# CanMeds Goals & Objectives - RVH

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1) Angiography & Interventional Objectives (RVH/MGH)

Program Goals

The aim of the rotation is to provide each resident with a basic exposure to and understanding of the principles of interventional procedures both diagnostic and therapeutic. The resident should learn the indications, contraindications, complications and limitations of the various angiographic and interventional procedures and to develop an understanding of the role of these procedures in the general context of the patient’s management.

Rotation to consist of minimum of 12 weeks to be taken with a minimum of two consecutive periods (8 weeks), preferably with the first 2 periods being consecutive.

Medical Expert

By the end of the regular four-month interventional rotation, the resident should know:

Vascular anatomy, variations and basic embryology.

- Residents should be familiar with the relevant vascular and non-vascular anatomy and be able to identify gross pathology.

- Various types of catheters, guidewires and their use; angiographic equipment including digital subtraction; contrast materials and their reactions and side effects as well as their management.

- Residents should know contrast volumes and rates. Know different types of contrast (I, CO2, gadolinium, lipiodol) and their indications. Recognize and treat contrast reactions.

- Residents should have an understanding of the various diseases and conditions being investigated and the role of angiography and intervention as in: atherosclerosis, thromboembolic disease including pulmonary embolism, neoplastic disease, gastrointestinal hemorrhage, bowel ischemia, reno-vascular hypertension, trauma and congenital anomalies.

All residents, by the end of their four period rotations, should be able to perform, on their own, diagnostic angiography cases such as thoracic and abdominal aortography, peripheral angiography, and should be able to do some selective studies of abdominal angiography.

- He or she should also be able to do a percutaneous nephrostomy in a dilated system and do a straightforward abscess, abdomen and chest drainages.

- Residents should be thoroughly familiar with indications and contra-indications of different procedures. Should know to obtain relevant clinical information, the limiting factors and measures taken to correct the limitations. Should know what type of pre-medication, antibiotic or analgesic is needed. (for example:
contrast reactions, impaired renal function, bleeding problems.

- As far as interventional procedures, residents are not expected to be able to perform these procedures on their own. However, they should be thoroughly familiar with the types of procedures that are available so that they may consult with their clinical colleagues and be in a position to suggest which types of interventional procedures are appropriate. They should also be familiar with follow-up procedures on these patients.

- Residents should develop an acceptable level of confidence but at the same time should know his/her limitations, not be overly aggressive and should not hesitate to ask for assistance of the senior fellow or the staff.

- If after training, a resident is to do patients on his/her own in a smaller community hospital, he/she should do additional training near the end of the residency program, for a total of six months. If he/she plans to specialize and practice angiography in a large referral centre then at least a one-year fellowship in a third level center, recognized teaching facility is recommended.

- Residents are encouraged to participate as second or first operator in as many cases as possible. The degree of responsibility given to a resident is often driven by the involvement of the resident. Residents are encouraged to perform at least 40 PICC lines per rotation; this one procedure combines many of the core skills required for IR, including vascular puncture and wire access (Seldinger technique), ultrasound guidance, catheter exchange, selective vessel catheterization and others. As such it provides the trainee with a strong base to build on.

- Residents should be able at the end of their rotation to perform on their own different types of venous access, including jugular vein, arm or femoral vein.

**Communicator**

- Residents are expected to develop a systematic, complete but concise reporting style, covering all potentially clinically significant data.

- residents must develop skills in discussing procedures with patients, understanding their concerns, and being sensitive to their right to information, balancing risks and benefits tailored to the individual patient needs.

- residents should be in a position to obtain informed consent from all patients for the most common procedures, being able to inform the patients of potential complications and benefits.

- residents must recognize the importance of effective communication with technical staff, nurses and secretarial staff so that clear messages are delivered in order that the correct treatment and follow up be arranged.
Collaborator
- Residents must demonstrate good consulting skills when interacting with other physicians and health team members.
- Residents must learn to interact appropriately with other radiology staff, demonstrating the importance of the team approach to patient care.
- Residents must learn and demonstrate the direct approach to teamwork in an emergency situation recognizing when direct immediate contact with relevant clinical colleagues is needed.
- Residents should be prepared to participate in interdisciplinary teaching rounds and research projects involving other specialties.
- The resident is required to enter all interesting cases of teaching value into the interventional radiology teaching file, (via PACS) together with all relevant clinical information and where possible, give references.
- The entire teaching file should be reviewed by the resident at all free moments and where he or she feels that corrections or additions are indicated, this should be done.

Leader
- Residents should demonstrate awareness of indications and contraindications to various angiographic and interventional procedures.
- Residents should consider the necessity and appropriateness of using costly equipment over less costly equipment to accomplish the required goal.
- Residents must consider available imaging resources when planning and recommending patient care, using them effectively and efficiently.

Health Advocate
- Residents must recognize and consider consent, patient comfort and other patient related issues when performing interventional acts, taking into account individual patient status and needs, also considering radiation exposure risk.
- Residents should recognize when a procedure has higher risks than benefits.

Professional
- Residents are expected to attend all departmental conferences unless occupied doing procedures. Although angiography conference is generally given by staff, residents should be prepared to present certain topics as required.
- Residents must demonstrate integrity, honesty, reliability and compassion.
- Residents must understand and practice the ethical and medico-legal requirements of interventional radiology.
Residents must recognize their own limitations and always keep in mind that the patient is paramount.

**Scholar**
- Is strongly recommended that the residents have a personal portfolio with all the procedures he/she participated on as observer, assistant or first operator.
- Residents should set personal learning goals and objectives.
- Residents should be capable of teaching others (junior residents, medical students, nurses and technicians).
- Residents must learn the importance of reading texts and journals as well as online learning sites and realize the necessity of a lifelong commitment to learning.
- Residents should be prepared to participate in any ongoing or new research projects.
- Reporting of cases before end of rotation: Please ensure that all cases are dictated. If you are unable to complete reading them, be sure to advise the attending M.D.

**Basic reading List**
- The Requisites: Vascular and Interventional Radiology, Kaufman, 2004
- Castaneda-Zuniga, 2nd edition 1993
- Abrams Angiography (reference)
- Imaging Guided Interventions, Mauro 2009. On line version (2011) available at the angio room, MGH.
- Interventional Oncology, Geschwind 2009
- SIR annual conference CDs contain up-to-date review lectures on most major topics, available in interventional radiology at Glen Campus.
- SIR Syllabus Series:
  - Peripheral vascular intervention
  - Thoracic and Visceral
  - Biliary
  - Portal Hypertension
  - Venous Interventional
Patient care

Quantitative Expectations:

Residents are encouraged to participate as much as they can on every procedure, because every case could be a teaching case.

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Primary Operator</th>
<th>Assistant</th>
</tr>
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<tbody>
<tr>
<td>Arterial</td>
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<tr>
<td>- Aortography</td>
<td>15</td>
<td>25</td>
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<tr>
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<td>10</td>
<td>25</td>
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<tr>
<td>- Embolization, all types</td>
<td>-</td>
<td>20</td>
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<tr>
<td>Angioplasty/Stenting</td>
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<td>10</td>
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<td>Thrombolysis</td>
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<td>1</td>
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<tr>
<td>Venous Procedures</td>
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<tr>
<td>- PICC Lines</td>
<td>50</td>
<td>25</td>
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<tr>
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<td>8</td>
<td>10</td>
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<tr>
<td>- Tunnelled Catheters</td>
<td>5</td>
<td>10</td>
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<tr>
<td>- Trans-venous biopsies</td>
<td>5</td>
<td>10</td>
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<tr>
<td>Central lines (IJ)</td>
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<td>15</td>
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<tr>
<td>Non-Vascular Interventions</td>
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<tr>
<td>- Nephrostomy tube</td>
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<td>8</td>
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<td>- Radio-Frequency Ablation</td>
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<td>- Vertebroplasty</td>
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<td>3</td>
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<tr>
<td>- Percutaneous Gastrostomy</td>
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<td>8</td>
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<tr>
<td>Nerve block</td>
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Updated: April 2017 (Dr. Cabrera)
2) Cardiac Imaging Rotation –(MGH/JGH/RVH)

Weekly Schedule

The weekly schedule in Cardiac imaging takes into account the multiple sites at McGill where Cardiac Imaging is performed. It is the resident's responsibility to get in touch with the staff at each site (see below) and organize daily activities. If there is no activity at a given time, it is the resident’s responsibility to fill the time with another acceptable activity and self-learning material, such as teaching files, independent study, etc. Attendance at the hospital is mandatory at all time. Attendance at daily rounds is required. Home studying is not acceptable.

<table>
<thead>
<tr>
<th>Daily schedule &amp; tasks</th>
</tr>
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<tbody>
<tr>
<td><strong>Monday am – RVH</strong></td>
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</table>
| **Monday pm – MCH & RVH** | • Cardiac / CVT rounds – 1400-1600 hrs.  
                          | • Adult cardiac MRI review session after CVT rounds. |
| **Tuesday am – MCH**  | • Pediatric ICU CXR OR observing pediatric heart Angiograms.  
                          | • Lecture by Dr Carpineta from 1100-1200 hrs. |
| **Tuesday pm – MCH**  | • MRI case study – Dr. Luc Jutras |
| **Wednesday am MGH, RVH or JGH** | • Preparation of cardiac presentation |
| **Wednesday pm – MCH** | • Cardiac MR Scanning and case review-Dr Jutras: 1200-1600 (resident does not attend Wednesday afternoon CCT) |
| **Thursday am – MCH** | • Thursday morning case review-Dr. Jutras from 9:30 to 11:00.  
                          | • Adult cardiac MRI and cardiac CT Dr. Sayegh/Dr. Friedrich/Dr. Semionov |
| **Thursday pm – RVH** | • Adult cardiac MRI and Cardiac CT Dr. Sayegh/Dr. Friedrich/Dr. Semionov |
Other mandatory tasks

1. A 10 minute presentation needs to be coordinated with Dr. Karl Sayegh. It is the resident’s responsibility to get in touch with Dr Sayegh and schedule the day of presentation.

2. Electronic Adult cardiac imaging teaching file (50 CXR cases) is to be completed by the end of the rotation.

3. Adult teaching files (Dr. Valenti CTA log book and Dr. Hanson teaching files)

4. Pediatric Teaching File Dr Jutras

5. Pediatric Teaching File Dr Carpineta

Rotation coordinator and head evaluator for all residents rotating in cardiac imaging:

Dr Karl Sayegh, 5149341934 ext 42888, 64800

Site coordinators:

RVH & MGH: Dr Karl Sayegh, ext 42888, 64800

MCH: Dr. Lucia Carpineta, ext 22130 (Claudia Subiabre)

JGH: Dr Bojan Kovacina 514-3408222 ext 5358

Additional Faculty:

MCH: Dr Luc Jutras

RVH: Dr Matthias Friedrich

RVH and MGH: Dr Alex Semionov

MGH: Dr. Genevieve Belley

JGH: Dr Jonathan Affilalo
Educational Objectives:
The rotation aims to provide a basis of knowledge and exposure to the field of cardiovascular imaging suitable for a general radiologist. A 4-week period program is intended to familiarize the trainee with various cardiac pathologies and modalities used in cardiac imaging rather than aiming at acquiring specialist consultative skills. The trainee rotates through adult sites (RVH, MGH and JGH) and pediatric site (MCH) to maximize exposure to cardiac imaging. The learning experience involves a combination of:

- Clinical case reviews (CT and MRI) and imaging rounds.
- Didactic lectures and presentations.
- Exposure to scanning techniques (CT and MR).
- Teaching files (Xray, CT and MR).
- Multidisciplinary rounds

Medical Expert
- Gain knowledge of anatomy of the heart, coronary arteries and thoracic aorta for all ages on both x-ray and cross sectional imaging (CT and MR).
- Gain an understanding of patient positioning and imaging planes in coronary angiography, CT and MR.
- Learn the indications for cardiac CT imaging and Cardiac MRI.
- Gain basic knowledge of the various post processing software used in cardiac Imaging and learn the basics of post processing in CT and MRI (for example interpretation of CT calcium score, MPR reformats for cardiac CTA and TAVI and ventricular volume quantifications by MRI)
- Learn interpretation of CT and MR of coronary artery disease, cardiomyopathies and thoracic aortic disease.
- Gain a basic understanding of the various techniques and protocols used in cardiac CT (EKG gating, coronary CTA, triple rule out protocol, TAVI, etc.)
- Gain a basic understanding of the various techniques, sequences and planes of imaging used in cardiac MRI.
- Show an understanding of a structured style of reporting.
- Actively participate in the daily clinical work (patient preparation, protocol planning, post processing and case review).

Communicator
- Communicate effectively with colleagues, patients and their families and have a compassionate interest in them.
- Produce imaging reports which describe major findings, most likely differential diagnoses and recommend further testing and management.
- Understand the importance of communication with referring physicians including an understanding of when the results of an investigation should be urgently communicated.

Collaborator
- Consult effectively with other physicians, technologists, nurses and other health care professionals.
- Demonstrate the ability to function as a member of a multidisciplinary health care team especially with referring cardiac surgeons and cardiologists.

Leader
- Utilize resources effectively to balance patient care and learning needs.
- Utilize information technology to optimize patient care.
Health Advocate
- Identify the important determinants of health affecting cardiac patients and balance radiation dose with the clinical benefit of an imaging study.
- Understand and communicate the benefits and risks of cardiovascular investigation and treatment including population screening.
- Recognize when radiological investigation or treatment would be detrimental to the health of the patient.
- Educate and advise on the use and misuse of cardiovascular imaging.

Scholar
- Develop, implement and monitor a personal continuing education strategy.
- Critically appraise sources of medical information.
- Demonstrate the ability to teach the plain film findings of cardiac disease to medical students, residents, technologists and clinical colleagues.
- Add interesting cases to the teaching file.
- Prepare a short 10 min presentation of a topic in cardiac imaging.

Professional
- Be punctual and available for assigned duties at all sites.
- Deliver the highest quality care with integrity, honesty and compassion.
- Exhibit appropriate personal and interpersonal behaviours.
- Accurately assess one’s own performance, strengths and weaknesses.
- Understand the ethical and legal requirements of cardiac radiology.

Evaluation
Mid-rotation verbal evaluation as required.

Written end of rotation evaluation using cardiac-specific ITER.

Expected Case load
Clinical Cases:
- Cardiac CT: 5-10/week
- Cardiac MRI: 10/week

Teaching files:
- CXR
- Cardiac CT
- Cardiac MRI
- Coronary Angiograms

Rotation Tasks:
MCH training overview:
The focus of the training in the MCH segment of the rotation is to expose trainees to presentations of congenital heart diseases and how to recognize them on CXR, learning about indications and contraindications of cardiovascular MRI vs CT in the pediatric heart disease, and how the technique of cardiac MRI in pediatrics differs from that in the adult: adjustments are required because of poor cooperation of pediatric patients, their smaller size, and the pathologies specific to pediatrics.
(congenital cardiopathies). An approach to segmental analysis is reinforced during the rotation. Below are some of the main components of the MCH rotation:

**Cardiac / CVT rounds:** Cardiac/CVT rounds multidisciplinary rounds are Mondays of each week in B.RC.3535 from 14h00-16h00. It is divided in 3 parts: (1) new cases with workup thus far (CXR, echo and ECG usually reviewed) with presentation of tentative diagnosis and next steps, (2) follow-up on pending cases with updates on new tests (e.g. results of heart cath and/or cardiac MRI are reviewed) and a treatment plan is developed, with CVT/cardiac surgery present as well as PICU so that everyone involved in the care of the patient perioperatively is aware of what will be done and what to be on the lookout for; and (3) follow-up of operated cases - intraoperative findings and unexpected developments, postoperative course, with new/revised treatment plans. These rounds are very clinically oriented and a great way to expose residents to cases at various steps of management. Residents get to see how cardiac imaging is integrated in a diagnostic, interventional, and surgical strategy for the treatment of children with congenital heart disease.

High level discussion but strongly recommended.

**MRI case study-Dr Jutras:** Tuesday afternoon from 13:30 to15:30 -16:00. Residents get one to one teaching with Dr Jutras about the imaging approach to congenital heart disease with an emphasis on the more complex malformations (D-TGA, AV-VA discordance, complex anatomy, etc.).

**Lecture by Dr Carpineta:** Every Tuesday, from 11-12am. These sessions consist of PowerPoint presentations/didactic teaching covering key concepts in Congenital Heart Diseases, and their imaging.

**Cardiac MR Scanning and case review-Dr Jutras:** Wednesday afternoon from 12:00 to 16:00. The residents are at the scanner with Dr Jutras. They learn about acquisition in cardiac imaging planes, they are exposed to the architecture of pulse sequences and to problem solving at the scanner. After exposure to scanning technique, the residents review and post process the cases with Dr Jutras.

**Thursday morning case review with Dr Jutras:** from 9:30 to 11:00. The residents get semi-directed teaching as it relates to simpler pediatric conditions (vascular rings and slings, cardiac masses, cardiomyopathies, etc.).

**Pediatric Teaching Files:** Pediatric Teaching Files, are primarily MRI with few CTs of congenital heart disease which cover interesting cases with teaching value to trainees. DR Jutras and Dr Carpineta provide two separate teaching files. They are to be covered at the pace of the resident, in their free time.

Dr Carpineta requires that prior to leaving the rotation, the trainee must add one interesting case they have seen during their rotation to the Teaching File (available on USB with our secretary Claudia) so as to keep it growing (>70 cases to date), up to date, comprehensive and interesting to future peers.
Pediatric ICU CXR OR observing pediatric heart Angiograms: This activity occurs on Tuesday mornings. The resident can either observe pediatric heart angiograms in progress OR select Cardiac related CXR from the PICU and NICU worklist focusing on ongoing cases of congenital heart disease pre and post intervention, to get exposure on the evolution of the chest radiograph in these patients before and after interventions. Expected case load ~ 15-20 CXR in an AM.

Adult sites training overview (RVH, JGH and MGH):
On top of the schedule outlined in this document, there are always urgent CT or MR add ons, residents are therefore strongly encouraged to regularly ask the CT and MR technologists in charge or staff whether there are any cardiac cases whenever they are free (applies to all sites). During free time, residents may also be contacted by staff at various sites to attend review sessions or participate in clinical work. Residents are expected to be present at the control room while MRs and CTs are being performed. Residents are also expected to participate in post-processing of images, preparing reports and reviewing the cases with attending staff.

Adult Cardiac MR:
The cardiac MR Service is run and supervised by the staff of the Division of Cardiac Imaging. The number of cardiac MR per week is expected to be approximately 20. Currently, a clinical MRI system is dedicated to cardiac imaging on Mondays and Thursdays at RVH, on Fridays at JGH and on Mondays AM at MGH. The residents are exposed to all facets of adult cardiac MR including assigning appropriate CMR protocols to specific indications, learning imaging planes and sequences at the scanner, post-processing techniques and image interpretation. Interpretation of CMR is done using dedicated cardiac imaging software (cvi42).

The resident is exposed to the normal anatomy of the heart by Cardiac MR and to the most commonly encountered disease states including:

- Ischemic heart disease
- Nonischemic cardiomyopathies
- Valvular diseases
- Cardiac masses
- Adult congenital heart diseases
- Pericardial disease
- Non cardiac thoracic MR imaging
- Vascular diseases of the chest

Residents are strongly encouraged to familiarize themselves with the cardiac imaging software (cvi42) prior to the rotation or during the first few days of the rotation to enhance their rotation experience. Several tutorial videos are available on YouTube.

(You can go to YouTube and type in CVI42 tutorial videos or go to the following link)
Residents should at least familiarize themselves with the ‘contouring tutorial’ prior to rotation.)

Adult Cardiac CT:
The cardiac CT service is run and supervised by the staff of the Division of Cardiac Imaging. The resident is exposed to all facets of cardiac CT including appropriate use of cardiac CT, adequate patient preparation and monitoring, how to design and adapt protocols to specific clinical situations, Cardiac CT post processing interpretation and Radiation safety. All CTs are currently done on GE 64 channels at RVH and Philips 64 channels (at MGH) scanners. Cardiac CTs are done on a Siemens Flash scanner (128 channels) at JGH. Interpretation is done on GE workstations or Philips Intellispace at MUHC and on Terrarecon at JGH. Residents are encouraged to familiarize themselves with the cardiac module of one of these softwares (if possible prior to the rotation or during the first few days of the rotation) to enhance their rotation experience. The case load of cardiac CT is variable but most cases are currently done at RVH on Thursdays and a few on Wednesday. Cardiac CTs are reviewed with residents on Fridays at JGH.

The resident is exposed to the normal anatomy of the heart by Cardiac CT and to the most commonly encountered disease states and types of studies including:

- Assessment of coronary artery disease in the acute and non-acute setting.
- Evaluation of aortic valve disease (TAVI)
- Calcium scoring
- Structural heart disease (vascular, valvular, left atrial appendage, etc.)
- Cardiac masses
- Triple rule out studies
- Aortic root evaluation
- Congenital anomalies.

Adult Teaching Files:
The trainee is required to complete the Electronic Cardiac Imaging Teaching File. The Teaching File is a compilation of excellent cardiac teaching cases from the collections of various MUHC staff radiologists. The teaching cases range from normal anatomy cases to studies of diverse congenital and acquired pathology; serving as important basic material to master during the Cardiac Imaging rotation. The file contains studies of varying modalities (plain films, angiograms, CT, MRI) and is a great tool for self-study, ensuring that all residents are exposed to the required basic objectives. The images in the file are identical to any other study on PACS; the tools for interpretation remain the same. The Electronic Cardiac Imaging Teaching File can be accessed by clicking on the “teaching collection” tab found at the top of the PACS interface (next to the “teaching file” tab). Next, in the “collection ID” query, entering 101 will prompt the cardiac teaching collection to be displayed at the bottom of the screen. Alternatively, the collection can be accessed by searching by "author" (rhanson). Each file within the collection can be accessed individually by double clicking on a particular file. For teaching purposes, it is recommended that the user check off the box next to "open in teaching mode"
(found at the bottom of the query list) prior to opening an individual file. This will prompt only the images with a scant history, allowing the user to solve the case for themselves. Once completed, additional tabs showing the correct interpretation can be accessed at the top right of the study interface. Systematically working through the cases in “teaching mode” will allow the resident to interpret studies before verifying with staff expert interpretation. This file was initially created by Akshat Gotra during medical school, as a pilot project in 2010-2011.

**Suggested Reading**
- www.scct.org (Society for Cardiovascular Computed Tomography). A great source of standards, guidelines, terminology, and a very focused cardiac CT journal.
- www.scmr.org (Society for Cardiovascular MR). A great source of standards, guidelines, terminology, and a very focused, free-access cardiac MR journal.
- www.thepreparedminds.com A site which aggregates abstracts of current publications in all cardiac imaging fields.
- https://mystatdx.com
- http://canscmr.org/resources.htm Website of the Canadian Society for Cardiovascular MR, with good resources, including standard CMR protocols
- Cardiac imaging software (cvi42) tutorial videos on YouTube.
- (You can go to YouTube and type in CVI42 tutorial videos or go to the following link
- https://www.youtube.com/playlist?list=PLBSFiK_IG_fRDJQMEt0k_sndgTNFKVR7b

Karl Sayegh, MD

Last updated April 4, 2017
3) CHEST Radiology – (MGH/ RVH)

GOALS: By the end of residency training, the resident should be familiar with the indications for CHEST imaging and be able to protocol, detect and diagnose common pathologies of the above system.

Rotation Objectives

Please refer to the attached detailed goals and objectives from the Society of Thoracic Radiology:


Specific CANMEDS Objectives:

Medical Expert

After completing one month of thoracic imaging, the resident should be able to:

- Know the most frequent indications for standard CHEST CT scan imaging and when to administer iodinated contrast material. The resident should also gradually become familiar with various scan protocols used in the chest, including CT angiograms for aortic and pulmonary artery assessment. The resident should actively participate in the protocolling of studies.
- Recognize normal anatomy of the chest both on radiographs and CT scan.
- Recognize the different lines and tubes seen on chest radiographs and CT scans and learn how to detect their complications and misplacement.
- Recognize pathology and be able to discuss characteristics of commonly seen pathologies of the thorax both on chest radiograph and CHEST CT scan.
- Know the most frequent indications for High resolution CT scan of the chest and the characteristic signs to look for on interpretation.
- Know how to perform a transthoracic needle biopsy and aspiration: the different techniques, the potential complications with their frequency and how to avoid and manage these complications.
- Know the appropriate techniques of dealing with contrast reaction and patient resuscitation in the CT scan suite environment.

Communicator:

- To dictate well organized reports describing relevant findings, diagnosis and recommendations.
- To demonstrate effective communication skills when dealing with patients, staff and referring clinical services.

Collaborator

- To demonstrate good consulting skills when interacting with other physicians & health team members.
- To interact appropriately with other radiology department staff, demonstrating a team approach to patient care.

leader

- To demonstrate awareness of the indications for standard CHEST CT scan as well as high resolution and low dose CT examinations.
Consider advantages and disadvantages of CT scan versus other imaging modalities.
To consider available imaging resources when planning and recommending patient care, using them effectively and efficiently.

Health Advocate
- Recognize and consider consent issues, patient comfort and other patient-related issues, when supervising CT scan examinations as well as transthoracic needle biopsies.
- Be aware of CT dose reduction strategies and when it is appropriate to implement them.
- Be aware of upcoming issues with regards to lung cancer screening.

Professional
- To demonstrate integrity, honesty and compassion.
- To practice understanding ethical and medical-legal requirements of radiologists.
- To demonstrate awareness of own limitations.

Scholar
- To set up personal learning goals and objectives during rotation.
- To take a leadership role in the teaching of others, with teaching/supervision of junior residents on rotations, elective students and off-service residents.

Rotation Responsibilities:
Resident responsibilities include:
- Review previous imaging history, in order to provide appropriate information for the involved technologists and for study interpretation.
- Review CT and High resolution CT scans of the CHEST independently prior to reviewing them with staff.
- Learning how to adequately interpret plain radiographs of the chest in the outpatient, in-patient and ICU setting.
- Learn how to obtain consent for the transthoracic needle biopsies under CT guidance.
- Assist the staff radiologist in the transthoracic needle biopsies and eventually perform the biopsies under staff supervision (senior resident).
- Provide supervision/guidance to the technologist for cases requiring a modified CT scan protocol.
- Report all cases he/she has been involved with (supervising or reviewing). All cases need to be read out in conjunction with the assigned staff radiologist.

Specific expectations for junior residents (R2 and R3), usually during their first 2 rotations in thoracic Imaging:
- A junior resident is expected to review 3 to 4 CT chest per half day.
- A junior resident is expected to review 20 Chest X ray per week.
- A junior resident is expected to assist in 1 to 2 lung biopsy per week.
- A junior resident is expected to participate in the protocolling of ~10 to 20 CT chest per week.
Specific expectations for senior residents (R4 and R5), usually residents who have already completed two months of thoracic imaging rotations:

- A senior resident is expected to review 4-6 CT chest per half day.
- A senior resident is expected to review 30-40 Chest X ray per week.
- A senior resident is expected to assist and gradually perform 1 to 2 lung biopsy per week.
- A senior resident is expected to participate in the protocolling of ~ 20 - 30 CT chest per week.

Teaching:
- The resident is encouraged to bring interesting cases to resident rounds.
- Supervision/teaching of elective medical students or off-service residents, along with assigned radiologist.
- Teaching of MR technologists and students, as appropriate
- Presentation of cases at thoracic tumor board as a senior resident

Rounds:
The resident is expected to attend the following rounds:
- Daily radiology rounds at 8:00 AM and 12:00 PM.
- Weekly radiology rounds on Wednesdays PM.
- Weekly chest rounds at the Glen site on Fridays at 8:00AM (for residents rotating at Glen).
- Weekly chest rounds at the MGH site on Thursdays at 8:00AM (for residents rotating at MGH).
- When there are no other teaching rounds, the residents rotating at GLEN should attend weekly thoracic tumor boards at Glen site (current schedule is on Thursdays at 12:00PM).

Evaluation:
The resident is assessed on a daily basis by staff assigned to CHEST reading, as well as during educational rounds.

Procedural skills to learn:
Transthoracic needle biopsies and aspirates as described above.

Recommended Reading
3) Webb WR, Muller NL, Naidich DP. High-Resolution CT of the Lung, 5th Ed. Lippincott Williams & Wilkins
7) Society of Thoracic Radiology website offers free educational material (http://thoracicrad.org/?portfolio=education)
8) Gautham P. Reddy, Robert M. Steiner, Christopher Walker. Cardiac Imaging: Case review series, 2nd Edition Elsevier
10) Suhny Abbara & Sanjeeva P Kalva. Problem Solving in Cardiovascular Imaging, 1st Edition

**Suggested additional references:**
2. Fraser RS, Colman N, Muller N, Pare PD. Synopsis of Diseases of the Chest, 3 Ed. Saunders; February 18, 2005.
3. Fraser RS, Muller NL, Colman NC, Pare PD. Fraser and Pare's Diagnosis of Diseases of the Chest, 4th Ed. 4 Volume Set. Saunders, 1999.

**Updated: February 2017**
4) CT Rotation

Rotation Objectives

General Objectives:
The goals of the General CT rotation at the RVH are to provide resident trainees with adequate knowledge base and expertise in the interpretation of CT images with regards to normal anatomy as well as common pathology. The resident must be able to advise the clinician and patient on the potential uses of diagnostic and interventional CT procedures. The trainee will acquire expertise in order to carry out basic procedures such as biopsy and drainage. In addition, the resident will learn more advanced techniques such as CT Angiography and CT Colonography.

Medical Expert/Clinical Decision Maker
- To learn the appropriate indications for variety of CT examinations.
- To demonstrate basic knowledge of protocols for all of the body systems mentioned above.
- To learn the normal anatomy of the above-mentioned systems.
- To develop basic image interpretation skills.
- To demonstrate knowledge of common pathologies (including trauma) and their associated CT findings.
- To learn formulation of appropriate differential diagnoses.
- To correlate CT findings with other imaging modalities (Plain films, Ultrasound, MRI etc.)
- To learn the technique and gain experience performing CT-guided biopsy (FNA & core), thoracentesis & paracentesis, including indications, contraindications as well as recognition and management of complications.
- To learn the basic CT physics and instrumentation related to equipment operation, image optimization and radiation dose reduction.
- To learn the indications as well as absolute and relative contra-indications of IV contrast.
- To learn identification and management of contrast reactions.
- To learn to prioritize studies based on their medical urgency.

Communicator
- To dictate well-organized reports, describing relevant findings, diagnosis and recommendations.
- To demonstrate effective communication skills when dealing with patients, staff and referring clinical services.
- To communicate life-threatening findings directly to the referring physician in a timely fashion.
- To document pertinent conversations with the clinician in the report.
- Collaborator:
  - To demonstrate good consulting skills when interacting with other physicians & health team members.
  - To interact appropriately with other radiology department staff, demonstrating a team approach to patient care.
Leader
- To demonstrate awareness of the indications for various CT examinations.
- Consider advantages and disadvantages of CT vs. other imaging modalities.
- To consider available imaging resources when planning and recommending patient care, using them effectively and efficiently.

Health Advocate:
- Recognize and consider consent issues, patient comfort and other patient-related issues, when participating in or performing CT/CT-guided procedures.
- Recognize and consider radiation doses when recommending, approving and performing diagnostic or interventional cases.
- To demonstrate knowledge and awareness of radiation protection and well as appropriate handling of body fluids.

Professional:
- To demonstrate integrity, honesty and compassion.
- To practice understanding ethical and medical-legal requirements of radiologists.
- To demonstrate awareness of own limitations.

Scholar:
- To set personal learning goals & objectives during rotation.
- To take a leadership role in the teaching of others, with teaching/supervision of junior residents on rotation, elective students, off-service residents.

By end of PGY 5 year:
- To be competent in objectives listed above.
- To demonstrate skill in biopsy and procedural techniques, performing with minimal supervision and guidance.
- To function as a junior consultant in the CT department.

Rotation Responsibilities

General
- Review previous imaging, and lab data as necessary, in order to enable correct choice of protocol and thorough study interpretation.
- Provide supervision/guidance to the technologist.
- Report all cases in which he/she has been involved. The target number of scans to be read is 12-15 per day. All cases to be reviewed by supervising radiologist.
- Under direct supervision, the resident is responsible for CT-guided procedures. These include abscess drainage and solid organ and tumor biopsies.

Teaching:
- The resident is encouraged to bring interesting cases to rounds.
- Supervision/teaching of elective medical students or off-service residents, along with assigned radiologist.
- Teaching of CT technologist.
**Rounds:**
Daily rounds 8 AM and 1 PM.

**EXPECTED CASE VOLUMES:**
THE RESIDENT ON CT IS EXPECTED TO REVIEW ALL THE EMERGENCY CT SCANS PERFORMED ON THE OVERNIGHT AND DURING THE DAY, AS WELL AS A SELECTION OF NON URGENT SCANS. EXPECTED VOLUME IS 12-15 CT / DAY.

**Evaluation:**
Assessed on a daily basis by staff assigned to CT, as well as staff at rounds.

Formal evaluation at end of 4-wk rotation with Face-to-Face feedback session during last week of rotation.

**Recommended texts:**
Webb WR, Brant WE, Helms CA. Fundamentals of Body CT

Lee JKT, Sagel SS, Stanley RJ, Heiken JP. Computed Body Tomography with MRI Correlation.

Federle, Jeffrey, Desser, 1st ed, Diagnostic Imaging**, Salt Lake City, Utah 2004

**Case Review Series by Mosby**
  a. Genitourinary Imaging
  b. Abdominal Imaging

**Genitourinary Imaging- coming out shortly.**

**Additional resources:** Internet

Departmental and Hospital Library

**Updated May 5, 2017**
5) ENT Radiology (MGH/RVH/JGH)
Rotation consists of 2 weeks at JGH, 2 weeks at MGH/RVH

GOALS: By the end of residency training, the resident should be familiar with the indications for ENT plain radiographic, CT and MR imaging and be able to protocol, detect and diagnose common pathologies.

Rotation Objectives

Medical Expert/Clinical Decision Maker
After completing one month of ENT imaging, the resident should be able to:

Know the indication/contraindications to CT and MR imaging and know where to consult the source documents for questions that arise regarding potential contraindications.

- Know the appropriate techniques of dealing with contrast reaction and patient resuscitation in the CT and MRI suite environments.
- Be familiar with basic CT parameters and MRI pulse sequences and their clinical applications.
- Be familiar with basic imaging artifacts and understand how they can be avoided.
- Recognize normal anatomy in the various imaging planes using the standardized imaging protocols.
- Recognize pathology and be able to discuss the signal and enhancement characteristics of commonly seen pathologies.

Communicator

- Able to provide and organize succinct, but thorough, diagnostic reports.
- Able to consult with referring physicians both before and after studies / procedures are performed, demonstrating effective communication skills.
- Demonstrate effective communication skills when dealing with patients, during interview, consent and procedure.
- Able to explain the procedure and findings in terms that the patient and family can understand.
- Demonstrate effective skills when dealing with staff from referring clinical services.

Collaborator

- Demonstrate adequate consultation skills when interacting with other physicians & health team members.
- Interact appropriately with other radiology departmental staff (technologists, nurses), demonstrating a team-based approach to managing patients.
- Participate in interdisciplinary rounds.

Leader

- To demonstrate awareness of the indications for ENT imaging examinations.
- Consider advantages and disadvantages of each imaging study.
• To consider available imaging resources when planning and recommending patient care, using them effectively and efficiently.
• Manage the section and report Emergencies immediately
• Help protocol examinations ahead of time and urgently when required

Health Advocate
• Recognize and consider consent issues, patient comfort and other patient-related issues, when participating or recommending imaging procedures.
• Recognize and consider radiation doses when recommending, approving and performing diagnostic or interventional cases
• To demonstrate knowledge and awareness of radiation protection and well as appropriate handling of body fluids.

Professional
• Demonstrate integrity, honesty and compassion.
• Ability to show sensitivity and care to the patient and the patient’s family.
• Practice understanding of ethical and medical-legal requirements of radiologists
• Demonstrate awareness of one’s own limitations.
  • Continuous motivation to learn

Scholar
• Set personal learning goals & objectives during rotation(s).
• Take a leadership role in learning from others, with teaching/supervision of junior residents on rotation, elective students, off-service residents.
• Create Teaching Files for use by future trainees.

Rotation Responsibilities:

General
**In first 1-2 weeks:** Focus on learning the basic anatomy as well as understanding the most common indications and contraindications to CT and MR imaging. Can review cases with the fellows and staff assigned to the rotation

Subsequent weeks resident responsibilities include:
• Interview patient, review patient charts, lab data, previous imaging history, in order to provide appropriate information for the involved technologists and study interpretation.
• Provide supervision/guidance to the technologist for cases requiring a modified CT or MR scanning protocol.
• Report all cases he/she has been involved with (supervising or reviewing). All cases need to be read out in conjunction with the assigned staff radiologist.
• Administer or supervise sedatives to patients as needed.

Teaching:
• The resident is encouraged to bring interesting cases to resident rounds.
• Supervision/teaching of elective medical students or off-service residents, along with assigned radiologist.
• Teaching of CT and MR technologists and students, as appropriate
Rounds:
Bring interesting ENT cases to ENT radiology rounds (MGH or JGH) or Grand Rounds at MGH

Evaluation:
Assessed on a daily basis by staff assigned to ENT, as well as during education rounds.

Formal ITER at end of 4-week rotation. PLEASE ARRANGE A TIME FOR THIS WITH SUPERVISOR!

Suggested resources:
Recommended texts: Imaging of the head and neck, Som & Bergeron.

Temporal Bone
Imaging of the Temporal Bone, Swartz & Harnsberger.

CT/MRI
CT and MRI of the Head and Neck, Mancuso & Hanafee.

MR and CT imaging of the head, neck and spine 2nd ed. Richard E. Latchaw

Temporal Bone Anatomy
- Head and Neck Imaging, 3rd Edition, Peter M. Som, Hugh D. Curtin

Miscellaneous
- Radiology of the Nose, Paranasal Sinuses and Nasopharyns. G. Dodd and B. Jing.

Additional resources: CT/MRI teaching file
Internet
Departmental journals

Procedural skills to learn:
None

Expected Volumes: 15-20 CT per day, 4 MR /day
Updated: Jan 2017
6) Mammography Rotation - Junior Resident

Objectives

Medical Expert:
- Be familiar with the pathologic processes associated with breast disease.
- Be aware of the various clinical manifestations of breast disease.
- Know how to further investigate a mammographic abnormality appropriately.
  (including those referred from outside institutions with partial work up).
- Know how a mammogram is performed technically including technical pitfalls.
- Understand the limitations of mammography.
- Know the BIRADS classification

Communicator:
- Produce concise and meaningful reports to referring physicians.
- Be able to discuss mammographic findings with the surgeons in the breast clinic as well as suggest further imaging workup and integrate clinical findings.
- Communicate some findings to patients and families.
- Explain procedures to patients.

Collaborator:
- To understand the roles of the other members of the health care team and interact appropriately with them. (clinicians, nurses, technicians, reception and filing staff)

Leader
- To be aware of available imaging resources and to use them efficiently when planning further work up.
- To be efficient in time management.

Health advocate
- Recognize the role of radiation dose when recommending further imaging.
- Be familiar with the Quebec Breast Screen Program and the role of the role of the Reference Center

Scholar
- To have knowledge of the various breast pathologies and how they appear on breast imaging.
- To set personal learning goals and objectives.
- Understand the current controversies in breast screening.
- To teach elective students (when appropriate) basic principles of breast imaging at their level.

Professional
- To demonstrate integrity honesty and compassion
- To demonstrate awareness of own limitations
- To demonstrate ethical behaviour when interacting with patients
Rotation Responsibilities

- To interpret, review with staff radiologist and dictate at least 10 – 12 mammograms a day.
- TO BE INVOLVED IN 5 ULTASOUNDS PER ROTATION
- To be familiar with interventional procedures,( core biopsy under ultrasound and stereotactic guidance, needle localization under ultrasound and stereotactic guidance, fine needle aspiration under ultrasound guidance

Reference Material

- Breast Imaging, Kopans, Lippincott, 2006
- ACR Bi-Rads Atlas 5th Edition
- Breast Ultrasound, A Thomas Stavros et al
- Breast MRI: Diagnosis and Intervention, Elisabeth Morris et al
- Diagnostic Imaging Breast Berg Yang 2013
- Breast Immaging: The Requisites 3rd Edition Ikeda Miyake

Updated: February 2017
7) Mammography Rotation - Senior Resident -

Objectives

Medical Expert:
- Be familiar with the more unusual pathologic processes associated with breast disease.
- Be aware of the various clinical manifestations of breast disease.
- Solidify goals of junior rotation
- Understand the indications for breast MRI as well as basic interpretation principles.

Communicator:
- Produce concise and meaningful reports to referring physicians.
- Be able to discuss mammographic findings with the surgeons in the breast clinic as well as suggest further imaging workup and integrate clinical findings.
- Communicate some findings to patients and families.
- Explain procedures to patients.

Collaborator:
- To understand the roles of the other members of the health care team and interact appropriately with them. (clinicians, nurses, technicians, reception and filing staff)

Leader
- To be aware of available imaging resources and to use them efficiently when planning further work up.
- To be efficient in time management.

Health advocate
- Recognize the role of radiation dose when recommending further imaging.
- Be familiar with the Quebec Breast Screen Program and the role of the role of the Reference Center

Scholar
- To have knowledge of the various breast pathologies and how they appear on breast imaging.
- To set personal learning goals and objectives.
- Understand the current controversies in breast screening.
- To teach elective students (when appropriate) basic principles of breast imaging at their level.

Professional
- To demonstrate integrity honesty and compassion
- To demonstrate awareness of own limitations
- To demonstrate ethical behaviour when interacting with patients

Rotation Responsibilities
- To interpret, review with staff radiologist and dictate at least 12-15 mammograms a day.
- To perform 10 ultrasounds per rotation.
To be involved in one core biopsy under ultrasound and stereotactic guidance, one needle localization under ultrasound and stereotactic guidance, fine needle aspiration under ultrasound guidance as well as one MRI guided biopsy.

To interpret 5-6 MRI examinations.

**Reference Material**

- Breast Imaging, Kopans, Lippincott, 2006
- *ACR Bi-Rads Atlas 5th Edition*
- *Breast Ultrasound, A Thomas Stavros et al*
- *Breast MRI: Diagnosis and Intervention, Elisabeth Morris et al*
- Diagnostic Imaging Breast Berg Yang 2013
- *Breast Imaging: The Requisites 3rd Edition Ikeda Miyake*

Updated: July 2017
8) MRI rotation – (MGH/RVH)

MR Rotation at the MUHC is Body MR only.

GOALS: By the end of residency training, the resident should be familiar with the indications for Body MR imaging and be able to protocol, detect and diagnose common pathologies of the above systems.

ROTATION OBJECTIVES:

Medical Expert:
- Know the contraindications to MR imaging and know where to consult the source documents for questions that arise regarding potential contraindications.
- Know the appropriate techniques of dealing with contrast reaction and patient resuscitation in the MRI suite environment.
- Know the most frequent indications for standard MR imaging.
- Be familiar with basic pulse sequences and their clinical applications.
- Be familiar with basic imaging artifacts and understand how they can be avoided.
- Recognize normal anatomy in the various imaging planes using standard pulse sequences.
- Recognize pathology and be able to discuss the signal and enhancement characteristics of commonly seen pathologies of the above-mentioned systems.
- Know how to use reconstruction software for reading out MRA, MRV, DCE and T2-DWI fused studies.

Communicator:
- To dictate well organized reports describing relevant findings, diagnosis and recommendations.
- To demonstrate effective communication skills when dealing with patients, staff and referring clinical services.

Collaborator
- To demonstrate good consulting skills when interacting with other physicians & health team members.
- To interact appropriately with other radiology department staff, demonstrating a team approach to patient care.

Leader
- To demonstrate awareness of the indications for MR examinations.
- Consider advantages and disadvantages of MRI versus other imaging modalities.
- To consider available imaging resources when planning and recommending patient care, using them effectively and efficiently.

Health Advocate:
- Recognize and consider consent issues, patient comfort and other patient-related issues, when supervising body MR examinations.
Professional:
- To demonstrate integrity, honesty and compassion.
- To practice understanding ethical and medical-legal requirements of radiologists.
- To demonstrate awareness of own limitations.

Scholar
- To set up personal learning goals and objectives during rotation.
- To take a leadership role in the teaching of others, with teaching/supervision of junior residents on rotations, elective students and off-service residents.

Rotation responsibilities:
In first 1-2 weeks: Focus on learning the basic pulse sequences for MR imaging as well as understanding the most common indications and contraindications to MR imaging. Can review cases with the fellows and staff assigned to the rotation

Subsequent weeks resident responsibilities include:
- Interview patient, review patient charts, lab data, previous imaging history, in order to provide appropriate information for the involved technologists and study interpretation.
- Provide supervision/guidance to the technologist for cases requiring a modified MR scanning protocol.
- Report all cases he/she has been involved with (supervising or reviewing). All cases need to be read out in conjunction with the assigned staff radiologist.
- Review all cases scanned that day, in addition to those specifically assigned to the resident for reporting.
- Administer antispasmodics and sedatives to patients parenterally as needed.

Teaching:
- The resident is encouraged to bring interesting cases to resident rounds.
- Supervision/teaching of elective medical students or off-service residents, along with assigned radiologist.
- Teaching of MR technologists and students, as appropriate

Rounds:
Weekly rounds. Weekly gynecology and Lower GI oncology rounds. Monthly biliary rounds. Tuesday noon MR physics rounds and Tues AM abdominal imaging round with a focus on MRI.

Evaluation:
Assessed on a daily basis by staff assigned to MRI, as well as during education rounds.

Formal ITER at end of 4-week rotation. PLEASE ARRANGE A TIME FOR THIS WITH SUPERVISOR!
Suggested resources:
   Recommended texts: Body MRI by Evan Siegelman
                    MRI Principles by Donald Mitchell

   Additional resources: MRI teaching
                         Internet
                         Departmental journals

Procedural skills to learn:
   None

Expected Volumes
   5-6 cases/ per half day session

Updated February 2017
9) Musculoskeletal Radiology Objectives (MGH/RVH)

Program Goals:
The goals of the Musculoskeletal radiology rotation at the MUHC are to provide resident trainees with adequate knowledge base and expertise in the interpretation of images with regards to normal skeletal anatomy, traumatic injuries and common pathology. The resident must be able to advise the clinician and patient on the potential uses of musculoskeletal percutaneous interventional procedures. The trainee must acquire expertise in order to carry out basic fluoroscopic diagnostic procedures such as joint aspiration and injection and MR and CT arthrography. In addition, the resident must feel comfortable consulting with orthopedic surgeons, rheumatologists, sports medicine physicians and other clinicians.

Residents are expected to show proficiency in the supervision and interpretation of plain radiographs, US, CT, and MRI. The resident must be able to advise the clinician and patient on the appropriate uses of each imaging modality.

General Objectives:

Knowledge:
- Knowledge of the anatomy of bone and skeletal muscle systems.
- Knowledge of all aspects of musculoskeletal radiology, including an understanding of diseases that pertain to the skeletal system, and the appropriate imaging investigations.
- Understanding of the general principles with regards to interventional procedures related to joints and to evaluation or treatment of bone and skeletal soft-tissue diseases.
- Performance of basic arthrography and image guided joint injections with progressive supervision and guidance.

Specific Objectives:

Medical Expert
- Skeletal and spinal anatomy: bones, joints, muscles and peripheral nervous system.

Pathology:
- skeletal trauma (including spine trauma) (mostly at MGH)
- arthritidies
- primary bone tumours (mostly at RVH)
- metastatic bone disease
- soft-tissue sarcoma (mostly at RVH)
- metabolic bone diseases

Appearance:
- Commonly used orthopedic hardware (mostly at MGH)
Communicator:
- Able to provide and organize succinct, but thorough, diagnostic reports.
- Able to consult with referring physicians both before and after studies/procedures are performed, demonstrating effective communication skills.
- Demonstrate effective communication skills when dealing with patients, during interview, consent and procedure.
- Able to explain the procedure and findings in terms that the patient and family can understand.
- Demonstrate effective skills when dealing with staff from referring clinical services.
- To document pertinent conversations with the clinician in the report.

Collaborator:
- Demonstrate adequate consultation skills when interacting with other physicians & health team members
- Interact appropriately with other radiology departmental staff (technologists, nurses), demonstrating a team-based approach to managing patients.

Manager:
- Consider advantages and disadvantages of various available imaging modalities, and advise consultants accordingly.
- Demonstrate awareness of the indications for various interventional modalities
- Consider advantages and disadvantages available of operative versus interventional techniques.
- Consider available imaging resources when planning and recommending patient care, using them effectively and efficiently.
- Demonstrate ability to manage phone calls, questions and requests from consultants, and technologists and seek advice when needed.
- Supervise MRI day cases, when required.
- Protocol CT scans independently.

Health Advocate:
- Recognize and consider consent issues, patient comfort and other patient-related issues, when participating or recommending imaging procedures.
- Recognize and consider radiation doses when recommending, approving and performing diagnostic or interventional cases.
- To demonstrate knowledge and awareness of radiation protection and well as appropriate handling of body fluids.

Professional:
- Demonstrate integrity, honesty and compassion.
- Ability to show sensitivity and care to the patient and the patient’s family.
- Practice understanding of ethical and medical-legal requirements of radiologists
- Demonstrate awareness of one’s own limitations.

Scholar:
- Set personal learning goals & objectives during rotation(s).
- Take a leadership role in learning from others, with teaching/supervision of junior residents on rotation, elective students, off-service residents.
• Create Teaching Files for use by future trainees.
Rotation Responsibilities:

Clinical:
- Provide supervision/guidance to the technologist for cases requiring consultation and/or scanning.
- Report all cases assigned to resident. All cases to be reviewed by supervising Musculoskeletal Staff (progressive autonomy). (R2 residents on their first MSK rotation will aim to achieve full levels of reporting by the final week of their rotation.
- Performance of arthrography/joint injection under radiologic guidance under direct supervision.
- Observe and participate in ultrasound examinations, when possible
- The rotation begins at 8 AM (or after morning rounds) until the work is completed. Resident must ensure reports are signed off daily.

Teaching:
- The resident is required to bring interesting cases to teaching rounds.
- Supervision/teaching of elective medical students or off-service residents.
- Teaching of technologists (if assigned).
- Prepare cases for teaching files (electronic or hard copy)
- Include all interventional procedures in personal data bank

Rounds:
- Depending on hospital site, may be required to prepare case show, short presentation, etc.

Evaluation:
- Assessed on daily basis by Musculoskeletal staff radiologist and Fellow assigned to reviewing cases (Plain film, CT, MR, US)
- Assessment of quality and quantity of Teaching Files created during rotation

Expectations:
- Trauma, Osteoarthritis Arthritides, Tumours, Metabolic Bone Disease
- Read CT Scans: Spine, Joints
- Read: Spine, Joints (junior resident - more knee and shoulders; senior resident-more complex joints)
- Procedures: Arthograms; Shoulder, Hip (senior resident-more complex joints)
- Senior resident expected to read increase volume and complexity of cases.

Minimum Expected for RVH/MGH resident:

Junior Resident
- CT: 10-15 per week
- MRI: 10-15 per week
- Arthrograms: 2 per week (usually more performed at the MGH)
- Plain films: 30 per week
Senior Resident:

- CT: 15-20 per week (more complex cases)
- MRI: 15-20 per week (more complex cases)
- Arthrograms: 2 per week (more complex joints; usually more performed at the MGH)
- Plain films: 50 per week
- Observe and participate in MSK US, when possible

Reference Texts for Musculoskeletal Radiology

- 1. Fundamentals of Diagnostic Radiology (MSK chapters): Brant and Helms (first rotation; junior)
- 2. Arthritis in Black and White: Brower (first rotation; junior)
- 3. Orthopedic Imaging: Greenspan, Adam (junior)
- 4. Musculoskeletal MRI: Kaplan, Dussault, Helms, Anderson, Major (junior and senior)
- 5. Musculoskeletal Imaging: The Requisites by B.J. Manaster (junior and senior)
- 6. Musculoskeletal imaging case review series by Joseph Yu (senior-exam prep)
- 7. Musculoskeletal Imaging: A teaching file by Felix Chew (senior-exam prep)
- 8. Bone and Joint Imaging: Resnick (senior; reference)

Updated: April 2017
10) Neuroradiology (MGH/RVH)

General goals & Objectives:
- Knowledge of the anatomy of the central and peripheral nervous systems, organs of special senses, and spinal cord in adults (with emphasis on radiological applications).
- Knowledge of the key aspects of Neuroradiology, including an understanding of diseases that pertain to the CNS, and the appropriate imaging investigations.
- Understanding of the general principles with regards to Neurointerventional procedures.
- Performance of basic lumbar puncture /myelogram with progressive supervision and guidance

CAnMEDS specific objectives:

i) medical expert:
- Knowledge of:
  - Neuroanatomy: brain and spinal cord
  - Neurovascular anatomy
  - Trauma, Stroke
  - Common pathology of the brain and spinal cord
    - cerebral tumors, degenerative and vascular diseases, hydrocephalus, cranial nerve pathology, sellar and posterior fossa pathology
    - congenital brain diseases
    - cord tumors, degenerative and vascular diseases, syringomyelia
    - congenital spinal diseases

- Spine
  1. Developmental disorders
  2. Tumor, infection and inflammation
  3. Trauma and vascular disorders
  4. Degenerative diseases

Communicator:
- Able to provide and organize succinct, but thorough, diagnostic reports.
- Able to consult with referring physicians both before and after studies / procedures are performed, demonstrating effective communication skills.
- Demonstrate effective communication skills when dealing with patients, during interview, consent and procedure.
- Able to explain the procedure and findings in terms that the patient and family can understand.
- Demonstrate effective skills when dealing with staff from referring clinical services.
Collaborator:
- Demonstrate adequate consultation skills when interacting with other physicians & health team members
- Interact appropriately with other radiology departmental staff (technologists, nurses), demonstrating a team-based approach to managing patients.
- Participate in interdisciplinary rounds

Leader:
- Consider advantages and disadvantages of various available imaging modalities, and advise consultants accordingly.
- Manage the section and report Emergencies immediately
- Help protocol examinations ahead of time and urgently when required
- Demonstrate awareness of the indications for various interventional modalities
- Consider advantages and disadvantages available of operative versus interventional techniques.
- Consider available imaging resources when planning and recommending patient care, using them effectively and efficiently.

Health advocate:
- Recognize and consider consent issues, patient comfort and other patient-related issues, when participating or recommending imaging procedures.
- Recognize and consider radiation doses when recommending, approving and performing diagnostic or interventional cases
- To demonstrate knowledge and awareness of radiation protection and well as appropriate handling of body fluids.

Professional:
- Demonstrate integrity, honesty and compassion.
- Ability to show sensitivity and care to the patient and the patient’s family.
- Practice understanding of ethical and medical-legal requirements of radiologists
- Demonstrate awareness of one’s own limitations.
- Continuous motivation to learn

Scholar:
- Set personal learning goals & objectives during rotation(s).
- Take a leadership role in learning from others, with teaching/supervision of junior residents on rotation, elective students, off-service residents.
- Create Teaching Files for use by future trainees.

Rotation Responsibilities:

Clinical:
- Provide supervision/guidance to the technologist for cases requiring consultation and/or scanning.
- Report all cases assigned to resident. All cases are to be reviewed by supervising Neuroradiologist, but with progressive resident autonomy.
- Performance of lumbar puncture/myelogram under direct supervision.
Teaching:
- The resident is required to bring interesting cases to teaching rounds.
- Supervision/teaching of elective medical students or off-service residents.
- Teaching of technologists (if assigned).
- Prepare cases for teaching files
- Include all interventional procedures in personal data bank

Rounds:
- required to prepare case show, short presentation.

Evaluation: (monthly ITER)
- Assessed on daily basis by Neuroradiology staff radiologist and Fellow assigned to reviewing cases (CT, MR, LP)
- Assessment of quality and quantity of Teaching Files created during rotation

Reference Texts for Neuroradiology

Expected volumes –Junior resident (PGY2/3)
CT: 10-15/day
MR: 3-5/day
LP: 2 / week

Expected volumes –Senior resident (PGY 3/4)
CT: 20/day
MR: 5-8day
LP: 2 / week

Updated: Jan 2017
11) **Ultrasound Rotation**

**PROGRAM GOALS:**

By the end of residency training, the resident should be competent in ultrasound skills required for general ultrasound including:

1. Ultrasound of abdomen, pelvis, small parts, peripheral vascular system
2. Advise technologist regarding special views or parameters required for cases

**Rotation Objectives:**

**Medical Expert/clinical Decision-Maker:**

- To demonstrate ultrasound scanning technique for abdominal and pelvic imaging.
- To develop skills in use of endo-vaginal ultrasound probe and image interpretation.
- To learn the appropriate indications for variety of ultrasound examinations.
- To learn the normal ultrasound anatomy of the abdomen, pelvis, scrotum.
- To demonstrate knowledge of common pathologies and their associated ultrasound findings:
  - Liver/biliary tree (obstruction, tumors, portal hypertension, cirrhosis, liver transplantation and its complications)
  - Urinary tract disease (Renal tumors, stones, obstruction, renal transplants and their complications, bladder neoplasms, testicular and scrotal pathology)
  - Gallbladder disease (cholecystitis, cholelithiasis, neoplasms)
  - Pancreatic inflammatory and neoplastic disease
  - Metastatic disease (liver, spleen, omentum/peritoneum)
  - Female pelvis: assessment of uterus, ovaries, endometrium, adnexa
  - Gastrointestinal disease (some neoplasms and some inflammatory disorders)
- To correlate ultrasound findings with other imaging modalities (Plain films, CT, MRI etc)
- To learn the basic ultrasound physics and instrumentation related to equipment operation, choice of probes, image optimization.

**Communicator**

- To dictate well-organized reports, describing relevant findings, diagnosis and recommendations.
- To demonstrate effective communication skills when dealing with patients, staff and referring clinical services.

**Collaborator**

- To demonstrate good consulting skills when interacting with other physicians & health team members.
- To interact appropriately with other radiology department staff, demonstrating a team approach to patient care.

**Leader**

- To demonstrate awareness of the indications for various ultrasound examinations.
Consider advantages and disadvantages of ultrasound vs. other imaging modalities.
To consider available imaging resources when planning and recommending patient care, using them effectively and efficiently.

Health Advocate
- Recognize and consider consent issues, patient comfort and other patient-related issues, when participating or performing ultrasound/ultrasound guided procedures.

Professional:
- To demonstrate integrity, honesty and compassion.
- To practice understanding ethical and medical-legal requirements of radiologists.
- To demonstrate awareness of own limitations.

Scholar
- To set personal learning goals & objectives during rotation.
- To take a leadership role in the teaching of others, with teaching/ supervision of junior residents on rotation, elective students, off-service residents.

Rotation responsibilities:

Junior Residents:
- **In the first two week rotation** Focus on learning basic US scanning techniques. May review interesting cases that have occurred during the day with assigned radiologist.
- **Subsequent weeks, resident responsibilities include:** First full rotation. 6 scans per day (total per rotation 84) Subsequent rotations 7-8 scans per day (total per rotation 98-112)
- Review patient charts, lab data, previous imaging.
- Report all cases he/she has been involved with (scanning or reviewing). All cases to be reviewed by supervising radiologist.

Senior Residents:
- In second and third rotations perform simple drainage procedures (ascites and pleural effusion) as well as simple organ biopsies (thyroid)

Teaching:
- The resident is encouraged to bring interesting cases to rounds.
- Supervision/teaching of elective medical students or off-service residents, along with assigned radiologist.
- Teaching of technologist and ultrasound students, as appropriate.

Evaluation:
Assessed by staff assigned to US,
Formal rotation evaluation at end of 4-wk rotation.

Suggested resources:
Recommended texts: Rumack & Wilson: Diagnostic Ultrasound, Vol. 1 and Vol. 2
Requisites series: Ultrasound
Sanders: Clinical Ultrasound
Additional resources: ACR Teaching files on CD ROM,
Journals- (JUM, Radiology, Radiographics, AJR)

Updated: April 2017
12) Nuclear Medicine Rotation

Basic Science
A thorough knowledge and understanding of the following topics is essential:

- Nuclear Physics relevant to Nuclear Medicine
- Radiation Safety
- Radiation Biology
- Radiopharmacy
- Instrumentation: Dose calibrators, portable radiation detectors, probes, Gamma cameras, PET scanners and Bone mineral densitometers
- Quality Control
- Basic Statistics
- Computer Science
- The concept of Molecular Imaging
- Antibodies, Tracer Kinetics and basic principles of RIA

Clinical Science:
The Resident should achieve the following objectives in the clinical sciences.

Medical Expert
- To be able to interpret scans.
- Become adept at performing nuclear medicine procedures
- To acquire an appreciation of the role of nuclear medicine in the diagnostic algorithm
- To acquire in depth knowledge of the pathophysiological basis of the specialty
- To understand the clinical applications of the specialty
- To be able to perform radiotherapy with unsealed sources

Communicator
To become an effective communicator with both the patient and the consulting physicians.

Collaborator
To become an effective collaborator with consulting physicians and other health care professionals.

- To especially develop an expertise in correlative imaging

Leader
To become a competent Leader:

- To utilize resources effectively to balance patient care, learning needs and outside activities
- To allocate the finite health care resources wisely
- To work effectively and efficiently in a health care organization
Health Advocate
To become a health advocate for the patient and the medical system in general.

- To know the benefits and relative risks of nuclear medicine procedures.
- To limit unnecessary radiation exposure to patient and staff
- To know the radiation limits for radiation workers and the public

Scholar
To become a scholar:

- To utilize the appropriate nuclear medicine texts, journals, audiovisual series, government publications (CNSC) and on-line resources in order to gain the appropriate knowledge needed to become a nuclear medicine specialist.
- To implement a personal continuing education strategy
- To critically appraise sources of medical information
- To contribute to teaching files
- To teach junior residents, housestaff and medical students
- To contribute to development of new knowledge

Professional
To become a true professional who delivers the highest quality care with integrity, honesty and compassion.

- To display appropriate personal and interpersonal professional behavior
- To practice medicine ethically.
- To become aware of the medico-legal issues relevant to nuclear medicine practice

Updated April 2017