
2. Demonstrate knowledge of ACR practice guidelines for CT examinations
3. Demonstrate knowledge of cost-effective imaging practices
4. Understand treatment implicated by findings on CT or MR (e.g. what is the next treatment that should occur based on the CT/MR findings).



### III. **EVALUATION of RESIDENTS on BODY ROTATION**

These are the evaluation mechanisms used to evaluate the resident and determine that the program goals and objectives are met.

#### Evaluation Forms

Monthly rotation evaluation by faculty Evaluation by CT technology staff.

#### Exams

ACR inservice exam

#### Portfolio Procedure Logs

The residents will also be evaluated on:

1. Attendance during Body rotation.
2. Efficiency during Body rotation.
3. Knowledge of Body protocols.
4. Knowledge of relevant anatomy, physiology and pathology.
5. Knowledge of proper prescription of CT/MR examinations.
4. Ability to provide a reasonable differential diagnosis for a CT/MR imaging finding and suggest the next most appropriate step in the work-up of the patient.
7. Ability to appropriately book and perform CT-guided interventions.
8. Efficiency in dictating studies.
9. Quality of dictations.
10. Interactions with referring physicians.
11. Affability with coworkers, technologists, secretaries, nursing staff and radiology support staff.

### IV. **CT REFERENCES**

- 1) Fundamentals of Body CT by W. Richard Richard Webb, William E. Brant, William E. Brant, Clyde A. Helms (Great for 1st years - quick intro to CT) 3<sup>rd</sup> Edition, Saunders, October 2005
- 2) Fundamentals of Diagnostic Radiology by William E. Brant, Clyde A. Helms Lippincott Williams & Wilkins, June 2006
- 3) Body MRI by Evan S. Siegelman Saunders, December 2004
- 4) Genitourinary Imaging : Case Review Series by Ronald J. Zagoria, William W. Mayo- Smith, Julia R. Fielding, Mosby, September 2006

- 5) Gastrointestinal Imaging : Case Review Series by Robert D. Halpert Mosby, 2007
- 6) Diagnostic and Surgical Imaging Anatomy: Chest, Abdomen, Pelvis: by Michael P Federle, Melissa L Rosado-de-Christenson, Paula J Woodward, Gerald F Abbott and Akram M Shaaban. Lippincott, Williams & Wilkins, December 2006.
- 7) Diagnostic Imaging: Abdomen. by Michael Federle, R. Brooke Jeffrey, Venkat Sridhar Anne. 2004

Reference to various anatomy texts and atlases will often be necessary.

### **Body CT Resident Reading Assignments by Year First Year**

First 2 week rotation:

- Body CT 3d edition (Webb, Brant & Major). Chapters 8-18 (Pages 167- 376)

Second 4 week rotation:

- Gastrointestinal Imaging Requisites 4<sup>th</sup> edition (Boland). Chapter 2 Stomach, Chapter 6 Liver, Chapter 7 Spleen, Chapter 9 Pancreas
- GU Requisites 2<sup>nd</sup> Edition Zagoria Chapter 3 Renal masses Chapter 4 Diffuse renal abnormalities, Chapter 9 adrenal gland.

### **Second Year**

4 week rotation

- Gastrointestinal Imaging Requisites 4<sup>th</sup> edition (Boland) remainder of chapters
- GU Requisites 2<sup>nd</sup> Edition Zagoria remainder of chapters
- Radprimer questions

### **Third Year**

4 week rotation

- Radprimer questions
- Genitourinary Radiology Case Review Series 2<sup>nd</sup> Ed (Zagoria, Mayo- Smith Fielding)
- Gastrointestinal imaging Case review Series 3d Edition (low)

### **Fourth Year**

- Repeat 3d year readings

StatDx used primarily as a radiology reference

V. **APPENDIX**

- CT Procedure Booking Sheet
- CT Database Entry Sheet
- Post Procedure Discharge Sheet
- CT Division central line policy
- Pregnant Patient Consent form

## **The RIH CT Policy for Contrast Administration and Catheter size/type.** (4-07):

### Types of intravenous contrast

- Omnipaque 350 will be used on all adult patients needing iv contrast.
- Visipaque 320 will be used for patients with decreased renal function. The Radiologist will protocol when a patient will receive Visipaque 320.
- Visipaque 320 is also used, by protocol, for ct scans of the heart. (cardiac cta and pulmonary vein mapping)
- Omnipaque 300 will be used on all pediatric patients needing iv contrast. The contrast volume for pediatric patients is determined by 1cc of iv contrast per pound of patient's body weight for patients less than 100 pounds. Pediatric patients weighing over 100 pounds will receive the adult contrast volume of Omnipaque 300.

### CT Scan Peripheral IV Access Policy

- Omnipaque 300/350 intravenous access requirements:
  - Injection rate of up to 2.4cc/second: 22 gauge or larger
  - Injection rate of 2.5cc/sec to 4cc/second: 20 gauge or larger
  - Injection rate of 4.1cc/sec or greater: 18 gauge or larger
- Visipaque 320 intravenous access requirements:
  - Injection rate of up to 3cc/second: 20 gauge or larger
  - Injection rate of 3.1cc/sec or greater: 18 gauge or larger

### CTA Scan Peripheral Intravenous Access Policy

- A 20 gauge or larger IV in an antecubital vein is preferred to perform a CTA study. Exceptions can be made at the discretion of the radiologist and technologist if a patient's current iv access can yield a quality study without reducing the injection rate.
- The rationale is to prevent extravasation and poor quality exams from inadequate intravenous lines.

### CT Scan Adult Patient Central Line Policy

- It is the policy of the CT department to establish, whenever possible, adequate peripheral iv access. Central lines will be used only when our own peripheral iv access cannot be attained.
- If a nurse accompanies the patient, always defer to her/him as to which line to use for an iv contrast injection. There are some lines that cannot be used at all.
- If a patient needs to have a port-a-cath accessed and the clinic is unable to do it, then a Radiologist can access the port. Access kits are available in the CT department for this purpose.
- All iv contrast injections will be monitored for as long as possible prior to the start of the scan.
- If there is any question or concern regarding the use of a central line, consult a Radiologist.

### Types of Central Lines in Adult Patients at Rhode Island Hospital

- **Port-a-cath / perm-a-cath / Hickman catheter:** These are generally found in the chest, however there are some versions that are placed in a patient's arm. A Hickman catheter is identifiable by its white color and usually has one or two ports. A port located in the patient's arm cannot be used for an iv contrast power injection. Only hand injections can be used with a port-a-cath, perm-a-cath, or Hickman catheter. Port-a-cath, perm-a-cath, or Hickman catheters cannot be used for CT angiography. Any implanted venous access device on adult patients should be accessed, flushed and deaccessed as described in Rhode Island Hospital Nursing Practice Manual, File K-7. The flush of heparinized saline is 5cc, 100 units/mL.
- **Swan-Ganz catheter:** These are identifiable by their yellow colored sheath. This catheter can sometimes go into a pulmonary artery. Never use a Swan-Ganz port that goes into a pulmonary artery. This port is identified on its outer tubing by the letters "PA". If iv contrast is injected directly into a pulmonary artery, flash pulmonary edema can occur. Usually, the blue "CVP" line can be used for iv contrast injection. When performing routine diagnostic contrast CT scans, an injection rate of 2cc/sec will be used. When performing CT angiography, an injection rate of 3cc/sec will be used.
- **Triple lumen catheter:** These can be located in the neck, chest or groin. They are identifiable by their three ports on the outer end of the catheter. The colors of the ports are blue, brown, and white. If possible, use a port that is not being used for anything else. When performing routine diagnostic contrast CT scans, an injection rate of 2cc/sec will be used. When performing CT angiography, an injection rate of 3cc/sec will be used.
- **PICC lines:** These can be found in both adult and pediatric patients. They are located in the patient's arm. PICC lines can never be used for power injection or hand injection. PICC lines are too small and easily ruptured.
- **Power PICC lines:** These can be found in adult patients and are approved for power injections. These are located in the patient's arm. Power PICC lines have two or three ports. One of the ports has purple tubing with a red end. The purple and red port can be used for CT scans. Power PICC lines can be injected up to a rate of 5cc/sec at a maximum of 300psi. The port for injection is labeled "5ml/sec MAX" directly on the clamp. Prior to and after each contrast power injection, the Power PICC is to be checked for patency via flushing with a 10cc normal saline. Do not proceed with power injection if complete catheter patency cannot be established.
- **Morpheus CT PICC lines:** These can be found in adult patients and are approved for power injections. These catheters can only be relied upon for CT studies with an injection rate of up to 4cc/second. Use **only warm contrast** when injecting through a Morpheus line. These are located in the patient's arm. Morpheus CT PICC lines may have a single port or a double port. Angio Dynamics states Morpheus CT PICC lines can be injected up to a rate of 6cc/sec at a maximum pressure of 250psi only if the iv contrast is warmed to body temperature. They also require that the catheter be flushed with heparinized saline after each use. The port for injection is labeled "6ml/sec" directly on the tubing. Prior to and after each contrast power injection, the Morpheus CT PICC is to be checked for patency via flushing with a 10cc normal saline. Do not proceed with power injection if complete catheter patency cannot be established.

- **Arterial lines (A lines):** These can never be used for any form of contrast injection.

#### CT Scan Pediatric Patient Central Line Policy

- It is the policy of the CT department to inject iv contrast through adequate peripheral iv access whenever possible. Central lines will be used only when peripheral iv access cannot be attained.
- Pediatric patients 14 years old and up **with adult sized central lines**, can have their central lines used as per the adult policy.
- Children 14 years old and under should only have central lines used if no peripheral iv access is available. If a central line needs to be used on a pediatric patient in this age category, only hand injections of iv contrast should be performed.
- The **iv contrast should always be warm** whenever performing a hand injection in an effort to reduce contrast viscosity.
- If a nurse accompanies the patient, always defer to her/him as to which line to use for an iv contrast injection. There are some lines that cannot be used at all.
- If a patient needs to have a port-a-cath accessed and the clinic is unable to do it, then a Radiologist can access the port. Access kits are available in the CT department for this purpose.
- All iv contrast injections will be monitored for as long as possible prior to the start of the scan.
- If there is any question or concern regarding the use of a central line, consult a Radiologist.

#### Types of Central Lines in Pediatric Patients at Rhode Island Hospital

- **Port-a-cath / perm-a-cath / Hickman / Broviac catheter:** These are generally found in the chest, however there are some versions that are placed in a patient's arm. Hickman and Broviac catheters are identifiable by their white color and usually have one or two ports. A port located in the patient's arm cannot be used for an iv contrast power injection. Only hand injections can be used with a port-a-cath, perm-a-cath, Broviac, or Hickman catheter. Port-a-cath, perm-a-cath, Broviac, or Hickman catheters cannot be used for CT angiography.
- **PICC lines:** These can be found in both adult and pediatric patients. They are located in the patient's arm. PICC lines can never be used for power injection. PICC lines can be used for hand injections of iv contrast on pediatric patients.
- **There are four other central lines specifically used for pediatric patients:**
  1. 4 french, 8cm, double lumen. These lines are usually in babies less than 12 months old.
  2. 4 french, 13cm, double lumen.
  3. 5.5 french, 8cm, triple lumen.
  4. 5.5 french, 13cm, triple lumen.

The four lines above can only have iv contrast hand injected through them.

The 5.5 french lines are rated to have a maximum flow of 1300cc of saline/hour.

This translates to .36cc of saline/second. Therefore, only hand injections of iv contrast are permitted.

Accessing a Central Venous Catheter for Intermittent Infusion  
(From Rhode Island Hospital Nursing Practice Manual, File C-53)

- Perform hand hygiene, using alcohol based gel and hand washing.
- Don non-sterile gloves. This is not a sterile procedure.
- Wipe the injection cap with alcohol. Cleanse using friction for 1 minute with each of three alcohol wipes. Allow residual alcohol to dry.
- Attach a 10 mL syringe of normal saline to the injection cap. Aspirate for blood return and flush.
- Connect iv contrast tubing access device to the injection cap.
- When the iv contrast injection is completed, disconnect tubing.
- Alcohol wipe injection cap, and flush with 10 mL normal saline.
- If a flush of heparinized saline is required, the patient's nurse should flush the line with heparin using positive pressure to prevent reflux of blood into the catheter.



**Rhode Island Hospital**

*A Lifespan Partner*

**Consent for Imaging Studies Using Ionizing Radiation**

**During Pregnancy**

Dr. \_\_\_\_\_ is requesting the following imaging

*referring physician*

study \_\_ which uses radiation to

*study to be performed*

evaluate \_\_\_\_\_ . Because you are pregnant, we

*indication*

would like you to understand what we know about the effects of the imaging study on you and your baby and need your consent before performing this exam. A patient information sheet that explains some of the risks from radiation in pregnancy is located on the back of this consent.

The following checked items apply:

- You and your baby will be exposed to low levels of radiation. This imaging study uses low doses of radiation and the risks from this test are much smaller than the normal risks of pregnancy. This examination might slightly increase the possibility of cancer later in my child's life, but the actual potential for a healthy life is very nearly the same as that of other children. The imaging study does not add to risks for birth defects. Birth defects occur in small numbers of pregnancies even without exposure to radiation.
- You will be given intravenous contrast during the scan. The FDA has not confirmed the safety of this contrast in pregnancy. Intravenous contrast can cross the human placenta and enter the fetus when given in usual clinical doses, but no well-controlled studies of the effects of this media have been performed in pregnant women. Tests in animals have shown no evidence of increased cancer or birth defects.

I understand this document and have had the opportunity to have my questions answered. I am aware that the practice of medicine is not an exact science and I acknowledge that no guarantees have been made to me regarding the outcome of this pregnancy. I agree to have the imaging study performed.

\_\_\_\_\_  
**Patient's Name (printed)**

\_\_\_\_\_  
**Patient's Signature**

\_\_\_\_\_  
**Patient's Agent or Representative**  
(If patient unable to consent)

\_\_\_\_\_  
**Relationship to Patient**

Date Signing: \_\_\_\_\_, 20\_\_\_\_ Time: \_\_\_\_\_ A.M./P.M.

**Physician's Acknowledgement**

The undersigned confirms that informed consent, as described above, has been given by the patient. I have also discussed the possible need for contrast including the potential risks, benefits and consent was obtained.

\_\_\_\_\_  
Referring Physician's Signature



Emergent situation precluded obtaining written informed consent.

Emergency

Rationale: \_\_\_\_\_

Please fax a copy of this form to Medical Physics at 444-4446, and place a copy in the patient's chart.

## Rhode Island Hospital

### Patient Information Sheet for Radiation Risks in Pregnancy

Your doctor has recommended that you have an imaging study to help in your care. Pregnant women may be concerned that radiation from these tests could harm the baby in some way. There is no specific amount of x-ray radiation that is totally free of adverse effects, so risks can never be said to be zero, however, in your case, the amounts of radiation used to make the pictures is very small. Common imaging studies use low doses of radiation and the risks from these studies are much smaller than the normal risks of pregnancy. The imaging study your doctor has ordered might slightly increase the possibility of cancer later in the child's life, but the actual potential for a healthy life is very nearly the same as that of other children. The imaging study does not increase the risk of birth defects.

Birth defects occur in 1 in 33 (3.0%) of all babies at birth, and cancer occurs in 1 or 2 in 1,000 children. Therefore a small percentage of all babies will have or will develop one of these problems whether the imaging study is performed or not. We can never guarantee that a baby will not have any of these problems. What we can say is that the chance of one of these problems occurring is not significantly increased by most of the examinations that we use for diagnosis. We would not recommend this study unless we felt that the information we will get from it is necessary to give you the best possible care.

### Radiation Risks in Perspective

The millisievert (mSv) is the measurement used to assess the amount of radiation. Each year, people who live in New England are exposed to about 3 mSv of radiation from naturally occurring sources including radon and cosmic rays.

The following are the approximate radiation doses to the mother from common radiology examinations:

Chest X-ray	0.1 mSv
Mammogram	0.4 mSv
Head CT	2 mSv
Chest CT	10 mSv
Abdomen or Pelvis CT	10 mSv each

The largest dose of 10mSv may be taken to have a risk to the mother that is comparable to the risk of dying in an automobile accident when driving a distance of ~8,000 miles.

### References:

1. ACR Practice Guidelines for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation- 2008 (Res. 26)
2. Cohen and Lee, "A Catalogue of Risks," Health Physics, vol. 36, June 1979
3. Centers for Disease Control and Prevention (CDC). Birth Defects: Frequently Asked Questions July 18,2007
4. American Cancer Society: Cancer Statistics 2008

**BREAST IMAGING**  
*including WOMEN & INFANTS HOSPITAL BREAST IMAGING*

Breast Imaging at Rhode Island Hospital is located in Suites G 85 and G95 at the Anne C. Pappas Center for Breast Imaging, in the Medical Office Building. Residents may also do a breast imaging rotation at Women and Infants Hospital. Both facilities perform state-of-the-art breast imaging with screening mammography, diagnostic mammography, digital tomosynthesis, breast MRI and a full range of diagnostic breast procedures.

In this rotation the resident shall learn BIRADS nomenclature for reporting. The resident will also learn the difference between screening and diagnostic mammography and how to perform a diagnostic work-up. (S)he will become familiarized with mammographic positioning and technique and quality assurance including MQSA and ACR requirements. The resident will learn to interpret mammographic images and the use of additional mammographic views for problem solving. (S)he will learn when and how to employ sonography and MRI in patient evaluation. By the end of the residency, it is expected that the resident will be competent in interpreting screening and diagnostic mammography, breast ultrasound and breast MRI.

For MQSA certification, the resident must interpret 240 mammograms during a 6 month period in the last 2 years of residency. Residents are expected to read at least 240 mammograms during the 3<sup>rd</sup> year rotation in breast imaging to make sure that this requirement is met.

In addition, the resident will learn to perform image-guided breast procedures. By the end of the residency program it is expected that each resident will have observed all procedures and will be competent in performing uncomplicated breast biopsy and needle localization.

It should be stressed that all diagnostic mammography and ultrasound examinations will be reviewed with the attending radiologist to determine the management of the patient before the patient leaves the department. If additional views are deemed necessary, they should be performed at the time of the patient's visit.

All cases for which there is a recommendation for short interval follow-up or biopsy should be discussed with the patient at the time of the examination. In cases in which biopsy is recommended, the procedure should be scheduled before the patient leaves and the referring physician's office should be contacted to obtain approval and a written order.

All cases for which there is a recommendation for short interval follow-up or biopsy should be discussed with the patient at the time of the examination. In cases in which biopsy is recommended, the procedure should be scheduled before the patient leaves and the referring physician's office should be contacted to obtain approval and a written order.

**Workday Schedule**

**Pappas:** The resident rotation begins at 8A.M. Residents are expected to attend multidisciplinary conference (MDC) once during each 4 week rotation at RIH. The MDC takes place in the Leone Conference Room in the Comprehensive Cancer Center (APC Building-1<sup>st</sup> floor) on Wednesday 9-10am. Attending this multidisciplinary conference will help the resident to further understand how imaging is incorporated with the surgery and oncology into the care of the patient with breast cancer.

As there are multiple learners on the breast imaging service, residents and fellows will be assigned to the various experiences (Screening, Diagnostic, Procedure, MRI) per a schedule which is posted in the reading rooms.

**WIH:** The work day begins at 8am. Residents can attend the Women & Infants Breast Tumor Board on Friday at 7:30 AM if no radiology conference is scheduled. As there are multiple learners on the breast imaging service, residents and fellows will be assigned to the various experiences (Screening, Diagnostic, Procedure, MRI) per a schedule which is posted in the reading rooms.

## **Educational Goals and Objectives**

### **First Rotation (Second Year Resident):**

#### **Medical Knowledge**

1. Describe proper patient positioning and labeling for mammography
2. Understand basic mammographic physics
3. Recognize suboptimal mammograms and breast US and suggest opportunities for improvement
4. Make core observations of common benign and malignant lesions on mammography and breast ultrasound
5. List the basic principles of contrast enhanced and implant evaluation breast MRI

#### **Patient Care**

1. Recommend appropriate imaging of the symptomatic breast
2. Recommend screening mammography appropriately
3. Recommend appropriate additional views and ultrasound for common mammographic findings
4. Perform uncomplicated breast procedures under direct supervision
5. Recognize inadequate, high risk or discordant biopsy and recommend appropriate management
6. Attends breast tumor board at least once per rotation

#### **Practice-Based Learning**

1. Identify, rectify and learn from personal errors
2. Incorporate feedback into improved perform

#### **Communication and Interpersonal Skills**

1. Obtain informed consent being able to answer patient questions specific to breast biopsy
2. Effectively and compassionately give breast imaging results to patients in routine, uncomplicated circumstances
3. Generate clear and concise breast imaging reports that do not require substantive correction on routine cases
4. Communicate routine results to providers and routine requests to secretaries and technologists clearly and concisely

#### **Professionalism**

1. Demonstrate respect for all members of the health care team
2. Respect patient confidentiality
3. Present oneself as a professional in appearance
4. Fulfill work-related responsibilities
5. Put patient care first and advocates for patient
6. Recognize limitations and seeks help when appropriate
7. Respond appropriately to constructive criticism

### **System-Based Practice**

1. Ensure that reports contain all necessary information for coding and billing
2. Participate in section QA by bringing cases with suboptimal imaging or patient outcome to faculty attention
3. Describe MQSA and medical audit parameters for quality practice

### **Second Rotation Goals and Objectives (Third Year Resident):**

These are additive to the goals and objectives for the PGY3 year

#### **Medical Knowledge**

1. Recognize suboptimal breast MR imaging and suggest options for improvement
2. Assist sonographer in performing breast US, accurately correlating clinical and mammographic findings with sonographic findings
3. Provide accurate and efficient interpretation of screening mammography
4. Direct diagnostic breast imaging, making recommendations for management efficiently and accurately
5. Accurately interpret uncomplicated breast MRI

#### **Patient Care**

1. Provide appropriate consultation on outside breast imaging studies
2. Recommend appropriate imaging in staging of the patient with newly diagnosed breast cancer
3. Recommend screening MRI appropriately
4. Competently perform breast procedures with minimal direction under direct supervision
5. Recognize and manage breast procedure complications
6. Attend breast tumor board at least once per rotation

#### **Practice-Based Learning**

1. Identify weaknesses in breast imaging knowledge and implement a plan for the rotation to improve

#### **Communication and Interpersonal Skills**

1. Communicate effectively with patients in challenging circumstances
2. Efficiently generate clear and concise reports that do not require substantive correction on common complex cases
3. Communicate appropriately with staff and providers under stressful situations

#### **Professionalism**

1. Continue to demonstrate professional behaviors
2. Function as an effective health care team leader

#### **System-Based Practice**

1. Consistently participate in section quality improvement

2. State the relative cost of mammography, breast US, breast MRI and breast biopsy

### **Third Rotation Goals and Objectives (Fourth Year Resident):**

These goals and objectives are additive to those for the prior years

#### **Medical Knowledge**

1. Independently modify breast MRI protocols when needed due to clinical circumstances
2. Independently perform breast US to optimize imaging
3. Make subtle observations and direct appropriate management of complex cases on mammography, breast US and breast MRI

#### **Patient Care**

1. Competently and independently perform breast biopsy and needle localization
2. Integrate literature and guidelines, taking into account cost effectiveness and risk-benefit analysis when performing and recommending breast imaging studies

#### **Practice-Based Learning**

1. Demonstrate an understanding of the resources available to maintain competence in breast imaging knowledge

#### **Communication and Interpersonal Skills**

1. Communicate effectively and compassionately with patients in difficult situations, such as recommendation for short interval follow-up or biopsy
2. Efficiently generate clear and concise reports that do not require substantive correction on all cases
3. Communicate effectively and professionally with all staff in all circumstances

#### **Professionalism**

1. Serve as a role model for professional behavior to students and junior residents

#### **System-Based Practice**

1. Describe ACR accreditation standards for breast imaging
2. Practice cost-effective breast imaging by reducing unnecessary examinations wherever possible

### **Mechanism of Evaluation**

Residents will be evaluated on the above goals and objectives by means of a monthly evaluation form filled out by the breast imaging faculty. In addition, interpersonal and communication skills and professionalism will be evaluated by the mammography technologists. Medical knowledge in breast imaging will be further evaluated by the ACR in-service examination.

## **Reading Instructions**

### **Texts:**

BI-RADS Atlas-available in the reading room in print and electronic versions

Breast Imaging: The Requisites, 2<sup>nd</sup> edition. Debra Ikeda 2011

**Additional resources:** Review articles on the intranet breast imaging folder, RadPrimer

## **First Rotation**

### **First 2 weeks-**

#### **BI-RADS mammography and US**

#### **Chapters from the Requisites:**

##### First week:

Monday: Chapter 1 (mammography acquisition, MQSA, CAD)

Tuesday: Chapter 2 (mammogram interpretation)

Wednesday: Chapter 3 (analysis of calcifications)

Thursday: Chapter 4 (analysis of masses)

Friday/Sat/Sun: Chapter 5 (breast US)

##### Second week:

Monday: Chapter 6 (procedures)

Tuesday: Chapter 7 (MRI)

Wednesday: Chapter 8 (post-operative breast)

Thursday: Chapter 9 (implants and reconstruction)

Friday/Sat/Sun: Chapter 10 (Clinical breast problems)

### **Second 2 weeks-articles from intranet folder/RadPrimer:**

##### Third week:

Monday- ACS guidelines for breast MRI screening

Tuesday-Breast MRI patterns of enhancement

Wednesday-Breast MRI artifacts

Thursday-US state of the art

Friday/Sat/Sun-25 cases from RadPrimer (breast basic)

##### Fourth week:

Monday-Breast US state of the art

Tuesday-Breast intervention

Wednesday-Male breast disease

Thursday-25 cases from RadPrimer (breast basic)



## **Reading Instructions, continued**

### **Second Rotation (your last breast rotation before the core exam!)**

**Get through all the RadPrimer breast cases**

**Review the powerpoint on mammography QA and regulations on intranet**

**Use review articles on intranet and Requisites book for areas you need to brush up on**

#### **First week:**

60 Radprimer cases

#### **Second week:**

60 Radprimer cases

#### **Third week:**

60 Radprimer cases

#### **Fourth week:**

60 Radprimer cases

### **Mammography - Policies and Procedures**

The description of the rotation and goals and objectives above can be accessed on the Lifespan intranet home page by accessing the following:

**Medical → Brown Radiology → Breast Imaging → Residency Manual**

Hospital policies and procedures for Mammography may be found on the Lifespan intranet home page by accessing the following:

**Medical → Radiology → RIH Radiology → RIH Polices and Procedures → Mammography**

## CARDIAC MRI & CT

The Cardiac Imaging rotation is primarily for 3<sup>rd</sup> and 4<sup>th</sup> year radiology residents and cardiology fellows. This residency manual section is aimed at these trainees. Of course, enthusiastic 1<sup>st</sup> and 2<sup>nd</sup> year residents interested in cardiac imaging are welcome to get an early start.

### **Introduction/Overview:**

MRI and CT have been used to evaluate the cardiovascular system for over two decades. However, recent innovations in technology have brought these modalities squarely into the clinical arena for cardiac evaluation. Both have become powerful tools for the assessment of a host of cardiovascular diseases. With ECG-synchronization, both MRI and CT are true 3-dimensional techniques that can provide high-resolution, stop-action images of the heart and surrounding structures. In general, cardiac MR (CMR) is used to evaluate cardiac function, blood-flow physiology, and tissue characterization, whereas cardiac CT (CCT)—with its very high spatial resolution—yields highly detailed images of anatomy, including the coronary arteries.

Indeed, there is considerable and evolving overlap between these modalities, and with more conventional methods for imaging the heart, including echocardiography, nuclear medicine, and angiography. It is important to understand the roles of the various techniques, their indications and applications as well as their strengths, weaknesses and limitations. Furthermore, it is also important to know how patients are prepared and what they can expect for each study, as well as how studies are performed, including basic techniques. Current CMR and CCT methods often require extensive post-processing. This is an integral part of the analysis process. Residents should become attempt to become facile with standard post-processing methods. Finally, image interpretation requires a sound understanding of cardiac anatomy, function, and disease.

**General Educational Goals and Objectives—Specific reading assignments for each of the four years of residency are provided in the shared Google Drive (GD) folders—see below under *Learning Techniques***

This document has the following sections:

- General Medical Knowledge
- Learning Techniques
- Daily Work
- Axes and Segments (see last 2 pages)

### **Cardiac Attendings**

- Dr. Agarwal (cell 307-760-1173)
- Dr. Atalay (cell 401-588-2734)

## General Medical Knowledge

### CT & MR Techniques

- A. Understand basic physics and underlying principles of CT/MR imaging
- B. Understand basis of ECG-synchronization, including retrospective and prospective gating for both CCT and CMR.
- C. Understand routine CMR pulse sequences and techniques for cardiac and vascular diagnoses, e.g. steady-state free precession (SSFP), 'viability' imaging, dark-blood spin-echo, short-tau inversion-recovery (STIR), phase-contrast imaging, MR angiography, grid-tagging, first-pass gradient echo dynamic imaging, etc.
- D. Understand basic implementation of pulse sequences, including scan duration and signal contrast (T<sub>1</sub>-, T<sub>2</sub>- weighted, etc.).
- E. Understand acquisition methods for CCT.
- F. Become familiar with CMR and CCT protocols for imaging the heart and aorta.

### Anatomy & Physiology

- A. Become familiar with normal cardiac and aortic anatomy and physiology, particularly as identified on CMR and CCT (See anatomy below).
- B. Understand routine metrics for evaluating cardiac disease, e.g. ejection fraction, cardiac indices, chamber sizes, valve area (planimetry), pressure gradients, wall thickness, ventricular mass etc.
- C. Understand how CMR and CCT can be used to evaluate these metrics
- D. Understand the anatomic and pathophysiologic basis of common adult and pediatric cardiac and aortic diseases (see reference #3).
- E. Understand the notions of myocardial hibernation, stunning, and viability; understand the physiologic basis of MRI *viability* imaging and it how it is employed clinically in patients with coronary heart disease.

### Synthesis

- A. **Learn Appropriate indications (7, 8, 9) for CMR & CCT ("Appropriate Use CCT CMR" in Google Drive residency folders)**
- B. Full Appropriateness criteria documents are available in in GD References:
  1. Hendel RC, Patel MR, Kramer CM, et al. *J Am Coll Cardiol* 2006;48:1475-1497
  2. Taylor AJ, Cerqueira M, Hodgson JM, et al. *J Am Coll Cardiol* 2010;56:1864-1894

#### General applications for CMR:

- Myocardial viability
- Global and regional ventricular function
- Ventricular mass, cavity volumes, and myocardial morphology
- Congenital heart disease before or after surgical repair
- Flow through large vessels and across valves (quantitative)
- Coronary artery anomalies/Bypass graft patency
- Cardiac and extracardiac masses
- Pericardial diseases, e.g. constrictive pericarditis or hematoma

- Cardiomyopathies, including infiltrative processes and those involving the right ventricle such as arrhythmogenic right ventricular dysplasia (ARVD)
- Valvular heart disease
- Diseases of the aorta, such as dissection, aneurysm, and coarctation

General applications for CCT:

- Coronary artery imaging
  - Equivocal stress test
  - Cardiomyopathy
  - Anomalous/abnormal coronary artery
  - Bypass graft or stent patency
  - Pre-op evaluation
  - Atypical chest pain
- Congenital heart disease
- Structure and morphology
- Pulmonary vein mapping—pre- & post RF ablation for atrial fibrillation
- Evaluation of cardiomyopathy
- Valvular heart disease
- Diseases of the aorta
- Pre TAVI/R assessment (Trans-catheter aortic valve insertion/replacement)

C. Understand the role of CT calcium scoring

D. Be able to develop an image-based differential diagnosis for cardiac and aortic abnormalities using CMR and CCT

Patient Care

- Develop an understanding of the strengths and weaknesses of CCT and MRI relative to other diagnostic tests—including imaging—for achieving a cardiac diagnosis
- Become familiar with the risks and contraindications of CMR and CCT (e.g. are recently inserted coronary stents O.K. for MRI?) Become familiar with radiation doses typically encountered in CCT and other types of imaging (e.g. stress-rest MIBI, chest radiograph, CT PE study, etc.). What are the risks of radiation?
- Become familiar with the contrast agents doses/risks/contraindications used in cardiac imaging
- Become familiar with the protocols for treatment of contrast reactions
- Understand patient preparation, including medications administered, for CCT and CMR. These include IV adenosine, IV regadenoson, IV dipyridamole, PO beta-blocker, SL nitroglycerin.
- Develop basic understanding of the roles of technologists, nurses and ancillary staff.

Practice-based learning and improvement

- Sit with MRI and CT technologists at the consoles during cardiac studies; attempt to understand interactive scanning principles. Learn how to modify imaging parameters and pulse sequences to optimize images and minimize artifacts

- B. Understand image post-processing at the work-stations. Learn how to post-process imaging data sets to efficiently render diagnostic quality images—multiplanar reformatted images (MPR), maximum intensity projections (MIP), volume renderings (VR), shaded-surface displays (SSD)—and accurate numeric data.
- C. Review studies prior to final interpretation with attending. Attempt to assimilate salient imaging features of each study in an analytic manner. Address clinical questions while building a repertoire of normal findings and variants.
- D. Incorporate feedback into improved performance
- E. Efficiently use electronic and print resources to access relevant information.

#### Communication and Interpersonal Skills

- A. Demonstrate interest and ability in patient management and diagnosis. Develop confidence in discussing cases with referring physicians.
- B. Learn how to concisely and accurately dictate cases using appropriate terminology

#### Professionalism

- A. Demonstrate respect for patients and all members of the health care team
- B. Respect patient confidentiality
- C. Present oneself as a professional in appearance and communication.
- D. Demonstrate a responsible work ethic with regard to work assignments

## Learning Techniques

### Shared Google Drive FOLDERS

*If you don't already have a GD, installation on PC, Mac, and iPad is straightforward. You'll need a GMAIL account. Search "Google Drive" and follow download instructions. If you need assistance, please ask Dr. Atalay or a co-resident. **Shared folders can be imported directly into your GD.***

### *Cardiac Imaging FOLDER*

**A. Required reading is listed in year-appropriate folders**

**B. Additional digital reference files are provided in the "Physics" and "Reference" folders**

### Online Education/Review

**A. Recommended viewing:** Society of Thoracic Radiology online presentations:

[http://thoracicrad.org/?page\\_id=1344](http://thoracicrad.org/?page_id=1344)

1. 3<sup>rd</sup> year

- a. CT Physics (2014) (S Teague)
- b. Cardiac Anatomy and Pitfalls (2012) (L Broderick)
- c. Coronary Anatomy / Normal Variants (2012) (A Wilcox)
- d. Coronary CTA: Update 2014 (2014) (U Schoepf)
- e. TAVR planning (2014, update 2015) (G Pearson)
- f. Valve Imaging (2012) (P Agarwal)
- g. Cardiomyopathies (2015) (K Cummings)

2. 4<sup>th</sup> years

- a. CMR of the infiltrative disorders of the myocardium (2016) (P Mergo)
- b. Coronary artery anomalies (2015) (S Teague)
- c. Coronary Artery Imaging in the ED (2016) (E Feldman)
- d. Cardiac Stress MRI: How I do it (2016) (J Christensen)
- e. Imaging of Cardiac Masses (2016) (S Bhalla)
- f. From Structure to Function: CT approaches to Myocardial Ischemic Imaging (2015) (U Schoepf)

Additional Useful Reference Sources

- A. ABR Core Examination Study Guide (In GD References Folder)
- B. *Questions and Answers in Magnetic Resonance Imaging*, A. Elster & J. Burdette
  - 1. <http://mriquestions.com/index.html>
- C. *MRI & CT of the Cardiovascular System*, 2<sup>nd</sup> ed., C. Higgins & A. de Roos
- D. *CT of the Heart: Principles and Applications*, U. Joseph Schoepf
- E. *Pathophysiology of Heart Disease*, Leonard S. Lilly

PACS should be regarded as a teaching file and interesting case FOLDERS are available. These include

- AORTA
- CARD CONG: congenital cases
- CARD ICM: ischemic cardiomyopathy
- CARD MASS: cardiac masses
- CARD NICM: non-ischemic cardiomyopathy
- CARD PERIC: pericardial diseases
- CARD VALVE: various valve lesions
- CARDIAC CT: illustrative coronary CT cases that show the range of diseases that might be seen, say, in the ED

Please feel free to visit and revisit these folders throughout the rotation and during other free moments when you are inspired or looking for interesting cases to show.

## Daily Work

Upper level residents on Cardiopulmonary rotation should review any cardiac cases in the PACS “BOD CARD” folder as they appear. Before leaving for the day, they should contact CT and MRI desks at RIH and TMH to determine what studies are scheduled for the following day. Indications for these studies, with specific questions, should be determined and relevant data obtained (e.g. echo/cath/nukes reports, patient cardiac history, etc.) Residents should attempt to take personal responsibility for each case that they ‘work-up’. Residents will also share dictations responsibilities. Dictation templates will be provided.

It is recommended that residents maintain a log of all cases reviewed and dictated; this is important for credentialing as well as for maintenance of a teaching file.

### *Exam supervision*

Residents should attempt to supervise cases as they’re being scanned.

### *Relevant Conferences*

7 a.m. Thursday—TMH Weekly cath conference, Hurvitz Conf Rm (CME)

7:30 a.m. Friday—Weekly Cardiology conference & monthly Grand Rounds, RIH APC 7<sup>th</sup> Flr.

7 a.m. 2<sup>nd</sup> Wednesday of each month, Galkin Conf rm (BB5)—Thoracic Aorta conference (CME)

### *Resident Evaluation Tools*

Participating staff will submit monthly evaluations on each resident.

### Important Numbers:

#### **RIH:**

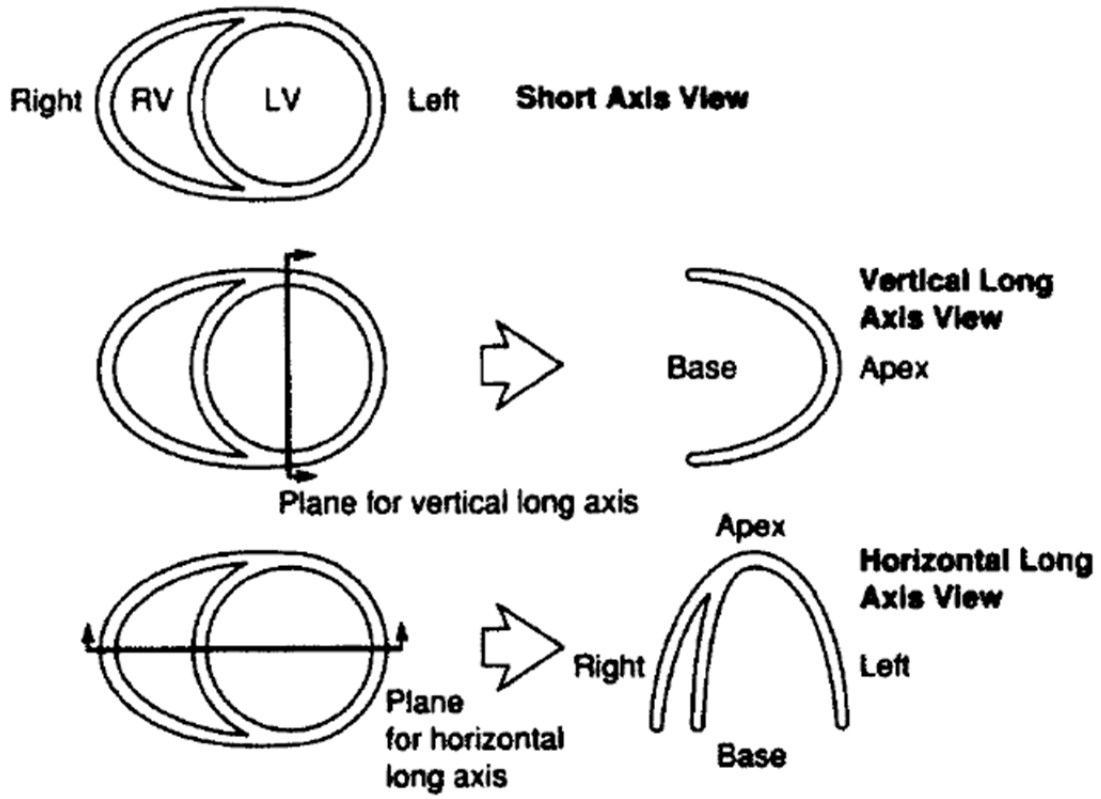
- CT: 444-4819 (Meehan CT: 444-4802)
- MRI: 444-4881 (Rm 2 scanner: 444-3931)

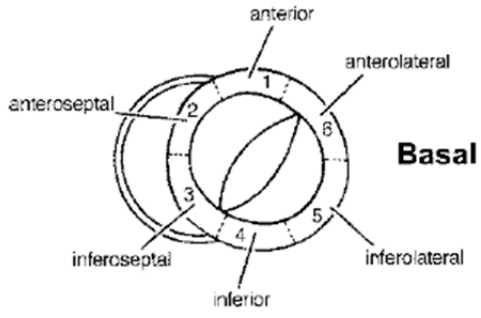
#### **TMH:**

- CT: 793-4437 (Scanner: 793-4469)
- MRI: 793-4448 (Console room: 793-4475)

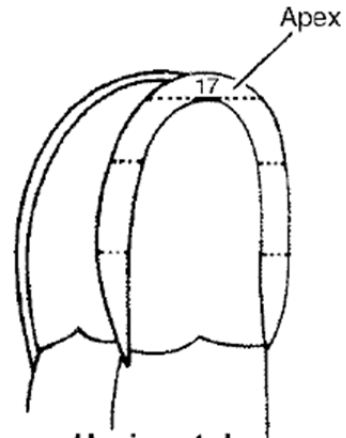


Axes and Segmental Anatomy

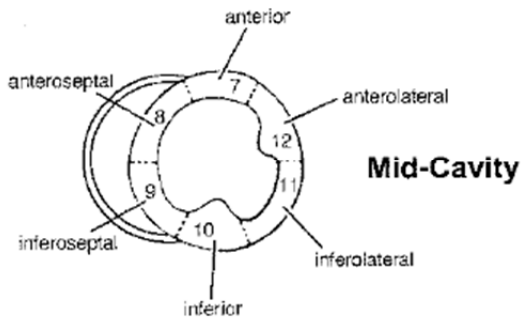




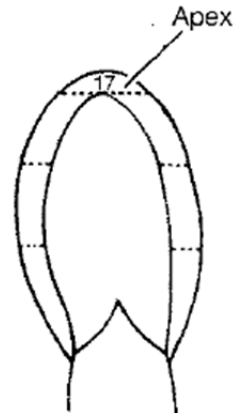
**Basal**



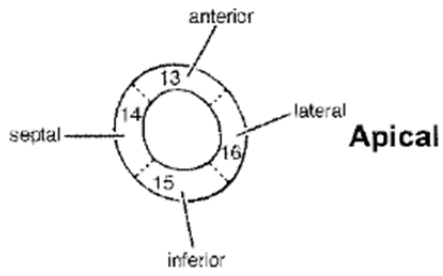
**Horizontal Long Axis (HLA)**  
(4 Chamber)



**Mid-Cavity**



**Vertical Long Axis (VLA)**  
(2 Chamber)



**Apical**

**Short Axis (SA)**

## **EMERGENCY RADIOLOGY**

The Emergency Department rotations, and especially overnight call, offer the resident the foremost opportunity to exhibit her/his mastery of the core competencies of the training program. The priorities of emergency care differ from that offered in a general clinic or outpatient setting in that timeliness of interpretation is as important as accuracy in this environment. During the ED rotation, therefore, the imaging modality skills acquired in other sections are combined in a unique and clinically relevant manner.

An attending radiologist is present in the Emergency Department between 6 a.m. and midnight, seven days a week and an attending radiologist, identified on the weekly schedule, is available for teleradiology or administrative backup at all hours. Resident coverage includes an 8:00 a.m. - 5:00 p.m. rotation (the "daytime" rotation), a weekday 5:00 p.m. - 10:00 p.m. call rotation, and night float resident coverage. Staff radiologists are on call to provide back-up for the various subspecialized radiology disciplines. Responsibilities and routine vary somewhat during the daytime and on-call time frames, so they will be addressed separately. However, at all times the resident is a representative of the department. Despite an often chaotic milieu which characterizes the ED reading room the Diagnostic Imaging resident is expected to maintain a professional demeanor and appearance.

### **Day/Evening Rotation**

Daily Work - Junior and Senior Residents

The resident is expected to review all studies as they appear on the PACS worklist (ED UR) for readout with the attending. The resident should also actively participate in consultations with the ED staff and be prepared to review outside imaging studies brought to the reading room. On occasion, the resident may be requested to perform sonographic procedures at the bedside in the critical care rooms.

The ED should be left unattended only during unusual circumstances when the expertise of those radiologists is required elsewhere in the institution.

### **Night Rotation**

Each spring, first-year residents will be tested to document their mastery of the skills necessary to manage independent overnight call responsibilities. These tests are likely to include both written and oral examinations. After consultation with the program director, residents who fail to demonstrate required skills will be asked to complete an appropriate educational process and repeat testing prior to participating in the overnight call pool.

Daily Routine

This rotation is part of the senior residents' "on call" requirement. He/She is responsible for all radiologic requests within Rhode Island Hospital, Hasbro and Women & Infants', including any questions regarding portable studies, specialty imaging examinations or unusual cases. Absence from the Emergency Department reading room is only permitted

when imaging expertise is required elsewhere in these hospitals.

During the daytime rotation, the resident should attempt to review and dictate all imaging studies that she/he is comfortable interpreting. The process of assuming responsibility for the rotation's workflow is an important part of the preparation for taking overnight, independent call. Cases should be reviewed at regular intervals with the attending radiologist and the reports should then be corrected and approved in PowerScribe.

During the overnight hours, when an attending radiologist is not present in the reading room, ED imaging studies (including CT/CR/US) should be dictated, transcribed and approved in PowerScribe, so that the preliminary reports (which are labeled as such) are readily available throughout the hospital information system. This serves to reduce overnight calls regarding already dictated cases. Overnight CT and US cases, as well as any difficult CR examinations, will be reviewed directly with the morning ("ER-1") attending radiologist beginning at 6:00 a.m., seven days a week. The on-call rotation ends at 8:00 a.m. and while the night float resident may be dismissed prior to that time at the discretion of the ER-1 attending, to conform with ACGME duty hour restrictions, the resident is expected to depart for home no later than 8:00 a.m.

Conferences:

The resident assigned to the day portion of the day/evening rotation should attempt to attend the General Surgery Trauma Conference at 7:00 a.m. every Monday.

### **Quality Assurance**

1. The foundation of accurate radiograph interpretation is good radiograph quality. The unique structure of the Emergency Department Diagnostic Imaging rotation allows the resident immediate input regarding overall technical radiograph quality. Residents should review all studies for completeness and quality. Suboptimal studies should be repeated. Technologists are to be encouraged to seek the resident's opinion on difficult imaging cases.
2. Communication of imaging findings to the Emergency Department physicians is a critical part of our activity in the Emergency Department. The responsible physician should be notified immediately of any urgent imaging findings. This should be documented in the written report (including the date, time and name of the clinician to whom the report is given). Critical test results must be reported and documented according to the departmental "RED RESULT" policy.

### **Goals and Objectives on Which Milestone Evaluations Will Be Based:**

**PGY-2 (1st year resident)**

#### **Patient Care:**

1. Uses established evidence-based imaging guidelines such as American College of

Radiology (ACR) Appropriateness Criteria®

2. Appropriately uses the Electronic Health Record to obtain relevant clinical information
3. Understands common CR, US and CT protocols employed in ED
4. Recognizes sub-optimal or incomplete imaging

**Medical Knowledge:**

1. Makes core observations, formulates differential diagnoses, and recognizes critical findings. Example: intracranial hemorrhage.
2. Differentiates normal from abnormal

**Professionalism:**

1. Demonstrates the following professional behaviors:
  - Puts patient care first and advocates for patient
  - Fulfills all work-related responsibilities
  - Recognizes personal limitations and seeks help
  - responds appropriately to constructive criticism
  - maintains patient confidentiality
2. Acts in professional and ethical manner

**Communication and Interpersonal Skills:**

1. Communicates information about imaging and examination results in routine, uncomplicated circumstances
2. Adheres to transfer-of-care policies
3. **Written/Electronic:** Generates accurate reports with appropriate elements required for coding
4. **Verbal:** Communicates urgent and unexpected findings according to Lifespan policy and ACR guidelines

**System-Based Practice:**

1. Understands Lifespan MERS event reporting system
2. Describes the mechanisms for reimbursement, including types of payors

**Practice-Based Learning:**

1. Describes the patient safety benefits of different imaging modalities
2. At change of shift, signs out pending cases or unresolved issues to incoming resident and attending
3. Understands how timeliness of imaging and reporting impacts patient outcomes
4. Understands indications for IV contrast and balance between risks of contrast and diagnostic information yielded by injection
5. Identifies, rectifies and learns from personal errors
6. Seeks out opportunities to review clinical imaging studies

7. Uses opportunities to use workstation software to perform CT reconstructions

### **PGY-3 (2nd year resident)**

#### **Patient Care:**

1. Recommends appropriate imaging of common conditions independently, such as acute abdomen, chest pain, suspected stroke, trauma.
2. Able to suggest most appropriate sequence of imaging tests and interventions for these disease processes.
3. Acts as the interface between the ED and Diagnostic Imaging to facilitate patient care

#### **Medical Knowledge:**

1. Understands the indications and requirements for less common examinations which require additional radiologist and consultation with referring clinician
2. Makes secondary observations, narrows the differential diagnosis, and describes appropriate management options. Example: Indeterminate free intraperitoneal fluid

#### **Professionalism:**

1. Is an effective health care team member
2. Demonstrates professional behaviors listed in the second column

#### **Communication and Interpersonal Skills:**

1. Communicates, under direct supervision, in challenging circumstances (e.g., cognitive impairment, cultural differences, language barriers, low health literacy)
2. Communicates, under direct supervision, difficult information such as errors, complications, adverse events, and bad news
3. **Written/Electronic:** Efficiently generates clear and concise reports that do not require substantive faculty member correction on routine cases
4. **Verbal:** Communicates findings and recommendations clearly and concisely

#### **System-Based Practice:**

1. Able to recognize suboptimal images/examinations
2. States relative cost of imaging modalities employed in the ED.
3. Understands the relative cost of imaging studies compared to missed diagnoses.
4. Understand the required components of a radiology report to support the code charged

#### **Practice-Based Learning:**

1. Able to manage contrast reactions with assistance

2. Understands how to get additional assistance with reactions in the ED
3. Incorporates feedback into improved performance

### **PGY-4 (3<sup>rd</sup> year resident)**

#### **Patient Care:**

1. Recommends appropriate imaging of uncommon or variant conditions. Over-reads outside imaging studies and defines abnormalities. Able to help ED clinicians revise their diagnostic and treatment plans.
2. Able to independently manage consultative and interpretive workflow in the ED radiology section.
3. Able to offer methods to improve suboptimal CR, US and CT images using alternative techniques, equipment, positioning
4. Demonstrates knowledge of physical principles to optimize image quality
5. Demonstrates understanding of role of imaging in management of ED patients

#### **Medical Knowledge:**

1. Provides accurate, focused, and efficient interpretations
2. Prioritizes differential diagnoses and recommends management

#### **Professionalism:**

1. Is an effective health care team leader, promoting primacy of patient welfare, patient autonomy, and social justice
2. Demonstrates professional behaviors listed in the second column

#### **Communication and Interpersonal Skills:**

1. Communicates, under indirect supervision, in challenging circumstances (e.g., cognitive impairment, cultural differences, language barriers, low health literacy)
2. **Written/Electronic:** Efficiently generates clear and concise reports that do not require substantive faculty member correction on common complex cases
3. **Verbal:** Communicates appropriately under stressful situations

#### **System-Based Practice:**

1. Works to improve and prevent suboptimal imaging studies.
2. Suggests methods to improve image quality, patient outcomes
3. Describes the technical and professional components of CR/CT/US/MR examinations

#### **Practice-Based Learning:**

1. Can manage contrast reactions independently

2. Knows ACR guidelines for prophylaxis regiment in patients with reported IV contrast allergies
3. Performs literature search to aid in knowledge of particular clinical problems.
4. Uses opportunities to suggest alternative examinations.
5. Works with attending staff to remedy deficiencies in knowledge base by reviewing clinical or teaching cases

### **PGY-5 (4th year resident)**

#### **Patient Care:**

1. Integrates current research and literature with guidelines, taking into consideration cost effectiveness and risk-benefit analysis, to recommend imaging.
2. Independently over-reads outside imaging studies and formulates diagnostic testing plan when local interpretation at variance with prior reports

#### **Medical Knowledge:**

1. Able to help CT techs, radiographers and sonographers perform or improve both routine and complex examinations
2. Able to perform supplemental workstation reconstructions
3. Applies physical principles to optimize image quality and minimize patient radiation exposure
4. Makes subtle observations
5. Suggests a single diagnosis when appropriate
6. Suggests appropriate follow-up examinations, timing of said studies and intervention when appropriate
7. Integrates current research and literature with guidelines to recommend management

#### **Professionalism:**

1. Serves as a role model for professional behavior
2. Demonstrates professional behaviors listed in the second column

#### **Communication and Interpersonal Skills:**

1. Communicates complex and difficult information, such as errors, complications, adverse events, and bad news
2. **Written/Electronic:** Efficiently generates clear and concise reports that do not require substantive faculty member correction on all cases
3. **Verbal:** Communicates effectively and professionally in all circumstances

#### **System-Based Practice:**

1. Independently suggests methods of image quality improvement
2. Independently recognizes inadequate studies or protocols and works to rectify



- those
3. Understand situations where imaging tests may offer an imaging alternative to decrease healthcare costs
  4. Works to reduce unnecessary imaging examinations whenever possible

**Practice-Based Learning:**

1. Understands which ED patients may require sedation prior to imaging and how to arrange that (e.g. epidural abscess)
2. Communicates alternative imaging or clinical strategies in cases where contrast reaction prophylaxis is not feasible due to patient condition
3. Independently performs literature searches for rare or unusual disease processes.
4. Demonstrates an understanding of resources available to maintain and expand competence in Emergency Radiology

**Additional Goals and Objectives for the Rotation:**

By the end of the first year, the resident should have achieved competence in the following areas:

**Medical Knowledge:**

By the completion of the first year, residents are expected to demonstrate knowledge of normal anatomy and recognition of abnormal imaging findings in life-threatening or unstable conditions, such as:

1. Cervical spine, pelvic and extremity fractures
2. Pneumothorax, free fluid in the abdomen, and signs of active bleeding
3. Acute intracranial hemorrhage and cerebrovascular accident (CVA)
4. Common causes of non-traumatic acute abdominal pain (e.g. appendicitis, diverticulitis)
5. Pulmonary embolism in uncomplicated cases

**Patient Care:**

1. Participate in the real-time integration of clinical and imaging data in the formation of the treatment plan. Before the junior resident begins to take overnight call, they must be prepared to develop a patient management plan based upon available information (including plain radiography, ultrasound, CT, and MRI). The assimilation of information from electronic reporting databases (including the hospital and radiology information systems of RIH and TMH) is an essential component of this process. Residents will be evaluated according to their ability to provide such services, relative to their level of experience. Emergency Medicine attending staff will be given the opportunity to evaluate the performance of residents on overnight rotations.

**Practice-based Learning and Improvement:**

The ED provides the resident with the opportunity to evaluate an exceptional number of unknown cases. From the resident's perspective this is an important learning opportunity, as experience with actual cases typical offers the most indelible learning. A primary goal of all ED rotations is to incorporate and evaluate Practice-based learning and improvement

of this type. To this end, as appropriate to their level, the resident is expected to:

1. Efficiently use electronic and print resources to access information. The resident is both asked to and expected to utilize access to on-line informational databases, as well as the collection of textbooks in the ED to expand their fund-of-knowledge in as close to a real- time manner as possible whenever confronted by unfamiliar diagnoses or entities.
2. Attend trauma conference; this multidisciplinary conference offers the resident an excellent opportunity to learn how imaging tests and interpretation influence management of the traumatized patient.

Communication and Interpersonal Skills:

Outstanding abilities in this area are essential to satisfactory performance in the Emergency Department. The ED affords the radiologist-in-training the unique opportunity to exert immediate influence over treatment decisions in often critically ill patients; that opportunity can only be exploited by timely and lucid discussions with referring physicians from many services. For this reason it is essential that the resident be directly available at all times while assigned to the ED. Absences from the reading room should be coordinated with the attending radiologist assigned to the ED.

As in the remainder of the department, all residents rotating through the ED are expected to (and will be evaluated according to their ability to):

1. Appropriately communicate and document in the patient record urgent or unexpected radiologic findings. The direct proximity of ED resident and staff physicians facilitates verbal discussions; it is the responsibility of the radiology resident to immediately locate responsible clinical staff so that they can be informed of urgent findings (e.g. tension pneumothorax) in accordance with departmental policies.
2. Produce radiologic reports that are accurate, concise and grammatically correct. The importance of all three in this environment cannot be overstated.
3. As residents change shifts, they are asked to identify outstanding issues to the arriving radiology team, in order to provide “continuity” of radiologic care.
4. Communicate effectively with all members of the health care team.

Professionalism:

At all times, the resident is expected to adhere to high standards of professionalism while in the ED, including (but not necessarily limited to):

1. Demonstrate respect for patients and all members of the health care team
2. Respect patient confidentiality
3. Present oneself as a professional in appearance and communication.

4. Demonstrate a responsible work ethic with regard to work assignments
5. Place the interest of the patient first and appropriately consult attending radiologist on call when necessary for assistance

Systems-based Practice:

1. During the daytime rotation residents are expected to attend the weekly Trauma Conference (Monday 7 AM, George Auditorium) and it is mandatory that daytime residents attend the departmental noon conference.
2. Demonstrate knowledge of how radiologic information is integrated with the other parts of the health care system in the treatment of the patient. The radiologist, as a member of both the Department of Diagnostic Imaging and the Emergency Department, is in a unique position to help patients and clinicians navigate through the complexities of both areas.
3. Demonstrate knowledge of trauma imaging protocols

Second Year Residents are expected to have the following objectives in addition to those listed for first year residents:

Medical Knowledge:

1. Further refinement of observational abilities and knowledge base with application into an appropriate differential diagnosis of:
  - a. Bowel disorders (e.g. ischemia vs. infection vs. neoplasm)
  - b. Focal diseases of solid organs
  - c. Focal brain lesions
  - d. Secondary signs of CVA and herniation
  - e. Diffuse and focal lung diseases
2. Knowledge of classification systems for:
  - a. Solid organ injury
  - b. Facial fractures
  - c. Pelvic fractures
  - d. Cervical spine fractures
3. Imaging protocols for trauma

Patient care:

1. Integrate clinical history and imaging findings to provide a diagnosis or an appropriate differential diagnosis
2. Provide an appropriate management plan for the patient based upon the above.

Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors
2. Efficiently use electronic and print resources to access information.
3. Attend trauma conference

Interpersonal and Communication Skills:

1. Teach first year residents and medical students emergency radiology
2. Provide consultation on imaging findings to emergency department staff

Professionalism:

1. Act as a role model for medical students and junior residents

Systems-based Practice:

1. Demonstrate knowledge of cost-effective imaging evaluation in the emergency department

Third Year Residents are expected to have the following objectives in addition to those listed for first and second year residents:

Medical Knowledge:

1. Further refinement of observational abilities and knowledge base with application into an appropriate differential diagnosis of:
  - a. Bowel disorders (e.g. ischemia vs. infection vs. neoplasm)
  - b. Focal diseases of solid organs
  - c. Focal brain lesions
  - d. Secondary signs of CVA and herniation
  - e. Diffuse and focal lung diseases
2. Knowledge of classification systems for:
  - a. Solid organ injury
  - b. Facial fractures
  - c. Pelvic fractures
  - d. Cervical spine fractures
  - e. Thoracic spine injuries
3. Imaging protocols for trauma

Patient care:

1. Integrate clinical history and imaging findings to provide a diagnosis or an appropriate differential diagnosis
2. Provide an appropriate management plan for the patient based upon the above.
3. Be prepared to function more independently in the ED and act increasingly as the first line consultant.

Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors
2. Efficiently use electronic and print resources to access information.
3. Attend trauma conference
4. Identify ways in which the department might function more efficiently or effectively as a partner in the management of emergency patients.

Interpersonal and Communication Skills:

1. Teach junior residents and medical students emergency radiology
2. Provide consultation on imaging findings to emergency department staff
3. Provide recommendations for patient care to emergency department staff

Professionalism:

1. Act as a role model for medical students and junior residents

Systems-based Practice:

1. Demonstrate knowledge of cost-effective imaging evaluation in the emergency department
2. Provide a professional interface between the Department of Diagnostic Imaging and other departments providing patient care in the ED.
3. Recommend and facilitate referrals for imaging tests or procedures performed outside the Bridge Building.

Fourth year residents are expected to have the following objectives in addition to those listed for first, second and third year resident:

Medical Knowledge:

1. Further refinement of detection abilities in subtle or complex cases

Patient Care:

1. Demonstrate knowledge of medical and surgical treatment of diseases and how treatment options may guide imaging
2. Be prepared to manage the Emergency Radiology section independently, with guidance and assistance from attending staff.

Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors
2. Efficiently use electronic and print resources to access information.
3. Attend trauma conference

Communication and Interpersonal Skills:

1. Function independently as a consultant to the emergency department attending staff

Professionalism:

1. Demonstrate respect for patients and all members of the health care team
2. Respect patient confidentiality
3. Present oneself as a professional in appearance and communication.
4. Demonstrate a responsible work ethic with regard to work assignments

Systems-based Practice:

1. Demonstrate ability to balance patient safety, patient throughput and cost-effective utilization of imaging resources in the Emergency Department

Mechanism of Evaluation

For the daytime rotation the monthly rotation E\*Value evaluation will be completed by the attending radiologists who have had interaction with the resident. Imaging conference presentations and dictations relevant to emergency radiology will be reviewed at the semi-annual review with the program director.

## **EMERGENCY RADIOLOGY READING INSTRUCTIONS**

**Text:** Emergency Radiology – the Requisites by Soto & Lucey

### **Additional resources:**

Musculoskeletal Imaging: The Requisites by Manaster and May  
Radiology of Acute Cervical Spine Trauma by Harris & Mirvis

1. First Rotation

### **First 2 weeks-Chapters from the Emergency Radiology Requisites**

#### **First week:**

Monday: Chapter 1 Up to section entitled “Head and Neck Trauma”  
Tuesday: Complete Chapter 1  
Wednesday: Chapter 2 (Chest Trauma)  
Thursday: Chapter 3 Abdomen trauma through to pancreatic injury  
Friday: Complete Chapter 3  
Sat/Sun: Chapter 4 Extremity trauma

#### **Second week:**

Monday: Chapter 5 Extremities: Nontrauma  
Tuesday: Chapter 7: Traumatic and Nontraumatic Spine Emergencies  
Wednesday: Chapter 8: Nontraumatic Emergency Radiology of the Thorax  
Thursday: Chapter 9: Nontrauma Abdomen  
Friday/Sat/Sun: Chapter 10 Pelvic Emergencies

**Third week:** The Radiology of Acute Cervical Spine Trauma (Harris, copy in library)

This is an easy to digest, heavily illustrated classic text on imaging the injured cervical spine that every reader should comfortably be able to complete during one week.

#### **Fourth week:**

Monday: Emergency Radiology Requisites, Chapter 11: Vascular Emergencies  
Tuesday: Musculoskeletal Radiology Requisites: Chapter 6 Elbow  
Wednesday: Musculoskeletal Radiology Requisites: Chapter 7 Wrist  
Thursday: Musculoskeletal Radiology Requisites: Chapter 10 Pelvis Fractures  
Friday: Musculoskeletal Radiology Requisites: Chapter 11 Hip and Femur

2. HARRIS, HARRIS & NOVELLINE- Radiology of Emergency Medicine  
Junior Resident - Chapter 1, Chapter 8 (pp. 503-529 and 536-559), Chapter 3, (pp. 127-134 and 243-280).  
Junior and Senior Residents - Continued reading based on cases encountered in daily readout.

3. Reference texts available in the Emergency Department reading room for use on an as- needed basis.
  - a. Meschan - Atlas of Anatomy Basic to Radiology
  - b. Keats - Normal Variants
  - c. Harris, Harris & Novelline - Radiology of Emergency Medicine
  - d. Osborn - Diagnostic Neuroradiology
  - e. Moss - CT of the Body - Abdomen/Pelvis
  - f. Armstrong - Imaging of Diseases of the Chest
  - g. Callen - US in Obstetrics and Gynecology
  - h. Jeffrey - Sonography of the Abdomen

## **FLUOROSCOPY/GASTROINTESTINAL and GENITOURINARY RADIOLOGY**

One or two residents are assigned to this area daily. If it is your first time on the fluoroscopy rotation, be familiar with the attached fluoroscopy protocols prior to your first day so that you can make the most of your experience. All residents need to know the "don'ts in fluoroscopy." If two residents are assigned, only one of the two residents is eligible for vacation at any one time. Should you contemplate a vacation during this rotation, it is incumbent upon you to negotiate with your resident colleague on the service for the leave.

### **Daily Work**

The more senior resident or the single resident when only one is assigned, should arrive in the Fluoroscopy section at 7:45 a.m. (at the latest) and the more junior resident should arrive by 8:00 a.m. The senior or single resident may want to arrive sooner to review and dictate The Miriam Hospital CTs to be read that morning. The two residents assigned to this service are responsible for all studies performed utilizing plain radiography and fluoroscopy to investigate the gastrointestinal and genitourinary tracts. All cases should be reviewed by the staff radiologist assigned to GI/GU prior to the patient leaving the department. The only examinations excepted are tube placement checks. Add-on cases should generally be accepted if the patients have been properly prepared. The residents are responsible for dictating the cases after review by the staff radiologist. In the event that the AM staff radiologist assigned to GI/GU is not available in the afternoon, staff responsibility shifts to the PM CT/GI radiologist. It is incumbent upon the residents to inform that radiologist of impending exams.

Both residents should remain in the Fluoroscopy area until all exams have been completed. The more junior resident should then continue to stay in the Fluoroscopy area until 5:00 p.m. in order to handle consultations and additional exam requests. The more senior resident may work elsewhere in the hospital, but must always be available by pager to assist with any case.

### **Conferences**

Uroradiology conference is held on Tuesday at 4:30 or 5:30 p.m. GI Radiology conference is held monthly at 7:30 a.m. on the first Wednesday of each month. Both residents will be expected to attend both conferences. If the GI conference lasts beyond 8:00 a.m., the more senior resident should proceed to the Fluoroscopy area at 8:00 a.m.

## **GASTROINTESTINAL RADIOLOGY**

The resident is responsible for performing all enteral contrast studies of the gastrointestinal tract. Prior to each study, review of the chart and previous studies together with an interview of the patient is mandatory to establish indications and to allow appropriate "tailoring" of the examination. Review of all films obtained in a timely manner is mandatory as the resident is responsible for the quality of the examinations. Preliminary interpretations of examinations will be provided in the form of a written note in the chart of inpatients. All requests for emergency and urgent studies will be evaluated



by the resident. They will be scheduled in cooperation with the technical staff. Following review of the films with a staff radiologist, the resident will complete dictations.

## **GENITOURINARY RADIOLOGY**

The resident is responsible for the performance, monitoring and quality assurance of all radiographic procedures of the genitourinary system. A complete chart review and interview with the patients is indicated. Review of prior films as well as the preliminary films for the study is mandatory. Following this review, the examination will be performed with appropriate "tailoring" for that particular patient. Treatment of contrast reactions is the direct responsibility of the resident; a staff radiologist should be notified immediately. All requests for emergency studies will be reviewed by the resident staff and scheduled in cooperation with the technical staff. Following review of all cases, the resident will dictate the studies. A preliminary report will be written in the patient's chart as noted in the Gastrointestinal portion of this manual.

Before both residents leave the area, a signout of any impending cases must be completed with the on-call resident. All scheduled cases must be completed. If the on-call resident is unable to attend this area because of on-going commitments elsewhere, then one of the two residents on this service must maintain a presence until all impending cases are completed as well.

In the Fluoroscopy reading room there is a list of technologist protocols for the examinations we perform in the Fluoroscopy Division. Review of these is useful to understand the preparation for examinations and the films required.

### **General Objectives**

To obtain proper training in the performance and interpretation of fluoroscopic and contrast studies involving the gastrointestinal and genitourinary systems.

### **Fluoroscopy Goals and Objectives**

#### **PGY-2 (1st year resident)**

##### **Patient Care:**

1. Uses established evidence-based imaging guidelines such as American College of Radiology (ACR) Appropriateness Criteria®
2. Appropriately uses the Electronic Health Record to obtain relevant clinical information
3. Understands gastrointestinal tract and spinal anatomy.
4. Competently performs basic studies such as modified barium swallow, upper gastrointestinal series and single contrast barium enema.
5. Competently performs lumbar puncture.
6. Understands departmental policy on anticoagulant use and contraindications for lumbar puncture and myelographic studies

### **Medical Knowledge:**

1. Understands the basic physics of fluoroscopy.
2. Can describe the physics of the image intensifier.
3. Aware of the affect of both kVp and mA on image quality.
4. Able to describe basic measures to reduce radiation exposure – time, distance and shielding.
5. Makes core observations, formulates differential diagnoses, and recognizes critical findings. Example: anastomotic leak.
6. Can describe normal radiologic anatomy of the esophagus, stomach and duodenum.

### **Professionalism:**

1. Demonstrates the following professional behaviors:
  - Puts patient care first and advocates for patient
  - Fulfills all work-related responsibilities
  - Recognizes personal limitations and seeks help
  - responds appropriately to constructive criticism
  - maintains patient confidentiality
2. Acts in professional and ethical manner

### **Communication and Interpersonal Skills:**

1. Communicates information about imaging and examination results in routine, uncomplicated circumstances
2. **Written/Electronic:** Generates accurate reports with appropriate elements required for coding
3. **Verbal:** Communicates urgent and unexpected findings according to Lifespan policy and ACR guidelines

### **System-Based Practice:**

1. Understands Lifespan MERS event reporting system
2. Describes the mechanisms for reimbursement, including types of payors

### **Practice-Based Learning:**

1. Understands the basics of radiation protection in fluoroscopy – time, distance, shielding.
2. Understands the importance of minimizing dose, particularly in the young patient
3. Identify, rectify and learn from personal errors
4. Use opportunities to observe and perform unfamiliar studies with an attending or more senior resident

### **PGY-3 (2nd year resident)**

### **Patient Care:**

1. Recommends appropriate imaging of common conditions independently, such as dysphagia, postoperative anastomotic integrity, postoperative spine evaluation.
2. Can suggest most appropriate first line imaging test for a suspected disease process
3. Competently performs more complex studies such as myelography, voiding cystourethrography and fistulography.
4. Has performed at least 5 lumbar punctures

### **Medical Knowledge:**

1. Understands the imaging requirements for less common examinations.
2. Able to describe more advanced dose reduction techniques and the ALARA principles.
3. Makes secondary observations, narrows the differential diagnosis, and describes management options. Example: Infectious esophagitis

### **Professionalism:**

1. Is an effective health care team member
2. Communicates, under direct supervision, in challenging circumstances (e.g., cognitive impairment, cultural differences, language barriers, low health literacy)
3. Communicates, under direct supervision, difficult information such as errors, complications, adverse events, and bad news.
4. Obtains informed consent

### **Communication and Interpersonal Skills:**

**Written/Electronic:** Efficiently generates clear and concise reports that do not require substantive faculty member correction on routine cases

**Verbal:** Communicates findings and recommendations clearly and concisely

### **System-Based Practice:**

1. Able to recognize suboptimal images/examinations
2. Participates in the case presentations in morning rounds and monthly GI radiology conference
3. States relative cost of fluoroscopy compared to other imaging modalities.
4. Understand the required components of a fluoroscopy report to support the code charged

### **Practice-Based Learning:**

1. Understands more advanced concepts of radiation protection such as field size, magnification and exposure factors
2. Incorporates feedback into improved performance.
3. Uses electronic medical record effectively to assist in image interpretation

## **PGY-4 (3rd year resident)**

### **Patient Care:**

1. Recommends appropriate imaging of more uncommon conditions independently, such as malabsorption syndromes, complex fistula evaluation, CSF leak.
2. Competently performs intermediate procedures such as thoracic and cervical myelography, preparation for intrathecal chemotherapy and retrograde urethrography.

### **Medical Knowledge:**

1. Able to offer methods to improve suboptimal fluoroscopy images by varying exposure parameters and/or imaging technique.
2. Demonstrates knowledge of physical principles to optimize image quality
3. Provides accurate, focused, and efficient interpretations
4. Prioritizes differential diagnoses and recommends management

### **Professionalism:**

1. Is an effective health care team leader, promoting primacy of patient welfare, patient autonomy, and social justice

### **Communication and Interpersonal Skills:**

1. Communicates, under indirect supervision, in challenging circumstances (e.g., cognitive impairment, cultural differences, language barriers, low health literacy)
2. **Written/Electronic:** Efficiently generates clear and concise reports that do not require substantive faculty member correction on common complex cases
3. **Verbal:** Communicates appropriately under stressful situations

### **System-Based Practice:**

1. Suggests methods of image quality improvement during the fluoroscopy rotation
2. Describes the technical and professional components of fluoroscopy examinations

### **Practice-Based Learning:**

1. Routinely incorporates a high level of radiation safety into every examination.
2. Perform literature search to aid in knowledge of particular clinical problems.
3. Use opportunities to perform complex procedures with the assistance of an attending or more senior resident

## **PGY-5 (4th year resident)**

### **Patient Care:**

1. Integrates current research and literature with guidelines, taking into consideration cost effectiveness and risk-benefit analysis, to recommend fluoroscopic studies
2. Performs advanced studies competently and independently

### **Medical Knowledge:**

1. Describes the components of a modern digital fluoroscopy system and their function
2. Makes subtle observations
3. Suggests a single diagnosis when appropriate
4. Suggests appropriate follow-up exams, timing of said exams and intervention when appropriate.
5. Integrates current research and literature with guidelines to recommend management

### **Professionalism:**

1. Serves as a role model to junior residents and medical students for professional behavior

### **Communication and Interpersonal Skills:**

1. Communicates complex and difficult information, such as errors, complications, adverse events, and bad news
2. **Written/Electronic:** Efficiently generates clear and concise reports that do not require substantive faculty member correction on all cases
3. **Verbal:** Communicates effectively and professionally in all circumstances

### **System-Based Practice:**

1. Independently suggests methods of image quality improvement
2. Can describe ACR accreditation standards for fluoroscopy.
3. Understand situations where a fluoroscopic study or procedure may be the most cost effective imaging alternative.
4. Practices cost-effective fluoroscopy by reducing unnecessary examinations wherever possible

### **Practice-Based Learning:**

1. Suggests methods by which radiation exposure may be reduced on an individual basis.
2. Independently performs literature searches for rare or unusual diseases.
3. Demonstrates an understanding of resources available to maintain knowledge of fluoroscopic findings.
4. Demonstrates intermediate level studies to more junior residents.

## **Mechanism of Evaluation**

The resident will be evaluated by the faculty by means of a monthly evaluation form. In addition, the lead technologist will be responsible for providing feedback to the resident from the technology staff by means of the standard technologists evaluation form. Procedure logs and imaging conference presentations will be kept in the resident's file for review by the program director.

## **GI/GU Radiology Reading List**

Fundamentals of Fluoroscopy  
Jeffrey D Houston  
Saunders 2001  
(Excellent "How-To" for fluoro studies)

Mayo Clinic GI Imaging Review  
C Daniel Johnson  
Informa Healthcare 2005  
(Great for all of GI imaging)

Textbook of Uroradiology  
by N. Reed Dunnick  
Williams and Wilkins 2007  
(Amalgamation of two previous texts. Superb.)

## **FLUOROSCOPY ROTATION FIRST YEAR READING ASSIGNMENTS**

***Textbook of Gastrointestinal Radiology, Third Edition Volume 1. Gore and Levine.***

FIRST ROTATION:

DAY ONE:

SECTION I: GENERAL RADIOLOGIC PRINCIPLES

3. Barium Studies: Single Contrast, David J. Ott, MD
4. Barium Studies: Principles of Double Contrast Diagnosis, Igor Laufer, MD; Marc S. Levine, MD
5. Pictorial Glossary of Double Contrast Radiology, Stephen E. Rubesin, MD

DAY TWO:

SECTION II: ABDOMINAL PLAIN IMAGES

15. Abdomen: Normal Anatomy and Examination Techniques, William M. Thompson, MD
16. Gas and Soft Tissue Abnormalities, James M. Messmer, MD, MEd
17. Abnormal Calcifications, Steven R. Baker, MD

DAY THREE:

SECTION III: PHARYNX, Stephen E. Rubesin, Editor

18. Pharynx: Normal Anatomy and Examination Techniques, Stephen E. Rubesin, MD
19. Abnormalities of Pharyngeal Function, Bronwyn Jones, FRACP, FRCR

20. Structural Abnormalities of the Pharynx, Stephen E. Rubesin, MD

DAY FOUR:

SECTION IV: ESOPHAGUS

21. Barium Studies of the Upper Gastrointestinal Tract, Igor Laufer, MD; Marc S. Levine, MD

22. Motility Disorders of the Esophagus, David J. Ott, MD

23. Gastroesophageal Reflux Disease, Marc S. Levine, MD

DAY FIVE

24. Infectious Esophagitis, Marc S. Levine, MD

25. Other Esophagitides, Marc S. Levine, MD

WEEKEND

26. Benign Tumors of the Esophagus, Marc S. Levine, MD

27. Carcinoma of the Esophagus, Marc S. Levine, MD; Robert A. Halvorsen, Jr., MD

DAY SIX

SECTION V: STOMACH AND DUODENUM

33. Peptic Ulcers, Marc S. Levine, MD

34. Inflammatory Conditions of the Stomach and Duodenum, Marc S. Levine, MD

DAY SEVEN

35. Benign Tumors of the Stomach and Duodenum, Marc S. Levine, MD

36. Carcinoma of the Stomach and Duodenum, Marc S. Levine, MD; Alec J. Megibow, MD; Michael L. Kochman, MD

DAY EIGHT

37. Other Malignant Tumors of the Stomach and Duodenum, Marc S. Levine, MD; Alec J. Megibow, MD

DAY NINE/TEN

38. Miscellaneous Abnormalities of the Stomach and Duodenum, Ronald L. Eisenberg, MD, JD; Marc S. Levine, MD

39. Postoperative Stomach and Duodenum, Richard M. Gore, MD; Claire H. Smith, MD

SECOND ROTATION

DAY ONE AND TWO:

Review of chapters from first rotation as needed.

DAY THREE:

SECTION VI: SMALL BOWEL, Stephen E. Rubesin, M

41. Barium Examinations of the Small Intestine, Stephen E. Rubesin, MD

45. Crohn's Disease of the Small Bowel, Richard M. Gore, MD; Gabriel Masselli, MD; Dina F. Caroline, MD, PhD

DAY FOUR:

46. Inflammatory Disorders of the Small Bowel Other than Crohn's Disease, Stephen E. Rubesin, MD

47. Malabsorption, Stephen E. Rubesin, MD

DAY FIVE/WEEKEND

48. Benign Tumors of the Small Bowel, John C. Lappas, MD; Dean D. T. Maglinte, MD; Kumar Sandrasegaran, MBChB

49. Malignant Tumors of the Small Bowel, Dean D. T. Maglinte, MD; John C. Lappas, MD; Kumar Sandrasegaran, MBChB

50. Small Bowel Obstruction, Stephen E. Rubesin, MD; Richard M. Gore, M

DAY SIX

SECTION VII: COLON

55. Barium Studies of the Colon, Igor Laufer, MD; Marc S. Levine, MD

56. Dynamic Evaluation of the Anorectum, Sat Somers, MB, ChB; Clive Bartram, MD; Julia R. Fielding, MD; Kang Hoon Lee, MD; Richard M. Gore, MD

DAY SEVEN

59. Diverticular Disease of the Colon, Richard M. Gore, MD; Emil J. Balthazar, MD

60. Diseases of the Appendix, Jill E. Jacobs, MD; Emil J. Balthazar, MD

DAY EIGHT

61. Ulcerative and Granulomatous Colitis: Idiopathic Inflammatory Bowel Disease, Richard M. Gore, MD; Igor Laufer, MD; Jonathan W. Berlin, MD

62. Other Inflammatory Conditions of the Colon, Seth N. Glick, MD; Richard M. Gore, MD

DAY NINE/TEN

63. Polyps and Cancer, Ruedi F. Thoeni, MD; Igor Laufer, MD

64. Other Tumors of the Colon, Stephen E. Rubesin, MD; Emma E. Furth, MD

65. Polyposis Syndromes, Carina L. Butler, MD; James L. Buck, MD

66. Miscellaneous Abnormalities of the Colon, Richard M. Gore, MD; Richard A. Szucs, MD; Ellen L. Wolf, MD; Francis J. Scholz, MD; Ronald L. Eisenberg, MD; Stephen E. Rubesin, MD

The Fluoroscopy Don'ts and updated protocols can be found on the Brown Radiology section of the intranet or by following this link: <https://remote.lifespan.org/lis/brown-radiology/Body%20Imaging%20%26%20Intervention/Fluoroscopy/Manual%20-%20Policies%20-%20Documents/,DanaInfo=intra.lifespan.org+fluoroscopy-protocols.pdf>



## MUSCULOSKELETAL RADIOLOGY (MSK)

### **I. General Objectives:**

When first confronted, the field of musculoskeletal radiology is somewhat overwhelming due to the diversity of topics covered in this field. It is important that residents from the very start categorize findings into the subdivisions of bone pathology (trauma; infection; neoplasm/tumor-like conditions; metabolic, systemic, and hematologic disorders; joint disorders, congenital anomalies and dysplasias). Only by using a strict algorithmic approach will the resident be able to properly arrive at a concise and well-thought out differential diagnosis.

The first year resident should have a thorough understanding of the techniques relevant to musculoskeletal radiology, as well a strong grasp of normal anatomy and associated variants. This will serve as a strong foundation on which the resident can build. Next the resident should focus on the fundamentals of basic orthopedic radiology, including but not limited to, fracture description and common fracture/dislocation patterns. This is the bread and butter of musculoskeletal radiology, and must be well understood both for board certification as well as for future practice. The resident should supplement their clinical experience, cases conferences, and didactic lectures with appropriate reading as referenced in sections IV and V. The first-year resident should also begin to categorize and organize the major subdivisions of musculoskeletal radiology focusing on trauma, joint disorders, and infection.

The second year resident should be increasingly facile with orthopedic radiology, particularly with growing experience in the Emergency Department. At this point, more detailed knowledge of neoplastic/tumor-like conditions; metabolic, systemic, and hematologic disorders; joint disorders; and infection is warranted. Supplementary reading again is a requirement as references in sections IV and V.

Third and fourth year residents should become increasingly facile at the algorithmic approach to differential diagnoses based on the major subdivisions of bone pathology. By the fourth year residents should have a detailed knowledge base of all major subdivisions of musculoskeletal radiology including congenital anomalies and dysplasias.

During the maturation of the resident increasing participation in unknown case analysis at noon conferences is expected.

Besides noon conferences, a host of orthopedic lectures are available on a daily basis, with orthopedic resident teaching conferences at 5:00 p.m., Monday through Friday. Additionally, orthopedic Grand Rounds is held at 7:00 a.m., Wednesday mornings.

In an effort to ensure that resident education is sufficient and that quality health care remains available in the United States, the ACGME has established six General Competencies that residents in all specialties must achieve, and has determined that each residency must be able to assess their residents' progress in achieving these competencies through Practice Performance Measurements. The Competencies include patient care (PC), medical knowledge (MK), practice-based learning and improvement (PBL),

interpersonal and communication skills (ICS), professionalism (P), and systems-based practice (SBP). The below objectives are arranged in reference to these core competencies.

### **Goals and Objectives on Which Milestone Evaluations Will be Based:**

#### **PGY-2 (1st year resident)**

##### **Patient Care:**

1. Uses established evidence-based imaging guidelines such as American College of Radiology (ACR) Appropriateness Criteria®
2. Appropriately uses the Electronic Health Record to obtain relevant clinical information

##### **Medical Knowledge:**

1. Recognizes sub-optimal plain radiographs
2. Demonstrates knowledge of protocols for xray imaging of bones and joints
3. Makes core observations, formulates differential diagnoses, and recognizes critical findings
4. Differentiates normal from abnormal
5. Recognizes normal anatomy, identifies common fractures and dislocations, understands fracture healing and complications including delayed union, malunion and nonunion, recognizes osteomyelitis and septic arthritis, aggressive processes, and complications of orthopedic devices

##### **Professionalism:**

1. Demonstrates the following professional behaviors:
  - recognizes the importance and priority of patient care and advocates for patient interests
  - fulfills work-related responsibilities
  - is truthful
  - recognizes personal limitations and seeks help when appropriate
  - recognizes personal impairment and seeks help when needed
  - responds appropriately to constructive criticism
  - places needs of patients before self
  - maintains appropriate boundaries with patients, colleagues, and others
  - exhibits tolerance and acceptance of diverse individuals and groups
  - maintains patient confidentiality
  - fulfills institutional and program requirements related to professionalism and ethics
2. Attends required conferences

### **Communication and Interpersonal Skills:**

1. Adheres to transfer-of-care policies
2. **Written/Electronic:** Generates accurate reports with appropriate elements required for coding
3. **Verbal:** Communicates urgent and unexpected findings according to Lifespan policy and ACR guidelines

### **System-Based Practice:**

1. Describes departmental QI initiatives
2. Understands Lifespan MERS event reporting system
3. Provides feedback to technologists regarding exposure and patient positioning
4. Participates in discussions regarding operational challenges and potential system solutions regarding radiologic services and patient care

### **Practice-Based Learning:**

1. Understands the required components of an xray report to support the code charged

### **PGY-3 (2nd year resident)**

#### **Patient Care:**

1. Recommends appropriate imaging of common conditions independently\* such as arthritis and osteomyelitis

#### **Medical Knowledge:**

1. Selects appropriate protocols and contrast agent/dose for routine MSK CT and MR
2. Makes secondary observations, narrows the differential diagnosis, and describes management options
3. Can monitor CT/MRI exams, builds on knowledge of anatomy, recognizes processes such as Pagets disease, arthritis, solitary bone lesion characterization, and osteonecrosis
4. Understands common knee and shoulder pathology

#### **Professionalism:**

1. Is an effective health care team member
2. Continues to demonstrate professional behaviors listed in the first column

### **Communication and Interpersonal Skills:**

1. **Written/Electronic:** Efficiently generates clear and concise reports that do not require substantive faculty member correction on routine cases
2. **Verbal:** Communicates findings and recommendations clearly and concisely

### **System-Based Practice:**

1. Incorporates QI into clinical practice
2. Provides feedback to technologists regarding exposure and patient positioning
3. Participates in discussions regarding operational challenges and potential system solutions regarding radiologic services and patient care
4. States relative cost of common procedures in MSK imaging such as x-ray, CT and MRI
5. Understands the required components of a CT and MRI report to support the code charged

### **Practice-Based Learning:**

1. Incorporates feedback into improved performance

### **PGY-4 (3rd year resident)**

#### **Patient Care:**

1. Recommends appropriate imaging of uncommon conditions independently such as neurofibromatosis and Maffucci Syndrome

#### **Medical Knowledge:**

1. Selects appropriate protocols and contrast agent/dose for advanced imaging
2. Demonstrates knowledge of physical principles to optimize image quality
3. Provides accurate, focused, and efficient interpretations
4. Prioritizes differential diagnoses and recommends management
5. Demonstrate learning of MRI and various pulse sequences, MRI safety issues including contraindications to scanning and contrast, MRI anatomy of the knee, shoulder, hip, ankle, wrist and elbow

#### **Professionalism:**

1. Is an effective health care team leader, promoting primacy of patient welfare, patient autonomy, and social justice
2. Continues to demonstrate professional behaviors listed in the first column

#### **Communication and Interpersonal Skills:**

1. **Written/Electronic:** Efficiently generates clear and concise reports that do not require substantive faculty member correction on common complex cases
2. **Verbal:** Communicates appropriately under stressful situations

#### **System-Based Practice:**

1. Suggests methods of image quality improvement for both CT and MRI

2. Provides feedback to technologists regarding MRI quality and patient positioning
3. Participates in discussions regarding operational challenges and potential system solutions regarding MSK radiologic services and patient care
4. States relative cost of common procedures in MSK imaging such as xray, CT and MRI
5. Understands the required components of a CT and MRI report to support the code charged

**Practice-Based Learning:**

1. Performs literature search to aid in knowledge of clinical problems
2. Identifies weaknesses in MSK knowledge and implements a plan for the rotation to improve knowledge

**PGY-5 (4th year resident)**

**Patient Care:**

1. Integrates current research and literature with guidelines, taking into consideration cost effectiveness and risk-benefit analysis, to recommend imaging
2. Can prioritize requests for add on cases and answer questions from support staff

**Medical Knowledge:**

1. Independently modifies protocols as determined by clinical circumstances
2. Applies physical principles to optimize image quality
3. Makes subtle observations
4. Suggests a single diagnosis when appropriate
5. Integrates current research and literature with guidelines to recommend management
6. Recognize findings of endocrine disease including hyperparathyroidism, renal osteodystrophy, osteomalacia/rickets as well as storage disease including sickle cell anemia, thalassemia, mastocytosis, and Gaucher's disease, recognizes common dysplasias and congenital conditions such as achondroplasia, osteogenesis imperfect, osteopetrosis

**Professionalism:**

1. Serves as a role model for professional behavior
2. Continues to demonstrate professional behaviors listed in the first column

**Communication and Interpersonal Skills:**

1. **Written/Electronic:** Efficiently generates clear and concise reports that do not require substantive faculty member correction on all cases
2. **Verbal:** Communicates effectively and professionally in all circumstances

### **System-Based Practice:**

1. Independently suggests methods of image quality improvement
2. Recognizes incomplete exams and acts independently to rectify
3. Participates in discussions regarding operational challenges and potential system solutions regarding radiologic services and patient care
4. Practices cost effective MSK CT and MRI by reducing unnecessary examinations whenever possible

### **Practice-Based Learning:**

1. Independently performs literature searches for rare or unusual disease processes
2. Demonstrates an understanding of resources available to maintain competence in MSK imaging knowledge

## **II. Additional Goals and Objectives for the Rotation:**

### **First-year Residents**

#### **Goals**

After completing the first four-week of the rotation in musculoskeletal radiology, the resident will be able to:

- Demonstrate learning of knowledge based objectives and mastery of technical objectives for the first rotation
- Generate accurate and concise radiographic reports
- Communicate effectively with patients, referring clinicians, technologists and supervisory staff
- Understand standard radiographic positioning and anatomy
- Obtain essential patient information pertinent to the radiologic examination
- Demonstrate knowledge of clinical indications for radiography and indications for urgent computed tomography (CT) and magnetic resonance (MR) examinations
- Demonstrate a responsible work ethic
- Participate in quality improvement/ quality assurance activities
- Participate in the education of students and interns
- Begin to protocol and monitor, with assistance, musculoskeletal examinations
- Contribute cases, when appropriate, to the MSK teaching file

#### **Objectives**

- **Knowledge based**
  - Demonstrate learning of normal radiographic and CT anatomy of the axial and appendicular skeleton
  - Demonstrate learning of normal MRI anatomy of the knee and shoulder

- Recognize and accurately describe common fractures and dislocations of the appendicular skeleton
  - Demonstrate learning of pathophysiology and radiology of fracture healing and complications of healing such as delayed union, malunion and nonunion
  - Demonstrate learning of radiographic presentation and evaluation of osteomyelitis and septic arthritis
  - Begin to distinguish an aggressive process, such as malignant bone neoplasm, from a more benign bone process, such as a benign bone neoplasm, based on specific radiographic findings.
  - Recognize and describe complications of orthopedic devices including fracture fixation and arthroplasty hardware
- **Technical**
    - Dictate clear, detailed, and accurate reports that include all pertinent information as established in the American College of Radiology (ACR) Guidelines for Communication<sup>4</sup> (PBL, ICS)
    - Use appropriate nomenclature when reporting radiographic, CT, MR or ultrasound (US) findings of musculoskeletal disease (ICS)
    - Communicate all unexpected or significant findings to the ordering provider and document whom was called and the date and time of the discussion in the report (ICS, PC, P)
    - Obtain relevant patient history from electronic records, dictated reports, the patient, or by communication with referring provider (PC)
    - Recognize and describe positioning and anatomy of standard radiographic examinations of the musculoskeletal system (MK)
    - Effectively provide feedback to radiology technologists regarding quality of exposure and patient positioning (ICS, SBP)
    - Recognize when it is appropriate to obtain help from senior residents or faculty when assisting referring clinicians (PC, P)
    - Demonstrate responsible, ethical behavior; positive work habits; and professional appearance; and adhere to principles of patient confidentiality (P)
    - Participate in discussions with faculty and staff regarding operational challenges and potential system solutions regarding all aspects of radiologic services and patient care (SBP)
    - Demonstrate knowledge of the American College of Radiology (ACR) standards and appropriateness criteria(P)
    - Attend all pertinent conferences (SBP)
    - Identify, rectify, and learn from personal error. Incorporate feedback into improved performance (PBL)

## Second Year Residents

### **Goals**

After completing the second/third week of the rotation in musculoskeletal radiology, the resident will be able to:

- Demonstrate learning of knowledge based objectives and mastery of technical objectives for the second rotation
- Continue to build and improve on skills developed during the first rotation
- Begin to protocol and monitor CT and MR examinations independently
- Demonstrate an understanding of the ACR Appropriateness Criteria<sup>5</sup> and ACR Practice Guidelines and Technical Standards for musculoskeletal imaging<sup>6</sup>
- Participate in the education of junior residents, interns, and medical students
- Perform image guided procedures

## Objectives

- **Knowledge Based**
  - Recognize and describe the radiographic presentation of Paget disease
  - Demonstrate learning of a systematic approach to arthritis. Be able to describe and differentiate salient radiologic (radiographic, CT and MR) features of common arthropathies including osteoarthritis, inflammatory arthropathy (rheumatoid, psoriatic, reactive, juvenile chronic, and septic), crystal deposition diseases (calcium pyrophosphate deposition, gout, hydroxyapatite deposition), neuropathic arthropathy, connective tissue disease (systemic lupus erythematosus, scleroderma, dermatomyositis), pigmented villonodular synovitis, and synovial chondromatosis
  - Demonstrate a systematic assessment of a solitary lesion of bone and be able to categorize the lesion as aggressive or nonaggressive. Develop an appropriate differential diagnosis based on patient age, lesion location, and lesion characteristics (margin, matrix, periosteal reaction, soft tissue extension). Demonstrate knowledge of systematic, safe and cost effective radiologic work-up of bone lesions including biopsy approach and compartmental anatomy.
  - Recognize and describe common locations of and radiologic manifestations of osteonecrosis.
  - Demonstrate knowledge of MRI safety issues including contraindication to scanning and use of contrast.
  - Demonstrate learning of the use of various pulse sequences and planes of imaging used in MRI of musculoskeletal disorders
  - Demonstrate learning of common knee and shoulder pathology on MRI (meniscal tear, tendon and ligament injury, fracture, chondral disease, rotator cuff tear, and labral pathology)
  - Demonstrate learning of the normal MRI anatomy of the hip and ankle
- **Technical**
  - Build and improve on skills acquired during first rotation



- Demonstrate the ability to gather essential and accurate patient information (electronic, personal communication) to appropriately prescribe MRI protocols (PC, ICS)
- Provide effective and timely feedback and education to CT and MRI technologists regarding quality of examinations (ICS, SBP)
- Demonstrate ability to monitor CT and MRI examinations, independently, to ensure the patient is adequately evaluated (MK, PC)
- Provide technical and educational guidance to junior residents and students (ICS)
- Safely perform fluoroscopically guided joint injections and aspirations with faculty supervision (PC)
- Attend orthopedic grand rounds when possible (SBP)
- Function more independently as a consultant in musculoskeletal radiology but demonstrate when it is appropriate to obtain help from faculty.(SBP, PC)

### Third Year Residents

#### **Goals**

After completing the second/third week of the rotation in musculoskeletal radiology, the resident will be able to:

- Demonstrate learning of knowledge based objectives and mastery of technical objectives for the second rotation
- Continue to build and improve on skills developed during earlier rotations
- Protocol and monitor CT and MR examinations with increasing independence
- Integrate the ACR Appropriateness Criteria and ACR Practice Guidelines and Technical Standards into the daily practice of musculoskeletal imaging
- Participate in the education of junior residents, interns, and medical students
- Perform image guided procedures

#### **Objectives**

- **Knowledge Based**
  - Recognize and describe the radiographic presentation of Paget disease
  - Demonstrate learning of a systematic approach to arthritis. Be able to describe and differentiate salient radiologic (radiographic, CT and MR) features of common arthropathies including osteoarthritis, inflammatory arthropathy (rheumatoid, psoriatic, reactive, juvenile chronic, and septic), crystal deposition diseases (calcium pyrophosphate deposition, gout, hydroxyapatite deposition), neuropathic arthropathy, connective tissue disease (systemic lupus erythematosus, scleroderma, dermatomyositis), pigmented villonodular synovitis, and synovial chondromatosis
  - Demonstrate a systematic assessment of a solitary lesion of bone and be able to categorize the lesion as aggressive or nonaggressive. Develop an

appropriate differential diagnosis based on patient age, lesion location, and lesion characteristics (margin, matrix, periosteal reaction, soft tissue extension). Demonstrate knowledge of systematic, safe and cost effective radiologic work-up of bone lesions including biopsy approach and compartmental anatomy.

- Recognize and describe common locations of and radiologic manifestations of osteonecrosis.
- Demonstrate knowledge of MRI safety issues including contraindication to scanning and use of contrast.
- Demonstrate learning of the use of various pulse sequences and planes of imaging used in MRI of musculoskeletal disorders
- Demonstrate learning of common knee and shoulder pathology on MRI (meniscal tear, tendon and ligament injury, fracture, chondral disease, rotator cuff tear, and labral pathology)
- Demonstrate learning of the normal MRI anatomy of the hip and ankle

- **Technical**

- Build and improve on skills acquired during earlier rotations
- Demonstrate the ability to gather essential and accurate patient information (electronic, personal communication) to appropriately prescribe MRI protocols (PC, ICS)
- Provide effective and timely feedback and education to CT and MRI technologists regarding quality of examinations (ICS, SBP)
- Demonstrate ability to monitor CT and MRI examinations, independently, to ensure the patient is adequately evaluated (MK, PC)
- Provide technical and educational guidance to junior residents and students (ICS)
- Safely perform fluoroscopically guided joint injections and aspirations with faculty supervision (PC)
- Attend orthopedic grand rounds when possible (SBP)
- Function more independently as a consultant in musculoskeletal radiology but demonstrate when it is appropriate to obtain help from faculty.(SBP, PC)

### Fourth Year Residents

#### **Goals**

After completing the last week of the rotation in musculoskeletal radiology, the resident will be able to:

- Demonstrate learning of knowledge based objectives and mastery of technical objectives for the third rotation
- Continue to refine skills developed during the first two rotations
- Effectively use information technology to address clinical problems
- Participate in the education of junior residents and medical students

- Become a more independent provider of musculoskeletal radiologic interpretive services
- Manage clinical and technical questions from technical and support staff

## Objectives

- **Knowledge based**
  - Recognize radiologic findings and describe pathophysiology of endocrine disease including hyperparathyroidism, renal osteodystrophy, osteomalacia/rickets, hypophosphatasia, hypophosphatemia
  - Recognize radiologic findings of hematopoietic and storage diseases including sickle cell anemia, thalassemia, mastocytosis, and Gaucher's disease.
  - Demonstrate systematic approach to relatively common dysplasias and congenital conditions such as achondroplasia, osteogenesis imperfecta, osteopetrosis
  - Demonstrate learning of common pathology of the hip and ankle on MRI
  - Demonstrate learning of anatomy and common injuries/pathology of the elbow and wrist on MRI
- **Technical**
  - Improve and build on skills acquired during the first two rotations
  - Demonstrate the ability to locate, appraise and assimilate evidence from scientific studies related to the performance and interpretation of musculoskeletal imaging (PBL)
  - Demonstrate the ability to teach a junior colleague how to protocol examinations and plan procedures (PC, ICS)
  - Demonstrate the ability to assess and prioritize requests for add-on procedures (PC)
  - Demonstrate the ability to answer common procedural and policy questions from technologists and support staff (PC, ICS)

### III. Mechanism of Evaluation:

Medical knowledge in musculoskeletal radiology will be specifically evaluated by the ACR in-service examination and the mock oral board examination. Patient care, practice-based learning and systems-based practice relevant to musculoskeletal radiology will be evaluated by imaging conference presentations and monthly evaluations by the faculty on the MSK rotation.

#### IV. Musculoskeletal Reading References

1. Resnick D, Kransdorf M. Bone and Joint Imaging, Third edition. W.B. Saunders. 2004. (“BABY” Resnick)
2. Resnick D. Diagnosis of Bone and Joint Disorders, Fourth Edition W.B. Saunders. 2002. Volumes 1-5.
3. Rogers L. Radiology of Skeletal Trauma. Churchill Livingstone. 1992. Third Edition. Volumes 1 & 2.
4. Helms C. Fundamentals of Skeletal Radiology, Third Edition. W.B. Saunders. 2004.
5. Greenspan A. Orthopedic Radiology, A Practical Approach, Fourth Edition. Lippincott Williams & Wilkins. 2004.
6. Weissman B. Orthopedic Radiology, Second Revised Edition. W.B. Saunders. 2002.
7. Brower AC, Flemming DJ. Arthritis in Black and White, Second Edition. W.B. Saunders. 1997.
8. Kaplan PA, Helms CA, Dussault R, Anderson MW, Major NM. Musculoskeletal MRI. W.B. Saunders. 2001.
9. Stoller DW. Magnetic Resonance Imaging in Orthopaedics & Sports Medicine, Second Edition. Lippincott-Raven Publishers. 1997
10. Miller T, Schweitzer M. Diagnostic Musculoskeletal Radiology. McGraw-Hill Professional. 2004.
11. Kransdorf, MJ. Imaging of Soft Tissue Tumors, Second Edition. Lippincott Williams & Wilkins. 2006.
12. Mirra JM. Bone Tumors: Clinical Radiologic and Pathologic Correlations. Lea & Febiger. 1989.
13. Dorfman HD. Bone Tumors. C.V. Mosby, 1<sup>st</sup> Edition. 1998.
14. Meyers, SP. MRI of Bone and Soft Tissue Tumors and Tumorlike Lesions. Thieme Medical Publishers. 2008.
15. Johnson KJ, Bache E. (Ed.) Imaging in Pediatric Skeletal Trauma: Techniques and Applications (Medical Radiology/ Diagnostic Imaging). Springer 2007.

#### V. Essential Reading

#1, #3 (Chapters 1-9), #4, #5 (Trauma chapters), #7, #8

Reading should be focused to meet goals for each level of rotation.

#### First-Year Reading Instructions

**Text:** Musculoskeletal Imaging: The Requisites, 4th edition. B.J. Manaster. 2013

**Additional resources:** Rad Primer cases

#### First Rotation

**First 2 weeks-Chapters from the Requisites:**

First week:

Monday: Chapter 1-3  
Tuesday: Chapter 4-6  
Wednesday: Chapter 7-9  
Thursday: Chapter 10-12  
Friday/Sat/Sun: 13-15

Second week:

Monday: Chapter 16-18  
Tuesday: Chapter 19-22  
Wednesday: Chapter 23-25  
Thursday: Chapter 26-28  
Friday/Sat/Sun: Chapter 29-32

**Second 2 weeks-Chapters from the Requisites/RadPrimer:**

Third week:

Monday- Chapters 33-36  
Tuesday-Chapters 37-39  
Wednesday-Chapters 40-43  
Thursday-Chapters 44-46

Friday/Sat/Sun-25 cases from RadPrimer (MSK basic)

Fourth week:

Monday-Chapters 47-48  
Tuesday-Chapters 49-50  
Wednesday-Catch up  
Thursday-25 cases from RadPrimer (MSK basic)

**VI. General References**

1. Flemming D, Davis KW, Dinauer PA, et al. Musculoskeletal Radiology Curriculum for Radiology Residents. Journal of the American College of Radiology, Volume 4, Issue 9, Pages 636 - 639 D.
2. Accreditation Council for Graduate Medical Education. Competencies Definitions and Practice Performance Measurements for Diagnostic Radiology. Available online at [http://www.acgme.org/acWebsite/RRC\\_420/420\\_compDefsPerfMeas.pdf](http://www.acgme.org/acWebsite/RRC_420/420_compDefsPerfMeas.pdf).
3. Accreditation Council for Graduate Medical Education. Program Requirements for Graduate Medical Education in Diagnostic Radiology. Available online at [http://www.acgme.org/acWebsite/downloads/RRC\\_progReq/42opr701\\_u705.pdf](http://www.acgme.org/acWebsite/downloads/RRC_progReq/42opr701_u705.pdf).

4. American College of Radiology. ACR Practice Guideline for Communication of Diagnostic Imaging Findings. Available online at [http://www.acr.org/s\\_acr/bin.asp?CID=541&DID=12196&DOC=FILE.PDF](http://www.acr.org/s_acr/bin.asp?CID=541&DID=12196&DOC=FILE.PDF).
5. American College of Radiology. ACR Appropriateness Criteria: Expert Panel on Musculoskeletal Imaging. Available online at [http://www.acr.org/s\\_acr/sec.asp?CID=1206&DID=15047](http://www.acr.org/s_acr/sec.asp?CID=1206&DID=15047).

Recommended internet resource including information on musculoskeletal fellowships, links to teaching files and cases of the day:

<http://www.skeletalrad.org>

## NEURORADIOLOGY

### General Objectives:

Welcome to Brown. We hope you enjoy and thrive during your neuroradiology rotations

An integrated approach to neuroradiology training is obtained for the resident during their rotations through MRI, CT and interventional radiology. A rich experience in all forms of neuroradiology imaging and in depth exposure to the evaluation and treatment of central nervous system diseases is obtained primarily at the Rhode Island Hospital campus, which serves as the primary and tertiary referral site for most significant neurologic diseases, having a referral population base of approximately one million people.

Attendance at weekly clinical neurosurgery conference is encouraged. Here active imaging cases of the week are discussed in terms of patient clinical presentation, imaging findings, treatment and outcome. Residents also have the opportunity, though scheduling conflicts often occur, to attend bimonthly clinical ENT, pediatric neuro-oncology, and epilepsy conferences

Neuroradiology lectures are presented to the residents by Brown neuroradiology faculty on a bimonthly basis that adhere to a defined syllabus. Syllabus topics are then supplemented with case conferences and board review sessions as the year progresses.

### Daily Work:

During the neuroradiology rotation the resident will be exposed to a large case volume of fascinating and common CT and MRI adult and pediatric brain/spine/head and neck imaging. The resident is responsible for determining patient history, assessing the relevance of the imaging exam and its relationship to prior imaging, reviewing the study and coming to an independent assessment of the findings. The resident should pre-dictate the case in PowerScribe. When this is completed the attending radiologist reviews all cases with the resident with attention to the salient anatomic and pathologic features presented by the case and develops with the resident a focused differential diagnosis.

There will be frequent consultations with specialists in adult and pediatric neurology and neurosurgery during the workday. The resident is encouraged to participate in these consultations, taking on an increasingly significant role as the resident progresses in training.

The Neuro Section also participates in a monthly "Interesting Case Conference", where the residents on service will work with the attending staff to prepare and deliver a case presentation for the whole department of all "fascinating, and educationally useful" cases from the preceding month. . This voluntary conference is a wonderful time for the neuro-attending radiologists to share their experience and teaching pearls with all in attendance in an informal setting.

During the interventional radiology rotation the resident is responsible for patient history review and formulation of a procedure plan. All procedures are performed under the guidance of the Attending Radiologist. Residents are trained in the performance of basic and advanced diagnostic and interventional neuroradiologic procedures.

Resources:

Neuroradiology Attending Staff:

Drs. Rogg (Director), Davis, Tung, Haas, Gold, Boxerman, Jayaraman, Brody.

Neuro-Interventional Attending Staff

Drs. Jayaraman (Director), Haas, McTaggart

Neuroradiology computer based teaching file accessible in MR

Web-based neuroradiology Case Reference, Amirsys Neuro Case Review

ACR Teaching File

Internet Resource Capability AJNR, pub med, Google Scholar etc.

### **Mechanism of Evaluation**

Medical knowledge in neuroradiology will be assessed by the ACR in-service examination and the mock oral board examination. In addition, after the completion of each month on MRI a global evaluation form will be completed by the neuroradiology faculty.

### **NEURORADIOLOGY REFERENCES**

Recent graduates of our residency have found the following neuroradiology textbooks to be the most useful primary educational aides:

#### **1. 1<sup>st</sup> Year 1<sup>st</sup> Rotation Reading List**

##### **Week 1-**

**Read MRI Made Easy** Available on loan during Neuro rotation as paper back. This short monograph is a straight forward approach to understanding MRI Basic Physics and Sequence Construction.

**Read Chapter 3, Brant and Helms: Cerebrovascular Disease**

##### **Week 2**

**Read Chapter 4, Brant and Helms: Neoplasm and Masses**

##### **Week 2**

**Read Chapter 7, Brant and Helms: CNS Infections**

##### **Week 3**

**Read Chapter 6, Brant and Helms: White Matter Disease**

**Read Chapter 11, Brant and Helms : Lumbar Spine Disc Disease and Stenosis**

##### **Week 4**

**Read Chapter 10, Brant and Helms: Non Degenerative Disease of the Spine**

**Additionally recommended for review during the first year is Anatomy in Diagnostic Imaging by Fleckenstein. Good neuroanatomy review included.**



2. **2<sup>nd</sup> Rotation: Neuroradiology: The Requisites by Grossman and Yousem, (3<sup>rd</sup> Edition). This book, now in its third edition and continually improving, has been accepted by the residents as their favorite all purpose neuro. readable text. Make sure you get the newest edition as the formatting and seriousness of this book has shown continual improvement through the years.**

Neuroradiology Companion by Mauricio Castillo, 2012 is a short overview of the field of neuroradiology. Good summaries and differentials. Secondary book can be purchased cheaply used.

3. Amirsys Series for Brain, ENT, Spine are excellent reference books but not readable. Now available on line at the Hospital. So not recommended for purchase.
4. Magnetic Resonance Imaging of the Brain and Spine 4<sup>th</sup> Edition , by Scott Atlas (has contribution from Drs. Jayaraman and Boxerman. An excellent reference for in-depth reading on a neuroradiology topic.
5. Barkovich AJ. Pediatric Neuroimaging. Raven Press 4<sup>th</sup> Edition. An excellent pediatric neuroradiology text that should be read in part if possible during later rotations.
6. Harnsberger HR. Handbook of Head and Neck Imaging Mosby, 1995. An excellent review of head and neck anatomy and pathology. This book may be reviewed prior to boards as it contains essential information not available in general neuroradiology texts.
7. Som PM and Curtin HD. Head and Neck Imaging 4<sup>th</sup> Edition. This is a comprehensive text on head and neck imaging and should be read as the specific need arises.
8. **Case Review Series by Loevner, Mosby, 2009. Highly recommended case review format. A must read prior to Boards. Here cases of common and esoteric Brain, Head and Neck, and Spine can be reviewed with images and one page synopsis of important information concerning the diagnosis.**

#### **ARTERIOGRAPHY:**

Osborne's textbook Introduction to Cerebral Angiography remains easily readable and reasonably comprehensive.

#### **PEDIATRICS:**

The handiest reference to use is Pediatric Neuroradiology by Bakovich. Barkovich also has excellent chapters particularly for learning about normal development, hypoxic/ischemic injury and congenital abnormalities brain and spine.

## **HEAD AND NECK:**

Head and Neck Imaging by Som, Curtin. This is an excellent reference for pathology and CT imaging as well as less commonly performed imaging tests such as sialography and dacrocystography.

## **Specific Educational Goals and Objectives for Neuroradiology**

### **First Year Residents:**

#### **Medical Knowledge**

1. Become familiar with neuroanatomy (brain/spine/vascular) and the imaging appearance of normal brain and spine .
2. Develop an understanding of the MRI features of general categories of neoplastic/inflammatory/degenerative/metabolic/congenital diseases of the CNS that is based on an understanding of their physiology and pathology.

#### **Patient Care**

1. Develop an understanding of the strengths/weaknesses of diagnostic tests for achieving a neuroradiology diagnosis (CT/CTA/CTP, MRI/MRA/MRS/MRP, angiography, myelography) relative to other diagnostic tests for achieving a diagnosis
2. Become familiar with the risks/contraindications of neuroradiology procedures
3. Become familiar with the contrast agents benefits/doses/risks/contraindications used in neuroradiology imaging. Specific attention to pathophysiology and risk factors associated with gadolinium induced nephrogenic systemic fibrosis and iodinated contrast induced nephropathy.
4. Become familiar with the protocol for treatment of contrast reactions
5. Demonstrate proper technique and planning in performing myelography and angiography

#### **Practice-Based Learning**

1. Review all cases and present findings with differential diagnosis to the attending. The attending interprets and modifies or corrects preliminary interpretation.
2. Review Attendings' Resident Evaluation form. Discuss comments when pertinent.
3. Learn to access and incorporate Pub Med and Google searches in interpretive armamentarium.
4. Attend clinical conferences in Neurology, Neurosurgery and Neuropathology (RIH)

#### **Communication and Interpersonal Skills**

1. Provide initial consultation with clinicians who come to review imaging studies
2. Begin to develop the skill of observation, verbalization and interpretation of neuroimaging findings leading to a useful differential diagnosis
3. Organize cases and present a lucid description of patient's clinical problem as well as past medical and surgical history prior to image interpretation

4. Dictate cases in an organized, succinct and informative fashion.

### **Professionalism**

1. Demonstrate respect for all patients
2. Serve as a role model for medical students and residents in other specialties
3. Respect patient confidentiality
4. Present oneself as a professional in appearance and communication
5. Demonstrate a responsible work ethic with regard to work assignments

### **System-Based Practice**

1. Attend clinical conferences in Neurosurgery, Neurology, Neuropathology (RIH)
2. Gain an understanding of the integration of MR imaging findings with clinical findings in obtaining a focused differential diagnosis
3. Gain an understanding of the relative costs and benefits of MRI compared to CT and other imaging modalities
4. Demonstrate knowledge of ACR appropriateness criteria through discussion with attending staff and case presentation at Imaging Conference

## **Second Year Residents**

### **Medical Knowledge**

1. Be able to develop a general image based differential diagnosis for brain and spine diseases that is supported by observation, description and synthesis of abnormal findings.
2. Be able to interpret CT stroke imaging with use of the Alberta Stroke Scale. Become familiar with CTA vascular anatomy and interpretation of CTA imaging for identification of Emergency Large Vessel Occlusion (ELVO) and collateral score.
3. Understand principles of CT/MR Imaging (Physics of image acquisition)
4. Understand MRI sequence design-strengths/weaknesses for achieving an unexpected diagnosis

### **Patient Care**

1. Develop an understanding of the risks/contraindications for performance of an MR examination. Become familiar with MR safety resources.
2. Become familiar with MRI/CT protocol design for evaluating suspected neuropathology.
3. Develop a working knowledge of guidelines for patient stroke intervention

### **Practice-Based Learning**

1. Review all cases and present findings with differential diagnosis to the attending. The attending interprets and modifies or corrects preliminary interpretation.
2. Review Attendings' Resident Evaluation form. Discuss comments when pertinent.
3. Learn to access and incorporate Pub Med and Google searches in interpretive armamentarium.

4. Attend clinical conferences in Neurology, Neurosurgery and Neuropathology (RIH)

#### **Communication and Interpersonal Skills**

1. Provide consultation with clinicians who come to review imaging studies
2. Further develop the skill of observation, verbalization and interpretation of neuroimaging findings leading to a useful differential diagnosis
3. Organize cases and present a lucid description of patient's clinical problem as well as past medical and surgical history prior to image interpretation
4. Dictate cases in an organized, succinct and informative fashion.

#### **Professionalism**

1. Demonstrate respect for all patients
2. Serve as a role model for medical students and residents in other specialties
3. Respect patient confidentiality
4. Present oneself as a professional in appearance and communication
5. Demonstrate a responsible work ethic with regard to work assignments

#### **System-Based Practice**

1. Attend clinical conferences in Neurosurgery, Neurology, Neuropathology (RIH)
2. Gain an understanding of the integration of MR imaging findings with clinical findings in obtaining a focused differential diagnosis
3. Gain an understanding of the relative costs and benefits of MRI compared to CT and other imaging modalities
4. Demonstrate knowledge of ACR appropriateness criteria through discussion with attending staff and case presentation at Imaging Conference

### **Third Year Residents**

#### **Medical Knowledge**

1. Demonstrate knowledge of neuroanatomy (brain/spine/vascular) and recognize variant versus significant abnormality on brain and spine imaging.
2. Understand the imaging features of neoplastic/inflammatory/degenerative/metabolic/congenital diseases of the CNS
3. Understand principles of CT/MR Imaging (Physics of image acquisition)
4. Understand MRI sequence design-strengths/weaknesses for achieving an unexpected diagnosis and develop an understanding of goal oriented protocol modification.
5. Be able to develop a refined image based differential diagnosis that is supported by observation, description and synthesis of abnormal findings and is based on an understanding of the anatomy, physiology, pathology and imaging features of brain and spine disease.
6. Be familiar with the role of advanced CT/MR imaging techniques, specifically MRSPECT, MR Diffusion, MR Perfusion, CTA/P, MR-RAPID in their application to the treatment of patients with vascular and neoplastic disease of the brain.

### **Patient Care**

1. Refine an understanding of the strengths/weaknesses of diagnostic tests for achieving a neuroradiology diagnosis (CT/A/P, MRI/A/P, angiography, myelography) relative to other diagnostic tests for achieving a diagnosis
2. Obtain informed consent, explaining to patients the risks/contraindications of neuroradiologic procedures
3. Demonstrate knowledge of contrast agents doses/risks/contraindications used in neuroradiologic imaging.
4. Appropriately treat contrast reactions
5. Produce a reasoned, complete and useful differential diagnosis based upon imaging findings
6. Develop an understanding of the strengths/weaknesses of MRI, MRSPECT, MR Perfusion in the care of patients with brain tumor. Understand the strengths/weaknesses of MRA/CTA/CTP in the treatment of patients with vascular diseases. Understand the role of myelography/CT/MRI in the treatment of patients with spine disease.
7. Be familiar with the risks/contraindications of the MR examination. Be familiar with MRI safety resources.
8. Be familiar with the contrast agents used in CT/MRI as well as doses and risks.

### **Practice-Based Learning**

1. Review all cases and present findings with differential diagnosis to the attending. The attending interprets and modifies or corrects preliminary interpretation.
2. Review Attendings' Resident Evaluation form. Discuss comments when pertinent.
3. Learn to access and incorporate Pub Med and Google searches in interpretive armamentarium
4. Attend clinical conferences in Neurology, Neurosurgery, Neuropathology (RIH).

### **Communication and Interpersonal Skills**

1. Consultation with clinicians who come to review imaging studies
2. Verbalization of observation and interpretation leading to a useful differential diagnosis
3. Organize cases and present a lucid description of patient's clinical problem as well as past medical and surgical history prior to image interpretation
4. Dictate cases in an organized, succinct and informative fashion
5. Teach junior residents/medical students MRI skills
6. Consultation with technologists who seek guidance regarding patient contrast and MRI safety.
7. Present at interdisciplinary and regional/national conferences

### **Professionalism**

1. Demonstrate respect for all patients
2. Serve as a role model for junior residents
3. Respect patient confidentiality
4. Present oneself as a professional in appearance and communication
5. Demonstrate a responsible work ethic with regard to work assignments

### **System-Based Practice**

1. Attend clinical conferences in Neurosurgery, Neurology, Neuropathology (RIH)
2. Gain an understanding of the relative costs and benefits of MRI, CT, myelography and angiography
3. Demonstrate knowledge of ACR appropriateness criteria through discussion with attending staff and case presentation at Imaging Conference
4. Understand the integration of MR imaging findings with clinical findings in obtaining a focused differential diagnosis

### **Fourth Year Residents**

#### **Medical Knowledge**

1. Demonstrate knowledge of neuroanatomy (brain/spine/vascular) and recognize variant versus significant abnormality on brain and spine imaging.
2. Understand the imaging features of neoplastic/inflammatory/degenerative/metabolic/congenital diseases of the CNS
3. Understand principles of CT/MR Imaging (Physics of image acquisition)
4. Understand MRI sequence design-strengths/weaknesses for achieving an unexpected diagnosis and develop an understanding of goal oriented protocol modification.
5. Demonstrate a refined, image based differential diagnosis that is supported by observation, description and synthesis of abnormal findings and is based on an understanding of the anatomy, physiology, pathology and imaging features of brain and spine disease.
6. Demonstrate understanding and interpretation of advanced CT/MR imaging techniques, specifically MRSPECT, MR Diffusion, MR Perfusion, CTA/P and MR-RAPID in their application to the treatment of patients with vascular and neoplastic disease of the brain.

#### **Patient Care**

1. Communicate an understanding of the strengths/weaknesses of diagnostic tests for achieving a neuroradiology diagnosis (CT/A/P, MRI/A/P, angiography, myelography) relative to other diagnostic tests for achieving a diagnosis
2. Obtain informed consent, explaining to patients the risks/contraindications of neuroradiologic procedures
3. Demonstrate knowledge of contrast agents doses/risks/contraindications used in neuroradiologic imaging.
4. Appropriately treat contrast reactions
5. Produce a reasoned, complete and useful differential diagnosis based upon imaging findings
6. Understand the strengths/weaknesses of MRI, MRSPECT, MR Perfusion in the care of patients with brain tumor. Understand the strengths/weaknesses of MRA/CTA/CTP/MR-RAPID in the treatment of patients with vascular diseases.
7. Understand the role of myelography/CT/MRI in the treatment of patients with spine disease.
8. Be familiar with the risks/contraindications of the MR examination. Be familiar with MRI safety resources.
9. Be familiar with the contrast agents used in CT/MRI as well as doses and risks.

### **Practice-Based Learning**

1. Review all cases and present findings with differential diagnosis to the attending. The attending interprets and modifies or corrects preliminary interpretation.
2. Review Attendings' Resident Evaluation form. Discuss comments when pertinent.
3. Learn to access and incorporate Pub Med and Google searches in interpretive armamentarium
4. Attend clinical conferences in Neurology, Neurosurgery, Neuropathology (RIH).

### **Communication and Interpersonal Skills**

1. Consultation with clinicians who come to review imaging studies
2. Verbalization of observation and interpretation leading to a useful differential diagnosis
3. Organize cases and present a lucid description of patient's clinical problem as well as past medical and surgical history prior to image interpretation
4. Dictate cases in an organized, succinct and informative fashion
5. Teach junior residents/medical students MRI skills
6. Consultation with technologists who seek guidance regarding patient contrast and MRI safety.
7. Present at interdisciplinary and regional/national conferences

### **Professionalism**

1. Demonstrate respect for all patients
2. Serve as a role model for junior residents
3. Respect patient confidentiality
4. Present oneself as a professional in appearance and communication
5. Demonstrate a responsible work ethic with regard to work assignments

### **System-Based Practice**

1. Attend clinical conferences in Neurosurgery, Neurology, Neuropathology (RIH)
2. Gain an understanding of the relative costs and benefits of MRI, CT, myelography and angiography
3. Demonstrate knowledge of ACR appropriateness criteria through discussion with attending staff and case presentation at Imaging Conference
4. Understand the integration of MR imaging findings with clinical findings in obtaining a focused differential diagnosis

## **MRI - Policies and Procedures**

The following policies and procedures for MRI may be found on the Lifespan intranet home page by accessing the following:

**Medical → Radiology → RIH Radiology → RIH Policies and Procedures → MRI**

### **Policies**

MRI-02 MRI Magnetic Field Safety Policy

### **Guidelines**

MRI Operations Guidelines

MRI Exams of Pregnant Patients (includes questionnaire)

MRI Guideline Gadolinium Contrast Administration and Reaction

MRI Guideline for Contrast Extravasation

MRI Guideline for Room Equipment Cleaning

MRI Guideline for Failed Patient Procedure

MRI Guideline for Inpatient /ED MRI Requests

MRI Guideline for Inpatient Sedation

MRI Guideline for Orbital Foreign Body Screening for MR Patients

MRI Guideline for Outpatient Medication Use

MRI Guideline for Patients with Implanted Medtronic Devices

MRI Guideline for Pregnant Employees in MR Environment

MRI Contrast Use in Patients with Renal Dysfunction

MRI-14 Guidelines for MRI Pediatric Patients with Programmable Shunts

Outpatient Oral Contrast Dispensing Guideline



## NUCLEAR MEDICINE

### **I. Daily Work**

The hours of service on this rotation are from 8:00 a.m. until all scheduled cases including cardiac studies have been reviewed. When necessary, the work day may extend later than 5:00 p.m. and the resident should plan on staying until all of these studies are completed unless s/he is needed elsewhere for on-call responsibilities. The resident is responsible for monitoring and supervising all studies performed in the Division of Nuclear Medicine. Chart reviews and interviews with patients are helpful in many patients. Other relevant imaging studies should be reviewed. All non-PET cases will be reviewed by the resident prior to discharging the patient from the section and additional views requested as necessary. The quality of these examinations is therefore the direct responsibility of the resident.

For PET/CT studies, the resident will review all requests and prescribe the appropriate imaging protocol on the day before the scheduled exam.

Following review of the studies with the staff radiologist, the resident will be responsible for performing the dictation and sign-off of reports in a timely manner. The resident will maintain a presence in the Department until at least 5:00 p.m. for the purpose of consultations and for monitoring any on-going examinations.

Before leaving the Department, should there be any pending examinations which have been arranged by the resident assigned to that rotation, the resident will sign out in a formal manner with the radiology resident on call that evening. The daily work will be completed prior to signing out.

The resident assigned to Nuclear Medicine will review requests for emergency studies and will arrange their scheduling in conjunction with the clerical and technical staff. As with routine studies, all complementary examinations will be reviewed prior to performing the emergency study.

Radiology residents will spend time on their first Nuclear Medicine rotation accompanying a Nuclear Medicine technologist in their departmental activities. They will receive training in radiopharmaceutical administration as well as gamma camera imaging, radiopharmaceutical preparation, camera and radiopharmaceutical quality assurance, radiopharmaceutical injection techniques, and radiation safety monitoring. Thereafter, they will be allowed to administer all diagnostic radiopharmaceuticals without supervision.

During the course of residency training, each resident must observe and participate in certain technical aspects of Nuclear Medicine (e.g., camera quality control, kit preparation). Completion of a formal didactic program in these procedures will be required including hands on participation where appropriate. In addition, the resident will be responsible for keeping a log of all Nuclear Medicine therapy cases in which the resident participates. Each resident must participate in (and document) at least three cases of radioactive iodine therapy for hyperthyroidism (dose < 33 mCi) and at least three cases of radioactive iodine therapy for thyroid cancer (dose > 33 mCi).

Throughout their residency, radiology residents will only be able to administer therapeutic radiopharmaceuticals under the direct supervision of a Nuclear Medicine attending physician who is present at the time of the radiopharmaceutical administration.

Nuclear medicine plays an important role in emergency and on call studies. Many nuclear medicine studies are not elective (V/Q scan, bleeding scans, etc.) and part of the resident's experience in Nuclear Medicine for these studies occurs in the call setting. It is expected that the on-call resident will be involved in triage, performance, and interpretation of these studies and recognize them as an extension of the nuclear medicine training experience. In the event that there is a request for a brain death nuclear medicine study or any other emergency Nuclear Medicine study that requires attending assistance, the resident on call should get in touch with one of the nuclear medicine physicians (Drs. Noto, Yoo, Movson, Noel). The Nuclear Medicine attending physician who will be covering the service on the next weekday should be contacted first with any off-hours Nuclear Medicine questions that the resident may have or to help with interpretation of on-call cases as needed.

With regard to Nuclear Cardiology studies, the resident should read out with the Nuclear Medicine attending whenever he/she is reading the cardiac studies. On days that a cardiologist is reading the Nuclear Cardiology studies, the resident should join the read-out for as much time as their non-cardiac responsibilities permit.

## **II. Evaluation**

The resident will be evaluated primarily on their performance in the daily operations of the department. This includes their general radiology knowledge, specific nuclear medicine knowledge, quality of dictated reports, consultative abilities with referring physicians, and ability to run the operations of the department.

In addition, the resident will be evaluated on their performance on cases shown in noon conference and the cases monitored and interpreted when on call.

Evaluations will be filled out by the Division Director and other Nuclear Medicine physicians at the end of each monthly rotation.

## **IV. Didactic Conferences**

An average of two nuclear medicine noon conferences will be given each month. This will include a mix of didactic lectures and case conferences designed to cover all areas of general nuclear medicine and PET in a two-year period.

## **V. Educational Goals and Objectives**

### **First Year Residents**

By the end of the first year, the resident should be able to:

### Medical Knowledge:

1. Describe basic radiopharmaceutical preparation and basic knowledge of nuclear medicine physics and instrumentation.
2. Discuss common types of pathology for frequently performed nuclear medicine exams.
3. Review all types of nuclear medicine exams to ensure that the exam is complete and request additional views when necessary.
4. Use a systematic approach to identify common abnormalities on frequently performed nuclear medicine exams.

### Patient Care:

1. Perform physical examinations and history relevant to the nuclear medicine study
2. Describe clinical indications and techniques for all frequently performed nuclear exams.
3. Review and protocol all PET/CT requests.

### Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors.
2. Incorporate feedback into improved performance.
3. Efficiently use electronic and print resource to access information.

### Communication and Interpersonal Skills:

1. Dictate all non-cardiac nuclear medicine examinations, including PET/CT, performed in a routine day in a coherent fashion after having reviewed scans with attending nuclear medicine physician.
2. Communicate appropriately with all Nuclear Medicine technical and clerical staff.
3. Call referring physicians with any urgent or unexpected positive results.

### Professionalism

1. Demonstrate appropriate professional behavior towards patients, nuclear medicine technical and clerical staff, and other physicians.
2. Respect patient confidentiality and privacy.
3. Present oneself as a professional in appearance and communication.
4. Demonstrate responsible work ethic.

### Systems-based Practice

1. Review for appropriateness any requests for studies that the technical and clerical staff are uncertain about, including protocol review for all PET/CT scans
2. Attend multi-disciplinary conferences, including oncology conferences, when appropriate.
3. Demonstrate knowledge of ACR standards and appropriateness criteria.

## **Second Year Residents**

By the end of the **second year**, the resident should be able to:

### Medical Knowledge:

1. Describe basic radiopharmaceutical preparation and basic knowledge of nuclear medicine physics and instrumentation.
2. Discuss common types of pathology for frequently performed nuclear medicine exams.
3. Review all types of nuclear medicine exams to ensure that the exam is complete and request additional views when necessary.
4. Use a systematic approach to identify common abnormalities on frequently performed nuclear medicine exams.
5. Describe the normal biodistribution of radiopharmaceuticals for commonly performed nuclear medicine exams.
6. Participate actively in nuclear cardiology reading session and understand basic concepts of nuclear cardiology interpretation.

### Patient Care:

1. Perform physical examinations and history relevant to the nuclear medicine study
2. Describe clinical indications and techniques for all frequently performed nuclear exams.
3. Review and protocol all PET/CT requests.
4. Participate in all types of Nuclear Medicine therapy including but not limited to treatment of hyperthyroidism, thyroid cancer ablation, radioimmunotherapy, and intracavitary therapy.

### Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors.
2. Incorporate feedback into improved performance.
3. Efficiently use electronic and print resource to access information.

### Communication and Interpersonal Skills:

1. Dictate all non-cardiac nuclear medicine examinations, including PET/CT, performed in a routine day in a coherent fashion after having reviewed scans with attending nuclear medicine physician.
2. Communicate appropriately with all Nuclear Medicine technical and clerical staff.
3. Call referring physicians with any urgent or unexpected positive results.
4. Perform appropriate basic consultations with referring physicians after having first reviewed scans with attending nuclear medicine physician.

### Professionalism

1. Demonstrate appropriate professional behavior towards patients, nuclear medicine technical and clerical staff, and other physicians.
2. Respect patient confidentiality and privacy.
3. Present oneself as a professional in appearance and communication.
4. Demonstrate responsible work ethic.

### Systems-based Practice

1. Review for appropriateness any requests for studies that the technical and clerical staff are uncertain about, including protocol review for all PET/CT scans

2. Attend multi-disciplinary conferences, including oncology conferences, when appropriate.
3. Demonstrate knowledge of ACR standards and appropriateness criteria.
4. Demonstrate knowledge of cost-effectiveness imaging practices, including appropriate utilization of high-cost procedures like PET/CT.

### **Third Year Residents**

By the end of the **third year**, the resident should be able to achieve all of the above (first and second year) objectives, plus the following:

#### Medical Knowledge:

1. Discuss in detail nuclear medicine physics and instrumentation, as well as planar, SPECT and PET camera quality control.
2. Interpret all types of nuclear medicine examinations, including an understanding of the normal biodistribution of all radiopharmaceuticals and the ability to provide an appropriate differential diagnosis list for all abnormalities.
3. Interpret all types of nuclear cardiology examinations.
4. Interpret all types of PET/CT examinations

#### Patient Care:

1. Independently run almost all facets of the daily operations of the nuclear medicine department.

#### Communication and Interpersonal Skills:

1. Actively participate in teaching of junior residents and medical students.

#### Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors.
2. Incorporate feedback into improved performance.
3. Efficiently use electronic and print resource to access information.

#### Professionalism:

1. Demonstrate appropriate professional behavior towards patients, nuclear medicine technical and clerical staff, and other physicians.
2. Respect patient confidentiality and privacy.
3. Demonstrate responsible work ethic.

#### Systems-based Practice:

1. Have general familiarity with Nuclear Medicine regulatory requirements.

### **Fourth Year Residents**

By the end of the **fourth year**, the resident should be able to achieve all of the goals and objectives for the first and second year, plus the following:

### Medical Knowledge:

1. Discuss in detail nuclear medicine physics and instrumentation, as well as planar, SPECT and PET camera quality control.
2. Interpret all types of nuclear medicine examinations, including an understanding of the normal biodistribution of all radiopharmaceuticals and the ability to provide an appropriate differential diagnosis list for all abnormalities.
3. Interpret all types of nuclear cardiology examinations.
4. Interpret all types of PET/CT examinations
5. Prepare basic radiopharmaceutical kits, describe radiopharmaceutical QC, and assay and administer radiopharmaceuticals in a proper fashion.
6. Understand and be capable of performing all nuclear medicine therapy procedures and the proper dose calculation, radiation safety, and radiopharmaceutical administration techniques.

### Patient Care:

1. Independently run almost all facets of the daily operations of the nuclear medicine department.
2. Appropriately answer questions from patients and family members, including those related to radiation safety issues from radiopharmaceutical exposure.
3. Be able to discuss all aspects of nuclear medicine therapy including radiation safety precautions with patients and their family.

### Communication and Interpersonal Skills:

1. Actively participate in teaching of junior residents and medical students.
2. Independently perform consultations with referring physicians regarding appropriate choice of studies and interpretation of all types of nuclear medicine studies.

### Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors.
2. Incorporate feedback into improved performance.
3. Efficiently use electronic and print resource to access information.

### Professionalism:

1. Demonstrate appropriate professional behavior towards patients, nuclear medicine technical and clerical staff, and other physicians.
2. Respect patient confidentiality and privacy.
3. Demonstrate responsible work ethic.

### Systems-based Practice:

1. Have general familiarity with Nuclear Medicine regulatory requirements.

### Mechanism of Evaluation

1. Monthly evaluation forms by all Nuclear Medicine attending physicians.
2. Evaluation by lead Nuclear Medicine technologist.
3. ACR in-service exam.
4. Imaging conference presentations.
5. Noon conference unknown case sessions.

## VI. Nuclear Medicine Reading Lists

A copy of the latest versions of Nuclear Medicine: The Requisites Thrall & Ziessman and Essentials of Nuclear Medicine Mettler & Guiberteau will be available to each resident at the beginning of the rotation. Both texts must be returned at the end of the rotation.

1. Nuclear Medicine: The Requisites  
Thrall & Ziessman  
Comprehensive overview of all types of Nuclear Medicine examinations, with detailed description of procedure techniques included.  
Rotation text – first to fourth year residents
2. Essentials of Nuclear Medicine  
Mettler & Guiberteau  
A very good basic clinical Nuclear Medicine text, concise but complete rotation text  
- first to fourth year residents
3. Diagnostic Nuclear Medicine  
Sandler et al  
A thorough review of all current aspects of Nuclear Medicine  
Supplemental text for third and fourth year residents
4. Principles & Practice of Positron Emission Tomography  
Wahl  
State-of-the-art comprehensive text on PET  
Supplemental text for third and fourth year residents
5. Introductory Physics of Nuclear Medicine  
Chandra  
Basic Nuclear Medicine physics, contains most of the Nuclear Medicine physics needed for the written boards
6. Atlas of Clinical Nuclear Medicine  
Fogelman  
Detailed atlas of Nuclear Medicine procedures, brief text included
7. Oncologic Imaging  
Bragg, Rubin, and Hricak
8. Clinical Practice of Nuclear Medicine  
Taylor/Datz
9. Differential Diagnosis in Nuclear Medicine  
Silberstein/McAfee

## **R1/PGY2 Radiology Nuclear Medicine Rotation Goals and Responsibilities**

Learn basic concepts of Nuclear Medicine physics, including modes of radioactive decay, radionuclide production, production of radiopharmaceuticals, and NM instrumentation.

Understand how Nuclear Medicine exams are performed including observation of technologists performing camera QC and acquiring NM exams. Observe radiopharmaceutical preparation at radiopharmacy one morning during first year rotation.

Learn the normal appearance of common NM exams including bone scans, hepatobiliary scans, thyroid scans, etc., and independently review these exams for completeness by the end of the first year rotation.

Become familiar with the various protocols for performing nuclear cardiology studies and be able to identify normal structures in short and long axes on myocardial perfusion scans.

Identify typical abnormalities on all common NM exams and on oncologic PET/CT studies. Begin to perform routine consultations for referring physicians and appropriately complete reports on all types of NM exams and all PET/CT exams after consultation with attending radiologist.

### **Reading list:**

First year text - Essentials of Nuclear Medicine Imaging, Mettler, FA and Guiberteau, MJ, 2012.

Week 1 - Days 1, 2, and 3 - chapters 1 and 2 (radiopharmaceuticals, instrumentation, and QC) and chapter 13 (radiation safety) Days 4 and 5 - chapter 8 (bone); Rad Primer basic cases 1-20

Week 2 - Days 1 and 2 - chapter 11 (PET) Days 3 and 4 - chapter 4 (endocrine); Rad Primer basic cases 21-40 Day 5 - chapter 3 (CNS)

Week 3 - Days 1 - chapter 6 (lung)

Day 2 - chapter 12 (infection)

Day 3 - chapter 7 (GI)

Day 4 - chapter 9 (GU)

Day 5 - chapter 10 (non-PET oncology)

Week 4 - Days 1 and 2 - chapter 5 (cardiac); Rad Primer basic cases 41-60 Day 3 - Review appendix E, F, G, H and I in Mettler; Rad Primer basic cases 61-80 Days 4 and 5 - Unknown case set in Mettler; Rad Primer basic cases 81-100



**Nuclear Medicine Classroom and Laboratory Training for AU Status  
 Department of Diagnostic Imaging Residency Program  
 Warren Alpert Medical School of Brown University/Rhode Island Hospital  
 July, 2017**

- 1) Dr. Villafana's weekly physics instruction. The entire program of instruction listed below is given every 2 years so the residents receive a total of 100 hours of Nuclear Medicine specific instruction over the course of their 4 year residency.

<u>Topic</u>	<u>General Course Overall hours</u>	<u>Nuclear Medicine Applicable Hours</u>	<u>Total Nuclear Medicine hours</u>
Basic Concepts in Physics	1	1	1
Basic Concepts of Radiation	3	3	4
X-ray Production	4	1	5
Interactions of Radiation with Matter	4	3	8
Radiation Safety (General)	4	4	12
Image Performance Measures	3	3	15
Digital Imaging Concepts	3	3	18
Computerized Tomography	5	2	20
Radiobiology	6	6	26
Radioactivity Basics	5	5	31
NMed Radiation Safety	6	6	37
Production of Radiopharmaceuticals	4	4	41
Measurements & Instrumentation	5	5	46
Quality Control Procedures	4	4	50
			Total...50 hours

- 2) Third year residents get an additional 15 hours nuclear medicine applicable hours by attending Dr. Villafana's 40 hour national review course

- 3) First year residents spend one morning at our local radiopharmacy (Cardinal Health) learning about radiopharmaceutical production, kit preparation, and radiopharmaceutical QA – 4 hours total
- 4) First year residents spend two mornings with technologist staff reviewing radiopharmaceutical administration techniques, camera and hot lab QC and departmental radiation safety procedures – 6 hours total
- 5) Radioactive Iodine Therapy (Drs. Noto, Yoo, Movson and endocrinology staff) – Minimum of 3 treatments >33 mCi I-131 and 3 treatments <33 mCi I-131, plus 2 one hour lectures on NM therapy (Dr. Noto) – 5 hours total

Total NM Classroom and Laboratory time spent = 130 hours

## PEDIATRIC RADIOLOGY

### Daily Work

The daily work begins at 8:00 a.m. Residents may arrive earlier if they wish depending on the morning conference schedule.

The resident is expected to function as both a resource and a liaison between clinicians, their patients and patients' families, and the Pediatric Radiology section.

Residents may observe clinical work rounds (PICU, inpatients, pedi surgery) in the section during the day, and will attend Pediatric Radiology conferences as listed below.

***Residents are encouraged to observe, perform and interpret pediatric US daily.*** All completed US examinations must be reviewed with the attending pediatric radiologist before the patient leaves the section.

Additional resident responsibilities vary by day of the week as follows:

### **Monday and Friday:**

First, the resident will review exams from the pediatric OUTSIDE list. Then, the resident will review exams from the pediatric UR list. The resident then reads out with one of the pediatric radiology attendings present in the section. The overnight outside exams and the exams with resident prelim reads should be reviewed and signed out by 11 AM daily.

Residents may observe attending interpretation of the exams from the neonatal intensive care unit at Women and Infants Hospital daily at both approximately 9:00 AM and 4:00 PM.

Then, the radiology resident will review exams from the pediatric UR list throughout the day. The resident then reads out with one of the pediatric radiology attendings present in the section.

### **Wednesday:**

Wed AM:

Fluoroscopy will be the primary responsibility of the resident with attending and/or physician assistant direct supervision Wed mornings. (As residents become more experienced, fluoroscopic exams may be performed with indirect supervision.) The resident will obtain prior imaging, history from the EMR and indications for scheduled examinations and review all scheduled patients with a pediatric radiology attending by 8:30 AM. All completed fluoro examinations must be reviewed with the attending pediatric radiologist before the patient leaves the section. The resident has no other specific responsibilities Wed AM, but should avail themselves of other opportunities (review NICU, US, MRI, etc.) as time allows.

### **Wednesday PM:**

The resident will accompany the attending to Women & Infants' Hospital to observe NICU work rounds at 1:30 PM and observe neonatal fluoroscopy and bedside ultrasound as they occur throughout the PM.

Then, the radiology resident will review exams from the Lifespan pediatric UR list throughout the PM. The resident then reads out with one of the pediatric radiology attendings present in the section.

### **Tuesday and Thursday:**

First, the radiology resident will review and dictate the NICU UR list at WIH. Immediately upon completion, the resident will sign-out with an attending pediatric radiologist. In general, this sign out is to occur no later than 9AM.

For the remainder of the day, the only responsibilities of the radiology resident are pediatric US in the Hasbro Imaging Center and the NICU unread list at WIH. You are to review, dictate, observe and, at times, perform pediatric ultrasound exams in the section. All US examinations must be reviewed with the attending pediatric radiologist before the patient leaves the section. The resident has no other specific responsibilities Tuesday and Thursday, but should avail themselves of other opportunities (review MRI, etc.) as time allows.

## **Educational Goals and Objectives**

### **First Year**

#### **Medical Knowledge:**

1. Understand common clinical pediatric entities and their imaging characteristics in chest, GI, GU, Musculoskeletal.
2. Primary focus on plain film interpretation, particularly emergency case interpretation.

#### **Patient Care:**

1. Begin to perform basic pediatric fluoroscopic examinations, focusing on VCUG, contrast GI studies
2. Begin to perform basic pediatric US examinations.
3. Begin to develop understanding of appropriate pediatric imaging protocols for common pediatric problems.
4. Introduction to ALARA
5. Uses established evidence-based imaging guidelines such as American College of Radiology (ACR) Appropriateness Criteria®

6. Appropriately uses the Electronic Health Record to obtain relevant clinical information

Practice-based Learning:

1. Identify, rectify, and learn from personal errors
2. Incorporate feedback into improved performance
3. Efficiently use electronic and print resources to access information

Communication and Interpersonal Skills:

1. Learn to work and interact appropriately with infants and children at all developmental stages
2. Learn to work with and communicate with parents effectively
3. Work effectively with pediatric imaging technologists, ancillary staff
4. Communicate radiologic findings and their significance to clinicians in a timely and effective fashion
5. Produce concise, accurate, and grammatically correct radiologic reports

Professionalism:

1. Demonstrate respect for patients and all members of the health care team
2. Respect patient confidentiality
3. Present oneself in a professional manner
4. Demonstrate a responsible work ethic

System-based Practice:

1. Attend pediatric work rounds, subspecialty conferences
2. Understand how radiologic information is integrated with other parts of the health care system
3. Demonstrate knowledge of ACR standards and appropriateness criteria
4. Demonstrate knowledge of cost-effective imaging practices
5. Demonstrate knowledge of pediatric radiation safety issues in imaging

**Second Year**

Medical Knowledge:

1. Demonstrate knowledge of common pediatric entities and competence in providing imaging interpretation of pediatric XR, US, CT and MRI especially emergency cases (ex. Bilious emesis).
2. Understand anatomy and pathologic entities necessary for interpretation of pediatric GI/GU cross sectional imaging.

Patient Care:

1. Performs basic pediatric fluoroscopic examinations, focusing on VCUG, contrast GI studies.
2. Develop further expertise in pediatric US, CT and MRI examinations, including appendicitis MRI, airway evaluation and complex GI/GU studies, including post-operative imaging.
3. Performs basic pediatric US examinations (ex. Renal).

4. Understands appropriate pediatric imaging protocols for common pediatric problems.
5. Understand ALARA principle.
6. Uses established evidence-based imaging guidelines such as American College of Radiology (ACR) Appropriateness Criteria®
7. Appropriately uses the Electronic Health Record to obtain relevant clinical information
8. Begin to protocol pediatric CT and MRI

Practice-based Learning and Improvement:

1. Identify, rectify, and learn from personal errors
2. Incorporate feedback into improved performance
3. Efficiently use electronic and print resources to access information

Communication and Interpersonal Skills:

1. Work and interact appropriately with infants and children at all developmental stages.
2. Work with and communicate with parents effectively
3. Work effectively with pediatric imaging technologists, ancillary staff
4. Communicate radiologic findings and their significance to clinicians in a timely and effective fashion
5. Produce concise, accurate and grammatically correct radiologic reports

Professionalism:

1. Demonstrate respect for patients and all members of the health care team
2. Respect patient confidentiality
3. Present oneself in a professional manner
4. Demonstrate a professional work ethic

Systems-based Practice:

1. Attend pediatric work rounds, subspecialty conferences
2. Understand how radiologic information is integrated with other parts of the health care system
3. Demonstrate knowledge of ACR standards and appropriateness criteria
4. Demonstrate knowledge of cost-effective imaging practices
5. Demonstrate knowledge of pediatric radiation safety issues in imaging

**Third Year**

Medical Knowledge:

1. In addition to knowledge of common pediatric entities:
2. Understand anatomy and physiology of congenital heart disease
3. Become familiar with pediatric CNS abnormalities (ex. Grading of IVH in premature infants, periventricular leukomalacia).
4. Understand pediatric oncological entities and imaging

Patient Care:

1. Develop further expertise in pediatric examinations, including airway evaluation and complex GI/GU studies, including post-operative imaging procedures
2. Participate in performance of neonatal imaging (US and fluoro) in the intensive care unit setting
3. Interpret pediatric body and MSK MRI examinations
4. Continued reinforcement of ALARA principles
5. Protocol pediatric CT and MRI

Practice-based Learning and Improvement:

1. Identify, rectify, and learn from personal errors
2. Efficiently use electronic and print resources to access information
3. Incorporate feedback into improved performance

Communication and Interpersonal Skills:

1. In addition to competence in communication skills listed for junior residents:
2. Effectively teach junior radiology residents, pediatric residents, medical students
3. Present imaging studies at clinical subspecialty conferences

Professionalism:

1. Demonstrate respect for patients and all members of the health care team
2. Respect patient confidentiality
3. Present oneself in a professional manner
4. Demonstrate a responsible work ethic

Systems-based Practice:

1. Attend pediatric work rounds, subspecialty conferences
2. Understand how radiologic information is integrated with other parts of the health care system
3. Demonstrate knowledge of ACR standards and appropriateness criteria
4. Demonstrate knowledge of cost-effective imaging practices
5. Demonstrate knowledge of pediatric radiation safety issues

**Fourth Year**

Medical Knowledge:

1. Independently interpret pediatric emergency imaging (all modalities).
2. Understand complex congenital and acquired pediatric conditions (VACTERL, neuroblastoma, Wilms tumor, etc.).
3. Demonstrates appropriate differential diagnoses of pediatric imaging findings (ex. Lucent metaphyseal bands, bowel obstruction, neonatal lung disease, etc.)

Patient Care:

1. Demonstrate expertise in fluoroscopic pediatric examinations, including airway evaluation and complex GI/GU studies, including post-operative imaging procedures
3. Participate in neonatal imaging in the intensive care unit setting

5. Continued reinforcement of ALARA principles
6. Interpret Pediatric Body MRI examinations
7. Understand principles of ALARA
8. Participate actively in clinical pediatric imaging rounds and conferences
9. Protocol pediatric CT and MRI

**Practice-based Learning and Improvement:**

1. Identify, rectify, and learn from personal errors
2. Efficiently use electronic and print resources to access information
3. Incorporate feedback into improved performance

**Communication and Interpersonal Skills:**

1. In addition to competence in communication skills listed for junior residents:
2. Effectively teach junior radiology residents, pediatric residents, medical students
3. Present imaging studies at clinical subspecialty conferences

**Professionalism:**

1. Demonstrate respect for patients and all members of the health care team
2. Respect patient confidentiality
3. Present oneself in a professional manner
4. Demonstrate a responsible work ethic

**Systems-based Practice:**

1. Attend pediatric work rounds, subspecialty conferences
2. Understand how radiologic information is integrated with other parts of the health care system
3. Demonstrate knowledge of ACR standards and appropriateness criteria
4. Demonstrate knowledge of cost-effective imaging practices
5. Demonstrate knowledge of pediatric radiation safety issues

**Mechanism of Evaluation**

At the completion of each rotation month the residents will be evaluated by the pediatric radiology attendings by means of the monthly evaluation form. In addition, the residents will be evaluated informally by the technology staff who report to the division director, Dr. Herliczek. The ACR in-service examination will also provide evaluation of medical knowledge in pediatric radiology.



## **Pediatric Radiology Conferences**

NB: All residents should complete the pediatric radiology course offered by the Cleveland Clinic online by the end of their second year. It can be found at: <https://www.cchs.net/onlinelearning/cometvsio/pedrad/default.htm>

1. Practical Pediatric Imaging, 2nd Edition  
Donald R. Kirks, Editor
2. Caffey's Pediatric X-Ray Diagnosis, 9th Edition  
Frederick Silverman & Jerald Kuhn, Editors
3. Imaging of the Newborn, Infant and Young Child, 3rd Edition  
Leonard Swischuk
4. Pediatric Orthopedic Radiology, 2nd Edition  
M.B. Ozonoff
5. Ultrasonography of Infants and Children  
Rita Teele and Jane Share
6. Pediatric Sonography, 2nd Edition  
Marilyn Siegel, Editor
7. Radiology of Syndromes, Metabolic Disorders and Skeletal Dysplasia, 4th Edition Hooshang Taybi, Ralph Lachman
8. Imaging of the Pediatric Head, Neck and Spine  
Mauricio Castillo, Suresh Mukherji
9. Pediatric Neuroimaging, 2nd Edition  
A. James Barkovich
10. Cardiac Imaging in Infants, Children and Adults  
Larry P. Elliott

Rotation: Pediatric Radiology

At least 2 hours per day of your time outside the hospital should be dedicated to reading.

## **First Year Reading Instructions**

First 4 week rotation:

Before starting the rotation: review Pediatric Imaging: The Fundamentals by Lane F.

Donnelly

*First 2 weeks:*

Read in its entirety; Pediatric Imaging: The Fundamentals by Lane F. Donnelly...  
Start web series listed for third week if time allows.

*Third week:*

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

Register online and choose your residency program as "RI-BROWN UNIV".

Complete the following topics online:

Lines and Catheters  
Radiation Safety  
Patient Care  
Childhood Pneumonia  
Neonatal Chest  
Esophageal Foreign Body  
Appendicitis  
Blunt Abdominal Trauma  
Hypertrophic Pyloric Stenosis  
Intussusception\  
Malrotation and Midgut Volvulus\  
Pneumoperitoneum  
Testicular Torsion  
Vesicoureteral Reflux  
Child Abuse: Skeletal Trauma  
Childhood Fractures  
Slipped Capital Femoral Epiphysis  
Newborn Cranial Ultrasound

*Fourth week:*

Review Donnelly again.

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

Complete the following topics online:

Vesicoureteral Reflux  
Acyanotic Congenital Heart Diseases  
Coarctation of the Aorta and Hypoplastic Left Heart  
Cyanotic Congenital Heart Disease  
Bronchopulmonary Foregut Malformations  
Mediastinal Masses  
Esophageal Atresia  
Congenital Duodenal Obstruction  
Hypertrophic Pyloric Stenosis

## **Second Year Reading Instructions**

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

Complete the following topics online:

Jejunal and Ileal Stenosis/Atresia  
Malrotation and Midgut Volvulus  
Newborn Jaundice  
Newborn Low Intestinal Obstruction  
]Omphalocele, Gastroschisis & Diaphragmatic Hernia  
Duplication of the Collecting System/Ureters  
Multicystic Dysplastic Kidney  
Neuroblastoma, Ganglioneuroblastoma, Ganglioneuroma

RadPrimer- 100 cases.

Move to the third year assignments when done.

## **Third year rotations:**

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

Complete the following topics online:

Posterior Urethral Valves  
Scrotal Neoplasms  
Ureteropelvic Junction Obstruction  
Wilms and Other Renal Tumors  
Child Abuse: Skeletal Trauma  
Developmental Dysplasia of the Hip  
Ewings Sarcoma  
Langerhans Cell Histiocytosis  
Legg-Calvé-Perthes Disease  
Osteogenic Sarcoma  
Rickets  
Septic Arthritis and Toxic Synovitis  
Chiari Malformations  
Child Abuse: Cerebral Trauma  
Childhood Stroke  
Hydrocephalus  
Pediatric Neck Masses  
Spine: The Sacral Dimple  
TORCH Infections  
Trisomy 21  
Leukemia and Lymphoma  
Sickle Cell Disease

RadPrimer- 100 cases

Email me at [thaddeus\\_herliczek@brown.edu](mailto:thaddeus_herliczek@brown.edu) once you complete these assignments.

## THORACIC RADIOLOGY

The key elements for learning thoracic radiology are: 1) daily exposure to a high volume of chest radiographs and associated CT, PET and MR examinations and 2) an organized approach to reading a specified core of material on cardiopulmonary radiology.

The chest radiology rotation endeavors to expose the resident to full range of imaging modalities including plain film; conventional and high resolution computed tomography; and magnetic resonance imaging, and appropriate nuclear medicine studies such as PET scan in the evaluation of and staging malignancies. Participation in such interventional procedures as transthoracic, fine needle aspiration biopsy and percutaneous catheter drainage of intrathoracic fluid collections occurs in the ultrasound, CT, and special procedures rotations. Radiofrequency ablation and other ablation techniques regarding thoracic malignancies are also not directly part of the thoracic radiology rotation. These are performed as part of the body imaging rotation

Resident participation in weekly pulmonary medicine conferences is expected. Resident participation in at least 1 pulmonary tumor board is expected during each rotation. These enhance the resident's knowledge of the various clinical problems faced by the pulmonologist and cardiothoracic surgeon, and form a basis for helping to guide radiologic workup.

### Daily Work:

The radiology resident assigned to chest division should begin review of cases no later than 8:00am. All pertinent previous radiographs and CT scans shall be reviewed and available. The staff radiologist assigned to the section will subsequently review cases as they are presented by the resident and provide daily teaching rounds with teaching file cases as the work load permits. A complete understanding of normal anatomy and its variations as represented on the chest radiograph and on CT imaging will be required of each resident. That knowledge will form the basis for recognizing abnormal findings and patterns on chest radiographs and CT studies. Differential diagnoses will be stressed.

When MR studies are associated with a case, they will be reviewed in conjunction with plain radiographic and CT findings. Also, nuclear medicine studies including PET scans will be a very important part of consolidating the various imaging modalities in the evaluation and staging of thoracic malignancies.

Frequent requests for consultation will be made by the clinical staff, both in person and on the phone consults. Those consultations should be made by the resident working with the staff radiologist. During their second, third and fourth months on rotation, residents should take increasing responsibility in those consultations. The staff radiologist shall be available at all times. Resident presence in the reading area, except for conference periods, is maintained until at least 5:00 p.m. All dictations should be completed prior to leaving the area. It is important to approve via power scribe all reports prior to leaving the rotation for the day.

Four staff radiologists. Drs. Terrance T. Healey, Thomas K. Eggin, Michael Atalay and Saurabh Agarwal will be primarily responsible for supervising this curriculum and evaluating resident performance. Other staff physicians frequently teaching thoracic radiology include Drs. Don Yoo, Dr. Richard B. Noto, and others.

#### Reading:

A reading list is included below. We have selected reading materials that we believe are the best sources and will guide residents to specific chapters according to their level of training.

#### Examinations:

Tests are a mechanism for organizing thoughts and stimulating further study. In-service exams will help residents gauge their level of knowledge.

#### Conferences:

Conferences will be presented as didactic lectures as well as the "hot seat" format in order to prepare residents for the board examination.

#### General Objectives:

To acquire adequate training in interpretation of chest radiographs and associated CT imaging studies. Essential elements of adult cardiac disease will be reviewed on this service

### **Educational Goals and Objectives**

#### **First Year Residents**

##### Medical Knowledge:

1. Proper patient positioning regarding chest radiographic views.
2. Basic technique in chest radiography, CT and PET.
3. Common radiographic manifestations of lung cancer.
4. Common radiographic manifestations of infectious disease, atelectasis, pneumothorax, congestive heart failure, aortic dissection and rupture
5. Radiographic appearance and proper positioning of common monitoring devices.
6. Recognize common complications of tube and the line placement.

##### Patient Care:

1. Recognize normal thoracic anatomy and its most common variations
2. Differentiate airspace from interstitial disease on chest radiographs and provide an appropriate differential diagnosis.
3. Distinguish malignant and benign pulmonary nodules/masses on chest radiography.

4. Critique the technical quality of a chest radiograph.
5. Understand the indications for Computed Tomography based upon chest radiographic findings.

Practice-based Learning:

1. Identify, rectify and learn from personal errors
2. Incorporate feedback into improved performance
3. Efficiently use electronic and print resources to access information

Communication and Interpersonal Skills:

1. Call the referring physician for positive results and document the communication in the report.
2. Learn the recommended terminology for reporting chest radiographic and CT findings.
3. Communicate effectively with all members of the health care team
4. Effectively utilize department protocol and procedure regarding communication of important and critical results.

Professionalism:

1. Demonstrate respect for patients and all members of the health care team
2. Respect patient confidentiality
3. Present oneself as a professional in appearance and communication.
4. Demonstrate a responsible work ethic with regard to work assignments

Systems-based Practice:

1. Attend Pulmonary Case Management Conference and demonstrate understanding of how chest radiographic, CT and PET imaging are integrated with the clinical care of the patient
2. Demonstrate knowledge of ACR standards for chest radiography and CT
3. Become familiar with ACR appropriateness criteria for evaluation of pulmonary signs and symptoms

**Second Year Residents**

Medical Knowledge:

1. Staging and surgical management of lung cancer
2. Uncommon manifestations of lung cancer
3. Manifestations and clinical management of less common thoracic diseases (idiopathic interstitial pneumonias, LCH, vasculitis, hypersensitivity pneumonitis, mediastinal tumors, pleural tumors, pneumoconiosis, sarcoidosis, airway diseases)
4. Familiarity with cardiac anatomy and pathology, especially radiographic manifestations of valvular heart disease

Patient Care:

1. Be able to discuss differential features of airspace and interstitial diseases on chest radiographs and CT/HRCT

2. Be able to construct a differential diagnosis for solitary and multiple pulmonary nodules and pulmonary masses detected on chest radiography and by CT
3. Be able to critique the technical quality of a CT/HRCT studies
4. Know the indications for computed tomography based upon chest radiographic findings

Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors
2. Incorporate feedback into improved performance
3. Efficiently use electronic and print resources to access information

Communication and Interpersonal Skills:

1. Call the referring physician for positive results and document the communication in the report.
2. Use the recommended terminology for reporting chest radiographic and CT findings, including HRCT.
3. Communicate effectively with all members of the health care team, including the proper communication of the important and critical results as per department protocol.
4. Teach medical students and medical residents basic thoracic imaging

Professionalism:

1. Demonstrate respect for patients and all members of the health care team
2. Respect patient confidentiality
3. Present oneself as a professional in appearance and communication.
4. Demonstrate a responsible work ethic with regard to work assignments

Systems-based Practice:

1. Attend Pulmonary Case Management Conference and demonstrate understanding of how chest radiographic, CT and PET imaging are integrated with the clinical care of the patient
2. Demonstrate knowledge of ACR standards for chest radiography and CT
3. Become familiar with ACR appropriateness criteria for evaluation of pulmonary signs and symptoms

**Third Year Residents**

Medical Knowledge:

1. Staging and surgical management of lung cancer
2. Uncommon manifestations of lung cancer
3. Manifestations and clinical management of less common thoracic diseases (idiopathic interstitial pneumonias, LCH, vasculitis, hypersensitivity pneumonitis, mediastinal tumors, pleural tumors, pneumoconiosis, sarcoidosis, airway diseases)
4. Familiarity with cardiac anatomy and pathology, especially radiographic manifestations of valvular heart disease

5. Further consolidate knowledge and understanding of the unusual and characteristic lung diseases as they appear clinically, by conventional radiography and on high-resolution CT
6. Continued understanding and knowledge of unusual manifestations of chest infections especially in the immunocompromised host, and in the transplant patient.

Patient Care:

1. Be able to discuss differential features of airspace and interstitial diseases on chest radiographs and CT/HRCT
2. Be able to construct a differential diagnosis for solitary and multiple pulmonary nodules and pulmonary masses detected on chest radiography and by CT
3. Be able to critique the technical quality of a CT/HRCT studies
4. Know the indications for computed tomography based upon chest radiographic findings

Practice-based Learning and Improvement:

1. Identify, rectify and learn from personal errors
2. Incorporate feedback into improved performance
3. Efficiently use electronic and print resources to access information

Communication and Interpersonal Skills:

1. Call the referring physician for positive results and document the communication in the report.
2. Use the recommended terminology for reporting chest radiographic and CT findings, including HRCT.
3. Communicate effectively with all members of the health care team, including the proper communication of the important and critical results as per department protocol.
4. Teach medical students and medical residents basic thoracic imaging

Professionalism:

1. Demonstrate respect for patients and all members of the health care team
2. Respect patient confidentiality
3. Present oneself as a professional in appearance and communication.
4. Demonstrate a responsible work ethic with regard to work assignments

Systems-based Practice:

1. Attend Pulmonary Case Management Conference and demonstrate understanding of how chest radiographic, CT and PET imaging are integrated with the clinical care of the patient
2. Demonstrate knowledge of ACR standards for chest radiography and CT
3. Become familiar with ACR appropriateness criteria for evaluation of pulmonary signs and symptoms

**Fourth-year Residents:**



### Medical Knowledge:

1. Imaging findings of the post-surgical chest.
2. Atypical manifestations of common thoracic diseases.
3. Adult manifestations of congenital diseases
4. Consolidate the knowledge of all prior years in one's residency, critically evaluate deficient areas of knowledge and create a plan to rectify any existing deficiencies.

### Patient Care:

1. Apply the proper management algorithm for common and less common thoracic diseases.
2. Advise clinicians regarding case management algorithms by integrating clinical history, physical and laboratory findings, and imaging results.

### Practice-based Learning:

1. Identify, rectify and learn from personal errors
2. Incorporate feedback into improved performance
3. Efficiently use electronic and print resources to access information

### Communication and Interpersonal Skills:

1. Appropriately communicate results to patients and clinicians and document communication in the report
2. Produce radiologic reports with proper terminology, concise structure, and clear conclusions and recommendations.
3. Communicate effectively with all members of the health care team. This includes the proper communication of important and critical results as per routine department protocol as it exists from time to time.
4. Mentor junior residents in the skills outlined in First and Second/Third Year goals.

### Professionalism:

1. Demonstrate respect for patients and all members of the health care team
2. Respect patient confidentiality
3. Present oneself as a professional in appearance and communication.
4. Demonstrate a responsible work ethic with regard to work assignments
5. Demonstrate a long-term plan for further education radiology, lifelong learning and a proper approach to staying current in the thoracic radiology after the end of one's formal education.

### Systems-based Practice:

1. Attend Pulmonary Case Management Conference and demonstrate understanding of how thoracic imaging modalities are integrated with the clinical care of the patient
2. Apply knowledge of ACR Standards for chest radiography and CT
3. Become familiar with ACR appropriateness criteria for evaluation of pulmonary signs and symptoms
4. Final review and consolidation of formal terminology as outlined by the Fleischer society and other organizations for chest imaging.

### **Mechanism of Evaluation**

Each resident will be evaluated on the basis of their daily work, their behavior (including interactions with clerical and technical personnel, consultants, and other radiologists), their completion of appropriate reading materials, and the development of their interpretive and reporting skills. At the end of each month the appropriate faculty will complete a monthly rotation evaluation.

### **Resources:**

Doctor Terrance Healey is an experienced chest radiologist and is responsible for the organization and supervision of the cardiopulmonary radiology rotation. Further exposure to thoracic CT and MR imaging will occur during the body imaging and MR rotations. Congenital thoracic abnormalities will also be taught during the pediatric rotations. Formal cardiac CT and MR are taught by separate cardiac staff, primarily Dr. Michael Atalay, Dr. Kevin Chang, and Dr. Saurabh Agarwal. The nuclear medicine evaluation of thoracic disease is taught by the nuclear medicine division, primarily Dr. Richard Noto and Dr. Don Yoo.

## **Bibliography**

Required reading: all books can be checked out from the resident library during a resident's months of rotation.

*Thoracic Radiology: The Requisites*, Theresa McLoud.

A concise and up-to-date overview of thoracic radiology.

*Imaging of Diseases of the Chest*. Hansell, Lynch, McAdams, Bankier 2010.

Excellent new comprehensive book.

*High Resolution CT of the Lung*, Webb, Muller and Naidich, 2009.

An excellent book with extensive illustrations.

*HRCT of the Lung: Anatomic Basis, Imaging features, Differential Diagnosis*. Gurney, Winer- Muram, Roasdo-de-Christenson, Mohammed, Abbott, Huller Maier. Amirsys 2009.

Nice DI series style with brief summaries of all HRCT diagnoses.

*Radiologic Diagnosis of Diseases of the Chest*. Muller, Fraser, Colman and Pare, 2001.

An excellent one-volume synopsis of a large, four-volume set. The four-volume set is available in Dr. Abbott's office during your rotation.

*Computed Tomography and Magnetic Resonance of the Thorax* , Naidich et al, third edition.

A comprehensive text of thoracic CT imaging.

## **R1/PGY2 Radiology Chest Rotation Goals and Responsibilities**

- Read residency manual which details goals and responsibilities prior to rotation
- Learn normal thoracic anatomy
- Recognize and call critical results into the ordering clinician
- Recognize normal and abnormal position of all lines and tubes
- Participate in at least one Thoracic Tumor Board (Monday 6:45 am)
- Arrive promptly by 8:00 AM and have all cases on the CHURALL list performed up to and including 5:00 PM read out with a staff radiologist

## **Reading**

Thoracic Requisites McLoud 2010 (All Chapters below)

Before starting the rotation: Residency manual. McLoud Ch 1.

Two week introductory rotation (Chest):

Day 1: Chapter 5

Day 2: Chapter 3  
Day 3: Chapter 15  
Day 4: Chapter 16, Chapter 17  
Day 5: Chapter 18  
Day 6: Chapter 10  
Day 7: Chapter 11Day 8: Chapter 12  
Day 9: Chapter 13  
Day 10: Chapter 14  
Day 11: Chapter 4, Chapter 9  
Day 12: Chapter 8, Chapter 7  
Day 13: Chapter 2, Chapter 6, Chapter 19 (these can be briefly reviewed as the material will also be covered during ER, Pediatric & VIR rotations).

Four week rotation (Cardiopulmonary):

First two weeks: RadPrimer basic cases (80). Case review series first round. Articles on the Lifespan intranet thoracic folder.

Second two weeks: RadPrimer intermediate cases (266).

Other resources:

World Wide Web:

The Society of Thoracic Imaging maintains a web page at: <http://www.thoracicrad.org> which includes the syllabus (text and images) from the annual meetings of the Society. Several excellent lectures are available at: <http://www.thoracicrad.org>

An excellent and educational web page was created by Dr. Gurney who was one of the most entertaining and authoritative teachers in thoracic imaging.  
[www.chestx-ray.com](http://www.chestx-ray.com)

## VASCULAR AND INTERVENTIONAL RADIOLOGY

The purpose of the training program in Vascular and Interventional Radiology is to provide residents with an introduction to the clinical and technical skills necessary for the practice of Vascular and Interventional Radiology, and stimulate interest in the field as a potential future career path. It is expected that after completion of the program, residents will be capable of performing basic diagnostic and interventional procedures. Those interested in performing advanced diagnostic and interventional procedures should pursue further training in a Vascular and Interventional Radiology Fellowship.

Performance criteria for each level of training are included within these requirements. The residents' evaluations will reflect their compliance with these expectations.

### **I. DAILY PROTOCOL**

A. Start time: Residents are to report to the Vascular and Interventional Radiology section by 7:15 a.m. daily unless inpatient rounding and pre-procedure patient work-up necessitates earlier arrival (which may occur on days when there are scheduled didactic lectures or conferences at 7:00 a.m.). Residents are to report to conference room A on the third floor in the main building promptly at 7:00 a.m. for the weekly scheduled Interventional Radiology didactic conference/lecture.

B. Pre-procedure assessment: Pre-procedure assessment for outpatients undergoing scheduled procedures will usually have occurred in clinic at RI Vascular Institute (RIVI), and for inpatients this usually occurs on the wards prior to scheduling the procedure. In rare circumstances, pre-procedure assessment may occur in the VIR department immediately prior to the procedure if it has not previously been done. Pre-procedure evaluation includes an updated history and physical examination, review of pertinent labs and imaging, formulation of a preliminary treatment plan, and obtaining informed consent for the intended procedure. The complete process of informed consent involves 4 items: 1.) A general explanation of the procedure in terms that the patient is able to understand, 2.) Discussion of the expected benefit(s) of the procedure, 3.) Discussion of the potential risks of the procedure, 4.) An explanation of potential alternative diagnostic procedures or treatments for the patient's condition. The patient should also be given the opportunity to ask questions about the intended treatment plan, and those questions should be adequately answered prior to obtaining a written or verbal consent to proceed.

C. Pre-morning report: All active inpatients on the VIR follow-up list should be evaluated prior to the start of morning report or scheduled conferences/lectures at the beginning of each work day. Inpatients that are scheduled for planned procedures that day should be evaluated, consented, and have all appropriate pre-procedure documentation (including pre-procedure medication orders) completed in LifeChart prior to morning report or didactic conference. This will allow nursing staff to prepare patients for procedures while physicians participate un-interrupted in these activities. Outpatients that are scheduled for elective procedures should have undergone a complete chart review prior to morning report, to include review of labs, pertinent allergies, clinical history, indication for the procedure, and basic treatment plan. It is required that residents review the scheduled

patient list with the fellows at the end of the previous workday and take primary responsibility for one patient on the list to have all necessary pre-procedure information and documentation ready and complete for formal presentation at morning report. As residents progress through subsequent years of training, it will be expected that they are able to prepare and present more than one patient at morning report on any given day. These assignments should be coordinated with the fellows so as to avoid redundant labor amongst physician team members. Residents must coordinate with the fellows to ensure that all patients scheduled as "first case" in any of the 3 procedure rooms has all pre-procedure documentation complete in the electronic medical record (H&P, consent, pre-procedure orders), and is present in the scheduled procedure room and appropriately verified according to the Universal Protocol prior to the start of morning report so that technologists may be actively prepping patients during the report to facilitate punctual procedure start times immediately following. The procedure must be explained to the patient and appropriate consent obtained. Pertinent information regarding informed consent to be discussed with the patient based on the type of procedure planned is available in written form on the specific consent forms for these procedures within the Department. Residents should familiarize themselves with basic description of the procedure and its pertinent risks using these forms as a reference prior to discussion with the patient. Questions regarding specific procedure-related risks or those pertaining to complex interventions should be resolved with the assistance of senior residents, fellows, or Attending Staff prior to morning report whenever possible. A thorough understanding of the patient's condition, the indication for the procedure, and the technique involved in performance of the procedure is mandatory. In many cases, this will require specific reading and preparation the evening prior to performance of the procedure. This preparation is a prerequisite for any direct resident involvement as the primary operator in the procedure. It is also strongly advised that evening reading while on rotation should specifically include material on cases scheduled for the next day, regardless of the anticipated level of involvement in the procedure. This will enhance the resident learning experience when all cases are discussed at the day's end during formal read-out.

The daily schedule should be reviewed on the prior evening. History and physical examinations performed in clinic at the Rhode Island Vascular Institute (RIVI) Office and physician consults completed during floor consults should be collected and reviewed in preparation for morning report. RIVI office notes are available in the RIMI Synapse system, or may be requested by fax by calling the RIVI office at (401) 421-1924. All pertinent images relevant to the planned procedure should be reviewed in preparation for morning report. Referring physicians should be consulted prior to morning report for clarification on treatment plans as needed.

D. Morning report: Morning report begins promptly at 7:45 a.m. each morning (8:00 a.m. on days when there are scheduled 7:00 a.m. conferences/lectures) and is to be completed by 8:30 a.m. to start the daily procedures and maintain workflow efficiency. The scheduled cases and any urgent/emergent overnight add-ons for the day are reviewed during morning report ("read-in"). The fellows and residents are responsible for presenting all relevant information on patients who are scheduled for procedures that day, to also include a preliminary assessment and plan of care. A finalized care plan will be generated during morning report after discussion with the Attendingstaff. All providers will have a printed copy of the daily case schedule and will be responsible for making

individual notes to be aware of and understand the treatment plan for each patient. Residents and fellows will compile relevant "To Do Lists" for their respective patients at this time. Residents will also be responsible for accessing LifeChart for each patient as they are discussed and entering any additional pre-procedure orders as a treatment plan is finalized. The "Active Inpatient Follow-up list" (see below, Section G) is reviewed after discussing scheduled cases to review issues pertaining to continuity of care for patients recently treated or consulted on by the VIR service. For any assigned patients, the resident should provide a brief description of active issues and update the team on the patient's clinical status, which is then followed by a brief discussion with the Attending staff regarding any necessary changes to the plan of care. As soon as time permits (if not already done), the resident or fellow is responsible for putting a brief follow-up note in LifeChart with the updated plan of care to facilitate communication with other patient care providers. This note is to be sent to the supervising Attending physician for co-signature. At the end of morning report, the VIR Consult/Protocol list in LifeChart should be reviewed to triage any urgent add-on procedures or consults in a timely fashion at the beginning of the day. The fellows will have primary responsibility for protocolling and triaging all requests for VIR procedures and consultations from this list throughout the day.

E. Procedures and Daily Workflow: Procedures should begin promptly after completion of morning report, which should be no later than 8:30 a.m. Whenever possible, residents should participate in procedures for patients that they evaluated prior to the procedure, where the intended treatment plan and procedure is well-known. Degree of involvement in procedures will be determined based on demonstrated ability. Familiarity with the clinical presentation, including the patient history and physical examination, laboratory data, imaging, and intended plan of care is considered a prerequisite for resident involvement in any case. This means that upon entering a procedure room, the chart must be reviewed. Most residents begin their IR experience as a second-assistant whose primary responsibility is to "run the equipment table". The practice of good sterile technique and demonstrating the ability to maintain a neat, organized equipment table, including preparation of saline flush and contrast syringes, is required prior to graduating to more advanced levels of procedural assistance as the primary or secondary operator. Residents who perform entry-level duties adequately may then progress to assisting with performance of procedures, which requires familiarity with procedural technique and involves direct use of catheter and guidewire skills. Excellent residents demonstrate procedural knowledge by anticipating the needs of the primary operator, having the next piece of necessary equipment prepared for use prior to the operator's request. This eliminates the need for the operator to wait during critical points in the procedure and improves workflow efficiency throughout the day. Residents who demonstrate competency in the roles of second, and then first assistant will graduate to primary operator on appropriate cases.

At all times while residents are in procedure rooms, whether performing, assisting, or observing, they are required to wear proper eye, nose and mouth protection. Face shields or goggles with side shields are mandatory. Eyeglasses alone are not sufficient.

### Regarding Daily Work-Flow:

Time that elapses between cases should not be viewed as a chance to take a break. When a case that a resident is involved in is completed (including all necessary post-procedure orders and documentation in LifeChart), the resident is expected to actively seek out ways to assist other members of the VIR team and promote efficient workflow in the Department. This will include monitoring the VIR CTA/MRA diagnostic imaging worklist for unread studies and reviewing these studies throughout the day for formal readout with Attending staff when time permits.

NOTE: Review of all CTA/MRA cases on the VIR worklist with the staff Attending is primarily the responsibility of the resident(s) on VIR rotation. VIR Fellows will often assist with this task if workload permits during the day. All cases on this worklist must be dictated by the end of the day, and residents on rotation are responsible for checking this worklist regularly and notifying the Attending staff when there are cases that are ready for formal review.

When the CTA/MRA worklist is empty, residents are expected to promote efficient workflow in other ways, such as: performing additional pre-procedure clinical assessments and obtaining informed consent on patients awaiting care in the pre-op holding area, providing patient instructions and arranging follow-up appointments at discharge, assessing inpatients on the wards, or observing/assisting other procedures as appropriate throughout the day. If a physician second assistant (in addition to the primary operator and physician first assistant) is already present in an ongoing procedure, then the resident should maximize his/her educational experience by observing the case from within the room if there are no other clinical duties to be performed. If no physician second assistant is present, the resident should scrub-in as a second assistant to run the equipment table for the remaining duration of the procedure.

Active inpatients on the VIR follow-up list that require attention during the day will be specified during morning report or throughout the day by an Attending physician or fellow. Duties pertaining to follow-up care on inpatients may at times (rarely) take priority over involvement in procedures in urgent situations, and residents may be asked to assist the team in these circumstances to manage these patients in a timely fashion. If there is more than one resident on rotation, both residents are equally responsible for sharing the resident clinical responsibilities. Seniority will determine case selection and level of involvement in procedures.

### Regarding Daily Work Hours:

The VIR rotation is a busy rotation with many clinical responsibilities for residents. Residents play an essential role on the VIR team to ensure appropriate and timely patient care both in the Department and on the wards. As such, there are no strictly defined daily work hours on the VIR rotation. (Most days end around 6:00 pm, but some days may be longer based on heavier case volume or complexity of the cases that day.) A break for lunch is granted to attend resident noon-conference, and this may be taken at liberty. The noon hour is considered protected time for the residents for this purpose. While on the VIR rotation, however, residents are expected to remain on duty until all scheduled cases



for the day are completed, unless they are formally excused by an Attending VIR physician to fulfill a conflicting educational or administrative responsibility (i.e. approved moonlighting shift, board review, or other approved duty).

Regarding Discharge of Patients from VIR:

All patient care plans and discharge instructions should be reviewed with an Attending physician prior to the patient being formally discharged from the department by a resident. Preliminary plans for ongoing care will be discussed at that time. The full details of the events and findings during the procedure and a formal plan for follow-up or ongoing management will be discussed at the end of the day during formal read-out. It is from this final review that the dictated report is generated.

F. Dictations: Cases may be dictated during “lulls” in the work day only if there are no other clinical duties that need to be performed. Otherwise, dictations should be done after all procedures and formal read-out are completed. As is the case with other rotations, ALL cases must be dictated prior to the day’s end to ensure timely and accurate communication of procedure results/outcomes to other inpatient physician providers. EVERY DICTATION MUST INCLUDE A BRIEF PLAN FOR ONGOING PATIENT CARE AS IT WAS DISCUSSED BY THE ATTENDING PHYSICIAN DURING READ-OUT. This improves communication to referring providers and also helps to coordinate patient care for our VIR colleagues when patients present for scheduled follow-up intervention (i.e. “Await pathology/cytology results. Biliary drain to remain capped for internal drainage. Patient will follow-up in “x” weeks for possible internal stent placement pending pathology results.” Or something along those lines to direct future plan of care based on information that may have been obtained from other care providers at the time of service).

G. Inpatient service: All active inpatients (whether specifically admitted to the VIR service or actively being followed by VIR but admitted to another medical/surgical service) are to be evaluated daily. This may be accomplished prior to start of the work day or after completion of all procedures and read-out in the department. All such clinical follow-up assessments and plans for ongoing patient care are to be formally documented in a note within the patient’s chart, to be co-signed by the Attending physician on service that day. More active patients may be seen both prior to and after the work day. Less active patients may be seen less frequently or discharged from the inpatient follow-up list as deemed appropriate by the Attending physicians. This will be determined on a case-by-case basis. As previously noted, procedural experience will remain paramount, and should not be sacrificed for routine ward rounds under usual circumstances. However, situations may rarely occur in which an emergent consult is requested, or urgent evaluation is necessary for an active inpatient that may require immediate attention during the day by a member of the VIR physician team and these cases should be handled accordingly.

Residents who are not actively rotating through the VIR service may rarely be called on to help cover the VIR inpatient service (patients specifically admitted to VIR) after hours prior to 2:00 AM when there are two residents and an Attending physician providing in-house coverage of the ER. Requests for assistance with the VIR inpatient service will usually come from VIR fellows or Attending physicians who take call from home. The requests will be for tasks that are regularly accomplished by junior residents, such as

assessing an inpatient's seemingly non-urgent new complaint, examining an access site, or performing a basic neurovascular assessment. This work will be coordinated with the on-call fellow or Attending physician. These requests should only RARELY occur and are strictly made on a courtesy basis. They should only be met by the in-house staff if workflow permits, or patient clinical condition necessitates emergent attention while the VIR team member is actively in transit to the hospital. After 2:00 AM residents should not be called to cover VIR clinical service, except as they would normally be contacted for imaging services by other clinical services, such as for performance of a CT scan or providing a wet reading on an imaging test.

H. Readout: All cases are formally reviewed at the end of the day in a dedicated read-out session for the educational benefit of all residents and fellows in the section. Read-out will be performed each day after completion of all scheduled procedures. Discussion during read-out will assist residents in generating accurate dictated reports.

I. Call: Residents share "first call" responsibilities with the fellows for 1 full week during each 4 week rotation through VIR. Residents must gather all pertinent information pertaining to emergent/urgent consults and attempt to formulate a preliminary treatment plan which is then reviewed with the fellow. If active VIR involvement is appropriate after-hours, the fellow will then initiate the on-call team and contact the Attending physician on-call. Occasionally the resident or fellow on-call may be required to evaluate a patient at the bedside for whom VIR has been consulted prior to making a decision as to whether or not an intervention should be performed. All consults to VIR after hours (including those that are strictly "phone consults" require that a brief note be placed in the patient's medical record to formally document VIR's recommended plan management, including specific indication(s) or contraindication(s) as to why a procedure should or should not be performed. These notes are to be sent to the supervising Attending physician for co-signature. Emergency call coverage is 24 hours a day, 7 days a week. There is always a staff Interventional Radiologist on call with the resident or fellow. The call schedule is posted in the division and maintained by the Interventional Radiology secretary. It is the residents' responsibility to know when they are on call. The on-call fellow is also responsible for the RIVI office pager.

In addition to being responsible for emergencies and other pages when on call, the on-call resident or fellow must round on all active VIR inpatients on the weekends and holidays. Pre-procedure inpatient evaluations are also required to be performed by the on-call resident or fellow on non-working days if the following day is a normal work day and those patients are scheduled for a procedure that morning. If a resident is on-call the night before changing rotations, he/she must either attend morning report to relay pertinent information on his/her assigned patients, or sign-out this information to the incoming resident or to a VIR fellow to ensure appropriate continuity of care.

If questions arise after hours about appropriate patient care, these should be first addressed with the VIR fellow on-call, and then with the on-call VIR Attending physician as needed.

J. Case Log: All residents are required to maintain a cumulative log of their procedures to document the type and number of procedures performed during their residency, as well as the outcome and incidence of their complications. This should be done independently in

a Microsoft Excel document format. Templates for procedure logs are available for download if necessary. Although there is a computerized database in the Interventional Radiology section (HI-IQ) that documents provider participation in cases, this does not provide the necessary level of case detail and may be inaccurate in documenting resident involvement. All 1<sup>st</sup> year residents are required to be proctored and signed-off on lumbar punctures by an Attending VIR physician. It is the responsibility of the residents to obtain those signatures from the supervising Attending physician to attest to their competency in performing lumbar punctures under fluoroscopic guidance prior to being able to take night-float call during their 2<sup>nd</sup> year of residency.

Resident membership in the SIR is not required, but strongly encouraged.

K. RIVI: If time and clinical work-load permit it, and with the approval of the VIR Section Director, residents who have a particular interest in IR may spend a limited amount of time directly observing the outpatient practice of IR at our private office clinic at the Rhode Island Vascular Institute (RIVI), 690 Eddy Street, across from Rhode Island Hospital. This optional educational opportunity should not interfere with regularly slated clinical duties expected of residents while on regular rotation at Rhode Island Hospital.

## II. PERFORMANCE CRITERIA FOR RESIDENTS

In addition to the staged expectations for daily performance of the residents depending on level of training, residents' work done outside of the section will be assessed during morning report, during procedures, and at evening read-out. Diligent reading of core text books (see reading list) and literature to result in familiarity with concepts of Vascular and Interventional Radiology commensurate with level of training is expected. Reading should be dictated in part by cases scheduled for the next day or another day in the future. At times, patient care may mandate literature review of a particular disease or procedure. Resident evaluations will depend in part on their achievement of these performance criteria.

Level of performance for each of the criteria is expected to vary based on experience. Fulfillment of expected level of performance will be categorized as introductory, familiarity, competency, or mastery. At all levels, achievement of performance criteria for all previous levels is assumed as a prerequisite. Definitions of these categories are given below.

- 1.) introductory--the resident has observed at least one of the procedures, and has seen or assisted another person performing the task
- 2.) familiarity--the resident has seen the task performed enough times to accurately describe technical factors necessary for performance of the task, and may have performed the task with supervision
- 3.) competency--the resident has observed and performed the task with supervision enough times to be capable of performing the task with direct or indirect supervision, but without explicit direction

- 4.) mastery--the resident has observed and performed the task with supervision enough times to be capable of performing the task without direct or indirect supervision

## **Educational Goals and Objectives**

### **A. First year residents:**

#### Medical knowledge:

1. Understand the physiology and clinical relevance of noninvasive procedures such as ankle brachial indices, pulsed volume recording, opening pressure, recirculation times, venous DUS, etc.
2. Discuss the technical skills required for independent performance of minor procedures, such as arthrograms, drainage catheter checks, nontunneled venous access, etc.
3. Describe the clinical relevance of catheter checks, including the need for preliminary films.
4. Participate in daily readout.

#### Patient care:

1. Accurately perform a history and physical examination.
2. Reliably handle daily requirements of the inpatients in cooperation with other residents and fellows under staff supervision.
3. Understand endpoints for treatment of inpatients
4. Formulate and execute patient care plans.
5. Diligently review relevant clinical data, e.g., chart, outpatient record, labs, prior imaging exams.
6. Acquire familiarity with the role of first and second assistant for major diagnostic and interventional procedures.
7. Achieve competency with minor invasive procedures, such as myelography, arthrography, and tube maintenance
8. Gain an introduction to vascular access techniques.

#### Practice-Based Learning:

1. Learn to address each problem individually, tailoring the performance of the diagnostic test to fit the clinical needs.
2. Pursue opportunities for procedural observation and performance, aggressively organize readout and other educational opportunities.
3. Efficiently use Lifelinks and the radiology information system as well as the link to the Brown library and internet to access information.
4. Attend the weekly VIR Fellows' conference , combined Vascular conference and Upper GI Tumor Conference.

#### Communication and Interpersonal Skills:

1. Provide concise and accurate patient presentations.
2. Appropriately obtain informed consent.
3. Produce radiologic reports that are accurate, concise, and grammatically correct.

4. Effectively teach medical students.
5. Communicate effectively with technical and nursing staff in the section.

Professionalism:

1. Demonstrate respect for patients and all members of the healthcare team.
2. Serve as a role model for junior residents and medical students.
3. Respect patient confidentiality.
4. Present one's self as a professional in appearance and communication.
5. Demonstrate initiative by being available and volunteering services during procedures and between cases.
6. Demonstrate willingness to perform additional duties that contribute to the overall patient care and academic interests of the section.

Systems-based practice:

1. Attend the vascular VIR conference.
2. Demonstrate knowledge of cost effectiveness of procedures such as prophylactic filter placement, endovascular treatment of aneurysms, and peripheral vascular disease vs. surgical intervention

**B. Second year:**

Medical knowledge:

1. Develop a working knowledge of the natural history, prognosis and need for therapy in patients with vascular disease and nonvascular disease (such as oncologic disease) amenable to interventional radiologic management.
2. Discuss fluid dynamics and the physiology of noninvasive tests such as ankle-brachial indexes, exercise testing, pulsed-volume recordings, venous DUS, as well as imaging such as CTA, MRA and laboratory data applicable to above disease processes
3. Accurate interpretation of fluoroscopic and digitally processed images including angiograms, venography and visceral contrast studies.

Patient care:

1. Demonstrate accurate clinical assessment of the patient, including those with vascular and oncologic disease.
2. Further clinical and patient assessment skills.
3. Improve the ability to tailor diagnostic and therapeutic procedures to suit individual needs.
4. Formulate a treatment plan based on a synthesis of clinical presentation, natural history of disease, and invasive findings.
5. Improve performance of minor procedures.
6. Knowledgeable in performing as first assistant in major interventions.
7. Acquire familiarity with first order selective catheterizations below the diaphragm and tunneled venous access procedures.

Practice-based learning:

1. Effectively use Lifelinks and radiology information system to access prior labs and reports.

2. Incorporate feedback obtained during morning report and afternoon readout into improved performance.
3. Attend fellows' VIR conference.

Communication and interpersonal skills:

1. Appropriately obtain informed consent
2. Appropriately communicate and document in the patient record urgent or unexpected radiologic findings.
3. Produce radiologic reports that are accurate, concise and grammatically correct.
4. Communicate effectively with nurses and technologists in the VIR section.

Professionalism:

1. Demonstrate initiative by being available and volunteering services during procedures and between cases.
2. Demonstrate willingness to perform additional duties that contribute to the overall patient care and academic interests of the section.
3. Demonstrate respect for patients and all members of the healthcare team.
4. Serve as a role model for junior residents and medical students.
5. Respect patient confidentiality.
6. Present one's self as a professional in appearance and communication.

Systems-based practice:

1. Attend the vascular VIR conference.
2. Demonstrate knowledge of cost effectiveness of procedures such as prophylactic filter placement, endovascular treatment of aneurysms, and peripheral vascular disease vs. surgical intervention, and minimally invasive management of venous and oncologic disease.

**C. Third Year:**

Medical knowledge:

1. Master the first assistant role during major interventions.
2. Master the understanding of the significance of the clinical presentation and its relevance to the planned procedure.
3. Gain competency with basic diagnostic and interventional procedures.
4. Gain competency with selective catheterization below the diaphragm and with tunneled venous devices.
5. Get an introduction to selective catheterization above the diaphragm.

Patient care:

1. Master understanding the significance of the clinical presentation and its relevance to the planned procedure.
2. Assimilate available clinical and verbal history prior to initiating any invasive procedure.

Practice-based learning and improvement:

1. Effectively use Lifelinks and radiology information system to access prior labs and reports.

2. Incorporate feedback obtained during morning report and afternoon readout into improved performance.
3. Attend fellows' VIR conference and attend combined GI tumor board whenever feasible

Communication and interpersonal skills:

1. Become competent in interdepartmental presentation of diagnostic findings and therapeutic interventions.
2. Appropriately obtain informed consent.
3. Produce radiologic reports that are accurate, concise, and grammatically correct.
4. Effectively teach medical students.
5. Communicate effectively with technical and nursing staff in the section.

Professionalism:

1. Demonstrate initiative by being available and volunteering services during procedures and between cases.
2. Demonstrate willingness to perform additional duties that contribute to the overall patient care and academic interests of the section.
3. Demonstrate respect for patients and all members of the healthcare team.
4. Serve as a role model for junior residents and medical students.
5. Respect patient confidentiality.
6. Present one's self as a professional in appearance and communication.

Systems-based practice:

1. Attend the vascular VIR conference.
2. Demonstrate knowledge of cost effectiveness of procedures such as prophylactic filter placement, endovascular treatment of aneurysms, and peripheral vascular disease vs. surgical intervention.

**D. Fourth year:**

Medical knowledge:

1. Gain a thorough understanding of pathophysiology of arterial and venous vascular disease, noninvasive tests, hemodynamics, and angiograms, as well as nonarterial disease (such as oncologic , gastrointestinal, genitourologic, neurologic and musculoskeletal disease) amenable to VIR treatment
2. Read and retain pertinent literature, including research for cases of particular interest.

Patient care:

1. Master clinical skills.
2. Properly synthesize data including lab and imaging results prior to initiating any procedure.
3. Achieve competency with all invasive diagnostic procedures including first-order selective arteriography, transhepatic cholangiography, antegrade nephrostogram, venography and biliary drainage.
4. Acquire familiarity with advanced interventions such as vena cava filter placement, angioplasty, intravascular stent placement, complex central venous access, TIPS,

- local and regional therapies for cancer , ablative techniques for superficial venous disease and pharmacomechanical approaches to deep venous disease.
5. Get an introduction to complex state-of-the-art intervention such as TIPS procedures, chemoembolization, neurointervention and pharmacomechanical therapy for VTE.

Practice-based learning and improvement:

1. Effectively use Lifelinks and radiology information system to access prior labs and reports.
2. Incorporate feedback obtained during morning report and afternoon readout into improved performance.
3. Attend and present at fellows' VIR conference..

Communication and interpersonal skills:

1. Achieve mastery in departmental presentation of diagnostic findings and therapeutic options.
2. Appropriately obtain informed consent.
3. Produce radiologic reports that are accurate, concise, and grammatically correct.
4. Effectively teach medical students.
5. Communicate effectively with technical and nursing staff in the section.

Professionalism:

1. Demonstrate initiative by being available and volunteering services during procedures and between cases.
2. Demonstrate willingness to perform additional duties that contribute to the overall patient care and academic interests of the section.
3. Demonstrate respect for patients and all members of the healthcare team.
4. Serve as a role model for junior residents and medical students.
5. Respect patient confidentiality.
6. Present one's self as a professional in appearance and communication.

Systems-based practice:

1. Attend the vascular VIR conference on Thursday mornings.
2. Demonstrate knowledge of cost effectiveness of procedures such as prophylactic filter placement, endovascular treatment of aneurysms, and peripheral vascular disease vs. surgical intervention.
3. Be able to discuss the relative merits of endovascular versus surgical approach to oncologic, peripheral vascular and neurovascular diseases; i.e. chemoembolization, cholangiography, port placement, metastatic liver disease, uterine artery fibroids, etc.

**Mechanism of Evaluation**

Evaluation of residents is performed in an ongoing manner during morning report and afternoon readout. In addition, the attending physicians in the department provide evaluation of the resident's performance based on the goals and objectives, as described previously. Residents are also evaluated electronically by division and course directors.



Finally the residents must maintain a procedure log which is reviewed on an ad hoc basis to assess their level of procedural competence.

### **VASCULAR AND INTERVENTIONAL RADIOLOGY READING LIST**

The core reading is listed below. Current editions of these references are available in the department.

- 1.) Strandness DE, van Breda A. Vascular diseases: Surgical and Interventional Therapy. Churchill Livingstone; New York, New York 1994.
- 2.) Kadir S. Diagnostic Angiography. W.B. Saunders; Philadelphia 1986.
- 3.) Kadir S. Current practice of interventional radiology. B.C. Decker, Inc.; Philadelphia, 1991.
- 4.) Kadir S. Atlas of normal and variant angiographic anatomy. W.B. Saunders Co.; Philadelphia, 1991.
- 5.) Abrams HL. Abram's Angiography. Little, Brown and Company; Boston 2005.
- 6.) Rutherford R. Vascular Surgery. W. B. Saunders Co.; Philadelphia 1989.
- 7.) Perler B, Becker G. Vascular Intervention. Thieme, New York, 1997.
- 8.) Connors J, Wojak J. Interventional Neuroradiology. W.B. Saunders Co.; 1999.
- 9.) Kaufman J, Lee M Vascular and Interventional Radiology: The Requisites; (?ed) 2003

#### ***First Year Reading Instructions***

***Each day's major procedures are typically booked in advance after a consultation has been performed at hospital for inpatients or in office for outpatients. Cases are listed at the scheduling desk in IR. The MOST effective learning will stem from review of the booked cases at least the night before and brief reading in any of the below resources to familiarize yourself with the disease process, its management and the procedure to be performed. Cross sectional interventions (bx, drainage, ablation) should be studied while on CT and US rotations)***

**Rotation: Vascular & Interventional Radiology**

#### **First 4 week rotation:**

First week:

Sat-Sun: Review Residency Manual IR section. CH 1-4 VIR Requisites  
Mon: CH 5-6,15 VIR Requisites  
Tues: CH 9-10 VIR Requisites  
Weds: CH 11-12 VIR Requisites  
Thur: CH 7-8 VIR Requisites  
Fri: CH 13-14,16 VIR Requisites

Second week:

Sat-Sun: CH 19-20 VIR Requisites  
Mon: CH 21-22 VIR Requisites  
Tues: CH 24 VIR Requisites, CH 7-10 Freiburger Arthrography (in VIR)  
Weds: CH 62, CH 71 Abram's Angiography  
Thur: CH 65-69 Abram's Angiography  
Fri: 70, 72 Abram's Angiography

Third week:

Sat-Sun: Creager NEJM 2012;366:2198-2206 Acute Limb Ischemia; Norgren Eur J Vasc Endovasc Surg;2007;33S1-75 TASC II, White NEJM 2007;356:1241-50 Intermittent Claudication  
Mon: Radprimer Interventional Basic Lesson 1-6  
Tues: Radprimer Interventional Basic lesson 7-11  
Weds: Radprimer Practice Basic Test 1-61  
Thur: Radprimer Interventional Intermediate Lesson 1-8  
Fri: Radprimer Interventional Intermediate Practice test 1-58

Fourth week: Substitute This week for whichever week you are on Call

Sat-Sun: Call & Case review  
Mon: Call & Case review  
Tues: Call & Case review  
Weds: Call & Case review  
Thur: Call & Case review  
Fri: Call & Case review

## **Vascular and Interventional Radiology - Policies and Procedures**

The following polices and procedures for Vascular and Interventional Radiology may be found on the Lifespan intranet home page by accessing the following:

**Medical → Radiology → RIH Radiology → RIH Polices and Procedures → Vascular Interventional Radiology**

VIR-01 Start Up and Shut-Down Procedure

VIR-02 Immobilization/Positioning for Imaging Procedures

VIR-03 Immobilization/Positioning for Radiology Imaging Procedures Over 2 Hours

VIR-05 On Call Policy (including consults, GI bleed, venous access)

VIR-06 Gamma Knife Pre Procedure

VIR-32 Handling and Disposing of Cytotoxic Drugs and Contaminated Materials

VIR-33 Informed Consent Policy

VIR-34 Infection Control Policy

VIR-35 Hours of Operation

VIR-36 Management of Latex Allergy Patients

VIR-37 Maternal Radiography

VIR-38 Vascular Interventional Radiology Nursing Procedures

VIR-39 Radiation Safety Protection and Monitoring in VIR suite

VIR-40 Patient Stretchers

VIR-41 Pregnancy Screening for High Dose Pelvic Imaging in Interventional Radiology

## ULTRASOUND

Overview:

Ultrasound is and will always be one of the primary imaging modalities for rapid noninvasive evaluation of many regions of the human body. Unlike CT and MRI, ultrasound can provide real time multiplanar assessment requiring the radiologist play an active role during the examination. Therefore, to become an expert in ultrasound a radiologist must be able to scan a patient while understanding the complex anatomy and pathology.

### **I. INTRODUCTION:**

Ultrasound remains the most versatile cross-sectional imaging modality due to its real time nature and multiplanar capabilities. Despite the advances in other modalities such as MR and CT, the volume of ultrasound studies continues to increase, newer applications are discovered and the technology continues to advance. Therefore, it is essential that each radiology resident become well trained in not only the indications and interpretation of ultrasound studies but also in their performance. The learning objectives of a radiology resident in ultrasound should be to develop a working familiarity with the technology and imaging anatomy initially and apply these techniques to answer specific diagnostic questions as deemed appropriate in a current high volume tertiary care academic center. At the completion of training, the resident should be skilled at US-guided procedures. The American College of Radiology appropriateness criteria should be used as a guide and learning tool to be incorporated into the daily clinical decision making when deemed necessary.

The Ultrasound rotation is busy and somewhat unique compared to others. There are ample opportunities to hone interpretive skills through read out and self-directed learning but a significant component of Ultrasound involves hands-on experience. The only way to develop this is through learning to scan patients yourself. The best way to do this is to jump right in and develop your technique as you go through training. Understanding and interpreting Ultrasound actually becomes much easier if you are a competent sonographer as well. In addition, there is a large volume of Ultrasound-guided procedures performed in the department which will be made substantially more enjoyable and less challenging if you are able to scan comfortably.

### **II. "HANDS-ON" SCANNING**

Below are suggestions for getting started with scanning. These are suggested findings and anatomy you should be comfortable with as you complete each month long rotation.

#### **BASIC (First Month)**

Gallbladder (gallstones/acute cholecystitis)

Liver (masses)

Kidney (hydronephrosis, stones)

Transabdominal/transvaginal pelvis (mass/cyst/free fluid)  
Lower extremity (deep vein thrombosis)  
Abdominal aorta (aneurysm)  
Pleural effusion and ascites  
Pregnancy (normal early intrauterine pregnancy)  
Thyroid nodules

**INTERMEDIATE (Second Month)**

Pancreas (pancreatitis, mass)  
Biliary (common bile duct, biliary ductal dilatation)  
Abdominal mass/adenopathy  
Kidney (mass/cyst)  
Basic Doppler (portal vein, pseudoaneurysm, arteriovenous fistula)  
Pregnancy (first trimester, failed pregnancy, ectopic pregnancy)  
Adnexal mass (ovarian and non-ovarian)  
Testis (pain and masses)  
Basics obstetrics (basic fetal biometry, basic second/third trimester fetal anatomy, placental localization, amniotic fluid volume) (TO BE COVERED AT W+I HOSPITAL)  
Neonatal brain (TO BE COVERED ON PEDIATRICS ROTATION)

**ADVANCED (Third and Fourth Months)**

Advanced obstetrics (TO BE COVERED AT W+I HOSPITAL)  
Pediatrics (abdomen, spine, hips) (TO BE COVERED ON PEDIATRICS ROTATION)  
Ultrasound-guided interventional procedures  
Parathyroid  
Carotid artery  
Advanced abdominal Doppler (visceral organs, organ transplants)  
Peripheral vessels (arterial bypass grafts, upper extremity veins)

**III. COMPREHENSIVE KNOWLEDGE**

Below is a reasonably complete set of guidelines regarding areas to direct your learning as you progress through the residency.

**A. PHYSICS/INSTRUMENTATION**

**BASIC (First Month)**

Define ultrasound, including the relationship of sound waves used in imaging  
Straight narrow sound beams, simple reflection, constant sound speed  
Beam shape: linear, sector, curved array  
Probes: transabdominal, endocavitary  
Endocavitary imaging: transvaginal, transrectal, endoscopic, laparoscopic  
Display: Gray scale, M-mode, pulsed wave Doppler, color and power Doppler  
Image orientation: standard images in different planes  
Image optimization: power output, gain, time gain compensation

Image recording options: electronic (digital), film, paper  
Acoustic properties of fluid, cyst, calcification, complex fluid and solid structures  
Tissue characteristics: acoustic shadowing and enhancement  
Focal zone

### **INTERMEDIATE (Second Month)**

Transducer choice: curvilinear, linear, sector, vector  
Frequency, sound speed, wavelength, intensity, decibels, beam width, Fresnel zone, Fraunhofer zone  
Interaction of sound waves with tissues: reflection, attenuation, scattering, refraction, absorption, acoustic impedance pulse-echo principles  
Generation/detection of ultrasound waves  
Doppler phenomenon, Doppler formula  
Beam formation/focusing  
Gray scale, M-mode, pulsed wave Doppler, color Doppler imaging, power Doppler imaging

### **ADVANCED (Third and Fourth Months)**

Beamwidth, sidelobe, slice thickness artifacts  
Multiple reflection artifacts - mirror image/reverberation  
Refractive artifacts  
Doppler artifacts- pulse wave, color imaging, including aliasing  
Gray scale versus Doppler (trade-off of penetration and resolution)  
3-D volumetric imaging  
Thermal/non-thermal effects on tissue: biological health risks  
Image optimization  
Harmonic imaging  
Ultrasound contrast agents  
Elastography  
Equipment quality assurance: phantoms, spatial/contrast resolution

## ***B. CLINICAL APPLICATIONS***

### **GENERAL**

The resident should understand the importance of clinical ultrasound protocols. Published protocols/standards from the American College of Radiology (ACR) or the American Institute of Ultrasound in Medicine (AIUM) with or without local modification are acceptable frames of reference. Residents should also be familiar with ACR appropriateness criteria as a guide for appropriate clinical use of ultrasound and other imaging modalities.

The resident should gain a general understanding of both the clinical uses and limitations of ultrasound as well as the appropriate integration of other complementary cross-sectional imaging studies, particularly CT and MRI.

The resident should understand the importance of documentation and reporting skills/ requirements

The resident should understand the importance of clinical quality assurance, including radiologic-pathologic correlation, as well as sonographer-physician discrepancies.

## **ABDOMINAL**

### **BASIC (First Month)**

Liver: normal echotexture, size, and shape (including anatomic variants), diffuse disease, (fatty infiltration, acute and chronic hepatitis, cirrhosis, edema), focal masses, metastases, granuloma

Gallbladder: normal appearance, wall thickening, gallstones, including supine, decubitus and erect positions, sludge, acute cholecystitis (calculous/acalculous), sonographic Murphy's sign, other etiologies of wall thickening, polyp

Bile ducts: normal intra- and extrahepatic bile duct diameters and dilatation

Pancreas: normal anatomy, pancreatic duct, mass

Spleen: normal echotexture, size and shape (including anatomic variants), focal masses (cystic versus solid), lymphoma, abscess, infarction, granuloma

Peritoneal cavity: ascites, fluid localization/quantification (free/loculated)

Pleural effusion

### **INTERMEDIATE (Second Month)**

Liver: hematoma, biloma, abscess

Post-liver transplantation collections: hematoma, biloma, abscess (see vascular section)

Gallbladder: hyperplastic cholecystoses, carcinoma

Bile ducts: bile duct stones, inflammatory disease, cholangitis, pneumobilia

Pancreas: neoplasm, cysts

Pancreatitis complications: abscess, pseudocyst and pseudoaneurysm, chronic pancreatitis

Peritoneal cavity: abscess, hemorrhage, omental mass, metastasis, carcinomatosis

Spleen: varices

### **ADVANCED (Third and Fourth Month)**

Liver: trauma

Bile ducts: neoplasm (cholangiocarcinoma)

Spleen: trauma

Chest: pericardial effusion, mass, atelectasis/pneumonia

Organ transplants: see vascular section

Gastrointestinal tract: normal gut ultrasound signature, acute appendicitis, diverticulitis, Crohn's disease

Peritoneal cavity: free air

Abdominal wall hernia, inguinal hernia

## **KIDNEYS, URINARY BLADDER AND PROSTATE**

### **BASIC (First Month)**

Normal renal cortical echotexture, size and shape, glomerulointerstitial renal disease, simple renal cyst

Ureters: hydronephrosis, pyonephrosis

Urinary bladder: calculi, wall thickening, ureteral jets, bladder volume, including post-void residual

**INTERMEDIATE (Second Month)**

Abscess/pyelonephritis, perinephric fluid

Post-renal transplant collections: hematoma, urinoma, abscess, lymphocele (see vascular section)

Complex renal cyst, adult polycystic disease and acquired renal cystic disease, renal cell carcinoma, angiomyolipoma

Urinary bladder: mass, infection, hemorrhage, wall thickening, bladder outlet obstruction, diverticula, ureterocele

Transabdominal prostate

Ureters: hydroureter

**ADVANCED (Third and Fourth Months)**

Kidneys: xanthogranulomatous pyelonephritis, emphysematous pyelonephritis, congenital anomalies, pelvic kidney (see pediatrics section), medullary nephrocalcinosis

Adrenal glands: mass

Retroperitoneum: adenopathy, mass

Ureters: ureteral stone

Urinary bladder: ectopic ureterocele

Renal artery stenosis, renal vein thrombosis (see vascular section section)

Transrectal prostate

**GYNECOLOGY**

**BASIC (First Month)**

Uterus: normal size, shape, position, echogenicity, fibroid identification

Endometrium: normal appearance during phases of menstrual cycle and thickness measurement (pre-menopausal, post-menopausal, effects of hormone replacement), intrauterine device, fluid

Ovary: normal size, shape, echogenicity, physiologic variation during phases of menstrual cycle (follicles, corpus luteum, hemorrhagic ovarian cyst)

Free pelvic fluid

**INTERMEDIATE (Second Month)**

Uterus: congenital anomalies, endometrial polyp, endometrial hyperplasia, endometrial carcinoma, endometritis, pyometrium, fibroid localization (submucous, intramural, subserosal), adenomyosis

Ovarian cyst: hemorrhagic/ruptured cyst, endometrioma, polycystic ovarian disease, ovarian hyperstimulation syndrome

Ovarian neoplasm: cystic/solid adnexal masses, cystadenoma/carcinoma, dermoid, fibroma, germ cell tumor, Doppler evaluation

Ovarian torsion

Pelvic inflammatory disease, tubo-ovarian abscess

Cervix: mass, stenosis, endometrial obstruction



Fallopian tube: hydrosalpinx, pyosalpinx  
Post-hysterectomy

**ADVANCED (Third and Fourth Months)**

Peritoneal inclusion cyst  
Ovarian cancer staging  
Saline hysterosonography (AT W+I)

**OBSTETRICS**

(TO BE COVERED ON W+I ROTATION)

**THYROID/NECK**

**BASIC (First Month)**

Normal thyroid echotexture, size and shape  
Thyroid disease: diffuse and focal disease  
Multinodular thyroid

**INTERMEDIATE (Second Month)**

Thyroid nodule characterization: echotexture, calcifications including microcalcifications, margins, recommendations for fine needle aspiration biopsy  
Hashimoto's thyroiditis/Graves' disease

**ADVANCED (Third and Fourth Months)**

Parathyroid mass: adenoma  
Congenital cysts: branchial cleft  
Lymph nodes: benign and malignant characterization  
Post-thyroidectomy recurrence  
Submandibular and parotid glands: normal and abnormal

**VASCULAR/DOPPLER**

**BASIC (First Month)**

Abdominal aorta: normal appearance and measurement, aneurysm  
Inferior vena cava: normal appearance, thrombosis  
Lower extremity deep vein thrombosis  
Hematoma  
Iatrogenic pseudoaneurysm

**INTERMEDIATE (Second Month)**

Peripheral vascular aneurysm, including iliac and popliteal arteries  
Hepatic vasculature: pulsed Doppler and color Doppler imaging of the portal veins, splenic vein, hepatic arteries and hepatic veins, including normal direction of flow  
Hemodynamics of cirrhosis, portal hypertension and varices, portal vein thrombosis

Upper extremity venous thrombosis: subclavian and internal jugular vein thrombosis, axillary and brachial vein thrombosis

Carotid artery: normal, atherosclerotic plaque, carotid artery stenosis and occlusion

Renal vein thrombosis

Iatrogenic arteriovenous fistula

Pre-graft vein mapping

### **ADVANCED (Third and Fourth Months)**

Renal transplant: arterial resistive index (rejection, acute tubular necrosis), transplant vein thrombosis, renal infarction, post-biopsy complications, renal arterial stenosis

Liver transplants, including hepatic artery stenosis or thrombosis (resistive index), portal vein thrombosis, post-biopsy complications, inferior vena cava stenosis

Pancreas transplant: arterial and venous anastomosis, patency and stenosis

TIPS evaluation and complications

Lower extremities: chronic venous insufficiency

Arterial bypass graft

Hemodialysis graft/fistula

Carotid artery: waveform analysis, stenosis, dissection, pseudoaneurysm, stent

Vertebral artery: subclavian steal syndrome

Mesenteric ischemia

Renal artery stenosis

## **SCROTUM**

### **BASIC (First Month)**

Testes: normal echotexture, shape and size

Epididymes

Testicular mass

Hydrocele

### **INTERMEDIATE (Second Month)**

Epididymitis, orchitis

Testicular torsion

Testicular mass characterization: microlithiasis, germ cell tumor, lymphoma, metastasis

Cystic ectasia of rete testis

Extratesticular masses/cysts, spermatocele, adenomatoid tumor, epididymal head cyst

Varicocele

Trauma

### **ADVANCED (Third and Fourth Months)**

Hernia

Non-descended testis

Fournier's gangrene

## **PEDIATRICS**

(WILL BE COVERED IN PEDIATRIC SECTION)

## **MUSCULOSKELETAL**

(ALSO COVERED ON MSK ROTATION)

### **BASIC (First Month)**

Mass  
Hematoma  
Baker's cyst, including rupture  
Cellulitis  
Abscess

### **INTERMEDIATE (Second Month)**

Normal tendon appearance  
Foreign body  
Soft tissue gas  
Joint fluid  
Muscle tear

### **ADVANCED (Third and Fourth Months)**

Tendon tear, inflammation  
Rotator cuff tear

## **BREAST**

(WILL BE COVERED ON BREAST ROTATIONS)

## **INTERVENTIONAL**

### **BASIC (First Month)**

Informed consent  
Sterile technique  
Ultrasound-guided paracentesis  
Ultrasound-guided thoracentesis  
Ultrasound-guided thyroid FNA

### **INTERMEDIATE (Second Month)**

Pre-procedural evaluation: coagulation laboratory studies, anticoagulation medication  
Stratification of risk for percutaneous procedures  
Techniques for ultrasound-guided invasive procedures: understanding important landmarks and pitfalls of percutaneous procedures, including recognition of critical structures to be avoided  
Biopsy of soft tissue masses  
Random core liver biopsy

Aspiration of fluid collections, cysts and catheter placement for abscess and fluid drainage (pleural, peritoneal and other spaces)

Post-procedural evaluation: radiographic studies, patient monitoring, management of complications

#### **ADVANCED (Third and Fourth Months)**

Fine needle biopsy versus core biopsy in specific application, such as focal liver mass, renal mass, thyroid/parathyroid mass, retroperitoneal lymphadenopathy

Pseudoaneurysm management: contraindications and technique of non-surgical treatment with ultrasound-guided compression repair versus thrombin injection

Intraoperative ultrasound guidance

## **IV. RESOURCES**

### **TEACHERS**

General Ultrasound and Intervention will be taught primarily by Drs. Atalay, Beland, Cronan, Grand, Karam, Kassem, Murphy, Pietryga, Song and the cross-sectional imaging fellow in the main department at Rhode Island Hospital.

Pediatric ultrasound will be taught during the residents' pediatric radiology rotation at Hasbro Children's Hospital.

Obstetrical ultrasound will be taught by the staff radiologists at Women & Infants' Hospital.

Breast ultrasound will be taught on rotations at the Pappas Breast Center and Women & Infants' Hospital.

### **REQUIRED READING**

#### **R1/PGY2: Initial 2 weeks Radiology Ultrasound Rotation Reading**

Before starting the rotation: Practical physics (Ultrasound Requisites pp3-27)

First week: Ultrasound Requisites chapters on the gallbladder (M), liver (T), bile ducts (W), pancreas (W), and spleen (Th), Neck and Chest (Fr).

Second week: Requisites chapters on the kidney (M), lower genitourinary (T), neck and chest (W), General Abdomen (Th), extremities (Fr).

#### **R1/PGY2 : 4 week Radiology Ultrasound Rotation Reading**

Before starting the rotation: Review Practical physics (Ultrasound Requisites, pp3-27)

First week: Requisites on the first trimester and ectopic pregnancy (M), Requisites Pelvis and Uterus (T), Adnexa (W), Radiology article on ovarian cyst guidelines (Th), Review article on thyroid nodules (Fr)

Second week: Rumack, Vol 1: Chpt 18 US-Guided Biopsy and Drainage of the Abdomen and Pelvis; Chpt 19 Organ Transplantation

Third week:, RadPrimer Basic US Cases, approximately 20 per night

Fourth week: General and Vascular US Case review series, cases from first round. RSNA online US Physics Module.

### **Subsequent 4 week Radiology Ultrasound Rotation Suggested Reading**

Diagnostic Ultrasound. Rumack et al. Fourth Edition.

Part V. Obstetrics and Fetal Sonography.

Part VI. Pediatric Sonography.

General and Vascular Ultrasound: Case Review Series. Second Edition.

Middleton WD, Mosby, St. Louis, 2007.

Ultrasonography in Obstetrics and Gynecology. Callen PW. Fifth edition, W.B. Saunders Co., Philadelphia, 2007.

Color Doppler Flow Imaging. Foley DW. Andover Medical Publishers, 1991.

[www.Sonoworld.com](http://www.Sonoworld.com) Free website with numerous expert lectures available

## **V. ROTATION RESPONSIBILITIES**

### **1. Daily Work**

- a. Daily work starts no later than 7:30 a.m. and finishes no earlier than 5:00 p.m.
- b. Exam supervision. The resident is the initial consultant for the ultrasound staff and clinical staff regarding the indication, scheduling, type of exam to perform and technical quality.

### **2. Resident responsibilities.**

- a. The Ultrasound rotation will be staffed by a junior and a senior resident or fellow. The junior resident will generally be more involved in the diagnostic cases and simpler procedures and the senior resident will be involved in the more complex interventional cases in addition to diagnostic cases. The expectations of each are detailed below. However, this is not an absolute separation of responsibility. As on any busy hospital service, residents are expected to help each other out to ensure the rotation is run efficiently and provides high quality patient care.

### **3. "Junior" resident responsibilities:**

- a. The junior resident should be familiar with all of the diagnostic cases performed during the day, including history and previous imaging examinations. The resident will be actively involved in scanning patients during the day and is expected to spend a significant amount of time in the

ultrasound rooms. The resident is expected to assist the technologist in scanning difficult cases and to obtain additional guidance from the senior resident or attending when appropriate.

- b. The junior resident is expected to decide at the beginning of the day an ultrasound examination skill (such as scanning a particular organ or ultrasound technique) they will be improving on that day. At the technologist's completion of an examination, the resident should spend a few minutes scanning this area. For example, a resident may choose to work on scanning the left kidney and should therefore be in the room for the scanning of all patients undergoing renal or complete abdominal examinations. At the completion of the examination, the resident would then specifically ultrasound the left kidney of each of these patients. At the completion of a 1 month rotation, significant skill should be obtained in performing the majority of the examinations routinely done in the department.
  - c. Because the junior resident may be the senior resident on their next ultrasound rotation, they will need to become familiar with the basics of ultrasound-guided procedures. Initial experience should be with paracentesis and thoracentesis. In general, the junior resident will be expected to perform these procedures routinely. In addition, the junior resident may become involved in thyroid biopsies or possibly more advanced procedures at the discretion of the attending and resident interest.
  - d. The junior resident will be responsible for dictating the majority of the diagnostic ultrasounds performed during the day, especially all ultrasounds in which they were involved.
4. "Senior" resident responsibilities:
- a. The senior resident should be familiar with all of the procedures performed during the day. This includes knowledge of the history, indication for procedure and relevant lab results for all scheduled cases and any add-ons for the day. Knowledge of all aspects of the procedure prior to the patient's arrival in the Ultrasound department is critical to a smooth running day. This includes issues surrounding consent, need for an interpreter, special specimen processing requests, sedation requirements, etc.
  - b. The senior resident should be familiar with all patients who currently are being followed by the body interventional service. With attending consultation, they are responsible for ensuring the appropriate follow-up and care is being given. While the junior residents may see the patients on rounds, the senior is still expected to be aware of the patients.
  - c. The senior resident is expected to dictate all cases they are involved in. In addition, they will be dictating diagnostic studies during the day to help out the junior resident.
  - d. The senior resident consults with the cross-sectional imaging staff and staff radiologist in US or CT regarding any add-on interventional procedures.
5. Conferences
- a. Morning Rounds, Body Reading Room, 8am daily
  - b. Subspecialty conferences, Friday 7am Conference Room A
  - c. Daily noon conference

- d. GYN oncology conference, Tuesday 7:30 a.m., Women & Infants' conference room (optional)
- e. Bimonthly imaging conference
- f. GI tumor board, every Thursday 7:00 a.m., APC 12 (strongly encouraged)

## 6. Ultrasound - Policies and Procedures

The following policies and procedures for Ultrasound may be found on the Lifespan intranet home page by accessing the following:

**Administrative → Lifespan Policies → Rhode Island Hospital → Diagnostic Imaging → Ultrasound → Ultrasound Protocols**

## VI. RESIDENT EVALUATION TOOLS

In addition to the knowledge outlined above, there are several other guidelines of competency as defined by the ACGME and ABR. There is an expectation that residents will generally progress through training towards the goal of becoming competent to interpret and oversee any ultrasound after training. The evaluations follow the Core Competencies and expectations are dependent on level of training. Please refer to the list below to be aware of what the expectations for competency are depending on your level of training.

### PGY 2

#### I. **Core Competency: Patient Care**

- Appropriately uses the Electronic Health Record to obtain relevant clinical information
- Competently performs basic procedures including paracentesis and thoracentesis

#### II. **Core Competency: Medical Knowledge**

- Understands the basic components of common ultrasound examinations, including RUQ, abdomen, renal, scrotal, female pelvis
- Differentiates normal from abnormal
- Recognizes sub-optimal imaging
- Discuss the ultrasound features of the most common diseases involving the: liver, gallbladder, spleen, pancreas, kidneys, RLG, uterus, ovaries, prostate, bladder, thyroid, testicles/scrotal contents

#### III. **Core Competency: Professionalism**

Demonstrates the following professional behaviors:

- Puts patient care first and advocates for patient
- Fulfills all work-related responsibilities
- Recognizes personal limitations and seeks help
- responds appropriately to constructive criticism
- maintains patient confidentiality
- Acts in professional and ethical manner

#### **IV. Core Competency: Communication and Interpersonal Skills**

- Communicates information about imaging and examination results in routine, uncomplicated circumstances
- Obtains informed consent
- Generates accurate reports with appropriate elements required for coding
- Communicates urgent and unexpected findings according to Lifespan policy and ACR guidelines

#### **V. Core Competency: System-Based Practice**

- Appropriately uses RAD CAT 3 and Red Result Macros

#### **VI. Core Competency: Practice Based Learning**

- Identify, rectify and learn from personal errors
- Use opportunities to perform basic directed US scanning of a particular organ with help of sonographer and attending

### **PGY 3**

#### **I. Core Competency: Patient Care**

- Recommends appropriate imaging of common conditions independently, such as biliary colic, renal colic, pelvic pain, thyroid nodules, testicular pain or mass, superficial masses, leg swelling
- Competently performs intermediate procedures, such as thyroid biopsies, lymph node biopsies and bakers cyst aspiration

#### **II. Core Competency: Medical Knowledge**

- Understands the basic components of common ultrasound examinations and less common examinations, including carotid, male genital, upper extremities, shoulder
- Makes secondary observations, narrows the differential diagnosis, and describes management options. Example: Indeterminate liver mass.

#### **III. Core Competency: Professionalism**



- Is an effective health care team member
- Demonstrates the following professional behaviors:
  - Puts patient care first and advocates for patient
  - Fulfills all work-related responsibilities
  - Recognizes personal limitations and seeks help
  - responds appropriately to constructive criticism
  - maintains patient confidentiality
  - Acts in professional and ethical manner

#### **IV. Core Competency: Communication and Interpersonal Skills**

- Communicates information about imaging and examination results in routine, uncomplicated circumstances
- Obtains informed consent
- Communicates, under direct supervision, in challenging circumstances (e.g., cognitive impairment, cultural differences, language barriers, low health literacy)
- Efficiently generates clear and concise reports that do not require substantive faculty member correction on routine cases reports with appropriate elements required for coding

#### **V. Core Competency: System-Based Practice**

- Recognizes sub-optimal imaging
- Participates in the case presentations in morning rounds and monthly Friday 7am conferences

#### **VI. Core Competency: Practice Based Learning**

- Incorporate feedback into improved performance.
- Improve visualization of structures during biopsy procedures

### **PGY 4**

#### **I. Core Competency: Patient Care**

- Recommends appropriate imaging of uncommon conditions independently, such as prostate disease, vascular disease including carotids, renal arteries and extremities, basic musculoskeletal ultrasound
- Competently performs intermediate procedures and random liver biopsies

#### **II. Core Competency: Medical Knowledge**

- Able to offer methods to improve suboptimal US images using alternative techniques, equipment, positioning
- Prioritizes differential diagnoses and recommends management
- Demonstrates knowledge of physical principles to optimize image quality
- Provides accurate, focused, and efficient interpretations

### III. Core Competency: Professionalism

- Demonstrates the following professional behaviors:
  - Puts patient care first and advocates for patient
  - Fulfills all work-related responsibilities
  - Recognizes personal limitations and seeks help
  - Responds appropriately to constructive criticism
  - Maintains patient confidentiality
  - Acts in professional and ethical manner
- Is an effective health care team leader, promoting primacy of patient welfare, patient autonomy, and social justice

### IV. Core Competency: Communication and Interpersonal Skills

- Communicates, under indirect supervision, in challenging and stressful circumstances (e.g., cognitive impairment, cultural differences, language barriers, low health literacy)
- Efficiently generates clear and concise reports that do not require substantive faculty member correction on common complex cases

### V. Core Competency: System-Based Practice

- Suggests methods of image quality improvement during read out of US

### VI. Core Competency: Practice Based Learning

- Perform literature search to aid in knowledge of particular clinical problems.
- Use opportunities to perform more complete US examinations with help of sonographer and attending

## PGY 5

### I. Core Competency: Patient Care

- Competently performs targeted solid organ and deep soft tissue biopsies and abscess drainages
- Integrates current research and literature with guidelines, taking into consideration cost effectiveness and risk-benefit analysis, to recommend imaging

## **II. Core Competency: Medical Knowledge**

- Makes subtle observations
- Suggests a single diagnosis when appropriate
- Able to independently assist sonographer in performing US examination
- Applies physical principles to optimize image quality
- Integrates current research and literature with guidelines to recommend management

## **III. Core Competency: Professionalism**

- Demonstrates the following professional behaviors:
  - Puts patient care first and advocates for patient
  - Fulfills all work-related responsibilities
  - Recognizes personal limitations and seeks help
  - responds appropriately to constructive criticism
  - maintains patient confidentiality
  - Acts in professional and ethical manner
- Serves as a role model for professional behavior

## **IV. Core Competency: Communication and Interpersonal Skills**

- Communicates, under indirect supervision complex and difficult information, such as errors, complications, adverse events, and bad news
- Efficiently generates clear and concise reports that do not require substantive faculty member correction on all cases
- Communicates, under indirect supervision, findings and recommendations clearly, concisely and professionally in all circumstances

## **V. Core Competency: System-Based Practice**

- Independently suggests to sonographers methods of image quality improvement
- Understand situations where US may offer an imaging alternative to decrease healthcare costs

## **VI. Core Competency: Practice Based Learning**

- Able to independently assist sonographer in attaining difficult anatomy

## WOMEN & INFANTS HOSPITAL - BODY

### INTRODUCTION:

The Diagnostic Imaging Department at Women & Infants performs a wide range of imaging services related to women's health. The resident will be exposed to a high volume of ultrasound, fluoroscopy, plain film radiography, CT and MR during the rotation and will be directly responsible for these examinations under supervision of an attending physician. Screening and Diagnostic Mammography with tomosynthesis, breast MRI and breast interventional procedures are currently jointly taught with RIH as a senior resident mammography rotation.

Examinations will be performed on inpatients, outpatients, and emergency room/triage patients. It is important for the resident to gain expertise in actually performing the examination, not only in the interpretation of the examination. Resident time performing OB-GYN ultrasound examinations will be encouraged. The resident will be expected to read a specified core of material on women's imaging as outlined in this section of the residency manual.

Emergency exams are to be read after hours by the resident on call. Preliminary reports on these examinations will be entered into a PACS workstation, located in the RIH ED, RIH CT, RIH MR, Hasbro or in the WIH Reading Room.

### DAILY WORK FOR OB/GYN IMAGING:

The radiology resident is in charge of the section with guidance and direction provided by the attending staff. The resident should report to the department by 8 am. The resident previews cases on PACS, obtains additional relevant studies, and reviews prior reports if indicated. The resident will then review the images and form an impression. All cases will be reviewed by an attending prior to final dictation. All stat cases will be dictated within one hour of the completion of the examination. All urgent cases will be dictated within four hours of completion. Any critical results will be directly reported to the licensed practitioner in charge of the patient and will be dictated as a critical result, highlighted as such in the dictated report.

A physician's assistant may be available to perform procedures in the department. The physician's assistant may also be available to assist the resident during procedures.

All positive ultrasound examinations are to be reviewed by the resident before the patient is discharged from the department. The positive findings should be confirmed by direct real-time evaluation by the resident. If emergent, the appropriate physician should be contacted.

Residents need to review and sign all dictated reports at the beginning of the work day and as often as possible through the day. Resident presence is required in the reading area until the day's work is finished, usually around 5:30 pm. All dictations for the day should be completed prior to leaving the reading room.

The attending staff and residents will be responsible for performing interventional procedures. These include hysterosonograms, hysterosalpingograms, paracenteses and thoracenteses. On the day of the procedure, the resident should review the relevant films with the attending to decide on the appropriate approach. The resident will be responsible for obtaining informed consent from the patient. All procedures are performed with the attending present, documented in the final dictation. Residents are responsible for the appropriate labeling of all the specimens and for discharge instructions to the patient.

### **READING FOR THE OB/GYN ROTATION:**

The reading list covers the basic aspects of women's imaging. Mandatory reading is divided into sections based on the level of the resident. Reference books are available in the WIH reading room and in the residency library.

#### **1. Required Reading**

##### **A. First Year Residents**

- Requisites: Ultrasound, second edition, by Middleton, Kurtz, Hertzberg, 2004
- Hysterosalpingography: A Text and Atlas by Ott, Fayez, Zagoria, 1998
- Doubilet, et al, "Diagnostic Criteria for Nonviable Pregnancy Early in the First Trimester, NEJM 2013; 369; 15, p. 1443-1451. (SRU Consensus statement on early pregnancy failure)
- Levine et al, "Management of Asymptomatic Ovarian and Other Adnexal Cysts Imaged at US: SRU Consensus Statement." Radiology 2010; 256(3) p. 943-954.
- AIUM Practice Guidelines for the Performance of the Obstetric Ultrasound Examinations, copyright 2013.
- Rad Primer

##### **Schedule:**

First week: Requisites chapters 12 (M-Tu), 13 (T-W), 14 (Th), Review AIUM Practice Guideline on Obstetric Ultrasound Examination.

Second week: Requisites chapters 22 (M), 23 (Tu). HSG book Chapters 2 and 3 (W) SRU Consensus statement on Early Pregnancy Failure, SRU Consensus statement on Ovarian Cyst (Th)

Third week: Requisites chapter 15 (M), 16 (T), 17 (W), 18 (Th).

Fourth week: Requisites chapter 19 (M), 20 (T), 21 (W), Basic questions on RadPrimer ob/gyn section (23 in all) (Th).

##### **B. Second and Third Year Residents**

Rad Primer

Print:

OB/GYN:

Callen, PW. Ultrasonography in Obstetrics and Gynecology, Saunders, 2017  
Chapters Fetal abnormalities

GYN, US and MRI  
Chromosomal abnormalities  
Multiple pregnancies

*MR:*

Siegelman, ES. Body MR, Elsevier 2005  
Chapter 1: Body MR Techniques  
Chapter 7: MRI of the Female Pelvis  
Chapter 8: Fetal MRI  
Chapter 10: MR of the Breast

## **2. Supplemental Reading**

Fleischer AC, et al  
Sonography in Obstetrics and Gynecology  
McGraw-Hill 2001

Hunt RB, Seigler AM  
Hysterosalpingography Techniques and Interpretation  
Year Book- 1990

Ott, Fayez ,Zagoria  
Hysterosalpingography: A Text and Atlas, 2nd edition  
William and Wilkins, 1998

Meaghan and Goldberg  
Diagnostic Ultrasound  
Lippencott-Raven 1998

Hamm and Forstner  
MRI and CT of the Female Pelvis  
Springer, 2006

### **TEACHING CASES:**

The senior resident or fellow in the section may be responsible for assembling cases for presentation at Imaging/ Fellows Conference. Attending radiologists are available for reviewing these cases prior to the conference.

### **CONFERENCES:**

The resident is expected to attend the noon Diagnostic Radiology conference at Rhode Island Hospital.

### **GENERAL OBJECTIVES:**

The general objective of the rotation is to become familiar with the scope of women's imaging and to receive adequate training in the interpretation of women's imaging studies and in performance of OB-GYN ultrasound interventional procedures in the department.

### **EDUCATIONAL GOALS & OBJECTIVES:**

**R<sub>1</sub>/PGY<sub>2</sub> Women and Infants' Rotation Goals and Responsibilities** (by the end of the second two week rotation)

- Learn basic ultrasound instrumentation, particularly related to equipment operation and transducer selection
- Observe and practice ultrasound scanning
- Check ultrasound images for the technologist and present them to the faculty
- Recognize and call critical results
- Create cogent reports on female pelvis and obstetric ultrasound
- Understands normal anatomy on ultrasound and plain radiography of the female pelvis
- Differentiates normal from abnormal obstetric ultrasound.
- Competently performs basic procedures including paracentesis, thoracentesis, and fluoroscopic guidance for hysterosalpingograms
- Help prepare for the women's imaging fellow conference as needed

### **First Rotation**

A. By the end of the first rotation, a resident should have achieved the following objectives and will be evaluated on these objectives as outlined below.

#### **Medical Knowledge:**

1. Understands protocols for complete first trimester and second/ third trimester obstetric ultrasound.
2. Recognize suboptimal ultrasound and plain film.
3. Make core observations formulate differential diagnoses and recognize the most common pathologic entities.
4. Differentiates normal and abnormal obstetric ultrasound
5. Understand the reasons for performing an interventional procedure.

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.
2. ACR In-Service exam.
3. Imaging conference presentations.

#### **Patient Care:**

1. Perform fluoroscopy for all radiographic procedures.
2. Perform paracenteses and thoracenteses with guidance.

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.

Practice-based Learning and Improvement:

1. Efficiently use electronic and print resources to access information.
2. Contact referring clinicians as previously indicated.

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.
2. Conference attendance.

Communication and Interpersonal Skills:

1. Appropriately obtain informed consent.
2. Appropriately communicate and document urgent or unexpected radiologic findings.
3. Produce radiologic reports that are accurate, concise and grammatically correct.

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.
2. Dictation sample review.

Professionalism:

1. Demonstrate respect for patients and all members of the health care team.
2. Maintains patient confidentiality.
3. Present oneself as a professional in appearance and communication.
4. Puts patients first and advocates for patients
5. Fulfills all work related responsibilities
6. Recognized personal limitations and seeks help when necessary
7. Responds appropriately to constructive criticism

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.

Systems-based Practice:

1. Attend Tumor Boards and Grand Rounds when appropriate.
2. Demonstrate knowledge of ACR standards and appropriateness criteria for OB/GYN imaging.
3. Demonstrates familiarity with Red Result and Critical Result reporting system

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.
2. Imaging conference presentations.
3. Conference attendance.

**Second Rotation**



- A. Residents in the second rotation will have additional goals and objectives beyond the rotation as follows:

Medical Knowledge:

1. Know of basic CT protocols for common acute and chronic indications
2. Recognize suboptimal fluoroscopy, ultrasound, and CT
3. Make secondary observations, narrow the differential diagnosis, and describe management options for common conditions
4. Describe pertinent anatomy on fluoroscopy, ultrasound and CT

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.
2. ACR In-Service exams.
3. Imaging conference presentations.

Patient Care:

1. Develop a management plan based on radiologic findings and clinical information.
2. Perform basic interventional cases competently such as paracenteses and thoracenteses.
3. Recommend appropriate imaging of common conditions independently
4. Manage the volume of cases efficiently in the reading room.

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.

Practice-Based Learning:

1. Attend Tumor board conferences and Grand Rounds when appropriate
2. Efficiently use electronic and print resources to access information

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.

Communication and Interpersonal Skills:

1. Effectively teach junior residents and medical students
2. Communicate effectively as a women's imaging consultant with all members of the health care team
3. Efficiently generates clear and concise reports that do not require substantive faculty member correction on routine cases
4. Communicate findings and recommendations clearly and concisely

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.

Professionalism:

1. Demonstrate respect for patients and all members of the health care team.
2. Maintains patient confidentiality.
3. Present oneself as a professional in appearance and communication.
4. Puts patients first and advocates for patients
5. Fulfills all work related responsibilities
6. Recognized personal limitations and seeks help when necessary
7. Responds appropriately to constructive criticism
8. Demonstrate a responsible work ethic with regard to work assignments.
9. Serve as a role model for junior residents and medical students.

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.

Systems-based Practice:

1. Demonstrate knowledge of cost-effective imaging practices.
2. Demonstrate knowledge of how radiologic information is integrated into the hospital information system in the treatment of the patient.

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.

**Third Rotation**

Medical Knowledge:

1. Knowledge of MR protocols for common acute and chronic indications
2. Knowledge of physical principles to optimize image quality
3. Recognize suboptimal ultrasound, CT, MR
4. Prioritizes differential diagnoses and recommends management, suggests a single diagnosis when appropriate
5. Describe pertinent anatomy on pelvic MR
6. Apply physical principles to optimize image quality
7. Integrates current research and literature with guidelines to recommend management

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.
2. ACR In-Service exams.
3. Imaging conference presentations.

Patient Care:

1. Develop a management plan based on radiologic findings and clinical information.
2. Recommend appropriate imaging of common and uncommon conditions

3. Integrate current research and literature with guidelines to recommend imaging
4. Competently perform all interventional cases with minimal direction.

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.

Practice-Based Learning:

1. Attend Tumor board conferences and Grand Rounds when appropriate.
2. Efficiently use electronic and print resources to access information.

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.

Communication and Interpersonal Skills:

1. Effectively teach junior residents and medical students
2. Communicate effectively as a women's imaging consultant with all members of the health care team.
3. Efficiently generates clear and concise reports that do not require substantive faculty member correction on common complex cases
4. Communicate findings and recommendations clearly and concisely

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.

Professionalism:

1. Demonstrate respect for patients and all members of the health care team.
2. Maintains patient confidentiality.
3. Present oneself as a professional in appearance and communication.
4. Puts patients first and advocates for patients
5. Fulfills all work related responsibilities
6. Recognized personal limitations and seeks help when necessary
7. Responds appropriately to constructive criticism
8. Serve as a role model for junior residents and medical students

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.

Systems-based Practice:

1. Demonstrate knowledge of cost-effective imaging practices.
2. Demonstrate knowledge of how radiologic information is integrated into the hospital information system in the treatment of the patient.
3. Uses Red Result and Critical Result reporting system
4. Check peer view for preliminary reports

The above will be evaluated by:

1. Monthly rotation evaluation by faculty.

**RESOURCES:**

Drs. Brody, Hillstrom, Khalil, Koelliker, Lazarus, Lourenco, Song, and Ward are responsible for the organization and supervision of the Women & Infants rotation.