



**UNIVERSITY OF CALGARY**  
CUMMING SCHOOL OF MEDICINE  
Department of Radiology

**DIAGNOSTIC RADIOLOGY RESIDENCY PROGRAM**

# **Residency Program Manual**

“We, the University of Calgary Radiology Residents, strive for excellence as learners and patient care providers, while fostering an environment of collegiality and respect.”

## TABLE OF CONTENTS

HOW TO USE THIS MANUAL .....	5
<b>PART I - PROGRAM ADMINISTRATION</b> .....	6
RESIDENCY PROGRAM COMMITTEE .....	7
➤ Terms of Reference .....	7
➤ Members of the RPC for 2022-2023 .....	8
➤ Members of the Competence Committee 2022-2023 .....	9
RESIDENCY PROGRAM ADMINISTRATORS .....	10
RESIDENCY PROGRAM OMBUDS .....	10
STUDENT LEGAL ASSISTANCE .....	10
<b>PART II - COMPETENCE BY DESIGN</b> .....	11
COMPETENCE BY DESIGN (CBD) .....	12
➤ Introduction to CBD .....	12
➤ CBD Core Principles .....	13
➤ Stages of Training .....	13
➤ EPAs and Milestones .....	14
➤ Entrustability Scale .....	14
➤ Competence Committee .....	15
➤ Appeals Process .....	16
➤ Member of the Competence Committee 2022-2023 .....	12
➤ Introduction to CBD .....	12
<b>PART III - POLICIES &amp; PROCEDURES</b> .....	17
SUPERVISION OF RESIDENTS POLICY .....	18
➤ Attending Radiologist Responsibilities .....	18
➤ Diagnostic Radiology Resident Responsibilities .....	19
SENIOR RESIDENT CLINIC SUPERVISION AND REVIEW .....	21
ON-CALL .....	23
RESIDENT “TRIGGER” POLICY .....	24
DISCREPANCY REPORTING POLICY .....	25
MINIMUM ROTATION REQUIREMENTS POLICY .....	29
ATTENDANCE POLICY – Daily Rotations, Rounds and Academic Events .....	29
ABSENCE POLICIES & EDUCATION ACCOMMODATIONS .....	30
➤ Vacation Policy .....	30
➤ Types of Absences .....	30
➤ Rotation Specific Absence Policy .....	31
➤ Leave Of Absence Policy .....	32
➤ Accommodation .....	32
➤ Exam Leave .....	33
EVALUATIONS AND PROMOTION POLICY .....	34
GRADUATED RESPONSIBILITIES IN DIAGNOSTIC RADIOLOGY POLICY .....	37
➤ Transition to Call (PGY2) .....	37
➤ Transition from Jr Resident To Sr Resident (Independent Call PGY4) .....	38
REMEDICATION, PROBATION AND DISMISSAL POLICY .....	40
SUSPENSION OR TERMINATION OF A RESIDENT .....	40
RESIDENT APPEALS POLICY .....	40
PHYSICIAN EXTENDERS IN AFFILIATED TEACHING HOSPITALS POLICY .....	41
➤ Alberta Children’s Hospital Resident Extenders .....	41
➤ Off-Service Resident Extenders .....	41
EXPENSE POLICIES .....	42
➤ PGME Resident Research Travel Grant .....	42

➤ Radiology Residency Travel Funding Policy .....	43
➤ Travel Expense Reimbursement Process .....	43
➤ Program & MEO Expenses .....	43
RESIDENT SAFETY POLICY.....	44
HEPATITIS B VIRUS AND HIV INFECTION POLICY .....	46
RESIDENT WELLNESS POLICY .....	47
➤ MENTORSHIP TEAMS 2021/2022 .....	48
PROFESSIONAL STANDARDS POLICY.....	49
AUDIO AND VISUAL RECORDING POLICY .....	49
<b>PART IV - ACADEMICS OF RADIOLOGY RESIDENCY</b> .....	50
ETIQUETTE FOR ROUNDS .....	51
ROUNDS .....	52
PGY1 INTRODUCTORY LECTURES.....	56
ACADEMIC HALF DAY .....	59
VISITING PROFESSORS .....	64
JOURNAL CLUB.....	65
MANDATORY ACTIVITIES .....	65
RESIDENT PORTFOLIO & CanMEDS FRAMEWORK.....	66
RESIDENT E-PORTFOLIO .....	67
OPTIONAL ELECTIVES AWAY FROM THE PROGRAM.....	68
CLINICAL INVESTIGATOR PROGRAM.....	69
RESEARCH .....	70
➤ QA/QI (Audit) Project In PGY2 .....	71
➤ Major Project in PGY3/4 .....	71
TUITION FEES .....	72
<b>PART V - GOALS &amp; OBJECTIVES OF TRAINING IN DIAGNOSTIC RADIOLOGY</b> .....	73
RCPSC ACCREDITATION.....	74
RESIDENT'S MISSION STATEMENT.....	74
GENERAL GOALS & OBJECTIVES OF DIAGNOSTIC RADIOLOGY PROGRAM.....	75
➤ Overall Goals & Objectives by The End Of PGY1 .....	77
➤ Overall Goals & Objectives by The End of PGY2 .....	77
➤ Overall Goals & Objectives by The End of PGY3 .....	78
➤ Overall Goals & Objectives by The End of PGY4 .....	78
➤ Overall Goals & Objectives by The End of PGY5 .....	79
PROGRAM SPECIFIC GOALS AND OBJECTIVES (In CanMEDS Roles).....	80
GENERAL ENABLING OBJECTIVES.....	83
CORE TRAINING.....	84
EVALUATIONS REQUIRED – PGY2 TO PGY5 .....	85
<b>PART VI - PGY1 ROTATION GOALS &amp; OBJECTIVES</b> .....	86
INTRODUCTION.....	87
PGY1 ROTATIONS.....	88
CanMEDS GENERAL EDUCATIONAL GOALS AND OBJECTIVES FOR THE PGY1 YEAR.....	89
PGY1 GENERAL INTERNAL MEDICINE/SUBSPECIALTY ROTATION .....	90
PGY1 GENERAL SURGERY ROTATION.....	93
PGY1 UROLOGY SURGICAL SUBSPECIALTY ROTATION .....	96
PGY1 EMERGENCY MEDICINE ROTATION .....	99
PGY1 ANATOMIC PATHOLOGY ELECTIVE ROTATION.....	101
PGY1 NEUROLOGY ROTATION .....	103
PGY1 ONCOLOGY ROTATION .....	105
PGY1 RADIATION ONCOLOGY.....	108
PGY1 PEDIATRIC EMERGENCY MEDICINE ROTATION .....	110

PGY1 RESPIROLOGY ROTATION .....	112
PGY1 RADIOLOGY ROTATION.....	114
<b>PART VII- EDUCATIONAL GOALS &amp; OBJECTIVES</b> .....	116
BODY COMPUTED TOMOGRAPHY .....	117
BODY MR.....	120
ULTRASOUND.....	122
THORACIC IMAGING .....	128
CARDIAC IMAGING.....	131
EMERGENCY RADIOLOGY (BODY) .....	136
EMERGENCY RADIOLOGY (NEURO) .....	141
GENITOURINARY AND GASTROINTESTINAL RADIOLOGY.....	149
MAMMOGRAPHY AND BREAST IMAGING .....	152
MUSCULOSKELETAL RADIOLOGY .....	159
NEURORADIOLOGY .....	163
NUCLEAR MEDICINE.....	187
OBSTETRICAL ULTRASOUND (Maternal Fetal Medicine).....	190
PEDIATRIC RADIOLOGY .....	194
PHYSICS .....	205
SENIOR RESIDENTS CLINIC .....	212
INTERVENTIONAL RADIOLOGY.....	217
<b>PART VIII - FORMS AND APPENDICES</b> .....	221

## **HOW TO USE THIS MANUAL**

There are goals and objectives in the different areas of training. Rotations during clinical radiology training are usually organized along organ system lines but may deal with more than one organ system due to logistic and patient volume reasons. Therefore, the manual is formatted into seven parts:

**Part I** - Administration of the program

**Part II** - Policies & Procedures

**Part III** - Academics of the program

**Part IV** - Mission statement, descriptions of the Royal College training requirements, our Program's general goals and objectives

**Part VI** - contains various clinical radiology sections divided mainly along organ system lines containing the goals and objectives to be achieved during rotations at various levels of training. These goals and objectives form the basis of rotation-end evaluations.

**Part VII** - Forms

- **ALL RESIDENTS:** please familiarize yourself with the contents of **Parts I to IV**
- **PGY1 RESIDENTS:** review **Part V** before beginning training
- **PGY2 to PGY5 RESIDENTS:** appropriate sections in **Part VI** should be reviewed ***before*** the start of each clinical radiology rotation and should also be referred to ***during*** the rotation

Please send any updates or discrepancies of this Manual to  
[Bonnie.McCardle@ahs.ca](mailto:Bonnie.McCardle@ahs.ca)

# **PART I - PROGRAM ADMINISTRATION**

**RESIDENCY PROGRAM COMMITTEE****Terms of Reference****Purpose**

To provide leadership and supervise all aspects of Postgraduate Medical Education (PGME), for a specific training program, within the Cumming School of Medicine, University of Calgary, and its affiliated teaching hospitals.

**Membership of the Committee**

The Residency Program Committee (RPC) is composed of faculty from the primary teaching site at the Foothills Medical Centre that are representative of the major subspecialty areas, one of whom is the Fellowship Director. All members of the committee must recognize that while their appointment to the committee may be to ensure representation of a particular group or teaching hospital, as a member of the committee they must act in a manner which places the "overall good" of the education program ahead of any specific group or geographic interest.

The committee shall consist of:

- Program Director as Chair
- Assistant Program Director
- Fellowship Director
- Chief Residents elected by peers
- Resident representatives from each year elected by peers
- One representative from each of the major teaching institutions involved in the Program (RGH/PLC, ACH, FMC)
- A Resident Research Coordinator
- Department Head (ex officio)
- Membership also includes an Assistant Program Director and Resident Wellness Director

**RPC Faculty Subcommittee**

There is an RPC Faculty Subcommittee made up of faculty from the sites listed above as well as the Department Head

**Chief Residents**

The two Chief Residents are PGY4 residents. Candidates for the position of Chief Resident are identified and chosen after a vote by their peers. The candidates are then appointed by the RPC for a one-year term beginning on July 1 and ending on June 30 each academic year.

**Frequency of Meetings**

- The General RPC meets quarterly, at minimum, with additional meetings, as necessary. The RPC Faculty Subcommittee meets after each General RPC meeting as well as ad hoc meetings, as necessary. Agenda and minutes are circulated prior to, or at the beginning, of the meeting.
- The Competence Committee meets quarterly, at minimum, with additional meetings, as necessary. The Competence Committee meetings are to be held close to the RPC meetings, to generate discussions with RPC sub-committee, as necessary.

**Quorum**

- Quorum of general RPC meeting consists of the program director, a minimum of 2 resident representatives, and a minimum of 2 other members of the committee.

- Quorum of Competence Committee consists of the Competence Committee chair, the program director, and members of the competence committee who are presenting residents up for discussion.

#### **The Residency Program Committee will:**

- Develop a schedule of rotations that incorporates all aspects of the College specialty specific requirements
- Develop rotation AND stage-specific objectives which are linked to an appropriate assessment strategy
- Develop a detailed curriculum map as appropriate to the program
- Ensure adequate physician and human resources to support the educational mandate of the program
- Develop a robust and diverse system of evaluation which includes a variety of assessment modalities
- Ensure timely delivery of feedback to the trainee and at least twice-yearly formal progress meetings with the Program Director or delegate
- Review applications and select candidates for admission to the program
- Establish sub-committees as required. These may include Admissions Committee, Competence Committee, Curriculum Committee, Wellness Committee or other as appropriate
- Make decisions based on input from the Competence Committee with regard to resident progress in the program
- Address and support residents who are experiencing academic difficulties
- Regularly review program specific policies and procedures
- Maintain an appeal mechanism which is consistent with PGME policy
- Seeks input from trainees with regards to the functioning of the program
- Address resident wellness in a proactive manner
- Provide oversight of the learning environment
- Engage in a process of continuous quality improvement with respect to the educational program

### **Members of the RPC for 2022-2023**

#### **Resident Representatives**

<b><u>PGY1:</u></b>	Derek Sin
<b><u>PGY2:</u></b>	Laura Neuburger
<b><u>PGY3:</u></b>	Andrew Kiraly
<b><u>PGY4:</u></b>	Fangshi Lu & Parthiv Amin
<b><u>PGY5:</u></b>	Chris Wright
<b><u>Chiefs</u></b>	Fangshi Lu & Parthiv Amin

#### **Faculty Members**

<b><u>FMC:</u></b>	Dr. James Huynh (Program Director)
	Dr. Alina Makoyeva (Assistant Program Director)
	Dr. Denise Chan
	Dr. Carmen Lydell
	Dr. Dorian Nobbie
	Dr. Morgan Willson
	Dr. Jason Wong
<b><u>ACH:</u></b>	Dr. Samarjeet Bhandal
<b><u>PLC/RGH:</u></b>	Dr. Jonathan Ehmann
<b><u>Department Head:</u></b>	Dr. Manish Joshi



**Research Director:** Dr. Sarah Manske  
**Wellness Director:** Dr. Denise Chan

### **Members of the Competence Committee 2022-2023**

Dr. Alina Makoyeva (Chair)  
Dr. James Huynh (Program Director)  
Dr. Tracy Elliot  
Dr. David Burrowes  
Dr. Mathew Li  
Dr. Robert Sevick  
Dr. Samarjeet Bhandal  
Dr. Ani Mirakhur  
Dr. Peter Salat  
Dr. Ruban Gnanakumar

### **Duties of the Competence Committee**

- Collect and synthesize data from documents collected throughout residency for each resident (ITERS, EPA assessments, OSCE results...)
- Review data to evaluate a resident's progress through various stages of training and determine whether resident is progressing as expected through various stages of training
- Present the data to members of the competence committee
- Recommend promotion to the program director if resident is progressing as expected
- Recommend a curated remediation plan for residents who are not progressing as expected
- Present results to the RPC sub-committee

Please see CBD section for further detail\*\*\*

**RESIDENCY PROGRAM ADMINISTRATORS**

There are three Program Administrators for the Diagnostic Radiology Residency Program.

[Bonnie.McCardle@ahs.ca](mailto:Bonnie.McCardle@ahs.ca) (Primary Program Administrator)

Phone: 403-944-4530

Fax: 403-944-4577

Monday-Friday 0830-1645

[Pamie.Dow@ahs.ca](mailto:Pamie.Dow@ahs.ca) (Part-Time Program Administrator) LOA until Nov 2022

Phone: 403-944-2259

Wednesday-Friday 0830-1645

[crystal.ryszewski@ahs.ca](mailto:crystal.ryszewski@ahs.ca)

403-944-4747

Monday-Friday 0800-1615

**RESIDENCY PROGRAM OMBUDSPERSON**

There is an Ombudsperson for the Diagnostic Radiology Residency Program. The residents can contact Dr. Sandra Dumanski at any time to discuss any issues with respect to the residency program.

Dr. Sandra Dumanski

Nephrologist, Dept. of Medicine

[sandra.dumanski@albertahealthservices.ca](mailto:sandra.dumanski@albertahealthservices.ca)

P: 403-944-8035

F: 403-944-2876

**Ombud, Terms of Reference**

The Ombud of a residency training program at the University of Calgary is appointed by the program, operates independently from existing administrative and formal dispute resolution processes, and has no formal decision-making authority.

The Ombud serves as a resource person for problems, concerns, or complaints about any aspect of resident's professional or personal life, provides resources and referrals, and serves as an informal and impartial third party in conflict resolution.

The Ombud may interpret policies and procedures, offer recommendations for policy or procedure changes, and collaborate with other university agencies in issues of general concern.

**STUDENT LEGAL ASSISTANCE**

Residents can contact Student Legal Assistance for notary, commissioner of oath and other legal issues.

<http://slacalgary.com/services/>

<https://www.ucalgary.ca/pubs/calendar/grad/current/student-legal-assistance-sla.html>

## **PART II – COMPETENCE BY DESIGN**

# COMPETENCE BY DESIGN

**LAUNCH DATE: July 1, 2022**

**CBD COHORT 1: 2022-2026**

## **INTRODUCTION:**

Competence by Design (CBD) is a Royal College of Physicians and Surgeons of Canada initiative to reform training of medical specialists in Canada. CBD is based on a global principle of Competency-Based Medical Education (CBME), which was developed by the medical education community to meet the demands of evolving health care systems. CBD is a multi-year initiative, focused on the learning continuum from the start of residency to retirement. It is based on the competency model of education and assessment and is specifically designed to address societal health needs and patient outcomes.

Through years of research, it has become apparent that although our system produces competent physicians, the methods of training and lifelong learning have remained stagnant over the past years, without any efforts to adapt to the ever-increasing demands on and expectations of physicians. Changes needed to be made to assist specialists who “graduate with knowledge gaps and feel unprepared for independent practice, who feel that current methods of feedback are ineffectual, who lack a clear understanding of the learning objectives of their program, who lose needed clinical practice time to exam preparation, and who find it challenging to determine which abilities and skills are needed in their practice”. Changes also need to be made to help educators who “struggle with inefficient and ineffective in-training assessment models, who are unable to focus teaching activities in the absence of clear learning objectives, who feel unprepared to provide meaningful and targeted assessments and who find it challenging to determine when a learner is falling behind.”

Major goals of CBD are to:

- Identify the competencies needed at all stages of training and practice
- Set up/follow a transparent learning plan to achieve these competencies
- Adjust learning to individual needs and abilities and consistently track progress
- Pinpoint areas where learners may be struggling and respond accordingly
- Provide/receive meaningful assessments against competencies
- Determine when and how new skills should be incorporated into practice
- Ensure a national baseline of competence across all specialties in Canada

Benefits of CBD:

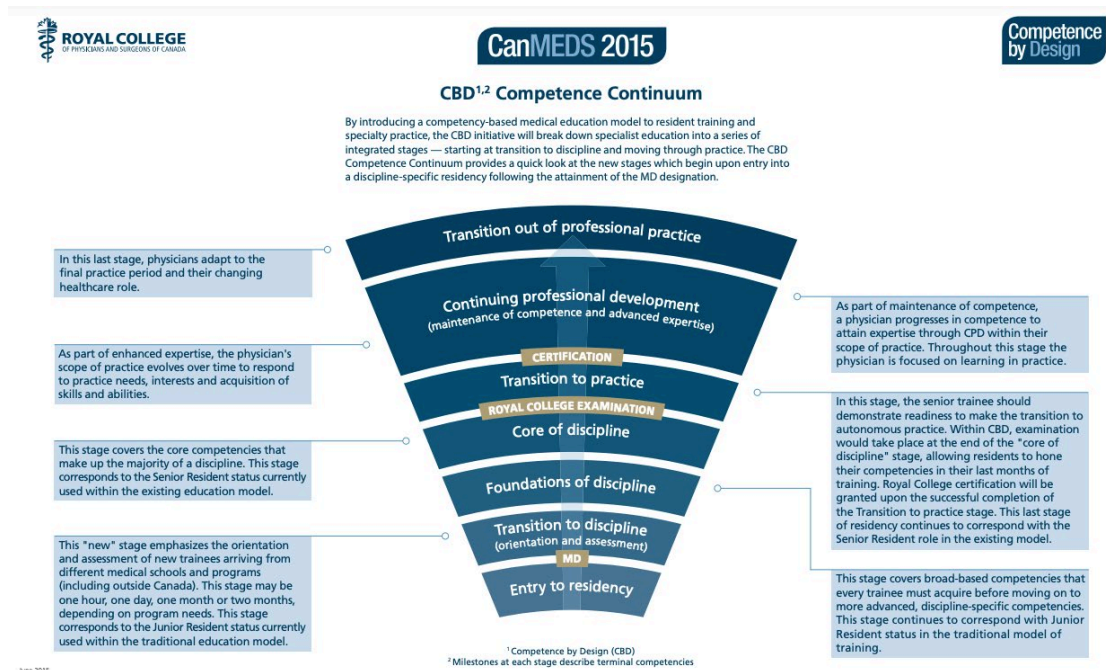
- More frequent observation and documentation
- More frequent and targeted feedback resulting in earlier identification of issues
- Focused learning around deficiencies
- Enhanced clarity around curriculum and required competencies

## CBD CORE PRINCIPLES:

- As per CBD, each specialty residency training program is organized into FOUR distinct stages of training:
- Within each stage of training, residents are provided with a list of learning objectives which are called Entrustable Professional Activities (EPAs) and Milestones
- A residents must be observed completing each EPA throughout residency
- Observers record EPA observations and feedback on resident performance on an electronic platform known as ePortfolio
- At regular intervals, during each stage of training, a Competence Committee reviews the documented observations along with other assessment data available through the ePortfolio
- The Competence Committee provides recommendations with the Residency Training/Program Committee on each resident's progress to the next stage of training
- Any gaps in learning are identified and addressed prior to progression to next stage

## STAGES OF TRAINING:

1. Entry into Residency
2. Transition to Discipline
3. Foundations of Discipline
4. Core of Discipline
5. Transition to Practice



## EPAs and MILESTONES:

Each stage of training includes EPAs and CanMEDS milestones. EPAs are specific tasks of a discipline. They are designed to be “developmental”, going from smaller tasks to bigger tasks, as residents progress through the various stages of training. Each EPA integrates a number of CanMEDS milestones which are based on CanMEDS roles. A bigger task may include more or more complex CanMEDS milestones. Like with other programs, EPAs for Diagnostic Radiology were built by specialty leaders working closely with the Royal College CBD Committees.

CanMEDS milestones are individual skills which are necessary to perform a specific task. A trainee and an observer may choose to focus on an EPA as a whole or focus on a specific milestone associated with that EPA.

EPAs are selected by trainees based on the clinical tasks performed during a specific rotation/workday. It is primarily the resident’s responsibility to take ownership of their curriculum and to initiate observations. However, any attending work with the resident may choose to initiate an observation. Similarly, the program director may choose to initiate an observation.

In a given rotation, multiple EPAs and Milestones can be initiated and completed by the resident.

Please see **APPENDIX A** for Diagnostic Radiology EPAs and Milestones.

## ENTRUSTABILITY SCALE:

Royal College requires utilization of entrustability scores to provide an impression of overall competence for a specific observation. The Ottawa Surgical Competency Operating Room Evaluation (O-SCORE) tool is specifically encouraged, as it is currently the only entrustability scale which has supporting validity evidence.

Entrustability scales are used to provide a retrospective opinion on a task that was just observed. They are not speculative and are not meant to be predictive of future performance. An observation does not indicate whether the resident has or has not achieved an EPA. The wording of entrustability scales is not meant to be interpreted literally. Each level of the scale indicated increasing level of independence with respect to a specific task. This scale applies to both procedural and non-procedural skills.

### O-SCORE Entrustability Scale

Level	Descriptor
1	<b>“I had to do”</b> i.e., requires complete hands on guidance, did not do, or was not given the opportunity to do
2	<b>“I had to talk them through”</b> i.e., able to perform tasks but requires constant direction
3	<b>“I had to prompt them from time to time”</b> i.e., demonstrates some independence, but requires intermittent direction
4	<b>“I needed to be in the room just in case”</b> i.e., independence but unaware of risks and still requires supervision for safe practice
5	<b>“I did not need to be there”</b> i.e., complete independence, understands risks and performs safely, practice ready

Gofton WT, Dudek NL, Wood TJ, Balaa F, Hamstra SJ. The Ottawa surgical competency operating room evaluation (O-SCORE): a tool to assess surgical competence. Acad Med. 2012;87(10):1401-7. Reproduced with permission of the authors.

## COMPETENCE COMMITTEE

Programs participating in CBD form a “Competence Committee”, which has a defined purpose which is separate from that of the Residency Training Committee. The main goal of the competence committee is to collect and synthesize qualitative and quantitative data from multiple documents (EPAs, Milestones, ITERs) to reveal a broad picture of a resident’s progress through various stages of training.

Competence Committee meetings are held quarterly. Additional meetings may be scheduled to accommodate a particular need for resident review. Members of a Competence Committee are assigned a cohort of residents for each meeting. Prior to the meeting, individual members of the Competence Committee prepare a summary of collected data for each assigned resident. This data is presented to the rest of the Competence Committee who review the data and make a recommendation on the resident’s progress to the program director. The program director then presents this data to the RPC sub-committee where final promotion decisions are made.

If a resident is progressing as expected, the RPC sub-committee will be informed and the resident will carry on to the next rotation/stage of training, as expected. If the Competence Committee identifies deficiencies, a curated remediation plan is proposed to the program director and subsequently to the RPC. The intent of this curated learning plan is to address specific deficiencies and to help the resident achieve specific goals. This curated plan avoids vague and non-directive recommendations such as “you need to read more” and “you need to do more volume”. For example, if a resident is consistently struggling with identifying acute strokes on a CTA Head and Neck, a plan will be created to increase resident exposure to this specific study, possibly with closer supervision and a specific didactic learning plan.

Royal College recommends two reviews per year for each resident. Competence Committee meetings are to be held close to the RPC meetings. A resident must be informed on his/her progress within approximately 1 week after RPC meeting. If a remediation/learning plan is proposed, the terms of this plan must be reviewed by the program director and the resident. The resident and the program director are to sign a document formalizing this remediation/modified learning plan.

## Appeal Process:

Both the residents in the CBD and the non-CBD cohort have the right to appeal an RPC decision with respect to promotion/remediation/dismissal. The Diagnostic Radiology Residency Program adheres to the University of Calgary PGME “Resident Appeals Policy” as follows:

<https://cumming.ucalgary.ca/sites/default/files/teams/6/policies/resident-appeal-policy-pgme-July2021-v2.pdf>

## Members of the Competence Committee 2022-2023

Dr. Alina Makoyeva (Chair)  
Dr. James Huynh (Program Director)  
Dr. Tracy Elliot  
Dr. David Burrowes  
Dr. Mathew Li  
Dr. Robert Sevick  
Dr. Samarjeet Bhandal  
Dr. Ani Mirakhur  
Dr. Peter Salat  
Dr. Ruban Gnanakumar



# **PART III - POLICIES & PROCEDURES**

## **SUPERVISION OF RESIDENTS POLICY**

The Diagnostic Radiology Residency Program adheres to the University of Calgary PGME “Policy for the Supervision of Residents” as follows:

<http://cumming.ucalgary.ca/pgme/current-trainees/residency-training-policies>

However, the Diagnostic Radiology Residency Program also has program-specific guidelines for the supervision of residents as follows:

1. The **supervising radiologist** has a dual professional responsibility to provide appropriate patient care and to provide education for trainees. There must be a careful assessment of the responsibility delegated to the trainee.
2. The **resident** has a dual responsibility to ensure patients (and their families) for whom they are providing care know they are on a teaching unit and to keep attending and consulting physicians informed about their patients.

## **Attending Radiologist Responsibilities**

It is the responsibility of the attending radiologist to:

1. Review the examinations and procedures with the resident in a timely manner. This includes:
  - Discussing the findings and their significance for patient management.
  - Involvement and agreement concerning major decisions relating to diagnosis and management.
  - Involvement with the planning and performance of procedures including direct supervision when required by patient safety or requested by the trainee.
  - Identification of aspects of the case affording educational emphasis.
2. Supervise the residents on-call as follows:
  - All residents (PGY-2 to PGY-5):
    - Subspecialty radiologists (Body and Neuro) in-house at Foothills Medical Centre until 2300h, 7 days/week.
    - 6 subspecialty radiologists (2 Body, 1 Neuro, 1 Interventional Body, 1 Interventional Neuro, 1 Nuclear Medicine) available by pager 24 hours/day.
  - PGY-2 residents (second 6 months of the year) and PGY-3 residents (first 6 months of the year):
    - Residents are on-call overnight only when a staff radiologist is working, either in-house or remotely, 24 hours/day at Foothills Medical Centre (2 weeks/4-week block).
  - PGY-3 residents (second 6 months of the year):
    - Resident’s responsibilities are graduated as they are now on call when a staff radiologist is not in-house 24 hours/day.
    - However, the staff radiologist will phone resident at 0200-0300h to complete a remote review session via PACS.
  - PGY-4 and PGY-5 (first 6 months) residents:
    - This is the final stage of graduated responsibilities on call as the resident is now on call independently from 2300h-0700h.
    - However, 6 subspecialty radiologists remain available by pager 24 hours/day.
  - PGY-5 residents (second 6 months):
    - Residents are no longer taking call from January 1-June 30 of the PGY-5 year.

3. Be available by pager or phone when on service at all times.
4. Complete the resident ITERs and EPAs in a timely manner and to notify the Competence Committee and/or Residency Program Director if a resident is failing or borderline passing a rotation. These concerns must also be discussed with the resident, both in the CBD and the non-CBD cohorts.
5. At the Alberta Children's Hospital, during the 4-block Pediatric Radiology rotation, the following Staff responsibilities also apply:
  - Minimum of 3 staff radiologists on site at all times (Monday-Friday), not including the 1 IR staff
    - e.g. 1 staff on MR, 1 staff on US, 1 staff on CT/Fluoro
  - The staff radiologist listed on the schedule should be present for clinical duties and readily available for resident supervision and review.
  - Any staff radiologist on administrative duties should be identified as such on the schedule and should not be listed on the staff schedule as one of the 3 staff radiologists on site for clinical duties to avoid any confusion.

### Diagnostic Radiology Resident Responsibilities

It is the responsibility of all Diagnostic Radiology residents to:

1. When interacting with patients directly, identify oneself as a resident and inform patient (and/or family) that they are on a clinical teaching unit and in a teaching hospital, and that their work is under the supervision of an attending physician.
2. When interacting with clinical services (nursing staff, physicians...), identify oneself as a resident and inform the clinical service member that their work is under the supervision of an attending physician.
3. Notify the supervising radiologist as appropriate when:
  - A diagnostic study has urgent findings that require immediate attention and notification of ordering service
  - An urgent or non-urgent finding or management plan is in doubt
  - A patient's condition is deteriorating in the context of a study or invasive/non-invasive procedure occurring in the diagnostic imaging department
  - Resident is unsure of anything (e.g. protocol, workflow in the department, imaging findings...)
4. Notify the attending or consulting physician of any abnormal imaging results that may need urgent management or may significantly affect current patient management. As such, the resident must follow:
  - The "Resident Trigger Policy"
  - The department's "Discrepancy Reporting Policy"
5. Record in writing on the patient's report the notification of the attending or consulting physician with preliminary results and changes in the report after the review session with staff in accordance with the "Discrepancy Reporting Policy".
6. Be available by pager or phone at all times when on service.
7. Ensure his/her ITERs (mid-rotation and end of rotation) and EPAs are completed in a timely manner.

- The resident is responsible for informing the staff preceptor of the end of the rotation and/or if the resident will not be present in the last few days of the rotation to ensure the ITER is completed.
- The resident is responsible for completing EPAs in a timely manner, to ensure adequate material for review at next Competence Committee meeting
- The PGY-2 resident is responsible for a Mid-Rotation ITER completed during the first 6 core blocks of PGY-2.

**SENIOR RESIDENT CLINIC SUPERVISION AND REVIEW****LOCATION:**

Advanced Medical Imaging Centre, first floor. Suite 100, 2000 Veterans Place NW.

**OBJECTIVES:**

- This is primarily an US rotation. The case mix has been selected to expose you to cases that are not seen in the hospital setting, but are “bread & butter” cases for a general radiology clinic practice.
  - General detailed OB US, abdomen and pelvis US, thyroid US, carotid US, extremity DVTs and HCCs.
  - Unfortunately, no MSK US as the CPSA requires a staff radiologist to be on site.
- If time permits, please read plain films. Plain films are strongly encouraged in your PGY-5 year

**SCHEDULING:**

**\*\*THIS CLINIC IS BOOKED EVERY DAY MONDAY-FRIDAY\*\***

- The Seniors Clinic is scheduled well in advance with the assistance of the Program Admins. Each resident is responsible for ensuring the schedule is correct for their rotation. You are responsible for covering the clinic or finding replacement coverage if you decide to take last minute vacation/days off or swap nights of call.
- Mandatory teaching sessions on any day that a resident absolutely cannot be available will be blocked off. This must be done well in advance when the Program Admins are organizing coverage for the clinic.
- If the resident is post-call or on vacation, someone else from your year MUST be a substitute for the day and cover the Clinic (please ask the current PGY-5s how they scheduled this). This must be a TEAM EFFORT and planned well in advance when the Program Admins are organizing coverage for the clinic.
  - 0800-1200h Monday-Friday: at Clinic
  - 1200-1300h Monday-Friday: Noon Rounds (except Thursdays)
  - 1300-1700h Monday-Friday: US dept at FMC or Stephanie Wilson’s clinic (except Thursday Academic Half-Day)
    - Confirm with the Program Director prior to your rotation. Alternatively, you can sit in any seat at FMC that is open or read plain films to gain additional experience
    - Please ensure that you check in with the relevant preceptor to ensure they know you will be working with them in the afternoon.

**Study Day (Tuesdays) from January-June:**

The PGY5 resident will work at the Clinic in the morning and have their regular study time in the afternoon. PGY5 can choose another afternoon of the week, at their discretion. Please make sure that appropriate preceptor is aware that you are taking an alternative study afternoon.

**PACS/IT**

- You must have EFW access including PACS and Powerscribe (most of you will have this set up from earlier Mammo II rotations)
- You must have Astraia access (some of you will have this training and set up from earlier MFM rotations)
- If you need to obtain training or access to these programs, please email AcctReq@EFWRad.com at least 2 weeks prior to your rotation:

**REVIEW OF CASES:**

- The primary staff radiologist you will review with is the Seton US radiologist. Please phone the reviewing radiologist first thing in the morning. All phone numbers are in a PDF document available on all EFW clinic desktop computers (Document is titled “Internal and External Contact Numbers”). Typically, there is one remote review session at ~1130h each day. If you are starting the Clinic rotation at the end of PGY-4, there may be 2 review sessions. You are encouraged to contact the attending radiologist at any other time if you have questions or concerns with respect to any individual case.
- In the event that a Seton US radiologist is unavailable there is a back-up system in place to ensure appropriate supervision is maintained at all times, listed in order of priority:
  1. Sunridge DI Rad
  2. As a last resort you can speak with the onsite Cambrian Mammo/Nuc Med Radiologist
  3. In the unlikely scenario in which patient care requires a staff radiologist physically scan or assess a patient, you can ask the Cambrian Mammo or Nuclear Medicine Radiologist for assistance
  4. For questions pertaining to advanced obstetrical imaging, you may contact a perinatologist (Local

numbers available of Contact Number PDF document)

**WHAT BLOCKS WILL YOU COVER IN THE SENIOR RESIDENT CLINIC?**

Each resident typically covers at least 2 blocks of the Seniors Clinic

- Some residents will have an “US\*” block, Blocks 12 & 13 in PGY-4 year
- Every resident has a “CLINIC” block in PGY-5 year.
- Some residents will have an “US\*” block in PGY-5 year.
- There is an “Elective” block for all PGY-5 residents, Block 11 of the PGY-5 year. This is again a TEAM EFFORT. All PGY-5 residents contribute to cover the Clinic this block—talk to the current PGY-5s, typically each of you will cover the Clinic approximately 1 day/week.

**ON-CALL**

The purpose of emergency call is to allow exposure to a wide range of emergency imaging situations aiming at development of independent assessment, procedural and interpretation skills as a junior consultant to clinical staff. This is indispensable training for future independent practice of radiology.

On-call residents should not be afraid to make recommendations for alternative, more appropriate investigations, and suggest priority of investigations as a junior consultant when such suggestions will provide better or more ethical patient care. However, an important component of training is also in appreciating one's own limitations and experience, and knowing when to seek help.

Calls/pages must be responded to in a timely fashion. Foothills Medical Centre is a designated trauma center, a neuroscience center, and a subspecialized surgical and oncologic center. Persons on call must be able to respond immediately to requests for urgent examinations.

The progression towards independent call is a graduated process, as follows:

- All residents (PGY-2 to PGY-5):
  - Subspecialty radiologists (Body and Neuro) in-house at Foothills Medical Centre until 2300h, 7 days/week.
  - 6 subspecialty radiologists (2 Body, 1 Neuro, 1 Interventional Body, 1 Interventional Neuro, 1 Nuclear Medicine) available by pager 24 hours/day.
- PGY-2 residents (first 6 months):
  - Residents are not on independent call.
  - Residents start call in November or early December and are "buddied" with a more senior resident who stays in the hospital with him/her overnight.
  - If the on-call resident has any question on the validity of the indication, conduct of the examination or interpretation of the results that he/she cannot answer, he/she must consult either the back-up/"buddy" senior resident and/or one of the 6 subspecialty radiologists on call.
- PGY-2 residents (second 6 months) and PGY-3 residents (first 6 months):
  - Residents are on-call overnight only when a staff radiologist is working, either in-house or remotely, 24 hours/day at Foothills Medical Centre (2 weeks/4-week block).
- PGY-3 residents (second 6 months):
  - Resident's responsibilities are graduated as they are now on call when a staff radiologist is not in-house 24 hours/day.
  - However, the staff radiologist will phone resident at 0200-0300h to complete a remote review session via PACS.
- PGY-4 and PGY-5 (first 6 months) residents:
  - This is the final stage of graduated responsibilities on call as the resident is now on call independently from 2300h-0700h.
- PGY-5 residents (second 6 months):
  - Residents are no longer taking call from January 1-June 30 of the PGY-5 year.

**RESIDENT “TRIGGER” POLICY**

Residents are reminded of the fact that there are 6 subspecialty-trained faculty radiologists on call each night. In the event that interpretation of diagnostic imaging exams requires the urgent assistance of a fellow or faculty radiologist, the resident is to consult the fellow or faculty radiologist(s) on call. Further, if the volume of cases exceeds the capacity of the resident on call, the resident should consult the senior fellow and/or faculty radiologist(s) on call. The resident “trigger” policy should be followed to ensure appropriate staff involvement when necessary.

	<b>BODY</b>	<b>NEURO</b>
<b>STAFF Responsibilities</b>	ALL RESIDENTS (PGY2/3/4/5)	
	Responds to ANY/ALL calls from resident	
	PGY3 ONLY (second 6 months)	
	Automatic review at 0200-0300 from home, unless ZERO cases	
<b>RESIDENT Responsibilities</b>	ALL RESIDENTS (PGY2/3/4/5)	
	<ol style="list-style-type: none"> <li>1. URGENT CASE (trauma, unstable ICU pt) that cannot be reviewed by resident in an appropriate time interval (time to verbal /preliminary report should be within <u>30 minutes</u> of the images being available on PACS).</li> <li>2. Any/all ER cases that cannot be reviewed by resident in an appropriate time interval (time to verbal/preliminary report should be less than <u>90 minutes</u> of the images being available on PACS).</li> <li>3. Patient going to the OR that night and there is ANY uncertainty regarding the findings.</li> <li>4. A patient management decision that night will depend on your report and you have ANY uncertainty about your findings.</li> <li>5. A STAFF physician (ER/Other) specifically asks for your staff to review the case.</li> <li>6. If a STAFF physician comes to review a case with you in person, you are to automatically ask them if they would like you to call your staff at home.</li> </ol>	<ol style="list-style-type: none"> <li>1. There is a clear discrepancy between the imaging findings and clinical signs/symptoms after discussion with the referring MD.</li> <li>2. Any uncertainty about the following diagnoses:                             <ul style="list-style-type: none"> <li>• Basilar thrombosis</li> <li>• Sinovenous thrombosis</li> <li>• Early signs of herpes encephalitis</li> </ul> </li> </ol>



## **DISCREPANCY REPORTING POLICY**

### **Discrepancy Reports**

These updates were established in collaboration with our ED colleagues and we hope that this will improve communication between our departments. Although major discrepancies are rare in the DI department, there is always room for improvement.

We invite staff radiologists to please contact [Deepak.Bhayana@ahs.ca](mailto:Deepak.Bhayana@ahs.ca) and residents to please contact your chiefs with any questions or comments.

### **1- WHAT**

- a) A discrepancy occurs when a verbal or written preliminary report has been sent to PACS/discussed with the ordering physician before staff review and a difference in detection or interpretation of findings was found following staff review.
- b) Major discrepancies include any difference in image interpretation affecting immediate patient management. If you are unsure whether or not the discrepancy will affect patient management, the safest course of action is to call the emergency physician to discuss.
- c) Minor discrepancies include findings that do not have immediate impact on patient care but do require attention from a physician. This includes, for example, findings requiring additional workup or follow-up. Once again, if you are unsure whether or not the discrepancy will affect patient management, call the emergency department to confirm.

### **2- WHEN**

- a) The discrepancy process applies to ALL preliminary written ("prelim&approve") or verbal reports regardless of the time of the day (24/7/365), rotation or status of the study (ER/IP/OP).
- b) In order to reduce the occurrence of discrepancies, residents should minimize preliminary reports as much as possible and keep their reports as draft until staff review, as appropriate, especially during hours when there is a staff physically in-house (until 2300h, 7 days/week).
  - Residents should review each ER case with staff as soon as possible
  - Residents can keep IP/OP under draft for a later block review, unless urgent or uncertain of findings/significance of findings
- c) Of course, this process may not be always feasible on busy shifts. In this scenario, residents should discuss with their staff and establish the best course of action.

*\*\*\*Obviously, this does not apply to overnight call - reports should be sent as preliminary reports overnight for neuro and body (except in junior years, when body staff is in-house)\*\*\**

### **3- HOW**

#### **a. Major discrepancy:**

- The macro should be used for all major discrepancies.
- The information within the DISCREPANCY REPORT macro should not only include a summary of the new/updated imaging findings, but also a summary of the findings/impression included in the

resident preliminary report (see example at the end of this email). It is important for the emergency physician who read and acted upon the resident report to have a trace of the information he/she was initially given.

- Please put the discrepancy macro on top AND at the bottom of the report

#### **b. Minor discrepancy:**

- Minor discrepancy findings should be added to the body AND the impression.
  - Emergency doctors found a way to retrospectively have access to both the preliminary report AND final report. As per their discussion with Dr. Bhayana, they will review each CT report later and compare the impression of both the preliminary and final reports for minor discrepancies (assuming that the major discrepancies have been addressed on the day the report was submitted).
- Therefore, if a minor discrepancy is found following morning review, it should be added to the impression with the mention that this was not initially included in the preliminary resident report.
- Residents do not need to add a discrepancy macro but can add an addendum/disclaimer on top if they wish, especially if this was communicated to the ER physician.
- Minor discrepancies do not require to be communicated back to ER.

#### **4 - DISCREPANCY MACRO**

The standard macro for discrepancy will remain the same.

<p><b>DISCREPANCY REPORT:</b> (Discrepancy pertaining to the preliminary resident interpretation with the final interpretation (with respect to the patient's acute presentation OR radiology recommended follow-up) following review of the study with the staff radiologist at _____ hours on _____ .)</p> <p>1. 2. Discrepancy was discussed with Dr. _____ at _____ hours on _____ .</p> <p>This ADDENDUM was placed on the PACS system following review of the study with the staff radiologist.</p>
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#### **5 - IN SUMMARY**

1. In order to minimize the frequency of discrepancy during the day, reports should be kept under draft until staff review whenever possible
  - a. ED reports should be reviewed as soon as possible to minimize delay, IP/OP reports can be reviewed in block at a later time, unless urgent or uncertain of findings/significance of findings.
  - b. This process does not apply to overnight shifts - reports should be sent as preliminary reports overnight (*except in junior years, when body staff is in-house, for body cases only*).
2. If reports are sent as preliminary reports ("prelim&approve") and a discrepancy is found after staff review, the appropriate discrepancy process should be followed regardless of the time of the day.
3. The processes for major and minor discrepancy are different - please familiarize yourselves with the details described above.
4. Minor discrepancies do not require to be communicate directly but do need to be clearly indicated in the impression of the report.
5. For radiologists reviewing cases - if you review and approve cases independently, please make sure to follow the appropriate discrepancy process OR ask the resident to do it.

**EXAMPLE FOR MAJOR DISCREPANCY**

I am the resident on evening shift (5-9pm) and I read a trauma case at 6:00 pm. It's very busy so Deepak and I agreed that I can send my reports as preliminary reports for now. I write the following impression.

**IMPRESSION:**

1. **No acute traumatic intrathoracic or intraabdominal finding.**
2. **Mild thickening of the large bowel which is of uncertain clinical significance and could represent mild inflammation.**

At 7:30 pm Deepak is free to review my cases. When reviewing my trauma case, he believes the wall thickening is marked and localized to the LLQ. He also finds associated trace mesenteric hematoma and few tiny locules of free air which were missed. His final impression is that the findings reflect bowel injury and not "mild inflammation". After review I describe these findings in the body and the impression of the final report which now reads as follows:

**IMPRESSION:**

1. **Marked thickening of a short segment of a large bowel loop within the left lower quadrant with associated mesenteric hematoma. Few locules of free-intraperitoneal gas are noted near the abnormal bowel segment. Considering the provided clinical context, findings are in keeping with traumatic bowel injury with perforation.**
2. **No acute intrathoracic finding.**

I call the ordering doctor to discuss the findings at 7:40. Here is how the DISCREPANCY REPORT disclaimer at the top of the final report should read:

**DISCREPANCY REPORT:**

**(Discrepancy pertaining to the preliminary resident interpretation with the final interpretation (with respect to the patient's acute presentation OR radiology recommended follow-up) following review of the study with the staff radiologist at 7:30 PM hours on 2020/10/01.)**

**Discrepancy was discussed with Dr. X at 7:40 PM hours on 2020/10/01.**

**The initial preliminary resident report submitted at 6:00 PM mentioned no acute traumatic intraabdominal finding. The final report following staff review includes marked thickening of the large bowel within the RLQ, mesenteric hematoma and trace free intraperitoneal air in keeping with acute bowel injury with perforation. These findings and final impression were not included in the initial preliminary resident report.**

**This ADDENDUM was placed on the PACS system following review of the study with the staff radiologist.**

\_\_\_\_\_ **EXAMPLE FOR MINOR DISCREPANCY** \_\_\_\_\_

I am the overnight resident and I read a trauma case at 2:00 am. I missed an adrenal nodule in my preliminary report. Following morning staff review, the findings related to the nodule were described in the body and the new impression at the bottom of the final report is:

**IMPRESSION:**

1. **No acute intraabdominal finding.**
2. **Isoattenuating adrenal nodule measuring 1.2 x 1.1 cm for which further outpatient assessment with a dedicated adrenal CT is recommended. Note that this was not included in the initial preliminary resident report submitted at 2:00 am on 2020/10/01.**

I do not need to call the "discrepancy" ED doc in the morning and no disclaimer/macro was added to the report.

## **MINIMUM ROTATION REQUIREMENTS POLICY**

A rotation may be deemed “incomplete” if less than 75% of the rotation length and/or rotation elements are completed. This does not include time away from the rotation for pre-/post call days, academic requirements (half day, visiting professor, mandatory education activities). However, the overall minimum requirement on service is 50% to complete a rotation.

## **ATTENDANCE POLICY – Daily Rotations, Rounds and Academic Events**

Each individual resident is responsible for ensuring that the daily work schedule is accurate.

### **Mandatory Academic Events**

- Monday Mayfair 7am Rounds
- Monday/Tuesday/Wednesday and Friday Noon Rounds
  - Case rounds, didactic teaching, QI/QA rounds, Grand Rounds
- Maternal Fetal Medicine Rounds
- Academic Half Day
- Journal Club
- Visiting Professor Days
- Research Day
- Physics
- Resident Retreat

A resident representative will be responsible for recording attendance at certain events, including Monday morning Mayfair Rounds, Maternal Fetal Medicine Rounds, Academic Half Day, Visiting Professor days, Journal Club, Grand Rounds, Research Day, and the Physics course. Attendance is considered mandatory. Note that Zoom allows for retrospective review of attendance during academic activities.

### **Attendance undergoes regular audits.**

If a resident is absent from a rotation without cause or a lack of attendance becomes a pattern (3+ incidences) at mandatory academic activities:

#### *Step 1:*

The Competence Committee will be notified by appropriate representative.

The PD will request a formal meeting to discuss appropriate professionalism.

#### *Step 2:*

If appropriate corrective measures are not undertaken by the individual, ongoing professionalism concerns will be managed by the RPC Faculty Subcommittee and professionalism concerns will be formally documented in the resident’s academic records. Licensing and regulatory bodies take concerns over professionalism to be very serious.

### **At the direction of the RPC Faculty Subcommittee consequences may include:**

- ***loss of permission to attend visiting professor lectures, academic half days or physics teaching***
- ***additional weekend/evening assignments***
- ***additional case rounds/grand rounds***
- ***delay or lack of approval of vacation/meeting time***
- ***denial of approval for program funds to attend meetings***
- ***suspension or termination from the program***

## **ABSENSE POLICIES & EDUCATION ACCOMMODATIONS**

### **VACATION POLICY**

The Diagnostic Radiology Residency Program adheres to both the Professional Association of Resident Physicians of Alberta (PARA) policy on Vacation and the University of Calgary PGME “Resident Vacation Policy”.

However, the Diagnostic Radiology Residency Program also has program-specific guidelines for vacation time which abide by the PARA Contract as follows:

- Vacation is important to maintain physical, mental, and emotional well-being.
- Vacation is typically taken in weekly segments. Part-of-week segments, especially before or after a long weekend, are unfair to fellow residents who must interrupt their own rotations for 1-2 days to cover for people away. Vacation periods may be less than one full week at the discretion of the Program Director.
- All requests for vacation and research days must be received by the chief residents/program admins at least 2 weeks in advance of the date requested.
- Flex days may be requested a minimum of 1 week in advance
- Any type of absence requested with less than two weeks’ notice should go to the Chief Residents and Program Director with explanation
- All requests must be approved by Chiefs and/or Program Director with a signature or approval email then submitted to the Administration team
- **Sick days** will not be assigned in retrospect; therefore, if you have missed a day of work and have not reported your absence in a timely manner it will be considered a vacation or special leave day.
- Residents should avoid taking holidays during RCPSC examination periods in the PGY-5 year (i.e. late May to early June) unless vacation time is used for study purposes.
- Similarly, residents should avoid taking vacation during the American College of Radiology (ACR) exam (usually within the first three weeks of January) and on the Department Research Day (usually May).

#### *PARA 20.02 Vacation Scheduling*

*c) Applications for vacation shall be made in writing to the Program Director a minimum of eight (8) weeks in advance to ensure appropriate service coverage.*

### **Types of Absences**

**Vacation days** = 20 per year

**Special leave days** = 5 per year max; program may request valid reason/documentation (for reasonable, unanticipated circumstances, e.g. illness of an immediate family member)

**Flex days** = 4 days with pay per year

**Research Days** = 20 days, total for PGY1 to PGY5

**PARA Winter Break** – 6 consecutive days during last 2 weeks of December. Dates at discretion of the program.

**Sick leave** = any absences greater than 5 consecutive working days are to be reported to the Medical Education Office (AHS). Requires documentation to PGME and MEO.

**Other** = Compassionate, bereavement, maternity/parental, educational (conference), and exam leave. Requires documentation to PGME and MEO. Please refer to the PARA agreement.

## Rotation Specific Absence Policy & Process

Historically the Diagnostic Radiology program has been very flexible and lenient compared to other residency programs in Calgary (many programs have very strict 8 or 12 week policies) in permitting short notice requests for vacation, flex days and research time. This has created difficulty for administration tracking time away from the program and difficulty for the chief residents to manage multiple requests and requests that arrive after the final 2 week schedule has been published. Subsequently plain film assignments are left unread, staff and technologists cannot reach residents that are on the schedule, and other issues frequently arise taking administrative time that would otherwise be used for more productive purposes.

### **PROCESS - Foothills Medical Centre**

If you are unable to report for duty (due to illness, family emergency etc.), you are required, as soon as possible, not less than two (2) hours before you are to report to duty to inform all of the following people:

1. **Preceptor** – via pager and/or email
2. **Chief Resident** DICchief.Residents@ahs.ca or page
  - a) Please coordinate with the Chief Residents if call coverage is required
3. **Program Administration Team** - Bonnie.McCardle@ahs.ca AND Dustin.Morris@ahs.ca
  - a) Program administration will notify the film library of your absence
4. **CT-GU Rotation** – Dr. Jonathan Ehmann jonathan.ehmann@ahs.ca
5. **MSK II Rotation** – Dr. Arden Lee ardenlee@gmail.com

### **PROCESS - Alberta Children's Hospital – PGY4**

If you are unable to report for duty (due to illness, family emergency etc.), you are required, as soon as possible, not less than two (2) hours before you are to report to duty to inform the following people:

1. **Preceptor** – Seemab.Haider@ahs.ca AND preceptor via page or email
2. **Chief Resident** –DICchief.Residents@albertahealthservices.ca or page
3. **Program Administration Team**– Cathy.Wall@ahs.ca AND Erin Pridmore erin@mypureform.com AND Bonnie.McCardle@ahs.ca AND Dustin.Morris@ahs.ca
4. **Call Coverage**– Cathy.Wall@ahs.ca
5. **Post Call** – Cathy.Wall@ahs.ca AND erin@mypureform.com AND DICchief.residents@ahs.ca

## Leave Of Absence Policy

- Circumstances that qualify residents for leaves of absence include maternity/paternity/adoption, parental leave, sick leave, compassionate, educational leave, and other leaves at the discretion of the Associate Dean, PGME.
- The Diagnostic Radiology Residency Program adheres to the University of Calgary PGME “Leave of Absence Policy”.
- Alberta Health Services, Medical Education Office also requires notification to ensure resident physicians are appropriately compensated as per the PARA Agreement (Please see **APPENDIX B**). This team is also responsible for facilitating all AHS Human Resources transactions and clinical access.
- The PGME “Leave of Absence Policy” and AHS “Resident Leave of Absence Process” is available:
- <https://cumming.ucalgary.ca/pgme/current-trainees/residents/starting-residency-training/policies-guidelines>
- If an illness is expected to exhaust the paid sick allowance (3 months per appointment year) the Resident Physician should contact PARA to apply for the Long Term Disability benefit.
- Medical Affairs also requires notification to initiate the Benefits Costing process (giving the Resident Physician the option of purchasing extended medical benefits through the unpaid leave period). Medical Affairs will also copy PARA when the notification of leave is distributed.
- Resident Physicians are not automatically eligible for Long Term Disability and must apply through a claims process. Only ADIUM can determine eligibility, so all Resident Physicians are recommended to contact PARA to initiate and be guided through the claims process.

## Accommodation

“Accommodation” means providing support to access services, courses, courses of study, programs or training, making exemptions to any regulations, policies, standards or practices, or making modifications to physical environments to the extent necessary to address discrimination against, or barriers, to a Medical Learner based on any Protected Ground.

Residents requesting an Accommodation on the basis of a Protected Ground must submit a completed Request for Accommodation Form in the manner set out in the Request for Accommodation Form and provide documentation to support their request, as set out in sections 4.3 and 4.8 to 4.11. Email to: [pgmeaccom@ucalgary.ca](mailto:pgmeaccom@ucalgary.ca)  
<https://cumming.ucalgary.ca/sites/default/files/teams/6/policies/pgme-resident-accommodation-policy-final-june20-v2.pdf>

### REFERENCE:

1. **Professional Association of Resident Physicians of Alberta (PARA)**  
<https://www.para-ab.ca>  
Toll Free: 1-877-375-PARA (7272)
2. **Postgraduate Medical Education Office, University of Calgary (PGME)**  
<https://cumming.ucalgary.ca/pgme/current-trainees/residents/during-residency-training/pgme@ucalgary.ca>  
403-220-7368
3. **Medical Education Office, Alberta Health Services (MEO)**  
CAL.MedicalEducationOffice@albertahealthservices.ca  
<https://insite.albertahealthservices.ca/ma/Page3314.aspx>  
403-943-1245
4. **Human Resources Contact Centre, Alberta Health Services**  
hrcontactcentre@albertahealthservices.ca  
1-877-511-4455



## **Exam Leave**

### ***(PARA agreement, article 13)***

Each Resident Physician shall be entitled to up to five (5) consecutive days off without loss of pay to write each Canadian qualifying and certifying examination component, which include those of the Medical Council of Canada, the College of Family Physicians of Canada, and the Royal College of Physicians and Surgeons of Canada. The days off will be as follows:

- a) Travel required – the day prior to outbound travel, the day of outbound travel, one (1) or two (2) days as required to attend the actual examination, and one (1) day for return travel, or
- b) No travel required – the day prior to the examination, one (1) or two (2) days as required to attend the actual examination. (PARA agreement 13.01)

A Resident Physician may be granted unpaid leave up to ten (10) days total over the course of their residency program for the purpose of taking all the components of the United States Medical Licensing Examination (USMLE). (PARA agreement 13.04)

## **EVALUATIONS AND PROMOTION POLICY**

### **NON-CBD COHORTS**

The Diagnostic Radiology Residency Program adheres to the University of Calgary PGME “Resident Assessment Policy” that address the evaluation, promotion, remediation, probation and dismissal as follows:

<http://cumming.ucalgary.ca/pgme/current-trainees/residency-training-policies>

However, the Diagnostic Radiology Residency Program also has program-specific guidelines for the evaluation and assessment of residents as follows:

Residents are evaluated throughout the year through formal and informal means to determine if training objectives have been achieved and to provide feedback to the residents regarding their weaknesses and strengths. Major areas evaluated include knowledge base, consultative skills, reporting ability, attitude, work ethics, quality control awareness and research commitment and ability. For example, daily face-to-face feedback is given to the resident at the time of multiple daily review sessions at the workstation.

Annually in the spring, the RPC Faculty Subcommittee reviews each resident for promotion to the next PGY level.

The Postgraduate Medical Education Office will approve promotion/extended probation/termination for all residents registered with the University of Calgary on the recommendation of the Program Director.

#### **Rotation Evaluations (ITER)**

An electronic system is utilized for evaluations (one45 system). At the end of each rotation, an evaluation of the resident’s performance is completed, also known as an “ITER” (In-Training Evaluation Report). On selected rotations, daily encounter cards are utilized. These are daily evaluations (paper forms) with which the resident engages in face-to-face assessment of performance. The resident is responsible for asking a preceptor to fill out one of these forms and to submit the completed forms to the Residency Program Office. The supervising preceptor on the rotation uses these encounter cards to complete the overall block evaluation. For longer rotations such as Interventional Radiology and Pediatric Radiology, a face-to-face with or without a written mid-rotation evaluation is performed.

The resident is responsible for asking the supervising staff to discuss his/her performance to facilitate face-to-face discussion both daily and at the end of the block. The completed block evaluation will be provided to the resident electronically. The resident must sign off the form (electronically) to confirm that you have read it. Appeals can be made to the Program Director and will be dealt with through the Residency Program Committee in accordance with the U of Calgary PGME “Resident Appeals Policy” (see below).

In June 2014, the RPC modified the policy for acknowledgement of the ITER by the resident if the resident was not available for a face-to-face evaluation at the end of the rotation (e.g. vacation, away on elective the next block). The RPC decided that if a resident was performing satisfactorily and the on-going feedback throughout the rotation indicated this, then it was acceptable for the preceptor completing the ITER to e-mail or phone the resident to inform the resident that he/she “Passed” the rotation. However, if there was any concern during the rotation, if the resident was going to “Fail” the rotation or if the resident was going to have to repeat the rotation (e.g. insufficient days on the rotation), then a face-to-face evaluation with the preceptor would be necessary.

At the end of the rotation, the resident evaluates the rotation as well as the preceptor(s) that he/she worked with. The rotation and preceptor evaluations are also provided and submitted electronically. They are returned to the office of the Program Director and are used for ongoing program refinement. The preceptor evaluations are sent to the Department Head for review. The provided information is treated in such a way so as to ensure confidentiality.

### **Six Month Evaluations (Fireside Chat)**

Residents will meet with the Program Director every six months to review their progress as well as to discuss the resident's research projects, career planning (fellowships, employment), resident concerns (internal and external to the residency program) and any other issues/concerns that the resident may have.

### **American College of Radiology Exam**

The American College of Radiology annual residents' examination is in January each year. This is a knowledge-based multiple-choice examination providing feedback to residents in areas not readily assessed during day-to-day interactions with staff. The College provides a percentile ranking for each section as well as an overall rank compared to residents at the same training level in Canada. PGY2-5

### **OSCE**

OSCE exams will be given twice each year to all residents from PGY2 to PGY5 to help residents prepare for their final certification examination. There will be one CanMEDS station on each OSCE exam. These opportunities also provide means of feedback on your knowledge base development and your achievement towards reaching the stated educational goals and objectives.

### **Senior OSCE**

This is a one-day OSCE/feedback/teaching session where each PGY5 resident will be presented with 1-2 complex obstetrical ultrasound cases and will be asked to interpret the images for the perinatologist and then present the results to and counsel a mock patient. The interaction with the mock patient is observed by the perinatologist and both the perinatologist and the mock patient give feedback on communication to the resident immediately following the counselling session. The perinatologist also gives feedback to the resident on the overall interpretation/presentation of the case. This is followed by a group teaching session with the PGY5 residents.

### **CanMEDS OSCE**

The stations often involve mock patients (i.e. some of the PGY5 residents) and simulations. The PGY5 residents are involved in organizing and supervising each station of the exam. At the end of each station, the PGY5 resident provides individualized feedback to the resident. After the exam has been completed, the PGY5 residents review all stations with the resident group to close the learning loop.

### **Resident Rounds**

A written evaluation of Resident Noon Rounds will be completed by his/her co-residents and preceptor several times each month. His/her co-residents and faculty will also assess each Resident Grand Rounds with a written evaluation.

### **Multisource Feedback (360° Evaluation)**

- a) A multisource feedback system (360° evaluation) occurs from multiple sources and depending on the rotation, this may occur 1-3 times/rotation. There are several components of the 360° evaluation which includes:
  - b) *Physician Achievement Review (PAR)*
    - a. SELF: Each resident will evaluate themselves annually using an evaluation on one45 every 1-2 years and to compare their self-evaluation with the results from their peers.
    - b. PEERS: Each resident is evaluated annually by all of his/her peers using an anonymous evaluation on one45.
  - c) *Multi-source Feedback*
    - a. PEERS: Each resident will be evaluated by his/her peers after presenting Noon Case Rounds (evaluation every 1-2 months) and Resident Grand Rounds (annually) using an anonymous evaluations addressing the CanMEDS competencies.
    - b. SELF: Using the same one45 evaluation (i.e. the PAR questionnaire), each resident is asked to complete this evaluation every 1-2 years and to compare their self-evaluation with the results from their peers.
    - c. TECHNICIANS/NURSES: Technicians and nurses who see a resident on a more regular basis during a rotation (e.g. ultrasound, angio/interventional, mammography, x-ray technicians/nurses) are to complete an evaluation addressing the CanMEDS competencies for the resident at the end of their rotation. CT technicians are asked to complete an evaluation of the resident after the resident completes an in-service.
    - d. MEDICAL STUDENTS: After each teaching session at the University of Calgary Medical School, the medical students are required to complete an evaluation on the resident who teaches that day.
    - e. ELECTIVE STUDENTS: Each elective student who comes through the department are required to complete an anonymous evaluation form addressing the CanMEDS competencies (i.e. 1-3 different residents should be evaluated during a 2 week elective block).

### **Chart Review**

In radiology, a “chart review” is considered the equivalent of dictated reports. As a junior resident, at least once during a rotation, or whenever there is a clear deficiency, discrepancy and/or error in the resident’s report, the preceptor will review the resident’s dictated report(s) with the resident face-to-face and/or with written feedback. Performance is recorded on the ITER evaluation.

### **CBD COHORTS**

Please see CBD section above.

**GRADUATED RESPONSIBILITIES IN DIAGNOSTIC RADIOLOGY POLICY**

**Transition to Call (PGY2)**

- *The evaluation of these increasing skills normally occurs as the resident transitions into on-call responsibilities halfway through the PGY2 year*
- *These requirements and responsibility targets will be reviewed in the context of evaluations from the 6 core radiology rotations with particular emphasis on direct feedback from staff that have worked with the resident. These components are used to help the RPC subcommittee determine the appropriate transitioning to On-Call responsibilities in Diagnostic Radiology*

Requirements

- A. Successful completion of 11 mandatory clinical blocks during the PGY1 year and the Transition to Radiology block
- B. Successful completion of the 6 core radiology rotations as outlined by the Residency Program Committee
  1. Body CT
  2. Neuro CT
  3. ER
  4. Ultrasound
  5. GI/GU
  6. Thorax
- C. Medical Expert
  1. Satisfactory performance on the summative End of Rotation OSCEs
  2. Satisfactory performance on the PGY2 National Call OSCE and/or PGY2 Emergency Radiology On-Call Simulation Modules
  3. Completion of PGY2 “buddy call” overnight and weekend day shifts with increasing responsibility
    - i) Satisfactory On Call ITERS from Body and Neuro staff reviews during buddy shifts
  4. Have developed a systematic approach to reviewing an imaging study (CT, X-ray, MRI, ultrasound), presenting the case to the faculty preceptor, verbally communicating the salient findings to the referring clinician
  5. Able to identify critical findings and provide an appropriate differential diagnosis when appropriate in the majority of common Emergency Radiology imaging indications (i.e. Trauma, stroke, appendicitis, cholecystitis, aortic dissection, renal colic, pulmonary embolism, infection)
- D. Communicator
  1. Able to prepare a clear and concise radiological report for common Emergency Radiology indications (i.e. Trauma, stroke, appendicitis, cholecystitis, aortic dissection, renal colic, pulmonary embolism, infection) including relevant positive and negative findings
- E. Collaborator
  1. Able to elicit appropriate clinical information from referring physicians when necessary
- F. Leader
  1. Able to appropriately allocate limited resources available after hours to achieve cost appropriate optimal patient care

- G. Health Advocate
1. Able to identify requests for inappropriate or potentially harmful tests and suggest alternative options if necessary
  2. Understand the fundamental principles of radiation protection (for him/herself, technologists and patients) and the fundamental principles of ALARA
  3. Understand CT contrast reactions and how they are managed
- H. Scholar
1. Demonstrates a commitment to learning through completion of recommended or assigned reading supplemented by learning around cases seen on call and on daily rotations
- I. Professional
1. Demonstrates high personal standards of behavior and ethical practice at all times to represent the Department of Radiology while providing on call services
  2. Demonstrates an awareness of his/her limitations and contacts staff when appropriate for guidance

### Transition from Junior Resident to Senior Resident (Independent Call PGY4)

- The evaluation of these increasing skills normally occurs as the resident transitions into independent on-call responsibilities beginning in PGY4
- These requirements and responsibility targets will be reviewed in the context of the evaluations from previous radiology rotations with particular emphasis on direct feedback from staff that have worked with the resident
- Additionally, performance on in-house or national OSCE examinations, ACR exam and 360<sup>0</sup> feedback from resident colleagues, staff, technologists, nurses and other allied health practitioners is used to help the RPC subcommittee determine the appropriate transitioning from Junior to Senior Diagnostic Radiology Resident

#### Requirements

- A. Successful completion of the following radiology rotations as outlined by the Residency Program Committee
1. 2 blocks Body CT
  2. 2 blocks Neuro CT
  3. 2 blocks ER
  4. 2 blocks Ultrasound (1 Maternal Fetal Medicine)
  5. 1 block GI/GU
  6. 2 blocks Thorax
  7. 2 blocks MSK
- B. Medical Expert
1. Show competence in manual and procedural skills as well as diagnostic and interpretive skills.
  2. Have a detailed systematic approach to reviewing an imaging study (CT, X-ray, MRI, ultrasound), presenting the case to the faculty preceptor, verbally communicating the salient findings to the referring clinician
  3. Able to identify critical findings and provide an appropriate differential diagnosis when appropriate in the majority of Emergency Radiology imaging indications
  4. Able to identify most incidental findings and recommend appropriate follow up when necessary based on reference guidelines

- C. Communicator
  - 1. Demonstrate a consistent and clear systematic approach to reporting
- D. Collaborator
  - 1. Consistently identifies and relays urgent findings to the referring physician in a timely manner and provides appropriate documentation in the examination report
  - 2. Demonstrate competence in effective consultation, conduct of clinic-radiological conferences, and the ability to present scholarly material and lead case discussions
- E. Leader
  - 1. Able to appropriately allocate limited resources to achieve cost appropriate optimal patient care
- F. Health Advocate
  - 1. Demonstrate the ability to manage the patient independently during a procedure, in close association with a specialist or other physician who has referred the patient. The radiologist should know when discontinuing a procedure, or referring the patient to another physician serves the patient's best interests
  - 2. Understand the acceptable and expected results of investigations and/or interventional therapy as well as unacceptable and unexpected results. This must include knowledge of and ability to manage radiological complications effectively
  - 3. Understand the appropriate follow-up care of patients who have received investigations and/or interventional therapy
- G. Scholar
  - 1. Understand the fundamentals of quality assurance in radiology
  - 2. Actively contribute to continuous improvement of health care quality and safety and adopt strategies that promote patient safety and address human and system factors
  - 3. Understand the fundamentals of epidemiology, biostatistics, and decision analysis
- H. Professional
  - 1. Demonstrates high personal standards of behavior and ethical practice at all times to represent the Department of Radiology while providing on call services
  - 2. Demonstrates an awareness of his/her limitations and contacts staff when appropriate for guidance

## **REMEDIATION, PROBATION AND DISMISSAL POLICY**

The Diagnostic Radiology Residency Program adheres to the University of Calgary PGME “Resident Assessment Policy” that address the evaluation, promotion, remediation, probation and dismissal.

For the CBD cohorts, the PD and the RPC sub-committee will take into consideration the recommendations of the Competence Committee for promotion, remediation, probation, and dismissal, again as per the Calgary PGME “Resident Assessment Policy”.

The Calgary PGME “Resident Assessment Policy” is available at:

<https://cumming.ucalgary.ca/sites/default/files/teams/6/policies/resident-remediation-probation-dismissal-pgme-oct21-v1.pdf>

## **SUSPENSION OR TERMINATION OF A RESIDENT**

Action may be undertaken by the Program Director/Department Head after due consideration and investigation of the complaint.

1. A suspension of privileges may be instituted by the Program Director/Department Head. In an emergency, the senior physician present, the Executive Director of an affiliated teaching hospital (or delegate), may suspend privileges pending an investigation by the Program Director/Department Head.
2. Any contract may be terminated at the discretion of the affiliated hospital, Alberta Health Services and/or the University of Calgary when the terms of a contract have not been met by the resident.

## **RESIDENT APPEALS POLICY**

The Diagnostic Radiology Residency Program adheres to the University of Calgary PGME “Resident Appeals Policy” if a resident wishes to appeal an evaluation or RPC decision with respect to their promotion/remediation/dismissal, as follows:

<https://cumming.ucalgary.ca/sites/default/files/teams/6/policies/resident-appeal-policy-pgme-July2021-v2.pdf>



## **PHYSICIAN EXTENDERS IN AFFILIATED TEACHING HOSPITALS POLICY**

The Diagnostic Radiology Residency Program adheres to the College of Physicians and Surgeons of Alberta “CPSA Physician Extender Policy” as follows:

<http://cumming.ucalgary.ca/pgme/files/pgme/info-for-physician-extenders-and-pds.pdf>

However, the Diagnostic Radiology Residency Program also has program-specific guidelines for physician extenders.

### **Alberta Children’s Hospital Resident Extenders**

- The resident must have successfully completed the mandatory ACH rotation.
- The resident demonstrates strong academic performance in all rotations.
- The resident must submit a request to participate to the RPC Subcommittee.
- The RPC Subcommittee reviews each request and will approve/decline on an individual basis.
- Permission may be revoked if the resident does not remain in good standing, academic performance changes or is negatively impacted by the extenders/additional call shifts
- Extender shifts are limited to Friday night, Saturday, Sunday, Stat days.
- If a PGY5 resident is involved, extender shifts are only offered until Christmas/New Years of their PGY5 year to allow adequate time to study.
- ACH and FMC call cannot be combined. This includes senior buddy shifts with PGY2s.
- Extender shifts should not cause violation of duty hours as outlined by PARA.

### **Off-Service Resident Extenders**

All off-service requests for resident extenders will be assessed by the RPC Subcommittee on an individual basis however the same general principles outlined above would be considered as well as the overall impact, both positive and negative, to the residents training.

Note: the provision of any medical services, whether formally organized or informal, outside of the confines directly related to the residency program may be considered an extender or independent practice therefore requires permission from the Residency Program, appropriate licensing from the CPSA (or appropriate regulatory body) and CMPA coverage.

## EXPENSE POLICIES

### PGME Resident Research Travel Grant

For complete and up-to-date information please access the University of Calgary PGME Resident Research Travel Grants webpage:

<https://cumming.ucalgary.ca/pgme/faculty-and-staff/awards-and-grants/grants/resident-research-travel-grants>

#### NOTE:

All residents applying for funding to present at a national or international conference **must apply for PGME funding first**. If this application is unsuccessful, the resident may apply for travel funding from the Diagnostic Radiology Residency Program. See page 29 for details.

#### Overview of Resident Research Travel Grant:

A limited amount of funding is available to support resident conference travel to present complete and original research conducted at the University of Calgary. Medical Staff Trust Funds and the PGME operational grant from Alberta Health are the funding sources. Continued funding is contingent on these funding sources being available on an annual basis. While these Resident Travel Grants fund research studies only, this does not mean that other forms of scholarly activity are less important; it simply means that they do not fit the requirements of this funding umbrella.

To qualify for this funding, the resident **must**:

- Be first author on the Abstract and have conducted the research
- Present new and original research (not presented before)
- Be attending a National or International level conference (not a local symposium, research day, retreat, or joint UofC/UofA provincial meeting)
- Submit a statement outlining the contribution of each author to the research and the number of full-time months spent on the research
- Must meet all additional requirements outlined in the Resident Research Travel Grant Application

Travel Grant applications are reviewed on a quarterly basis and must be received by the deadline to be eligible for review. Application deadlines are listed below.

Conference Dates	Application Deadline	Award Date
<b>April 1 – June 30</b>	March 15	By March 31
<b>July 1 – September 30</b>	June 15	By June 30
<b>October 1 – December 31</b>	September 15	By September 30
<b>January 1 – March 31</b>	December 15	By December 31

**Note:** The provision of medical services within the residency program limits the maximum number of Residents away at meetings at any one time.

## Radiology Residency Travel Funding Policy

### ELIGIBLE TRAVEL

1. **Presentation at meetings** - Each resident may receive travel support to attend major radiological meetings during their training when presenting a scientific paper or exhibit as the first author. Proof of acceptance of the paper or exhibit must be provided prior to approval of travel. Similar presentations at different meetings will only be funded once. **Approval must be obtained at least 2 months in advance** of the meeting. Please complete the *Resident Physician Absence or Leave Request form* found in Radiology Education drive. Residents will be funded to attend a maximum of 4 conferences during their residency at which they are presenting a paper or poster. Up to \$1500 max.
2. **Preparation for Call Course** - Each PGY2 resident **may be** funded to attend the University of Ottawa Call course. Up to maximum \$1500.
3. **Funding for PGY-5 Review Course:** Each resident may choose to attend a review course in their PGY5 year. Funds are available to help cover expenses up to \$1500.00.
4. **Funding for AIRP:** The resident's tuition (currently \$1800.00 USD) will be paid. If funds are available, the resident's flight, accommodation and/or meals will also be covered up to \$3000.00 CDN.

### Travel Expense Reimbursement Process

- **Original itemized** receipts must be submitted to the Residency Program Office 2 weeks after completion of travel
- No credit card statements or receipts will be accepted
- For foreign currency expenses - submit your credit card statement and original itemized receipts for reimbursement at daily exchange rate
- Do **NOT** use Expedia or Booking.com for flight and hotels. They do not provide itemized receipts and UofC will not reimburse non-itemized receipts
- **MAXIMUM FUNDING is \$1,500.00** per Conference / Course and is subject to availability of funds
- Original itemized receipts are required for;
  - Conference Registration
  - Conference Itinerary
  - Airfare
  - Hotel
  - Meals
  - Ground Transportation
- <http://cumming.ucalgary.ca/pgme/current-trainees/expense-reimbursement>
- <https://cumming.ucalgary.ca/sites/default/files/teams/6/finance/travel-expense-reimbursement-handbook-pgme-mar2019.pdf>

### Program & MEO Expenses

- For program expenses incurred for VP, journal club, BBQs, Christmas, etc.
  - **Original, itemized** receipts must be submitted to the Program Office 2 weeks after the event
  - no credit card statements will be accepted
  - attendance list of attendees **must** be attached
- **CMPA** – At the end of each month MEO will automatically pay a portion of the CMPA reimbursement to anyone who has been active within the month
- **ACLS/BLS** – submit through iExpense after July 1st
  - <https://insite.albertahealthservices.ca/fin/Page11122.aspx>
  - Note – Life support courses (ACLS/BLS) are required for PGY1 and are not necessary for PGY2-5

## **RESIDENT SAFETY POLICY**

The University of Calgary Diagnostic Radiology Residency Program is committed to the safety of its residents and staff. The Residency Program strives to be proactive in providing a safe learning environment for all residents and to support a culture of safety for all members of the team.

The Residency Program has an “open door” policy whereby residents are encouraged to identify any concerns about safety at any time to the Residency Program Director, the Chief Resident(s), any member of the Competence Committee, Residency Training Committee, the Mentors on the Mentorship Teams or the faculty. All concerns brought forth are handled in a confidential manner.

It should be recognized that resident safety is a shared responsibility amongst the resident, the Residency Program, the Post Graduate Medical Education office of the Faculty of Medicine and Alberta Health Services.

The Residency Program adheres to the University of Calgary PGME “Resident Safety Policy,” the Professional Association of Resident Physicians of Alberta (PARA) Contract Articles regarding resident safety, as well as the Alberta Health Services “Workplace Health and Safety Management System (WHSMS),” “Workplace Violence Policy” and “Safe Disclosure/Whistleblower Policy” as follows:

<http://cumming.ucalgary.ca/pgme/current-trainees/residency-training-policies>

[The Professional Association of Resident Physicians of Alberta | Professional Association of Resident Physicians of Alberta \(para-ab.ca\)](#)

**Alberta Health Services – insite – Human Resources – Working Safely (WHS)**

<https://insite.albertahealthservices.ca/hr/Page947.aspx>

However, as there are multiple facets to resident safety, the Diagnostic Radiology Residency Program and the Department of Diagnostic Imaging also have *program-specific* guidelines for the safety of residents as follows:

### **ON-CALL**

- The Faculty strongly support resident safety, as well as patient safety, by providing comprehensive in-house faculty support of residents as outlined in the “On Call” section of the Residency Training Manual.
- The Residency Program adheres to all Articles in the Professional Association of Resident Physicians of Alberta (PARA) Contract regarding resident safety while on-call. For example, the residents have access to a clean and safe call room that is in close proximity to their primary workstation while on-call.
- Physical safety of residents is critical. Therefore, residents are informed that he/she may access the PARA Taxi Reimbursement Program to enable the resident to travel home safely after being on call.
- The residents are made aware that they should contact the Security Department at each Hospital Site to escort them to the parking lot or other mode of transportation before and/or after a call shift or regular day shift in the evening and/or early morning or at any time of the day.

### **RADIATION SAFETY**

- The resident is required to adhere to the DI Department radiation safety protocols.
- The resident is required to regularly wear radiation dosimeter badges and appropriate attire (e.g. lead apron or lead vest/skirt, thyroid shield, protective eyewear), especially on rotations that involve fluoroscopy (e.g. image-guided fluoroscopic procedures such as GI/GU and Interventional Radiology rotations) and radioactive agents (e.g. Nuclear Medicine rotation). The DI Department provides the radiation dosimeter badges and apparel to all residents. The radiation dosimeter badges are monitored and replaced regularly by the DI Department.
- Residents attend the monthly Physics Course where radiation safety is addressed.
- Residents are also taught about radiation safety during their CT, Nuclear Medicine, x-ray, mammography rotations as well as educational sessions throughout residency.

### **MR SAFETY**

- The resident is required to adhere to the DI Department MR safety protocols.
- Residents are taught about MR safety during the MR rotations, Physics Course and educational sessions throughout residency.

### **PREGNANCY**

- A Diagnostic Radiology resident who is pregnant may encounter specific risks to the expectant mother and fetus. Therefore, she may inform the Program Director to assist with modifying her schedule to minimize radiation exposure on certain rotations and/or environments while pregnant.
- The Residency Program adheres to all Articles in the Professional Association of Resident Physicians of Alberta (PARA) Contract during pregnancy (e.g. on-call duties).

### **PSYCHOLOGICAL SAFETY**

- The Residency Program has a “zero tolerance” policy for intimidation, harassment, and discrimination.
- The Residency Program also provides program-specific resident wellness workshops, resources, and activities to promote psychological safety. These program-specific measures are in addition to the more global resources available through the PGME, Alberta Medical Association Physician and Family Support Program and PARA initiatives that are discussed annually with the residents by the Program Director and outlined in the Residency Training Manual and in the PGME Policy on Resident Safety.

### **PROFESSIONAL SAFETY**

- Professional safety of residents is also very important
- The Residency Program provides program-specific initiatives to encourage Professional Safety through an interactive Conflict and Communications workshop that has been tailored for our residents and a session on “Gender and Cultural Issues in Radiology” that is presented by one of the faculty.

## **HEPATITIS B VIRUS AND HIV INFECTION POLICY**

The Diagnostic Radiology Residency Program adheres to the Alberta Health Services “Workplace Health and Safety Services” guidelines as follows:

<https://insite.albertahealthservices.ca/hr/Page947.aspx>

However, the Diagnostic Radiology Residency Program also has program-specific guidelines as follows:

### **Hepatitis B Virus**

- As residents are expected to participate in invasive procedures during their PGY1 year as well as undergo three four-week periods of mandatory interventional training, all residents are strongly advised to complete immunization as soon as possible if they have not already done so.
- Any resident who is HBV-infected, or recently found positive, has to inform the Department and Program Director immediately.
- When acute HBV infection is recognized, the resident must refrain from invasive patient contact until the resident is no longer HBeAg-positive.

### **HIV**

- As invasive patient contact is inevitable during residency training; residents who have acquired HIV infection must inform the Department and Program Director immediately so that appropriate measures can be taken to ensure safety for patients and staff.
- Care should be taken when handling blood contaminated instruments. The following should be observed:
  1. Use the minimum number of needles required (e.g. use only a single long #25 needle for freezing rather than using a short #25 gauge needle and a longer #22 gauge needle).
  2. Never recap a used needle.
  3. Ensure that all used needles are placed in a secure and safe place on the tray away from other instruments.
  4. Discard needle or scalpel into sharps bucket when they are no longer required.
  5. Communicate clearly to people around you when “sharps” are being used or moved so that they do not step into you.
  6. Make sure that you are protected from exposure to your eyes and mouth by wearing glasses and a mask or a face shield when making an arterial puncture.
  7. Use disposable gloves.
  8. Use Luer-locking plastic syringes when handling contaminated fluid to avoid spraying fluid around the room.
- The above guidelines also apply to the safe handling of “sharps”, in general.

## **RESIDENT WELLNESS POLICY**

Resident wellness is of utmost concern for all Diagnostic Radiology residents at the University of Calgary. Wellness Director – Dr. Denise Chan [Denise.Chan@ahs.ca](mailto:Denise.Chan@ahs.ca)

Within the department, residents can approach the Program Director, Assistant Program Director, Department Director, their faculty and/or resident mentors on the Mentorship Teams, their preceptors in the various rotations, or the Chief Resident(s) for help. In recognition of the different mix of personalities, residents may choose to approach any faculty member they feel comfortable with for counseling.

External resources are also available to residents for assistance in dealing with stress;

### **1. AMA Physician and Family Support Program (PFSP)**

- <https://www.albertadoctors.org/services/pfsp>
- Phone: **1-877-767-4637** - accessible 24 hours a day
- Speak directly with a physician if you are in need of confidential advice, support, or help with personal or professional problems.
- When you call you will speak with an intake professional who will take your information, which will be anonymized and kept confidential. You will then be contacted by the on-call physician to discuss your concerns. This can be used as a one-time phone call interaction, or lead to more prolonged support from an external provider, as appropriate.

### **2. U of C Resident Affairs and Physician Wellness (PGME)**

- <https://cumming.ucalgary.ca/pgme/wellness/residents> Contact the PGME Office to discuss questions and concerns in a confidential, objective environment. Support and appropriate referral will be individualized.
- [residentwellness@ucalgary.ca](mailto:residentwellness@ucalgary.ca)

### **3. U of C Counselling Centre, U of C main campus**

- <https://www.ucalgary.ca/wellnesscentre/services/mental-health-services>
- Room 370 MacEwan Student Centre, Phone: **403-210-WELL**

### **4. Alberta Health Services Employee Assistance Program via Workhealthlife**

- <https://www.workhealthlife.com>
- Phone: **1-866-833-7690** accessible 24 hours a day
- Contracted external provider of confidential support. Access to online, phone, or in-person counselling, and information on various topics related to mental health and well-being (articles, media, forum).
- **Insite (AHS Intranet):** *Employee Tools > Employee Health, Wellness, and Safety > Employee and Family Assistance Program*

### **5. Calgary Distress Center**

- <http://distresscentre.com>
- Phone: **403-266- HELP (4357)**

### **6. Suicide Prevention Hotline**

- Phone: **1-800-SUICIDE (784-2433)** – accessible 24 hours a day
- Call if you, or someone you care about is feeling hopeless or having thoughts of suicide. They provide confidential, non-judgmental support to anyone feeling suicidal, thinking about suicide, who is worried about someone else, or who has lost someone to suicide.

**7. Sexual Violence Support Advocate**

- Phone: 403-220-2208
- Email: svsa@ucalgary.ca
- ucalgary.ca/sexualviolencesupport
- Carla Bertsch is the university’s sexual violence support advocate (SVSA). The SVSA provides information and confidential support to anyone affected by sexual violence

**8. Residency Program Ombudsperson**

- The Ombudsperson for the Diagnostic Radiology Residency Program is Dr. Sandra Dumanski a Nephrologist at the Foothills Medical Centre. The residents are able to contact Dr. Dumanski at any time to discuss any issues with respect to the residency program.
- Dr. Sandra Dumanski  
[sandra.dumanski@ahs.ca](mailto:sandra.dumanski@ahs.ca)  
 P: 403-944-8035 | F: 403-944-2876

**MENTORSHIP TEAMS 2022-2023**

**Diagnostic Radiology - Mentorship Teams - 2022-2023**

TEAM A	TEAM B	TEAM C	TEAM D	TEAM E	
Dave McDougall	Winston Ying	Alex Medellin	Jason Wong	Roy Park	
Eric Herget	Mohammed Hatem	Mike Bristow	Matthew Li	Mark Hudon	
Zach Guenther	Carla Wallace	David Burrowes	Rob Sevick	Ryan Phillipson	
Clare Romano	Deepak Bhayana	Kathleen Jacobs	Andrew Lee	Jason Wong	
Andrew Warkentin	Tracy Elliot	Dorian Nobbee	Summit Sawhney	Alina Makoyeva	
Tara Lawrimore	Amar Udare	Zarina Assis	Stephanie Nguyen	Manish Joshi	
			Vince Dinculescu		

<b>PGY1</b>	Burnet, Scott	Cheng, Alex	Hong Yejun	Pillay Shaylin	Scott, Sarah	
<b>PGY2</b>	Khusraw Jamil	Meaghan Reid	Derek Sin	Nicolas Gibson	Abdul Sidiqi	Tim Luo
<b>PGY3</b>	Alice Wang	George Mitwiri Jr	Bradley Bergin	Laura Neuberger		
<b>PGY4</b>	Andrew Kiraly	Chaitanya Shah	Giovanny CasaDiego	Jacky Chow	C. Blomquist	Victoria Peterson
<b>PGY5</b>	Parthiv Amin	Ryan Choo	Fangshi Li	Hans Lafford	Lindsay Burrowes	Jonathan Dykeman



## ***PROFESSIONAL STANDARDS POLICY***

Both faculty members and residents are required to behave in a professional manner at all times.

The Diagnostic Radiology Residency Program adheres to the University of Calgary, Faculty of Medicine “Professional Standards for Faculty Members and Learners in the Faculty of Medicine” as follows:

<http://cumming.ucalgary.ca/equity/>

Additional resources include:

- **The Physician and Family Support Program (PFSP)**  
Phone: 1-877-767-4637
- **University of Calgary Ombudsperson**  
Phone: 403-220-6420  
E-mail: [ombuds@ucalgary.ca](mailto:ombuds@ucalgary.ca)

## ***AUDIO AND VISUAL RECORDING POLICY***

Audio and/or visual recording of academic half-day presentations, rounds, view box read out sessions or other departmental teaching/presentations is not permitted without the expressed consent of the presenter. If consent is obtained recordings may only be utilized or distributed in the manner to which the presenter gives permission to do so. Consent obtained does not imply permission to record or distribute any other past or future presentations without obtaining specific consent for each instance.

# **PART IV - ACADEMICS OF RADIOLOGY RESIDENCY**

## ***ETIQUETTE FOR ROUNDS***

The resident is required to abide by the guidelines for etiquette at rounds, lectures and daily on rotations as follows:

### **ATTEND**

Speakers spend time to prepare for the rounds and lectures. Speakers will not be encouraged to return or improve their teaching material if attendance is low.

### **BE PUNCTUAL**

Residents have priority to attend department teaching rounds and lectures. It is the staff radiologist's responsibility to cover during this period. There is no reason for being late. Five minutes late each day will lead to a cumulative loss of over 12 hours of rounds per year.

### **CONTRIBUTE**

Collect cases during your rotation. For General Open rounds, general cases (especially plain films), Aunt Minnies, artifacts are excellent teaching cases. Help others learn as they helped you. Each resident will be assigned to prepare for organ systems-oriented rounds on a rotary basis on Mondays and Tuesdays.

### **QUALITY**

Research your cases. Faculty can help provide valuable information based on their knowledge and experience, but the resident should still confirm the diagnosis through collaboration with pathology reports or clinical outcome before showing their cases, unless the imaging findings are pathognomonic. Seeing proven cases is powerful re-enforcement in the learning process.

### **READ AHEAD**

Information on clinical features, pathogenesis, classification schemes and staging are of interest to other residents and faculty. A concerted effort equates to more exposure and more frequent review than anyone can achieve on their own. Do literature searches to obtain up-to-date reviews and information.

### **PATIENT CONFIDENTIALITY**

Cases presented at any teaching session or rounds must protect patient privacy and confidentiality at all times. All cases must not have any identification information. In the Alberta Health Services (AHS) environment, while collecting, using, and disclosing information, all residents must be in compliance with the *Freedom of Information and Protection of Privacy Act and the Health Information Act*. Please refer to the following AHS site for the most current guidelines: <http://www.albertahealthservices.ca/121.asp>

### **COPYRIGHTS**

Any cases, diagrams, tables, etc. from a textbook, journal article or download from the internet presented during any teaching session or rounds must be presented in a way that is compliant with the University of Calgary Copyright Policy. This includes acknowledging all resources used with each image, diagram, table, etc. Please refer to the U of Calgary Copyright Policy link (<http://library.ucalgary.ca/copyright>) for the most current policies.

**ROUNDS****NOON ROUNDS**

Noon rounds are held daily each week, with the exception of Thursdays, at the R.D. Johns Lecture Theatre. These rounds are video conferenced to ACH, PLC, RGH, Cambrian Heights, and RRDTTC, with the exception of QI/QA rounds.

The purpose of these rounds is:

- To train residents in the skills of film observation, organization, and interpretation of data.
- To train residents to develop a list of concise and relevant differential diagnoses.
- To train residents in case presentation techniques and to be an effective consultant.
- To provide a forum for sharing knowledge and experience for both staff and residents.
- To enhance experience for both staff and residents through exposure to interesting pathologies that others have come across in their daily work.

The PGY2 residents are expected to participate fully in these sessions.

These are educational rounds and not working rounds to solve problems on specific cases. The quality of the rounds can be improved if material presented is clinically or pathologically confirmed with a complete imaging workup.

**Types of Noon Rounds:**1. Staff Rounds

Staff will contribute and lead cases on Wednesdays and Fridays each week, typically organized by topic or system. Participation is essential to make these sessions effective. Short cases, pathognomonic radiographic findings (“must-gets” or “Aunt Minnie’s” in exams), film artifacts or pointers to techniques are especially well suited to this type of rounds.

2. Fellow Rounds

Fellows will contribute and lead cases when available, typically organized by topic, system or modality. Short cases, pathognomonic radiographic findings (“must-gets” in exams), film artifacts or pointers to techniques are especially well suited to this type of rounds.

3. Case Rounds

Interesting cases collected by individual residents during subspecialty rotations can be organized according to a specific theme for presentation at these rounds as a mini review of a certain topic occurring on Mondays. Cases and format should be reviewed beforehand with staff radiologist preceptor for that session.

4. Peer Rounds - Quality Improvement

Residents and staff will contribute cases that will be assembled in an anonymous fashion. These rounds will be led by a resident, each of which will each present at least once during residency. The QI/QA Rounds Coordinator will be the preceptor for these rounds. Film artifacts, pointers to techniques and morbidity and mortality cases are especially well suited to this type of rounds. Not to be presented outside of Radiology to protect patient confidentiality.

5. Resident Grand Rounds

Each resident will present Grand Rounds annually on the first or second Tuesday noon hour from September to June.

## **MORNING ROUNDS**

Morning rounds are held on 2 days of each week, every Monday and every third Wednesday of each month.

The purpose of these rounds is:

- To train residents in the skills of film observation, organization, and interpretation of data.
- To train residents to develop a list of concise and relevant differential diagnoses.
- To train residents in case presentation techniques and to be an effective consultant.
- To provide a forum for sharing knowledge and experience for both staff and residents.
- To enhance experience for both staff and residents through exposure to interesting pathologies that others have come across in their daily work.
- To foster collaboration with other specialties (i.e. obstetrics and gynecology).

### **Types of Morning Rounds**

1. Mayfair Monday Morning General Radiology Rounds  
Mayfair Diagnostic Staff will contribute and lead cases every Monday morning (0700-0800h), typically organized by topic or system. Participation is essential to make these sessions effective. Short cases, pathognomonic radiographic findings (must-gets or “Aunt Minnie’s” in exams), film artifacts or pointers to techniques are especially well suited to this type of rounds. These rounds are located in the R.D. Johns Lecture Theatre. Attendance is taken.
2. Wednesday Morning Obstetrical Ultrasound Rounds  
Every third Wednesday of each month (0730-0830), there will be Obstetrical Ultrasound Rounds organized and lead by EFW perinatologists from the Department of Obstetrics and Gynecology. These rounds will typically be organized by a systems-based approach. These rounds are located in the Cambrian Wellness Centre, 1000 Veterans Way NW. Attendance is taken.

## **MULTIDISCIPLINARY ROUNDS**

Every day of the week, there are multidisciplinary rounds that are either mandatory or are strongly encouraged for the resident to attend. On certain rotations, or if time permits on other rotations, the resident may attend these rounds which are led by the subspecialty staff radiologist and/or subspecialty clinician or surgeon. Residents, fellows, medical students and surgical and clinical faculty from all of the disciplines involved also attend these rounds.

The purpose of these rounds is:

- To train residents in the skills of film observation, organization, and interpretation of data.
- To train residents to develop a list of concise and relevant differential diagnoses.
- To train residents in case presentation techniques and to be an effective consultant.
- To provide a forum for sharing knowledge and experience for both staff and residents.
- To enhance experience for both staff and residents through exposure to interesting pathologies that others have come across in their daily work.
- To practice collaborating and communicating with other specialties and to provide imaging findings that will aid in patient management.
- To understand the importance of imaging to other specialties.

## **Examples of Multidisciplinary Rounds**

### **BODY IMAGING (Body MR, Body CT, Ultrasound, Interventional Radiology rotations)**

#### 1. Hepatobiliary Rounds

Radiologists (interventional, body MRI and ultrasound radiologists), hepatobiliary surgeons, hepatologists, oncologists, and residents/fellows from these disciplines discuss cases from across Calgary as well as patients referred from Southern Alberta. The radiographic findings on MRI, CT and/or ultrasound are reviewed and a management plan is discussed. Some of the cases are morbidity and mortality type cases for educational purposes. Residents on Body MRI and Interventional Radiology rotations are required to attend. These rounds are located in the R.D. Johns Lecture Theatre on Tuesday mornings from 0700-0800h. Rounds currently available on Zoom \*

### **THORACIC/BREAST IMAGING (Mammography, Chest rotations)**

#### 1. Breast Rounds

Radiologists with subspecialty training in breast imaging, breast surgeons, oncologists, and residents/fellows from these disciplines discuss cases from across Calgary as well as patients referred from Southern Alberta. The radiographic findings on mammography, ultrasound and/or MRI are reviewed and a management plan is discussed. Some of the cases are morbidity and mortality type cases for educational purposes. Residents on Mammography rotations are strongly encouraged to attend. These rounds are located in the R.D. Johns Lecture Theatre every second Wednesday afternoon from 1630-1730. Rounds currently available on Zoom\*

#### • Chest Rounds

Radiologists with subspecialty training in chest imaging, respirologists, thoracic surgeons, and residents/fellows from these disciplines discuss cases from across Calgary as well as patients referred from Southern Alberta. The radiographic findings on x-rays and CT, are reviewed and a management plan is discussed. Some of the cases are morbidity and mortality type cases for educational purposes. Residents on Chest rotations are strongly encouraged to attend. These rounds are located in the R.D. Johns Lecture Theatre on Friday mornings from 0700-0800. Rounds currently available on Zoom\*

Interstitial Lung Disease (ILD) Rounds – q every 2 weeks, McCaig Tower Room 7580 or zoom, Wednesdays 0800-0900. Organized by Dr. Kerri Johannson & Dr. Fell (Resp/GIM). Residents circulating through their

Cardiothoracic radiology blocks attend these rounds with the radiology staff. Rounds currently on Zoom

### **MUSCULOSKELETAL IMAGING** (Musculoskeletal rotations)

#### 1. Sarcoma Rounds

Radiologists with subspecialty training in musculoskeletal imaging, oncologists, orthopedic and general surgeons, and residents/fellows from these disciplines discuss cases from across Calgary as well as patients referred from Southern Alberta. The radiographic findings on x-rays, CT, MRI, bone scans are reviewed and a management plan is discussed. Some of the cases are morbidity and mortality type cases for educational purposes. Residents on MSK and MSK MRI rotations are strongly encouraged to attend. These rounds are located in the Tom Baker Cancer Centre every second Monday afternoon from 1615-1715. Rounds currently available on Zoom\*

### **NEONATAL IMAGING** (Ultrasound/Maternal Fetal Medicine rotations)

#### 1. Neonatology (NICU) Rounds

Radiologists with subspecialty training in neonatal imaging, neonatologists, and residents/fellows from these disciplines gather to discuss complicated cases from the Neonatal Intensive Care Unit at the Foothills Medical Centre. The radiographic findings on x-rays, ultrasounds and occasionally CT, are reviewed and a management plan is discussed. Some of the cases are morbidity and mortality type cases for educational purposes. Residents on the General Ultrasound rotation are strongly encouraged to attend. These rounds are located in the Ultrasound Department Radiology Reading Room on Tuesday mornings from 0800-0900. Rounds currently available on Zoom\*

### **NEURORADIOLOGY IMAGING** (Neuro CT, Neuro MR Rotations)

There are approximately 15 Neuroradiology associated rounds involving neuroradiologists, neurologists, stroke clinicians, neurosurgeons, and oncologists throughout the week/year at the Foothills Medical Centre. While radiology residents are permitted to attend any of these rounds, there are a few select rounds that are highly recommended to radiology residents:

#### 1. Stroke Rounds

These rounds are located in the R.D. Johns Lecture Theatre on Thursday mornings from 0730-0830.

#### 2. Clinical Neurosciences Grand Rounds

These rounds are located in the Coombs Lecture Theatre on Friday mornings from 0800-0900.

#### 3. Head and Neck Imaging Rounds

These rounds are located in the R.D. Johns Lecture Theatre quarterly on Thursdays from 1715-1900.

### ***PGY1 INTRODUCTORY LECTURES***

At the end of the PGY1 year, when the PGY1 residents have the Transition to Radiology block (block 13), the PGY1 residents have a 2-week series of noon lectures specifically designed to prepare them for the start of their PGY2 year as a Radiology resident at the Foothills Medical Centre.

There are 8 lectures to be held Monday-Friday, with the exception of Thursdays.

The lecture topics are as follows:

1. Communication and Reporting Skills
2. Musculoskeletal Radiology
3. Body Imaging—Introduction, Approach, Protocolling
4. GU Examinations
5. Gastrointestinal Imaging—Barium studies
6. Ultrasonography
7. Neuroradiology—Introduction and Protocolling
8. Chest

### **PGY1 ULTRASOUND SCANNING SKILLS COURSE**

During block 13 an introductory ultrasound scanning skills course is held each year. The goals of this course are to familiarize the resident with the ultrasound machine and probes, basic scanning techniques and assessment of normal ultrasound anatomy. The course is organized by Roxanne Blacquiere ([Roxanne.Blacquiere@albertahealthservices.ca](mailto:Roxanne.Blacquiere@albertahealthservices.ca)) the ultrasound educational coordinator at FMC.





DIAGNOSTIC RADIOLOGY RESIDENCY PROGRAM

**Interdisciplinary Weekly Rounds & Case Rounds Schedule**  
September – June each year

Rounds remain available on Zoom. Some rounds will restart in person in the Fall of 2022.\*  
AHD & Noon rounds are in person in DJ Theatre  
Case rounds are extremely confidential and are invite only.

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
0700-0800 Mayfair GENERAL RADIOLOGY	0700-0800 HEPATOBIILIARY CASE	0730-0830 MFM/OB/US 3rd Wed of month (Cambrian)	0730-0830 STROKE CASE	0700-0800 CHEST CASE
	0800-0900 NICU CASE (US Dept) On hold	0800-0900 ILD CASE q 2 weeks (McCaig - Rm 7580)	0730-0830 FD&T CASE (Cambrian)	0800-0900 NEUROSCIENCE GR CASE (Coombs)
1200-1300 NOON ROUNDS *Residents *GR-Senior Resident 1 <sup>st</sup> Monday of month	1200-1300 NOON ROUNDS *Fellows *GR-Junior Resident 2 <sup>nd</sup> Tuesday of month *Peer Learning Last Tuesday of month	1200-1300 NOON ROUNDS *Staff	1330-1630 ACADEMIC HALF DAY	1200-1300 NOON ROUNDS *Staff
1615-1715 SARCOMA CASE q 2 weeks (TBCC)	1630-1800 BREAST CASE		1700-1900 HEAD & NECK Quarterly	

Mandatory for:	Rounds to attend:	Organized by:
ALL Residents (PGY1 to PGY5)	AHD	Program office
ALL Residents, except PGY1	Noon, Head & Neck, Mayfair, MFM/OB/US	Program office
Residents on BODY MR and IR	Hepatobiliary	Dr. Danny Ng c/o Lisa.Douglas@ahs.ca
Residents on US and MFM	NICU, FD&T (fetal diagnosis & therapy)	NICU - Dr. <a href="mailto:David.Lautner@efwrad.com">David.Lautner@efwrad.com</a> FD&T - <a href="mailto:Melissa.Saville@efwrad.com">Melissa.Saville@efwrad.com</a>
Residents on NEURO CT/MR	Stroke/ Neuroscience GR	Stroke - <a href="mailto:Kayley.Stang@ahs.ca">Kayley.Stang@ahs.ca</a> Neuroscience - <a href="mailto:Christopher.smith2@ahs.ca">Christopher.smith2@ahs.ca</a> or <a href="mailto:Quentin.Collier@ahs.ca">Quentin.Collier@ahs.ca</a>
Residents on MSK	Sarcoma	<a href="mailto:Cathy.Fedechko@ahs.ca">Cathy.Fedechko@ahs.ca</a>
Residents on CHEST or MAMMO	Chest/ Breast	Chest - Cheryl Manktelow <a href="mailto:camankte@ucalgary.ca">camankte@ucalgary.ca</a> Breast - Dr. May Lynn Quan c/o <a href="mailto:Debbi.Martens@ahs.ca">Debbi.Martens@ahs.ca</a>
Residents on CARDIOTHORACIC	ILD (must attend with radiology staff)	Dr. Charlene Fell c/o <a href="mailto:Ruby.Leachman@ahs.ca">Ruby.Leachman@ahs.ca</a>

Resident Manual  
Revised: Tuesday, April 18, 2023



**DIAGNOSTIC RADIOLOGY RESIDENCY PROGRAM**

**RADIOLOGY STAFF SCHEDULE**

**For Noon Rounds**

<b>JANUARY-JUNE</b>	<b>WEDNESDAYS</b>	<b>FRIDAYS</b>
Week 1	THORACIC (CHEST, MAMMO, CARDIAC)	THORACIC (CHEST, MAMMO, CARDIAC)
Week 2	NEURO	NEURO
Week 3	BODY (CT, US, MR)	BODY (CT, US, MR)
Week 4	IR	MSK
Week 5, as necessary	NUC MED	ANY

<b>SEPTEMBER-DEC</b>	<b>WEDNESDAYS</b>	<b>FRIDAYS</b>
Week 1	NEURO*	NEURO*
Week 2	IR*	IR*
Week 3	BODY (CT, US, MR)	BODY (CT, US, MR)
Week 4	THORACIC* (CHEST, MAMMO, CARDIAC)	MSK
Week 5, as necessary	NUC MED	ANY

*\*the Noon Rounds schedule for Residents and Fellows is scheduled at the beginning of July and January each year.*

**ACADEMIC HALF DAY**

Academic Half Day is held on Thursday afternoons from 1330-1630 in the R.D. Johns Lecture Theatre. This time is protected time and all residents (PGY1 to PGY5) are excused from all clinical duties to attend. Attendance will be taken.

The purposes of Academic Half Day are:

1. To give didactic and case-based lectures on the different subspecialty areas of radiology.
2. To provide hands-on ultrasound training in general and musculoskeletal ultrasound.
3. To train residents in the skills of film observation, organization and interpretation of data, and development of a list of concise and relevant differential diagnoses.
4. To train residents in case presentation techniques to be an effective consultant.
5. To provide a forum for sharing knowledge and experience for both staff and residents.
6. To teach and assess the CanMEDS competencies.
7. To provide didactic and case-based lectures by a Visiting Professor (external or internal to the Department).

The format of Academic Half Day is a “block” system where each subspecialty area of radiology is given a block of Thursday afternoons to teach at Academic Half Day. This encourages each subspecialty area to tailor their lectures and to allow residents to focus on a particular subspecialty for a longer period of time to get a more comprehensive review of a given subspecialty area. To allow each subspecialty area to develop a lecture series, there is a 2-year cycle of subspecialty blocks.



DIAGNOSTIC RADIOLOGY RESIDENCY PROGRAM

**Academic Half Day Lecture Curriculum**  
*(Topics Covered in a 2-year Cycle)*

***BODY***

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**Hepatobiliary**

- Liver – *Dr. D. Ng, Dr. A. Makoyeva*
- Biliary – *Dr. S. Kelly*

**Pancreas, Spleen**

- Pancreas - *Dr. E. Raber*
- Spleen - *Dr. C. Romano*

**Genitourinary**

- Kidneys – *Dr. S. Nguyen*
- Adrenal glands – *Dr. D. Burrowes*
- Prostate - *Dr. S. Sawhney, Dr. M. Hatem*
- Female Pelvis - *Dr. D. Bhayana*

**Gastrointestinal**

- Fluoroscopy – *Dr. D. Reid*
- Small and Large Bowel – *Dr. A. Cheng*
- Rectal – *Dr. D. Bhayana, Dr. M. Hatem*

**Bowel and Contrast Enhanced Ultrasound**

- Ultrasound of the Bowel – *Dr. S. Wilson*
- Contrast-enhanced Ultrasound – *Dr. S. Wilson*

**CanMEDS**

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Some topics are covered during Resident Retreats\* or as part of the Radiology CanMEDS OSCE\*\*.

- GENERAL:
  - a. CanMEDS Overview- *Dr. K. Paterson*
  - b. CanMEDS 2015 – *Dr. K. Paterson*
  - c. Radiology CanMEDS OSCE (annual) – *Dr. K. Paterson*
- COMMUNICATOR Role:
  - a. Communication & Reporting Skills in Radiology (PGY1 Intro Lecture) – *Dr. R. Sevick*
  - b. CMPA (Communication and Consent CME's)
  - c. Reporting/Dictation Skills\*\*
  - d. Patient Counseling in Radiology\*\*
- COLLABORATOR Role:
  - a. Conflict & Communication in Radiology – *Judge Heather Lameroux*
  - b. "Mindfulness" Workshop – *Drs. A. Elliott and M. Jericho*
- HEALTH ADVOCATE Role:
  - a. PGME Ethics Workshop
  - b. Gender/Cultural Issues – *Dr. C. Romano*
  - c. Contrast Reactions – *Dr. D. Ng or Dr. E. Raber*
  - d. Contrast Reactions Simulation\*\*
  - e. Physician & Family Support Workshops (various topics) – *various presenters*
  - f. Resident Wellness Workshop – *Dr. Joan Horton*
  - g. Various Resident Wellness and Team-building Activities
  - h. Physics Course – *Dr. B. Goodyear*
  - i. Patient Safety in Radiology\*\*
  - j. Radiation Safety\*\*
  - k. Breast Screening\*\*

- **MANAGER Role:**
  - a. PGME Medico-legal Workshop
  - b. DI Department Workflow & Policies – **Dr. D. Lautner, Dr. D. Bhayana**
  - c. General Introduction, PGME & Residency Policies, Residency Training Manual (annual)– **Dr. K. Paterson**
  - d. Careers Days – **representatives from urban and rural radiology practices in Alberta**
  - e. MD Management Workshops (radiology practices, personal financial management)
  - f. “Leadership” Workshop – **Mr. G. McVicar**
  - g. “Radiology Practices” – **Dr. D. Kaura**
  - h. “The Business of Radiology” – **Ms. Mary Learning (ASR)**
  - i. “Transition to Practice” – **Ms. Mary Learning (ASR)**
  - j. Triage in Radiology\*\*
- **PROFESSIONAL Role:**
  - a. Professionalism in Radiology – **Dr. A. Lee**
  - b. CMPA (professionalism and medico-legal cases in radiology)
- **SCHOLAR Role:**
  - a. PGME Biostatistics Workshop
  - b. PGME Introduction to Research Methods Workshop
  - c. Research Methods in Radiology – **Dr. M. Goyal**
  - d. Psychology of Learning – **Dr. A. Lee**
  - e. Research in the DI Department – **various presenters**

## **CARDIAC, THORACIC, BREAST**

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### **Thoracic**

- Interstitial lung disease including smoking related lung disease, HP, Sarcoidosis, CTD- **Dr. Elliot, Dr. Lee, Dr. Guenther, Dr. MacGregor, Dr. Dinculescu**
- Eosinophilic Lung disease-**Dr. Guenther**
- Lung cancer- screening, staging, imaging, surgical techniques-**Dr. Bristow, Dr. Huynh**
- Lymphoma and lymphoproliferative disease-**Dr. Huynh**
- Cystic lung disease- **Dr. Lee**
- Large and small airway disease-**Dr. Elliot**
- Pleural disease – **Dr. Guenther**
- Mediastinum- **Dr. Elliot**

### **Cardiac**

- MRI- congenital disease pre and post repair- **Dr. Merchant**
- MRI- patterns of late Gad enhancement and Cardiomyopathies, Cardiac masses-**Dr. Bristow**
- Pericardial Disease-**Dr. Bristow**
- Valvular Disease-**Dr. Bristow**
- Cardiac CT - CAD, SCAD, Cor A Anomalies, and cases- **Dr. Lydell**

### **Breast**

- Digital Tomosynthesis and missed Cancers-**Dr. MacGregor**
- Breast US-**Dr. Lee**
- Diagnostic Mammography (masses, asymmetries, calcifications)-**Dr. Elliot**
- Male Breast-**Dr. Elliot**
- Nipple Discharge-**Dr. Elliot**
- Screening for Breast Ca/Screening Programs-**Dr. Elliot**
- Rad-Path Correlation-**Dr. Elliot**
- Breast MRI-**Dr. Docktor**
- Biopsy techniques-**Dr. Docktor**

## **INTERVENTIONAL RADIOLOGY**

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**Taught by: C. Caughlin, D. Sadler, S. Przybojewski, E. Herget, J. Wong, B So**

- IR 101 – **Dr. C. Caughlin**
- Trauma & Embolization – **Dr. D. Sadler**
- GI/GU & cryoablation – **Dr. S. Przybojewski**
- Interventional oncology – **Dr. E. Herget**
- Biopsies & IR pain management – **Dr. J. Wong**
- Aorta – **Dr. J. Wong**

## **MATERNAL FETAL MEDICINE/OBSTETRICAL ULTRASOUND**

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Taught by perinatologists *Drs. J. Pollard, N. Soliman, D. Somerset, R. Chadha, S. Dwinell, J. Walsh, C. O'Quinn*

- Normal Fetal Anatomy
- First Trimester Screening/Nuchal Translucency
- First Trimester Dating Ultrasound
- Second and third trimester OB ultrasound
- Biophysical Profile
- Common Major Fetal Anomalies (by systems)
- Fetal Cardiac Screening
- Dopplers
- Chromosomal markers—trisomy 13, 18, 21
- Twin Pregnancies (and other multiples)
- Chorionic Villus Sampling, Amniocentesis
- Placenta (including Previa, Abruption)
- Cervical Insufficiency
- Subchorionic Hemorrhage, Chorioamnion Separation
- Cases

## **MUSCULOSKELETAL**

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Taught by : *T. Lawrimore, R. Park, M. Cook, A. Warkentin, J. Boubalos, D. Nobbee, D. McDougall, C. Wiens, M. Li*

- Arthritis – *Dr. D. McDougall*
- Bone tumors
- Soft Tissue tumors and tumor-like conditions
- Imaging of joints and associated conditions with particular emphasis on the Knee, Shoulder, Hip
- Fractures and Orthopedic hardware
- MSK US applications and uses – *Dr.C. Wiens*
- Metabolic/endocrine diseases affecting bone
- Bone Infection – *Dr.C. Wiens*
- Sport Injuries – *Dr.C. Wiens*

## **NEURO**

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- Cerebral White Matter Disease in the Pediatric and Adult Patient – *Dr. J. Lysack*
- Cranial Nerves: Anatomy and Pathology – *Dr. J. Lysack*
- Encephalitis and Encephalopathy – *Dr. J. Scott*
- Endovascular Therapy in Acute Ischemic Stroke - *Dr. M. Hudon*
- Head and Neck Anatomy & Pathology Seminar – *Dr. J. Lysack*
- Imaging Cognitive Decline and Dementia – *Dr. J. Scott*
- Imaging the Seizure and Epilepsy Patient – *Dr. J. Scott*
- Intracranial Neoplasms in the Pediatric and Adult Patient – *Dr. J. Lysack*
- MR Spectroscopy – *Dr. J. Scott*
- Non-Degenerative Diseases of the Spine and Spinal Cord – *Dr. W. Hu*
- Percutaneous Spine Interventional Radiology – *Dr. W. Morrish*
- Vascular Disorders of the Brain – *Dr. M. Goyal*
- Neuro MR Sequences – *Dr. M. Goyal*
- Traumatic Assessment of the Spine – *Dr. M. Willson*

**DR. JOHN LYSACK'S HEAD & NECK SERIES (Quarterly sessions on Thursdays 1700 – 1830h) (Suspended 2022-2023)**

- 1) Head & Neck Imaging: Principles and Modalities
- 2) Temporal Bone
- 3) Imaging the Skullbase: Anatomy and Pathology
- 4) Nasal Cavity and Paranasal Sinuses
- 5) Spaces of the Neck
- 6) Head and Neck Cancer
- 7) Pediatric Head and Neck Lesions

## **NUCLEAR MEDICINE**

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- BMD – *Dr. I. Tchajkov, Dr. R. Gnanakumar*
- Bone Scintigraphy – *Dr. D. Chan*
- Brain – *Dr. R. Gnanakumar*
- Cardiac Nuclear Medicine – *Dr. W. Ying*
- GI/Hepatobiliary – *Dr. L. Lou*
- Infection Imaging – *Dr. R. Gnanakumar*
- Lung Scintigraphy – *Dr. I. Tchajkov, Dr. R. Gnanakumar*
- Neuroendocrine Tumors – *Dr. D. Chan*
- Nuclear Medicine Therapy – *Dr. D. Chan*
- PET/CT – *Dr. R. Gnanakumar*
- Prostate Cancer – *Dr. D. Chan*
- Renal – *Dr. R. Gnanakumar*
- Thyroid/Parathyroid – *Dr. D. Chan*

## **PEDIATRICS**

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- Chest and Cardiac – *Dr. V. Moorjani*
- Gastrointestinal – *Dr. S. Bhandal*
- Genitourinary – *Dr. S. Mohsin*
- Musculoskeletal – *Dr. J. Olubaniyi* (sports medicine)
- Musculoskeletal - *Dr. S. Haider* (Infection/tumors/NAT)
- Ultrasound, including intracranial US – *Dr. X. Wei, Dr. S. Haider*
- Neuroradiology – *Dr. X. Wei, Dr. Z. Assis, Dr. H. Kaur*
- Cases – *Dr. S. Haider*

## **PHYSICS**

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*Taught by: Drs. E. Stewart, L. Lauzon, A. Blaize, J. Tse, S. Pichardo, M. Lebel, B. Goodyear, I. Koslowsky, C. de Bakker*

- General Radiography, Fluoroscopy and Interventional
- Radiation Biology / Protection
- Computed Tomography
- ultrasound physics / instrumentation
- MRI
- Nuclear Medicine Imaging
- Atoms and Radiation
- Ultrasound
- Image Properties
- Nuclear Medicine Production

***VISITING PROFESSORS*****EXTERNAL VISITING PROFESSORS**

There are typically 4-6 Visiting Professor Sessions throughout a given academic year. The Visiting Professor days are held on certain Thursdays (0830-1600h) and Friday mornings (0830-1200h) in the R.D. Johns Lecture Theatre. On Thursday evening, the residents and all radiologists in the city hospitals are invited to a dinner lecture and social evening. Attendance is taken and required.

The Visiting Professor Sessions have been developed as time for a luminary in radiology to visit the program and to give lectures to the residents on Thursday and Friday morning, as well as to residents and staff radiologists on Thursday evenings. The resident teaching involves both didactic and case-based lectures. This is an opportunity for the residents to be taught by the top names in radiology, typically from across North America, to be exposed to different cases and the latest imaging techniques and to interact with the Visiting Professor to learn more about potential Fellowships.

**IN-HOUSE VISITING PROFESSORS**

There are typically 3-5 In-house Visiting Professor days each academic year. An “In-house Visiting Professor” is a local faculty member. The entire Faculty at the Foothills Medical Centre are all Fellowship-trained. Therefore, the faculty provides a variety of backgrounds of education from many different Universities across North America. Many Faculty have been identified by the resident group as being exceptionally gifted at teaching. Therefore, the PGY5 residents select the local faculty to participate. The In-house Visiting Professor days are held on certain Thursdays (0830-1600h) in the R.D. Johns Lecture Theatre.



**JOURNAL CLUB**

The purposes of Journal Club are:

1. To train residents in the skills of selecting articles and critically appraising the literature, including biostatistics.
2. To train residents in presentation technique.
3. To provide a forum for sharing knowledge and experience for both staff and residents.
4. To foster collaboration with other specialties (i.e. Emergency Medicine, General Surgery)

Journal Club is held on Thursdays (1700-1630h) approximately 5-6 times per academic year. Journal Club is held on-site in the R.D. Johns Lecture Theatre at the Foothills Medical Centre. Journal Club is attended by residents, staff and fellows. Attendance is mandatory for all residents and attendance is taken for the residents. On some occasions, Journal Club may be hosted off-site (typically at a staff radiologist's home). Dinner is catered for all Journal Club meetings.

In June of the prior academic year, a list of Journal Club dates and subspecialty areas are published. By the end of July, resident must sign up for a specific Journal Club (3 residents/session). These residents will be responsible for collaborating with the subspecialty staff to choose a topic/theme (e.g. topics may relate to recently published literature and usually focus on emerging techniques, new imaging applications, or a comparison of inter-modality diagnostic performance), select articles and critically appraise the literature. Dedicated Medical Statisticians at the University of Calgary are available to review statistics prior to the meeting and at the meeting. Articles are to be electronically sent to all residents, staff and fellows 2 weeks prior to the date of the Journal Club.

Several times per year, there are additional Journal Club meetings organized in collaboration with other departments. For example, there are ENT-Diagnostic Radiology Journal Clubs and Emergency-Diagnostic Radiology Journal Club. Additional collaborative efforts occur with other departments such as General Surgery and Pulmonology.

The Pediatric Radiologists at the Alberta Children's Hospital conduct regular Pediatric Journal Clubs that are attended by the residents during the 4-block Pediatric Radiology rotation in the PGY4 year.

**MANDATORY ACTIVITIES**

The resident is responsible for the following activities:

- Quality Improvement/Audit project completed by the end of PGY2 and presented at the Department's Annual Research Day
- Completion of a major research project by the end of PGY4 to be presented at the Department's Annual Research Day
- Annual Grand Rounds presentation
- Sitting the annual ACR DXIT examination in January (PGY2 to PGY5 residents)
- Two OSCE examinations each academic year as specified by the Residency Training Committee (typically in June and December)
- Attendance to monthly Physics Course, Morning Rounds, Noon Rounds, Academic Half Day, Visiting Professors, Mandatory PGME workshops, Resident Retreats
- Lecture assignments for technical students
- Presenting assigned Noon Rounds, Morning Rounds and/or Multidisciplinary Rounds
- Journal Club
- Resident Portfolio
- PGME Workshops – RATTs, Ethics, Biostats, Medical Legal, CMPA Symposium

**RESIDENT PORTFOLIO & CanMEDS FRAMEWORK (Non-CBD COHORTS)**

The Resident Portfolio has been designed to keep all of your educational activities and logbooks in one place and should be kept with you at all times. The information will enable you to identify areas of deficiency as well as to create a Portfolio and comprehensive Curriculum Vitae at the end of residency.

The information in each section should be updated on an ongoing basis as items are completed, not just once or twice during the residency program. At each 6-month evaluation with the Residency Program Director, you will be required to bring your Portfolio with you for evaluation (please ensure your Portfolio are updated *prior* to each 6-month evaluation).

At the end of the Portfolio is the Table of Contents from the Radiology Residency Training Manual. While the Residency Training Manual is always accessible electronically on the education (U:) drive, in hardcopy in the Residents Library (AGW27) and has been electronically sent to you at the start of PGY1 and with every update, this will provide you with quick access to topics for reference should you need them.

There are five sections to the Portfolio:

**I. SCHOLARLY ACTIVITIES**

Your Scholarly Activities should be recorded for each year of residency and on an ongoing basis. A separate Scholarly Activities form has been provided for each year of residency (PGY1 to PGY5).

**II. LOGBOOKS**

- a. ULTRASOUND
- b. INTERVENTIONAL RADIOLOGY
- c. CT COLONOGRAPHY

Three different Logbooks have been provided, as listed above. The goal is not to complete all of the lines, with the exception of the CT Colonography Logbook, but instead, to identify areas where you may require more knowledge or exposure. For example, you have not seen a reasonable number of Renal Transplant ultrasounds or AVM/AVF ultrasounds or you have not yet seen a TIPS procedure.

For CT Colonography, you will be required to document that you imaged, post-processed, interpreted and reported of a minimum of 50 CT Colonography cases by the end of residency. By the current Canadian guidelines, this will enable you to read CT Colonography upon entering a practice after residency.

**III. PORTFOLIO**

- a. FRAMEWORK for a CanMEDS Portfolio for you to complete
- b. SAMPLE of a CanMEDS Portfolio

The framework for your CanMEDS Portfolio has been provided. Please ask Karen/Joanne for an electronic version (template) to complete. Please update your Portfolio regularly and submit your final Portfolio in your PGY5 year. A sample of a Portfolio from a PGY5 Radiology Resident has been provided for your reference.

**IV. CanMEDS FRAMEWORK****V. RESIDENCY TRAINING MANUAL REFERENCE (Table of Contents)**

**RESIDENT E-PORTFOLIO (CBD COHORTS)**

The Resident Electronic or ePortfolio is a tool designed by the Royal College to monitor a trainee's progress throughout residency and to consolidate EPAs and Milestones throughout residency. The ePortfolio is also a tool utilized by observers of a resident's training (Attendings, colleagues) to supervise the resident and provide feedback, using EPAs and milestones, as defined by the Royal College Competence by Design Curriculum. The ePortfolio should be utilized by trainees and observers participating in CBD on a regular basis.

The ePortfolio:

- Allows for electronic capture of observations
- Contains up-to-date Royal College educational standards and program learning plans
- Enables competence committees to assess learner's progress
- Facilitates learner and observer interactions
- Produces analytics and reports for monitoring and benchmarking
- Archives a physician's learning data in a single secure location

Steps:

Learner:

- Plans learning
  - Views Program Learning Plan, EPAs and Milestones
  - Selects training activities
  - Requests observation from an observer
- Participates in learning
  - Works with observer and peers
  - Reflects on learning
  - Contributes evidence of learning

Observer:

- Supports learning
  - Works with learners
  - Contributes narrative
  - Reviews evidence
- Prepares for observation
  - Reviews and accepts observation
  - Reviews EPAs and Milestones

## ***OPTIONAL ELECTIVES AWAY FROM THE PROGRAM***

Prior approval must be obtained for any resident wishing to spend more than three months away from The University of Calgary for an education program.

If a Program Director recommends that a resident leave the University of Calgary for more than three months as a part of a special educational program, a proposal for this time away must be forwarded from the Program Director to the Associate Dean (Graduate Clinical and Continuing Medical Education) for consideration by GCEC.

Shorter elective rotations away from the University of Calgary must meet the approval of the Program Director and the Residency Program Committee but need not be approved by GCEC.

These rotations must meet the following criteria:

1. Electives are only to be taken after completion of a substantial part of the core training.
2. The elective experience provides training not available in the primary teaching institution.
3. The emphasis should be on subspecialty training to complement existing training or Alberta rural training to encourage development of interest in rural practice.
4. Adequate teaching and supervision must be available at the elective site from qualified clinicians, ideally fellowship/subspecialty-trained radiologists.

## **CLINICAL INVESTIGATOR PROGRAM**

### **BACKGROUND**

The University of Calgary's Clinician Investigator Program (CIP) is a postgraduate medical training program for residents in any specialty or subspecialty who want to develop a strong foundation for a career in clinical research. It provides a tailored combination of research, clinical and coursework experiences that provide the knowledge, attitudes and technical competence graduates need to be successful in clinical and translational research in their chosen field. The CIP is recognized and accredited by the Royal College of Surgeons and Physicians of Canada (RCSPC).

The CIP is the only postgraduate medical program that allows residents to pursue a graduate research degree (MSc or PhD) whilst concurrently completing their residency specialty or subspecialty. Furthermore, it provides an established framework of instruction specifically designed for aspiring clinician investigators. Your program experience will be tailored to compliment your area of study.

To complete the program, you must be enrolled in a University of Calgary accredited specialty or subspecialty Residency program (through PGME) and spend at least 80% of your time conducting research for a minimum of 2 years. CIP specific requirements including Seminars must also be completed.

You must complete all Graduate Studies program requirements including coursework, research proposal and thesis submission, and defence. PhD candidates will also complete a candidacy exam.

Once all program requirements have been fulfilled, you will receive a graduate degree (MSc or PhD) from the UofC and a Certificate of Completion from the RCPSC.

### **HOW TO APPLY**

To apply for the CIP, you must first seek approval from your residency program director and be accepted into (or at least in the process of applying to) the University of Calgary Graduate Program. You must then submit a complete application kit that includes an application form, curriculum vitae, letter of reference, university transcripts and proof of funding.

### **CONTACT INFORMATION**

**Website:** <http://cumming.ucalgary.ca/cip/>

**Email:** [cip@ucalgary.ca](mailto:cip@ucalgary.ca)

**Program Director:** Maitreyi Raman MD MSc FRCPC CAGF  
Clinician Investigator Program

**Application Deadlines:** Vary. Check website for accurate dates.

## **RESEARCH**

### **PURPOSE**

It is imperative in the practice of radiology to have a basic comprehension of research in order to be able to critically evaluate literature in the practice of evidence-based medicine or to pursue quality assurance and research activities. In order to provide continuous exposure to these principles, lecture/tutorial sessions, journal club and other teaching experiences are provided in the residency program. Practical experience is gained through participation in research and Quality Assurance/Quality Improvement (QA/QI or Audit) projects.

In line with the Royal College of Physicians and Surgeons of Canada Subspecialty objectives for residency training in diagnostic radiology, residents are required to conduct research over the course of the residency. In Calgary, TWO projects are mandatory (QA/QI/Audit project and Major research project) to be eligible to write the RCPSC exam in the PGY5 year. **Residents are entitled to 20 research days to be taken by the end of the PGY5 year. Research Day is typically held in early June each year.**

**Research Director: Dr. Sarah Manske**

**Email:** [smanske@ucalgary.ca](mailto:smanske@ucalgary.ca)

**Phone:** 403-210-6046

### **TERMINAL GOALS**

1. To acquire an understanding of:
  - Literature critique skills.
  - Study methodology.
  - Study hypothesis testing and estimation.
  - Patient consent and other ethical issues in research studies.
  - Basic statistics and concepts and be familiar with common forms of analysis found in radiology research.
2. To acquire a basic understanding of database structures and computers in research.
3. To participate in a project in quality improvement/assurance.

### **ENABLING OBJECTIVES**

#### ***LITERATURE CRITIQUE SKILLS***

1. To participate in journal club activities.
2. To participate in critical discussions at rounds and seminars.
3. To attend in Biostatistics Lecture workshops through the PGME.
4. To attend the Introduction to Research Methods workshop through the PGME.

#### ***RESEARCH PARTICIPATION***

1. To participate in an audit project during the PGY2 year (mandatory).
2. To participate in at least one research project during the PGY3 year (mandatory) aiming at presentation at national or international meetings.

#### ***MANUSCRIPT PRESENTATION***

1. To participate in the process of abstract and manuscript preparation.

#### ***PARTICIPATION IN SCIENTIFIC MEETINGS***

1. To participate in the process of research presentation at scientific meetings.

## **GUIDELINES FOR TWO RESEARCH PROJECTS TO BE UNDERTAKEN BY RESIDENTS**

### **QA/QI (Audit) Project In PGY2**

The first mandatory requirement is an audit project. This is fundamentally a quality assurance/improvement (QA/QI) exercise, but also serves as an introduction to research techniques, including data gathering, analysis, and presentation. The QA/QI project may be initiated by the resident or, alternatively, a staff radiologist may provide a topic for the resident. In either event, there must be a staff supervisor identified with each project.

***\*\*\*The QA/QI project is to be completed by the end of the PGY2 year\*\*\****

The preliminary written proposal must be submitted to receive approval from the Residency Research Director and/or Residency Program Director by the end of September. Projects should be completed by the following June for presentation at Research Day.

Each resident must also submit his/her project to a scientific meeting/conference. This will enable the resident to understand the process of submitting research work to a meeting and hopefully to be able to understand how to present a poster or oral presentation if their project is accepted. At minimum, the quality improvement project should be submitted to the annual Canadian Association of Radiologists (CAR) conference. If the project is deemed appropriate by the Research Director or research preceptor, the project could be submitted to another conference instead (e.g. Radiological Society of North America [RSNA] or other conference of similar caliber).

### **Major Project in PGY3/4**

The second mandatory requirement is a formal investigative project, preferably hypothesis driving research, with the aim for publication in a refereed radiology journal. If this is not achievable, the aim should then be for a presentation at a major radiology conference in North America (e.g. RSNA). Each project must be approved and supervised by a staff radiologist in the appropriate field. A written proposal must be filed with the Residency Research Director and/or the Residency Program Director.

***\*\*\*The Major project is to be completed by the end of the PGY4 year\*\*\****

The investigative project should be started at the beginning of PGY3 and is **to be completed by the end of PGY4**. Completed projects or in-progress reports are to be presented at the annual Residents' Research Day.

In total, **each resident will be responsible for 2 presentations at Research Day** during their residency.

### **3) ADDITIONAL RESEARCH**

For those residents who are motivated, additional research projects may be conducted during residency. There are many prolific investigators in the department who can serve as mentors. Participation in research is encouraged by the residency program and for those residents whose abstracts have been accepted for presentation at a major radiology conference, support for travel will be provided. See the section under Travel (Part I) for further details.

**TUITION FEES**

All residents will be registered with the University of Calgary. In order to continue in a residency program, residents must pay the tuition fees established by the University of Calgary.

Residents with outstanding fees are no longer considered residents in the view of the University, and as such, are technically not covered by practice liability insurance. Their University records are also considered frozen and no confirmation of their training will be provided to licensing authorities or other parties.

Additional information can be found on the University of Calgary PGME website as follows:

<http://cumming.ucalgary.ca/pgme/current-trainees/registration>



# **PART V - GOALS & OBJECTIVES OF TRAINING IN DIAGNOSTIC RADIOLOGY**

**RCPSC ACCREDITATION**

**Training in Canada**

The foregoing represents the general and specific objectives that all candidates for the Royal College of Physicians and Surgeons of Canada (RCPSC) examinations in Diagnostic Radiology are expected to meet. For those training in Canadian programs, these objectives will be accomplished in a staged manner. Residents may obtain the documents describing this approach from their program directors or through the following links:

**RCPSC Specific Standards of Accreditation of Residency Programs in Diagnostic Radiology**

[http://www.royalcollege.ca/rc/faces/oracle/webcenter/portalapp/pages/ibd.jspx?lang=en&\\_adf.ctrl-state=vqs6ct60t\\_4&\\_afLoop=124254063300346&\\_afWindowMode=0&\\_afWindowId=vqs6ct60t\\_14](http://www.royalcollege.ca/rc/faces/oracle/webcenter/portalapp/pages/ibd.jspx?lang=en&_adf.ctrl-state=vqs6ct60t_4&_afLoop=124254063300346&_afWindowMode=0&_afWindowId=vqs6ct60t_14)

**RCPSC Specialty Training Requirements in Diagnostic Radiology**

[http://www.royalcollege.ca/rc/faces/oracle/webcenter/portalapp/pages/ibd.jspx?lang=en&\\_adf.ctrl-state=vqs6ct60t\\_4&\\_afLoop=124254063300346&\\_afWindowMode=0&\\_afWindowId=vqs6ct60t\\_14](http://www.royalcollege.ca/rc/faces/oracle/webcenter/portalapp/pages/ibd.jspx?lang=en&_adf.ctrl-state=vqs6ct60t_4&_afLoop=124254063300346&_afWindowMode=0&_afWindowId=vqs6ct60t_14)

**RESIDENT'S MISSION STATEMENT**

“We, the University of Calgary Radiology Residents, strive for excellence as learners and patient care providers, while fostering an environment of collegiality and respect.” (2013)

**GENERAL GOALS & OBJECTIVES OF DIAGNOSTIC RADIOLOGY PROGRAM**

- Diagnostic Radiology is a branch of medical practice concerned with the use of imaging techniques and procedures in the study, diagnosis and treatment of disease.
- On completion of the educational program the graduate physician will be competent to function as a consultant in Diagnostic Radiology. This requires the physician to have the ability to supervise, to advise and to perform imaging procedures to such a level of competence, and across a broad range of medical practice, as to function as a consultant to referring family physicians and specialists.
- Demonstration of competency in all CanMEDS roles is the foundation on which a successful radiological career is built. Maintaining a successful radiological career is dependent on the acquisition of an attitude to the practice of medicine, which recognizes both the need to establish a habit of continuous learning and recognition of the importance of promoting a team approach to the provision of imaging services.
- Residents must demonstrate the knowledge, skills and attitudes relating to gender, culture and ethnicity pertinent to Diagnostic Radiology. In addition, all residents must demonstrate an ability to incorporate gender, culture and ethnic perspectives in research methodology, data presentation and analysis.
- Residents must demonstrate an ongoing commitment to patient safety and quality improvement including the risks and benefits of diagnostic imaging tests in the delivery of health care.
- Finally, while applying the above principles in the journey through residency, residents will provide each patient with optimal patient centered care and advance the health and well-being of all patients to the best of their ability.

**In order to achieve these goals the Diagnostic Radiology Residency Program aims to provide the following:**

- 1) Environment
  - Provide a safe, supportive, collaborative teaching and learning environment.
  - Support the health and well-being of our Residents, Preceptors and Program staff.
- 2) Residents
  - Recruit high quality medical students to our Program.
  - Strive for all residents to complete the Program in 5 years of study.
- 3) Teaching
  - Attract, support and retain Preceptors and Faculty who are effective teachers and strong clinicians.
  - Provide high quality teaching, supervision and mentoring to residents.
- 4) Curriculum
  - Provide an effective, consistent and integrated curriculum in line with the future role of the radiologists in North America, specifically Canada.
  - Use appropriate and varied teaching delivery methods.
- 5) Administration
  - Provide effective and efficient administrative processes that support all aspects of our program.
- 6) Learning
  - Graduate competent residents capable of working in a variety of settings.
  - Facilitate development of Resident skills for:
    - independent, reflective, life-long learning
    - leadership and teaching
    - quality improvement and quality assurance
    - research and scholarship
- 7) Accreditation
  - Maintain full accreditation by the Royal College of Physicians and Surgeons of Canada.
- 8) Social Accountability

- Graduates deliver healthcare while meeting locally and nationally identified priority health needs.

9) Assessment and Evaluation

- Use rigorous, transparent and constructive methods of Resident assessment.
- All residents pass the RCPSC exam.
- Consistently use rigorous, transparent and constructive methods of Faculty evaluation and feedback.
- Undertake regular, consistent and effective Program evaluation.

## Overall Goals & Objectives by The End Of PGY1

The PGY1 year has been structured to allow the resident to hone their clinical, technical, communication and collaborative skills in the context of diagnostic radiology at a community hospital in Calgary, the Rockyview General Hospital.

Each resident will have 12 blocks of a combination of clinical and surgical rotations as well as elective time as outlined in the RCPSC Specialty Training Requirements for Diagnostic Radiology. The final block (Block 13) is a Transition to Radiology rotation that is focused on the transition into the diagnostic radiology portion of the residency program at the primary teaching site and tertiary care centre in Calgary, the Foothills Medical Centre. During Block 13, the resident will focus on learning the day-to-day procedures for each rotation (e.g. protocolling, learning imaging techniques from the various technicians, etc.), initiate reading around radiology, learn the hospital layout and policies, become oriented with radiology specific information technology (e.g. PACS workstation, PS360 Voice Recognition dictation system) as well as the electronic health records, clinical information systems and other technology related to health care delivery. This block will also allow the PGY1 residents to start building working relationships with their resident peers and radiology faculty.

During this year, there will be a dedicated PGY1 Program Director at the Rockyview General Hospital who manages the resident's schedules, vacation time, evaluations and most issues that may arise. However, the resident will ultimately be the responsibility of the Diagnostic Radiology Residency Program.

PGY1 residents will be responsible for attending mandatory Diagnostic Radiology Academic Half Days on Thursday afternoons, Visiting Professor Sessions and resident group activities (e.g. Resident Retreat, Research Day), as well as the following mandatory PGME Workshops:

- Ethics (1 session)
- Medical-Legal – Module 1 – Areas of Risk for Physicians (1 session)
- Biostatistics (4 sessions, must attend all 4)
- RATTs (1 session) – Residents as Teachers Toolkit

While the residents are encouraged to start reading radiology textbooks and journal review articles, the primary goal of the PGY1 year is to create a solid clinical foundation to compliment the radiology expertise they will acquire in the PGY2 to PGY5 years.

## Overall Goals & Objectives by The End of PGY2

The PGY2 year is structured to provide the core rotations in radiology and to prepare the resident to start on-call. The resident will also complete a QA/audit project by the end of the academic year.

By the end of PGY2, the resident will have completed a minimum of the following rotations:

- Body CT
- Neuro CT
- ER (Emergency Body, Neuro and Musculoskeletal imaging—X-rays, ultrasound, and CT)
- General Ultrasound and Obstetrical Ultrasound
- GI/GU Imaging (Gastrointestinal & Genitourinary, Fluoroscopy)
- Mammography
- Neuro MRI
- Chest Imaging
- Musculoskeletal Imaging
- Nuclear Medicine

By the end of PGY2, the resident will:

1. Have completed reading materials from the recommended reading lists for each rotation and imaging modality.
2. Have developed a systematic approach to reviewing an imaging study (X-ray, ultrasound, CT and MRI), presenting the case to the faculty preceptor, verbally communicating the salient findings to the referring clinician and creating an effective report.
3. Have developed a solid foundation in anatomy and pathophysiology knowledge in the context of radiology (e.g. anatomy on cross-sectional, radiographic and sonographic imaging modalities).
4. Have developed competence to start supervised overnight call in the second half of PGY2
5. Understand the fundamental principles of radiation protection (for him/herself, technologists, and patients) and the fundamental principles of ALARA.
6. Understand how images are formed and acquired for CT, radiographic and ultrasound imaging studies.
7. Understand CT contrast reactions and how they are managed.
8. Complete a QA/audit project and present his/her research at the Resident Research Day in June.

### Overall Goals & Objectives by The End of PGY3

The PGY3 year has been structured to build on the foundation of the core rotations in radiology, to provide experience in image-guide procedures and to foster subspecialty interests with electives. Scholarly activities will continue to evolve with the residents starting a major research project with the goal of presenting at the Resident Research Day in PGY4 and ideally submitting the project to a journal and/or conference.

By the end of PGY3, the resident will have completed a minimum of the following rotations:

- Angio/Interventional Radiology
- Musculoskeletal Imaging and Procedures
- GU Imaging and Procedures (Genitourinary)
- Cardiac Imaging
- Body CT
- Neuro CT
- ER (Emergency Body, Neuro and Musculoskeletal imaging—X-rays, ultrasound and CT)
- Mammography
- Elective

By the end of PGY3, the resident will:

- 1) Continue to enhance reading from the recommended reading lists for each rotation and additional reading from journals.
- 2) Have developed communication and collaboration skills to function as a junior radiology resident consultant.
- 3) Develop competence with a variety of common image-guided procedures.
- 4) Have developed competence to start full overnight independent call at the start of PGY4.
- 5) Have started a major research project with the goal of presenting at the Resident Research Day at the end of PGY4.
- 6) Have developed an understanding of basic radiologic physics.

### Overall Goals & Objectives by The End of PGY4

The PGY4 year has been structured to complete the majority of the core rotations as outlined in the RCPSA Specialty Training Requirements and to allow the resident to advance his/her consultative skills with

referring physicians and families during the pediatric radiology rotation. The resident will attend a radiologic-pathologic course in Washington D.C. Scholarly activities will be completed with the resident completing a major research project, presenting the research at the Resident Research Day at the end of PGY4 and ideally submitting the project to a journal and/or conference.

By the end of PGY4, the resident will have completed a minimum of the following rotations:

- Pediatric Radiology
- Radiologic-Pathology Course (AIRP)
- GI/GU Imaging (Gastrointestinal and Genitourinary)
- Body MRI
- Neuro MRI
- Mammography
- Chest Imaging

By the end of PGY4, the resident will:

- 1) Have completed the majority of the core rotations in radiology.
- 2) Have developed communication and collaboration skills to function as a senior radiology resident consultant.
- 3) Have developed competence in the majority of the core areas of radiology in preparation for exams.
- 4) Have gained expertise in teaching elective students and junior residents and will participate in teaching sessions at the medical school.
- 5) Have completed a major research project and presented the research at the Resident Research Day.

## Overall Goals & Objectives by The End of PGY5

The PGY5 year has been structured to complete the final rotations. The resident will also gain practical experience of a community radiologist by running the Senior Residents Clinic and provide a significant amount of consultations during the final maternal fetal medicine (obstetrical ultrasound) rotation. This component of training has been focused to assist in the subsequent transition from resident to independent practice.

By the end of PGY5, the resident will have completed a minimum of the following rotations:

- Senior Residents Clinic
- Obstetrical Ultrasound
- Body MRI
- Neuro MRI
- Mammography
- Chest Imaging
- Elective

By the end of PGY5, the resident will:

- 1) Have the knowledge and skills to be a competent general radiologist.
- 2) Have the skills and knowledge to continue on a path of independent, reflective, lifelong learning including leadership, teaching, quality improvement/quality assurance, research and scholarship.

**PROGRAM SPECIFIC GOALS AND OBJECTIVES (In CanMEDS Roles)**

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At the completion of training, the resident will have acquired the following competencies and will function effectively as a:

**Medical Expert/Clinical Decision-Maker**

*General Requirements:*

- Demonstrate diagnostic and therapeutic skills for ethical and effective patient care.
- Access and apply relevant information to clinical practice to develop competence in clinical radiological skills.
- Demonstrate effective consultation services with respect to patient care, education, and legal opinions.

*Specific Requirements:*

- Understand the nature of formation of all types of radiological images, including physical and technical aspects, patient positioning and contrast media.
- Develop knowledge of theoretical, practical, and legal aspects of radiation protection, including other imaging techniques and their possible harmful effects.
- Develop knowledge of human anatomy at all ages, both conventional and multiplanar, with emphasis on radiological applications.
- Develop knowledge of all aspects of clinical radiology, including understanding of disease, appropriate application of imaging to patients, importance of informed consent, complications such as contrast media reactions, and factors affecting interpretation and differential diagnosis.
- Understand the fundamentals of quality assurance in radiology.
- Actively contribute to continuous improvement of health care quality and safety and adopt strategies that promote patient safety and address human and system factors.
- Understand the fundamentals of epidemiology, biostatistics and decision analysis.
- Show competence in manual and procedural skills as well as diagnostic and interpretive skills.
- Demonstrate the ability to manage the patient independently during a procedure, in close association with a specialist or other physician who has referred the patient. The radiologist should know when discontinuing a procedure or referring the patient to another physician serves the patient's best interests.
- Understand the acceptable and expected results of investigations and/or interventional therapy as well as unacceptable and unexpected results. This must include knowledge of and ability to manage radiological complications effectively.
- Understand the appropriate follow-up care of patients who have received investigations and/or interventional therapy.
- Demonstrate a consistent and clear systematic approach to reporting.
- Demonstrate competence in effective consultation, conduct of clinic-radiological conferences, and the ability to present scholarly material and lead case discussions.

**Communicator**

*General Requirements:*

- Establish appropriate therapeutic relationships with patients/families.
- Listen effectively.
- Share appropriate information with patients/families and the healthcare team and obtain informed consent for tests and procedures when this is needed.



*Specific Requirements:*

- Produce a radiologic report that will describe the written or electronic information about the medical encounter to optimize detection of imaging findings, most likely differential diagnoses, and, when indicated, recommend further testing and/or management.
- Engage patients and their families in developing plans that reflect the patients' health care needs and goals.
- Recognize the physical and psychological needs of the patient and their families undergoing radiological investigations and/or treatment, including the needs of culture, race and gender.

**Collaborator**

*General Requirements:*

- Consult effectively with other physicians and health care professionals.
- Obtain the appropriate information during consultation with referring physicians in order to make recommendations regarding the most appropriate testing and/or management of patients.
- Contribute effectively to interdisciplinary team activities.

*Specific Requirements:*

- Develop ability to function as a member of a multi-disciplinary health care team in the optimal practice of radiology.
- Understand the importance of communication with referring physicians, including an understanding of when the results of an investigation or procedure should be urgently communicated.

**Leader**

*General Requirements:*

- Utilize resources effectively to balance patient care, learning needs, and other activities.
- Allocate finite health care resources wisely for optimal patient care.
- Work effectively and efficiently in a health care organization.
- Utilize information technology to optimize patient care, life-long learning and other activities.
- Contribute to the improvement of health care delivery.

*Specific Requirements:*

- Be competent in conducting or supervising quality assurance including an understanding of safety issues and economic considerations.
- Be competent in information technology as it pertains to the practice of radiology including radiology information systems, clinical information systems and electronic health records while being aware of patient confidentiality and privacy.

**Health Advocate**

*General Requirements:*

- Identify the important determinants of health affecting patients.
- Contribute effectively to improve the health of patients and communities.
- Recognize and respond to those issues where advocacy is appropriate.

*Specific Requirements:*

- Understand and communicate the benefits and risks of radiological investigation and treatment including population screening.
- Recognize when radiological investigation or treatment would be detrimental to the health of a patient.
- Educate and advise on the use and misuse of radiological imaging.

## **Scholar**

### *General Requirements:*

- Develop, implement and monitor a personal continuing education strategy.
- Critically appraise sources of medical information.
- Facilitate learning of patients, house staff/students and other health professionals.
- Contribute to development of new knowledge.

### *Specific Requirements:*

- Demonstrate competence in evaluation of the medical literature.
- Demonstrate the ability to be an effective teacher of radiology to medical students, residents, technologists, clinical colleagues, and the public.
- Demonstrate the ability to conduct a radiology research project, which may include quality assurance.
- Appreciation of the important role that basic and clinical research plays in the critical analysis of current scientific developments related to radiology.

## **Professional**

### *General Requirements:*

- Deliver highest quality care with integrity, honesty, and compassion by applying best practices and ethical standards.
- Exhibit appropriate personal and interpersonal professional behaviors.
- Practice medicine ethically consistent with the obligations of a physician respecting societal expectations and the needs of culture, race and gender.

### *Specific Requirements:*

- Be able to accurately assess one's own performance, strengths and weaknesses.
- Understand the ethical and medical-legal requirements of radiologists.

**GENERAL ENABLING OBJECTIVES**

These are in addition to rotation, specific recommendations:

**PGY2**

- Complete review of American College of Radiology (ACR) teaching files.
- Complete review of Keats' Atlas of Normal Variants.
- Complete review of cross-sectional and conventional anatomy in chest, abdomen, pelvis and head through atlases.
- Complete review of Clark's Atlas of Radiographic Positioning or similar text.
- Review of physics through:
  - Christensen's Introduction to the Physics of Diagnostic Radiology: Curry and Dowdey.
  - A Review of Radiologic Physics: Houda.
- Interpreting the Medical Literature: Practical Epidemiology for Clinicians: Gehlbach
- The Brant and Helms Solution: Fundamentals of Diagnostic Radiology, Third Edition, Plus Integrated Content Website (4 vol. set): Brant and Helms
- Review Textbook in Radiology and Imaging: Sutton.
- Review of Clinical Imaging: Atlas of Differential Diagnosis: Eisenberg.
- Completion of mandatory audit project.
- Develop basic structure in film approach and presentation at rounds.
- Develop a concise and effective style of reporting.

**PGY3**

- Revision and expand reading of PGY2 material, such as anatomy of the extremities, physics in relation to imaging artifacts, etc.
- In-depth reading and development of knowledge base along organ system lines.
- Develop skills in critical appraisal and research through planning and execution of mandatory research project.
- Improve film presentation and reporting - should be able to pick up most abnormal major and minor findings with appropriate major differential diagnoses included, with minimal help.

**PGY4**

- Completion of core reading.
- Review and identify weaknesses in knowledge base and seek to remedy weaknesses.
- Identify procedural deficiencies and plan use of elective time in PGY5 to make up for deficiencies.
- Improve film presentation and reporting - should be able to pick up abnormal major and minor findings and present them in a structured manner arriving at a logically ordered list of differential diagnoses without help.
- Develop consultative skills through presentations at clinical rounds and interaction with clinical colleagues.

**PGY5**

- Review of physics, radiographic position, artifacts, and normal variants.
- Perfect film presentation and reporting - should be able to pick up abnormal major and minor findings with confidence and present them in a structured manner arriving at a logically ordered list of differential diagnoses and be able to suggest appropriate management options.
- Consolidate clinical knowledge base and be able to hold brief discussions about common diseases, and some less common diseases with pathognomonic radiological features, describing their pathogenesis, typical and diagnostic clinical features, diagnostic laboratory tests, staging and usual clinical treatment. Prepare for independent practice with more responsibility in decision-making, attention to administrative organization and quality assurance.
- Review ACR files and department teaching files in preparation for final Royal College certification examination.

**CORE TRAINING**

The program has been structured to allow each resident to complete rotations in order to satisfy almost all of the RCPSC Specialty Specific minimal requirements by the end of the PGY4 year. In addition, the resident will attend the AIRP (American Institute of Radiologic Pathology) radiologic-pathology course in Washington in the PGY-4 year.

The remainder of the time will be used for additional experience in special areas of interest for the resident, research or updating training in subspecialty areas before the final RCPSC examination. Part of this time may be used for electives in other specialties or in diagnostic radiology outside of the U of C program provided these meet educational objectives of the program and equivalent training is not offered by our program. These electives must be acceptable to the Program Director and satisfy RCPSC & U of C regulations.

The scope of training includes:

1. Lecture series in radiology
2. Monthly physics course
3. AIRP (American Institute of Radiologic Pathology) radiologic-pathology course
4. Practical experience gained during service work in subspecialty areas
5. Teaching at one-on-one read out/review sessions with staff radiologists
6. 7am and Noon rounds
7. Multidisciplinary rounds
8. Journal club
9. Acting as consultants to clinical colleagues
10. Teaching of technical staff, junior residents, and medical students
11. Organizing and conducting quality improvement/audit and research projects
12. Presentation of research results at the departmental research day as well as national and international conferences

With the changing requirements and expectations from the RCPSC and the evolving examination formats for the RCPSC examination, these requirements will demand changes in the teaching program to prepare new residents for the final exiting examination. The format of teaching, evaluation and rotation structure will continue to evolve to address these new requirements and incorporate Competency Based Medical Education.

Evaluations Required – PGY2 to PGY5

EVALUATION KEY	PGY-2	PGY-3	PGY-4	PGY-5
On-Call Evaluations (2 early, 2 later)	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>			
Professionalism Evaluation (P-MEX)	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Research—QA/Audit Project (end of PGY-2)	<input type="checkbox"/>			
Research—Final/Major Project (end of PGY-4)			<input type="checkbox"/>	
Image Interpretation Evaluation (I-MEX)		<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>
Direct Observation of Procedural Skills (DOPS)				
<b>BEFORE STARTING CALL:</b>				
US—Thoracentesis	<input type="checkbox"/>			
US—Paracentesis	<input type="checkbox"/>			
GI—Esophagram	<input type="checkbox"/>			
GI—UGI/SBFT	<input type="checkbox"/>			
GI—Barium enema (single contrast)	<input type="checkbox"/>			
GI—Barium enema (double contrast)	<input type="checkbox"/>			
GI—Lumbar puncture	<input type="checkbox"/>			
<b>SOMETIME IN PGY-2 to PGY-5:</b>				
US—Liver biopsy			<input type="checkbox"/>	
US—Renal biopsy			<input type="checkbox"/>	
CT Colonography			<input type="checkbox"/>	
IR—Abscess drainage (CT-guided)			<input type="checkbox"/>	
IR—Abscess drainage (US-guided)			<input type="checkbox"/>	
IR—Biopsy (CT-guided)			<input type="checkbox"/>	
IR—Biopsy (US-guided)			<input type="checkbox"/>	
IR—Central line placement			<input type="checkbox"/>	
MSK—Joint injection/aspiration			<input type="checkbox"/>	
BREAST—biopsy/aspiration			<input type="checkbox"/>	
NM—VP shunt			<input type="checkbox"/>	
NM—sentinal node (breast)			<input type="checkbox"/>	
NM—sentinal node (melanoma)			<input type="checkbox"/>	
NM—lymphoscintigraphy			<input type="checkbox"/>	

# **PART VI - PGY1 ROTATION GOALS & OBJECTIVES**

**INTRODUCTION**

The first clinical postgraduate year is based at Rockyview General Hospital, a community general hospital in Calgary. A few rotations are scheduled at the Foothills Medical Centre or other Alberta Health Services sites in Calgary.

This first clinical postgraduate year aims to provide an opportunity to broaden the resident's medical background and to gain a better understanding of the relevance of diagnostic imaging for a wide spectrum of clinical conditions and their management in major clinical specialties. To assist in the transition from medical school to residency PGY1 residents should be given graded responsibility to develop independent thinking and critical assessment of clinical and laboratory information and formulate reasonable management plans under direct supervision of attending physicians. Through direct management of patients, the resident will develop an understanding of the information clinicians require from imaging work-ups, and will form the foundation for more effective communication of imaging results to their clinical colleagues. He/she must participate in the care of patients to a level equivalent to that expected of a junior resident of the specialty under which he/she is training.

Since the resident is a part of the Radiology Residency Program, he/she will be invited to all program activities such as academic half-days, physics, visiting professors, research days and retreats.

While there are general overall educational goals and objectives that apply to all rotations, there are also specific goals and objectives for each rotation. Included in this section are the rotation specific goals and objectives for the core rotations and the most common selective rotations.

The scheduling of rotations is in no specific order other than the Radiology rotation in Block 13 for all PGY1 Radiology residents.

The Block 13 rotation for all PGY1 residents is an introduction to Radiology rotation. The intention of this rotation is to guide the resident through the transition from clinical rotations into radiology and provide the basic skills and tools required to begin core radiology specific rotations in PGY2.

**SUPERVISORS**

OVERALL SUPERVISOR: Dr. Ryan Lenz

INDIVIDUAL ROTATION SUPERVISOR: Rotation dependent.

## ***PGY1 ROTATIONS***

These rotations are based on the RCPSC Subspecialty Training Requirements for Diagnostic Radiology

### **Core Rotations**

General Internal Medicine	
General Internal Medicine	4 weeks
General Internal Medicine Subspecialty	4 weeks
General Surgery	
General Surgery	4 weeks
Surgical Subspecialty	
Most commonly Urology	4 weeks
Emergency Medicine	4 weeks
Elective	
Most commonly Anatomic Pathology	4 weeks
Neurology	4 weeks
Oncology	
Medical Oncology	2 weeks
Radiation Oncology	2 weeks
Pediatric Emergency Medicine	4 weeks
Respirology	4 weeks
Diagnostic Radiology	4 weeks



## **CanMEDS GENERAL EDUCATIONAL GOALS AND OBJECTIVES FOR THE PGY1 YEAR**

### **MEDICAL EXPERT/CLINICAL DECISION MAKER**

- Gain knowledge of anatomy, physiology, and pathology of the body systems relevant to each specific rotation.
- Learn to properly assess, treat, and follow up patients for their acute or chronic illnesses.

### **COMMUNICATOR**

- Communicate effectively with all members of the health care team.
- Learn to consult with physicians.
- Demonstrate effective communication skills when dealing with patients.
- Communicate effectively with patients and family.
- Maintain well-organized patient notes and discharge summaries.

### **COLLABORATOR**

- Use proper communication skills when interacting with members of the health team.
- Interact appropriately with others and demonstrate a team-based approach to managing patients.
- Contribute to multidisciplinary rounds and conferences.

### **LEADER**

- Consider advantages and disadvantages of various available diagnostic tests.
- Demonstrate awareness of the indications for interventions.
- Consider advantages and disadvantages of operative versus interventional techniques.
- Grasp of the limitations of the public health care system.
- Manage a reasonable clinical caseload during each rotation.

### **HEALTH ADVOCATE**

- Recognize consent issues, patient comfort and other patient-related issues.
- Recognize radiation dose issues when considering imaging.
- Understand the principles of Health Advocacy as it pertains to the individual patient as well as the population at large.
- Promote screening examinations and regular health care provider visits.

### **PROFESSIONAL**

- Demonstrate integrity, honesty and compassion.
- Show sensitivity and care to the patient and the patient's family.
- Practice understanding of ethical and medical-legal requirements of all physicians.
- Demonstrate awareness of one's own limitations.

### **SCHOLAR**

- Set personal learning goals & objectives.
- Take a leadership role in learning from others and teaching medical students.
- Create teaching cases for use by future trainees.
- Read journals regularly and attend journal clubs.
- Attend Radiology academic half-days when possible

**PGY1 GENERAL INTERNAL MEDICINE/SUBSPECIALTY ROTATION**

**PREAMBLE**

The internal medicine rotation will enable the diagnostic radiology resident to obtain the knowledge and skills necessary to understand the management of patients with a spectrum of conditions included under internal medicine in a multidisciplinary team environment.

The resident will possess a body of knowledge and management skills relevant to internal medicine. This will enable the resident to collect and to interpret data and to carry out diagnostic and therapeutic procedures within the limits of their expertise. Clinical exposure is essential to develop an understanding of the principles and degree of complexity of various medical pathologies.

**GOALS AND OBJECTIVES:**

**MEDICAL EXPERT/CLINICAL DECISION-MAKER:**

- Elicit a focused and accurate history relevant to the patient's presenting complaint. This should include a review of performance status, medications, travel history, occupational exposures, family history and social history.
- Accurately perform a physical exam relevant to the patient's presenting complaint, recognizing and describing abnormal findings.
- Order appropriate investigations and be able to interpret the results, particularly emphasizing hematologic and metabolic abnormalities as well as CXR and ECG.
- Understand the pharmacology of agents used in the treatment of the common medical conditions outlined above.
- Correlate gross anatomy with surface anatomy as a basis for imaging anatomy.
- Understand and explain basic anatomy, pathophysiology (and relevant DDx), and diagnostic plan for common acute medical presentations / diagnoses:
  - chest – pain, shortness of breath, dyspnea (e.g. asthma, COPD, angina, MI)
  - fever, sepsis (e.g. pneumonia, UTI, cellulitis)
  - abdomen - pain (RUQ, epigastric, diffuse, LLQ), N&V, diarrhea, GI bleed, hepatitis
  - stroke, TIA, HTN
  - failure to thrive
  - metabolic disturbances, acid/base disorders, fluid imbalances, diabetic ketoacidosis
  - DVT
  - cancer
- Understand and explain initial management / therapeutic plan for common medicine diagnoses.
- Understand and explain the main indications, relevant anatomy, and main complications (if any) in the following tests / procedures:
  - ECG
  - chest x-ray
  - venous Doppler
  - venipuncture
  - central line insertion

**COMMUNICATOR:**

- Provide a verbal and written summary of the patient's medical problems, and keep legible and accurate records of inpatient as well as outpatient care.
- Explain to the patient his/her medical condition and the proposed plan for investigation and management.

- Outline the potential risks and benefits of any treatment.
- Obtain informed consent for procedures.
- Demonstrate effective communication skills when dealing with patients (during consent, bedside assessments or procedures), patient's families, as well as with consulting clinicians, nursing and clerical staff.
- Dictate concise discharge summary, consult / clinic note.
- Discuss end-of-life care and wishes, taking into account different cultural issues related to death and dying when dealing with patients for whom treatment options are limited.

#### **COLLABORATOR:**

- Develop a collaborative patient centered approach with medicine team. Make yourself a valuable team member.
- Maintain collegial relationships with colleagues, nurses, and unit clerks. Contribute effectively to interdisciplinary team activities.
- Consult effectively with other health care professionals.

#### **LEADER:**

- Develop time management skills to ensure you complete tasks on time, for effective medicine team functioning.
- Assess several new patients simultaneously and be able to prioritize according to the level of acuity (i.e. triage of patients).
- Appropriately divide multiple tasks among colleagues (including clinical clerks) and provide supervision of their activity.
- Provide the laboratories with direction in terms of patient priority for each test when multiple patients require use of limited resources such as CT scans.
- Manage his/her time so that clinical responsibilities do not interfere/overlap with mandatory participation in educational activities.
- Consider socioeconomic (cost) issues in selecting medications for patients.

#### **HEALTH ADVOCATE:**

- Function as an advocate for their patient to obtain adequate care corresponding to the priority of their conditions.
- Provide information on programs such as stroke recognition and help the patient to promote good health habits smoking cessation, diabetic screening and stroke recognition and help the patient to promote good health habits.

#### **PROFESSIONAL:**

- Demonstrate consistent professional behavior in all encounters with patients, clerical and nursing staff, and physicians from surgical and referring teams.
- Demonstrate understanding of the basic principles of medical ethics including patient autonomy, beneficence, confidentiality, conflict of interest, and advance directives.
- Demonstrate honesty and confidentiality with respect to patients, their families and colleagues.
- Demonstrate awareness of own limitations, seeking advice when necessary.
- Demonstrate respect when providing feedback and also be accepting of feedback from colleagues and peers.

#### **SCHOLAR:**

- Set personal learning goals and reading plan during rotation.
- Contribute to the learning of others, with teaching/supervision of medical students on rotation, where appropriate.
- Identify learning needs and make use of available learning resources and resource faculty.

- Participate in bedside teaching provided by attending internists.
- Present interesting, unusual or difficult cases at daily or weekly rounds.

**PGY1 GENERAL SURGERY ROTATION**

**PREAMBLE**

The general surgery rotation will enable the diagnostic radiology resident to obtain the knowledge and skills necessary to understand the surgical management of a variety of patient problems within a multidisciplinary team environment.

The resident will possess a body of knowledge and management skills relevant to inpatient and outpatient general surgery. This will enable the resident to collect and to interpret data and to carry out diagnostic and therapeutic procedures within the limits of their expertise. An understanding of potential surgical complications and their management is essential. Exposure to surgical operations is desirable but should be judiciously allocated to allow variety rather than volume to develop an understanding of the principles and degree of complexity of various surgical procedures.

**GOALS AND OBJECTIVES:**

**MEDICAL EXPERT/CLINICAL DECISION-MAKER:**

- Demonstrates the general knowledge of:
  - The principles of wound healing
  - The principles of resuscitation, stabilization, and disposition
  - The natural history and progress of surgically related disease in the pediatric, adult, pregnant, and geriatric population
  - The indications and limitations of investigative modalities
  - The indications and limitations, mechanisms of action, interactions, and complications of pharmacologic agents
  - The indications, techniques, and complications of manipulative procedural skills
- Demonstrate the knowledge of:
  - The correlation of gross anatomy with surgical anatomy as a basis for imaging anatomy including congenital and anatomic variations
  - Acute abdomen—understand and explain the assessment of a patient with acute abdomen, including history, physical exam, lab investigations and required imaging
  - Trauma—understand and explain role of medical imaging in assessment of patient
    - blunt trauma
    - penetrating trauma
  - Oncology—understand and explain principles of staging common abdominal malignancies, imaging indications prior to surgery and in follow-up
  - Post-op management—understand and explain role of imaging in follow-up of surgery/complications
- Understand and explain basic anatomy and pathophysiology (and relevant DDx) of common acute surgical conditions:
  - Cholecystitis
  - Choledocholithiasis
  - Ascending cholangitis
  - Gastric / duodenal ulcer with perforation
  - Pancreatitis
  - Crohn Disease / Ulcerative colitis
  - Appendicitis
  - Diverticulitis
  - Toxic megacolon
  - Ischemic bowel

- Small bowel obstruction
- Large bowel obstruction
- Bowel perforation
- Pneumoperitoneum
- Understand and explain the main indications, anatomic changes expected, and main complications in the following surgical procedures:
  - Nissen fundoplication
  - Stomach
    - Billroth 1 partial gastrectomy
    - Billroth 2 partial gastrectomy
    - complete gastrectomy
    - gastrojejunostomy
  - Small bowel
    - Roux-en-Y anastomosis
    - segmental resection small bowel
    - ileostomy
  - Hepato-Pancreatico-Biliary
    - cholecystectomy
    - choledocojejunostomy
    - pancreas
      - Whipple resection
      - Tail resection
    - liver
      - segmental resection
      - lobar resection
  - Colon - rectum
    - right / left hemicolectomy
    - colostomy
    - subtotal colectomy
    - Hartman procedure
    - low anterior resection
    - abdominal-perineal resection (APR)
    - total proctocolectomy and J-pouch
  - Hernias / defects
    - Abdominal wall
      - inguinal direct and indirect
      - femoral
      - umbilical
      - incisional
      - Spigellian
      - Internal
      - Obturator
  - Breast
    - lumpectomy
    - mastectomy
    - axillary node dissection
- Demonstrates the skill of:
  - An appropriate clinical assessment of the surgical patient with respect to the history and physical examination.
- Demonstrates procedural skills of:
  - Surgically assist for common, uncomplicated procedures

- Incise and drain localized abscesses
- Wound closure and repair
- Cyst removal
- +/- Sigmoidoscopy/protoscopy
- +/- Skin biopsy

**COMMUNICATOR:**

- Provide a verbal and written summary of the patient's medical/surgical problems, and keep legible and accurate records of inpatient as well as outpatient care.
- Explain to the patient his/her medical/surgical condition and the proposed plan for investigation and management.
- Outline the potential risks and benefits of any treatment.
- Obtain informed consent for procedures.
- Demonstrate effective communication skills when dealing with patients (during consent, bedside assessments or procedures), patient's families, as well as with consulting clinicians, nursing and clerical staff.

**COLLABORATOR:**

- Develop a collaborative patient centered approach with members of general surgery team.
- Make yourself a valuable team member by consulting effectively with other health care professionals and contributing effectively to interdisciplinary team activities.

**LEADER:**

- Develop time management skills and organizational skills to ensure you complete tasks on time, for effective surgical team functioning.
- Make effective use of information technology to optimize patient care.
- Allocate healthcare resources wisely.

**HEALTH ADVOCATE:**

- Function as an advocate for their patient to obtain adequate care corresponding to the priority of their conditions.
- Provide information on screening programs (e.g. colon cancer screening).

**PROFESSIONAL:**

- Demonstrate consistent professional behavior in all encounters with patients, clerical and nursing staff, and physicians from surgical and referring teams.
- Demonstrate understanding of the basic principles of medical ethics including patient autonomy, beneficence, confidentiality, conflict of interest, and advance directives.
- Demonstrate honesty and confidentiality with respect to patients, their families and colleagues.
- Demonstrate awareness of own limitations, seeking advice when necessary.
- Demonstrate respect when providing feedback and also be accepting of feedback from colleagues and peers.

**SCHOLAR:**

- Set personal learning goals and reading plan during rotation.
- Contribute to the learning of others, with teaching/supervision of medical students on rotation, where appropriate.
- Accept the responsibility for self-directed learning as a life-long goal; attend rounds, seminars and other learning events.
- Read around cases and demonstrate ability to apply.

**PGY1 UROLOGY SURGICAL SUBSPECIALTY ROTATION**

**PREAMBLE**

The urology surgical subspecialty rotation will enable the diagnostic radiology resident to obtain the knowledge and skills necessary to understand the surgical management of a variety of patient problems within a multidisciplinary team environment.

The resident will possess a body of knowledge and management skills relevant to urologic surgery. This will enable the resident to collect and to interpret data and to carry out diagnostic and therapeutic procedures within the limits of their expertise. An understanding of potential surgical complications and their management is essential. Exposure to surgical operations is desirable but should be judiciously allocated to allow variety rather than volume to develop an understanding of the principles and degree of complexity of various surgical procedures.

**GOALS AND OBJECTIVES:**

**MEDICAL EXPERT/CLINICAL DECISION-MAKER:**

- Correlate gross anatomy with urologic anatomy as a basis for imaging anatomy including congenital and anatomic variations.
- Trauma – understand and explain role of medical imaging in assessment of urologic injury in the trauma patient:
  - blunt trauma
  - penetrating trauma
- Oncology – understand and explain principles of staging common urologic malignancies, imaging indications prior to surgery and in follow up.
- Post-op management – understand and explain role of imaging in follow up of urologic surgery / complications.
- Observe / participate in the following urologic surgical procedures, to correlate imaging and surgical anatomy:
  - laparoscopic, endoscopic, open and robotic surgeries + retrograde pyelogram
  - clinic procedures – cystoscopy - assessing bladder, urethra
- Understand and explain basic anatomy and pathophysiology (and relevant DDx) of common acute urologic conditions:
  - renal colic / urolithiasis
  - hydronephrosis
  - hematuria
  - trauma (blunt, penetrating)
  - urinary tract infection
    - pyelonephritis, pyonephrosis, renal abscess
    - cystitis



- Understand and explain the main indications, anatomic changes expected, and main complications in the following urologic procedures:
  - percutaneous nephrostomy
  - ureter stent insertion
  - lithotripsy, including Extracorporeal Shock Wave Lithotripsy (ESWL)
  - nephrectomy (open/laparoscopic; partial/complete)
  - pyeloplasty
  - nephroureterectomy
  - cystectomy
    - ileal conduit
  - prostatectomy
  - ureter repair

#### **COMMUNICATOR:**

- Provide a verbal and written summary of the patient's medical/urologic problems, and keep legible and accurate records of inpatient as well as outpatient care.
- Explain to the patient his/her urologic condition and the proposed plan for investigation and management.
- Outline the potential risks and benefits of any treatment.
- Obtain informed consent for procedures.
- Demonstrate effective communication skills when dealing with patients (during consent, bedside assessments or procedures), patient's families, as well as with consulting clinicians, nursing and clerical staff.

#### **COLLABORATOR:**

- Develop a collaborative patient centered approach with members of the urology team.
- Make yourself a valuable team member by consulting effectively with other health care professionals and contributing effectively to interdisciplinary team activities.

#### **LEADER:**

- Develop time management skills and organizational skills to ensure you complete tasks on time, for effective surgical team functioning.
- Make effective use of information technology to optimize patient care.
- Allocate healthcare resources wisely.

#### **HEALTH ADVOCATE:**

- Function as an advocate for their patient to obtain adequate care corresponding to the priority of their conditions.
- Provide information on screening programs (e.g. prostate cancer screening).

#### **PROFESSIONAL:**

- Demonstrate consistent professional behavior in all encounters with patients, clerical and nursing staff, and physicians from surgical and referring teams.
- Demonstrate understanding of the basic principles of medical ethics including patient autonomy, beneficence, confidentiality, conflict of interest, and advance directives.
- Demonstrate honesty and confidentiality with respect to patients, their families and colleagues.
- Demonstrate awareness of own limitations, seeking advice when necessary.
- Demonstrate respect when providing feedback and also be accepting of feedback from colleagues and peers.

#### **SCHOLAR:**

- Set personal learning goals and reading plan during rotation.
- Contribute to the learning of others, with teaching/supervision of medical students on rotation, where appropriate.
- Accept the responsibility for self-directed learning as a life-long goal; attend rounds, seminars and other learning events.
- Read around cases and demonstrate ability to apply critical appraisal and evaluation of relevant literature.

**PGY1 EMERGENCY MEDICINE ROTATION**

**PREAMBLE**

The ER rotation will enable the diagnostic radiology resident to obtain the knowledge and skills necessary to understand the assessment and management of a variety of patient problems in an urban emergency room.

The resident will possess a body of knowledge and skills relevant to assessing patients with emergent/urgent/sub-acute presentations, assisting and/or performing procedures and managing the care of patients under the supervision of an ER consultant. This will enable the resident to collect and to interpret data and to carry out diagnostic and therapeutic procedures within the limits of their expertise.

**GOALS AND OBJECTIVES:**

**MEDICAL EXPERT/CLINICAL DECISION-MAKER:**

- Demonstrate ability to conduct an efficient history and physical.
- Correlate gross anatomy with surface anatomy as a basis for imaging anatomy.
- Order appropriate investigations, integrate results to help manage patient in timely fashion.
- Understand and explain basic anatomy, pathophysiology (and relevant Ddx), and diagnostic plan for common acute ER presentations / diagnoses:
  - cardiac/respiratory arrest
  - chest – pain, shortness of breath, dyspnea, cough
  - abdomen - pain (RUQ, epigastric, diffuse, RLQ, LLQ), N&V, diarrhea, GI bleed
  - GU – renal colic, UTI
  - CNS - stroke, TIA, seizure, trauma, HA
  - fever, sepsis
  - metabolic disturbances, acid/base disorders, fluid imbalances, diabetic ketoacidosis
  - MSK – fractures, dislocations, sprains, osteomyelitis, septic joint, back pain
  - OB/Gyn – pain, bleeding, infection, disorders of pregnancy
  - lacerations
  - burns
- Understand and explain initial management / therapeutic plan for common ER diagnoses.
- Understand and explain the main indications, relevant anatomy, and main complications (if any) in the following tests / procedures:
  - venipuncture, ABG's
  - urinalysis
  - ECG
  - imaging - chest x-ray, abdomen 3 views, MSK x-ray, US abdomen/pelvis, leg doppler US, CT
  - FAST ultrasound
  - central line insertion
  - suturing
  - needle aspiration

**COMMUNICATOR:**

- Provide a verbal and written summary of emergent/urgent/sub-acute cases to the ER consultant and keep legible and accurate records of ER patients.
- Explain to the patient his/her medical condition and the proposed plan for investigation and management.
- Outline the potential risks and benefits of any treatment.
- Obtain informed consent for procedures.
- Demonstrate effective communication skills when dealing with patients (during consent, bedside assessments or procedures), patient's families, as well as with consulting clinicians, nursing and clerical staff.

**COLLABORATOR:**

- Develop a collaborative patient centered approach with members of ER team.
- Make yourself a valuable team member by consulting effectively with other health care professionals and contributing effectively to interdisciplinary team activities.

**LEADER:**

- Develop time management skills and organizational skills to ensure you complete tasks on time, for effective ER team functioning.
- Make effective use of information technology to optimize patient care
- Allocate healthcare resources wisely.

**HEALTH ADVOCATE:**

- Function as an advocate for their patient to obtain adequate care corresponding to the priority of their conditions.

**PROFESSIONAL:**

- Demonstrate consistent professional behavior in all encounters with patients, clerical and nursing staff, and physicians from consulted teams.
- Demonstrate understanding of the basic principles of medical ethics including patient autonomy, beneficence, confidentiality, conflict of interest, and advance directives.
- Demonstrate honesty and confidentiality with respect to patients, their families and colleagues.
- Demonstrate awareness of own limitations, seeking advice when necessary.
- Demonstrate respect when providing feedback and also be accepting of feedback from colleagues and peers.

**SCHOLAR:**

- Set personal learning goals and reading plan during rotation.
- Contribute to the learning of others, with teaching/supervision of medical students on rotation, where appropriate.
- Accept the responsibility for self-directed learning as a life-long goal; attend rounds, seminars and other learning events.
- Read around cases and demonstrate ability to apply critical appraisal and evaluation of relevant literature.

**PGY1 ANATOMIC PATHOLOGY ELECTIVE ROTATION**

**PREAMBLE**

The Anatomic Pathology elective rotation will enable the diagnostic radiology resident to obtain the knowledge and skills necessary to understand the components of a pathology laboratory with a focus on surgical pathology and autopsy. This will enable the resident to learn to correlate clinical, radiological and pathological findings within the limits of their expertise.

**GOALS AND OBJECTIVES:**

**MEDICAL EXPERT/CLINICAL DECISION-MAKER:**

- Demonstrate knowledge of normal basic anatomy and histology.
- Demonstrate basic knowledge of common pathological conditions, including infection, inflammatory conditions and neoplasms.
- Understand how specimens are handled and processed in a pathology laboratory, including frozen sections, cytological, surgical and autopsy material.
- Demonstrate an understanding of how correlation is made between pathology specimens, imaging studies and clinical information.
- Demonstrate a basic understanding of the principles of ancillary techniques in surgical pathology and how to organize and work up a case, with the assistance of a staff pathologist.

**COMMUNICATOR:**

- Provide a verbal and written summary of cases to the pathologist.
- Demonstrate effective communication skills when dealing with technical staff, support staff, supervisors and colleagues.

**COLLABORATOR:**

- Make yourself a valuable team member by developing a collaborative patient centered approach with members of pathology team.
- Demonstrate an understanding of the role of the anatomical pathologist in the health care team.

**LEADER:**

- Demonstrate a basic understanding of laboratory management structure and workload issues.
- Demonstrate an introductory understanding of safety and quality assurance issues, as well as laboratory information systems.

**HEALTH ADVOCATE:**

- Demonstrate an understanding of the pathology laboratory role in providing accurate information pertaining to public health issues, including infectious diseases.

**PROFESSIONAL:**

- Demonstrate:
  - Consistent professional behavior in all encounters with patients, clerical and technical staff and physicians from consulted teams.
  - An understanding of the basic principles of medical ethics including patient autonomy and confidentiality.
  - A responsible work ethic, interest and enthusiasm for learning.
  - Professional work habits: punctual, organized, and efficient.
  - Honesty and confidentiality with respect to patients, their families and colleagues.
  - Awareness of own limitations, seeking advice when necessary.
  - Respect when providing feedback and also be accepting of feedback from colleagues and peers.

**SCHOLAR:**

- Set personal learning goals and reading plan during rotation.
- Contribute to the learning of others, with teaching/supervision of medical students on rotation, where appropriate.
- Accept the responsibility for self-directed learning as a life-long goal; attend rounds, seminars and other learning events.
- Read around cases and demonstrate ability to apply critical appraisal and evaluation of relevant literature.

**PGY1 NEUROLOGY ROTATION**

**PREAMBLE**

The neurology rotation will enable the diagnostic radiology resident to obtain the knowledge and skills necessary to understand the management of patients with neurologic diseases in a multidisciplinary team environment.

The resident will possess a body of knowledge and management skills relevant to inpatient and outpatient neurology including stroke cases. This will enable the resident to collect and to interpret data and to carry out diagnostic and therapeutic procedures within the limits of their expertise. Clinical exposure is essential to develop an understanding of the principles and degree of complexity of various neurologic pathologies.

**GOALS AND OBJECTIVES:**

**MEDICAL EXPERT/CLINICAL DECISION-MAKER:**

- Elicit a focused and accurate history relevant to the neurologic system. This includes symptoms of neurologic pathology and should include a review of performance status, medications, travel history, occupational exposures, family history and social history.
- Accurately perform a physical exam relevant to the neurologic system, recognizing and describing abnormal findings. Be able to perform lumbar puncture.
- Order appropriate investigations in conditions such as stroke, seizure disorders, movement disorders, degenerative brain disorders, and be able to interpret the results, particularly emphasizing CT and MRI interpretation of the brain and spinal cord.
- Correlate neuroanatomy with imaging anatomy including congenital and anatomic variations.
- Stroke – understand basic pathophysiology and explain the role of medical imaging in assessment of the stroke patient.
  - ischemic
  - hemorrhagic
- Oncology – understand and explain basic classification of common CNS malignancies and the role of imaging.
- Understand and explain basic anatomy, pathophysiology, and management principles (and relevant DDx) of common neurologic conditions:
  - stroke (ischemic, hemorrhagic)
  - cerebral edema
  - hydrocephalus
  - CNS infection
  - multiple sclerosis
  - epilepsy
  - neurodegenerative conditions

**COMMUNICATOR:**

- Provide a verbal and written summary of the patient's neurologic and medical problems, and keep legible and accurate records of inpatient as well as outpatient care.
- Explain to the patient his/her neurologic condition and the proposed plan for investigation and management.
- Outline the potential risks and benefits of treatment.
- Obtain informed consent for neurologic procedures such as lumbar puncture.

- Demonstrate effective communication skills when dealing with patients (during consent, bedside assessments or procedures), patient's families, as well as with consulting clinicians, nursing and clerical staff.

#### **COLLABORATOR:**

- Understand the role of the neurologist in the multidisciplinary approach to patient management of neurologic conditions including strokes and malignancy.
- Consult effectively with other health care professionals.
- Contribute effectively to interdisciplinary team activities.

#### **LEADER:**

- Develop time management skills and organizational skills to ensure you complete tasks on time, for effective surgical team functioning.
- Make effective use of information technology to optimize patient care.
- Allocate healthcare resources wisely.

#### **HEALTH ADVOCATE:**

- Function as an advocate for their patient to obtain adequate care corresponding to the priority of their conditions.
- Provide information on programs such as stroke recognition and help the patient to promote good health habits.

#### **PROFESSIONAL:**

- Demonstrate consistent professional behavior in all encounters with patients, clerical and nursing staff, and physicians from surgical and referring teams.
- Demonstrate understanding of the basic principles of medical ethics including patient autonomy, beneficence, confidentiality, conflict of interest, and advance directives.
- Demonstrate honesty and confidentiality with respect to patients, their families and colleagues.
- Demonstrate awareness of own limitations, seeking advice when necessary.
- Demonstrate respect when providing feedback and also be accepting of feedback from colleagues and peers.

#### **SCHOLAR:**

- Set personal learning goals and reading plan during rotation.
- Contribute to the learning of others, with teaching/supervision of medical students on rotation, where appropriate.
- Accept the responsibility for self-directed learning as a life-long goal; attend rounds, seminars and other learning events.
- Read around cases and demonstrate ability to apply critical appraisal and evaluation of relevant literature.



**PGY1 ONCOLOGY ROTATION**

**MEDICAL ONCOLOGY**

**PREAMBLE**

The medical oncology rotation will enable the diagnostic radiology resident to obtain the knowledge and skills necessary to understand the management of oncology patients in a multidisciplinary team environment in an academic tertiary care setting (inpatients and outpatients).

The resident will learn a body of knowledge and management skills relevant to medical oncology. This will enable the resident to collect and to interpret data and to observe and/or assist diagnostic and therapeutic procedures within the limits of their expertise and availability on the rotation. Clinical exposure is essential to develop an understanding of the principles and degree of complexity of various pathologies encountered in medical oncology. The resident will also learn to assist the multidisciplinary team to manage patient care/complications as well as follow-up.

**GOALS AND OBJECTIVES:**

**MEDICAL EXPERT/CLINICAL DECISION-MAKER:**

- Elicit a focused and complete history relevant to an oncology patient.
- Accurately perform a physical exam relevant to the patient's presenting oncologic condition and/or complaint, recognizing and describing abnormal findings.
- Order appropriate investigations and be able to interpret the results, particularly emphasizing hematologic and metabolic abnormalities as well as CXR and ECG.
- Understand the pharmacology of agents used in the treatment of the common medical oncology conditions.
- Correlate gross anatomy with oncologic anatomy as a basis for imaging anatomy including congenital and anatomic variations.
- Understand and explain principles of staging common malignancies, imaging indications prior to treatment and in follow-up.
- Understand pharmacologic basics and the planning/administration of common therapeutic regimens, including:
  - Chemotherapy
  - Hormonal therapy
  - Targeted therapy
  - Radiation and surgery in managing cancer patients at various stages of disease.
- Understand the differences between adjuvant, curative and palliative therapies and demonstrate general knowledge about the indications of these in the common solid tumors.
  
- Demonstrate proficiency in the following procedures, as available:
  - Thoracentesis
  - Paracentesis
  - Bone marrow aspiration and biopsy
  - Lumbar puncture
- Understand and explain basic anatomy, pathophysiology, treatment considerations and expected anatomic changes (following treatment) of common malignancies, including some or all of:
  - Lung

- Breast
- Colorectal
- Head & neck
- Prostate
- Lymphoma
- CNS
- Understand importance of radiologist report in assisting oncologist to gauge treatment success.

**COMMUNICATOR:**

- Elicit relevant information from patients and families to assist in patient care.
- Be able to communicate patient cases to Medical Oncology consultants, residents and nurses to ensure consistency and continuity of patient care.
- Demonstrate effective and compassionate communication skills when dealing with patients (during clinic, bedside assessments or procedures), as well as with consulting clinicians, nursing and clerical staff.
- Dictate concise discharge summary, consult / clinic note.

**COLLABORATOR:**

- Develop a collaborative patient centered approach with the medical oncology team. Make yourself a valuable team member.
- Maintain collegial relationships with colleagues, nurses, and unit clerks.
- Contribute effectively to multidisciplinary team activities, including patient oriented and educational rounds.
- Consult effectively with other health care professionals.

**LEADER:**

- Understand the limitations of health care resources and incorporate evidence based medicine principles when making management decisions that maintain the best interest of the patient.
- Develop time management skills to ensure you complete tasks on time, for effective and efficient medical oncology team functioning.

**HEALTH ADVOCATE:**

- Identify risk factors important in the development of malignancies and provide appropriate counselling to patients and families.
- Understand the role of cancer screening and promote preventive strategies.
- Function as an advocate for oncology patients to obtain adequate care corresponding to the priority of their conditions.

**PROFESSIONAL:**

- Demonstrate consistent professional behavior in all encounters with patients, clerical and nursing staff, and physicians.
- Demonstrate honesty and confidentiality with respect to patients, their families and colleagues.
- Demonstrate awareness of own limitations, seeking advice when necessary.
- Demonstrate respect when providing feedback and also be accepting of feedback from colleagues and peers.

**SCHOLAR:**

- Set personal learning goals and reading plan during rotation.
- Review and critically appraise medical information and incorporate evidence-based medicine in clinical decision making on a daily basis.

- Develop the necessary skills in medical oncology education of patients, medical students, residents and other health care professionals.
- Identify learning needs and make use of available learning resources and resource faculty.
- Gain exposure to clinical trials as they pertain to radiology and understand their importance and contribution to medical oncology.

**PGY1 RADIATION ONCOLOGY**

**PREAMBLE**

The radiation oncology rotation will enable the diagnostic radiology resident to obtain the knowledge and skills necessary to understand the management of oncology patients in a multidisciplinary team environment in an academic tertiary care setting (inpatients and outpatients).

The resident will learn a body of knowledge and management skills relevant to radiation oncology. This will enable the resident to collect and to interpret data and to observe and/or assist diagnostic and therapeutic procedures within the limits of their expertise and availability on the rotation. Clinical exposure is essential to develop an understanding of the principles and degree of complexity of various pathologies encountered in radiation oncology. The resident will also learn to assist the multidisciplinary team to manage patient care/complications as well as follow-up.

**GOALS AND OBJECTIVES:**

**MEDICAL EXPERT/CLINICAL DECISION-MAKER:**

- Elicit a focused and complete history relevant to an oncology patient.
- Accurately perform a physical exam relevant to the patient's presenting oncologic condition and/or complaint, recognizing and describing abnormal findings.
- Order appropriate investigations and be able to interpret the results, such as CXR and ECG.
- Understand the basic principles of radiobiology in the treatment of the common radiation oncology conditions.
- Correlate gross anatomy with oncologic anatomy as a basis for imaging anatomy including congenital and anatomic variations.
- Understand and explain principles of staging common malignancies, imaging indications prior to treatment and in follow-up.
- Understand pharmacologic basics and the planning/administration of common therapeutic regimens, including:
  - Chemotherapy
  - Hormonal therapy
  - Targeted therapy
  - Radiation and surgery in managing cancer patients at various stages of disease.
- Understand the differences between adjuvant, curative and palliative therapies and demonstrate general knowledge about the indications of these in the common solid tumors.
- Observe/participate in the planning/administration of radiation treatments
- Understand and explain basic anatomy, pathophysiology, treatment considerations and expected anatomic changes (following treatment) of common malignancies, including some or all of:
  - Lung
  - Breast
  - Colorectal
  - Head & neck
  - Prostate
  - Lymphoma
  - CNS
- Understand importance of the radiology report in assisting an oncologist to gauge treatment success.

**COMMUNICATOR:**

- Elicit relevant information from patients and families to assist in patient care.
- Be able to communicate patient cases to Radiation Oncology consultants, residents and nurses to ensure consistency and continuity of patient care.
- Demonstrate effective and compassionate communication skills when dealing with patients (during clinic, bedside assessments or procedures), as well as with consulting clinicians, nursing and clerical staff.
- Dictate concise discharge summary, consult / clinic note.

**COLLABORATOR:**

- Develop a collaborative patient centered approach with the radiation oncology team. Make yourself a valuable team member.
- Maintain collegial relationships with colleagues, nurses, and unit clerks.
- Contribute effectively to multidisciplinary team activities, including patient oriented and educational rounds.
- Consult effectively with other health care professionals.

**LEADER:**

- Understand the limitations of health care resources and incorporate evidence based medicine principles when making management decisions that maintain the best interest of the patient.
- Develop time management skills to ensure you complete tasks on time, for effective and efficient radiation oncology team functioning.

**HEALTH ADVOCATE:**

- Identify risk factors important in the development of malignancies and provide appropriate counselling to patients and families.
- Understand the role of cancer screening and promote preventive strategies.
- Function as an advocate for oncology patients to obtain adequate care corresponding to the priority of their conditions.

**PROFESSIONAL:**

- Demonstrate consistent professional behavior in all encounters with patients, clerical and nursing staff, and physicians.
- Demonstrate honesty and confidentiality with respect to patients, their families and colleagues.
- Demonstrate awareness of own limitations, seeking advice when necessary.
- Demonstrate respect when providing feedback and also be accepting of feedback from colleagues and peers.

**SCHOLAR:**

- Set personal learning goals and reading plan during rotation.
- Review and critically appraise medical information and incorporate evidence-based medicine in clinical decision making on a daily basis.
- Develop the necessary skills in radiation oncology education of patients, medical students, residents and other health care professionals.
- Identify learning needs and make use of available learning resources and resource faculty.
- Gain exposure to clinical trials as they pertain to radiology and understand their importance and contribution to radiation oncology.

**PGY1 PEDIATRIC EMERGENCY MEDICINE ROTATION**

**PREAMBLE**

The Pediatric ER rotation will enable the diagnostic radiology resident to obtain the knowledge and skills necessary to understand the assessment and management of emergent pediatric problems in an urban emergency room.

The resident will possess a body of knowledge and skills relevant to assessing patients with emergent/urgent/sub-acute presentations, assisting and/or performing procedures and managing the care of patients under the supervision of a pediatric ER consultant. This will enable the resident to collect and to interpret data and to carry out diagnostic and therapeutic procedures within the limits of their expertise.

**GOALS AND OBJECTIVES:**

**MEDICAL EXPERT/CLINICAL DECISION-MAKER:**

- Demonstrate ability to conduct an efficient history and physical.
- Correlate gross anatomy with surface anatomy as a basis for imaging anatomy.
- Order appropriate investigations, integrate results to help manage patient in timely fashion.
- Understand and explain basic anatomy, pathophysiology (and relevant DDx), and diagnostic plan for common acute ER presentations / diagnoses:
  - trauma
  - cardiac/respiratory arrest
  - chest – pain, shortness of breath, dyspnea, cough
  - abdomen - pain (RUQ, epigastric, diffuse, RLQ, LLQ), N&V, diarrhea, GI bleed
  - GU – UTI, hematuria
  - CNS - stroke, seizure, trauma, HA
  - fever, sepsis
  - metabolic disturbances, acid/base disorders, fluid imbalances, diabetic ketoacidosis
  - MSK – fractures, dislocations, sprains, osteomyelitis, septic joint, back pain
  - lacerations
  - burns
  - failure to thrive
  - abuse
- Understand and explain initial management / therapeutic plan for common ER diagnoses
- Understand and explain the main indications, relevant anatomy, and main complications (if any) in the following tests / procedures:
  - venipuncture, ABG's
  - urinalysis
  - ECG
  - imaging - chest x-ray, abdomen 3 views, MSK x-ray, US abdomen/pelvis, leg doppler US, CT
  - FAST ultrasound
  - central line insertion
  - suturing
  - needle aspiration

**COMMUNICATOR:**

- Provide a verbal and written summary of emergent/urgent/sub-acute cases to the pediatric ER consultant and keep legible and accurate records of pediatric ER patients.
- Explain to the patient's parents/guardian his/her medical condition and the proposed plan for investigation and management.
- Outline the potential risks and benefits of any treatment.
- Obtain informed consent for procedures.
- Demonstrate effective communication skills when dealing with patients (during consent, bedside assessments or procedures), patient's families, as well as with consulting clinicians, nursing and clerical staff.

**COLLABORATOR:**

- Develop a collaborative patient centered approach with members of pediatric ER team.
- Make yourself a valuable team member by consulting effectively with other health care professionals and contributing effectively to interdisciplinary team activities.

**LEADER:**

- Develop time management skills and organizational skills to ensure you complete tasks on time, for effective pediatric ER team functioning.
- Make effective use of information technology to optimize patient care.
- Allocate healthcare resources wisely.

**HEALTH ADVOCATE:**

- Recognizes and responds to those patient care issues where patient advocacy is appropriate.
- Identifies the important determinants of health, including injury prevention.
- Identifies situations where patient advocacy and preventative health awareness is required.
- Recognizes the importance of identifying situations and giving accurate information with respect to immunizations, promoting safety in the home and on the street and counseling (e.g. smoking and substance abuse).

**PROFESSIONAL:**

- Demonstrate consistent professional behavior in all encounters with patients, clerical and nursing staff, and physicians from consulted teams.
- Demonstrate understanding of the basic principles of medical ethics including patient autonomy, beneficence, confidentiality, conflict of interest, and advance directives.
- Demonstrate honesty and confidentiality with respect to patients, their families and colleagues.
- Demonstrate awareness of own limitations, seeking advice when necessary.
- Demonstrate respect when providing feedback and also be accepting of feedback from colleagues and peers.

**SCHOLAR:**

- Set personal learning goals and reading plan during rotation.
- Contribute to the learning of others, with teaching/supervision of medical students on rotation, where appropriate.
- Accept the responsibility for self-directed learning as a life-long goal; attend rounds, seminars and other learning events.
- Read around cases and demonstrate ability to apply critical appraisal and evaluation of relevant literature.

## **PGY1 RESPIROLOGY ROTATION**

### **PREAMBLE**

The respiratory rotation will enable the diagnostic radiology resident to obtain the knowledge and skills necessary to understand the surgical management of a variety of patient problems within a multidisciplinary team environment.

The resident will possess a body of knowledge and management skills relevant to inpatient and outpatient respiratory. This will enable the resident to collect and to interpret data and to carry out diagnostic and therapeutic procedures within the limits of their expertise. An understanding of potential procedure complications and their management is essential.

### **GOALS AND OBJECTIVES:**

#### **MEDICAL EXPERT/CLINICAL DECISION-MAKER:**

- Demonstrate ability to conduct an efficient history and physical.
- Correlate gross anatomy with surface anatomy as a basis for imaging anatomy.
- Order appropriate investigations, integrates results to help manage patient in timely fashion.
- Understand and explain basic anatomy, pathophysiology (and relevant DDx), and diagnostic plan for common respiratory presentations / diagnoses:
  - chest pain
  - shortness of breath, dyspnea
  - pulmonary edema
  - fever, sepsis
  - Pneumonia (CAP, nosocomial, opportunistic etc.)
  - pleural effusion
  - pulmonary embolus
  - COPD +/- exacerbation
  - diffuse lung disease
  - Chest malignancies - lung cancer, metastatic disease.
- Understand and explain initial management / therapeutic plan for common medicine diagnoses
- Understand and explain the main indications, relevant anatomy, and main complications (if any) in the following tests / procedures:
  - Flow spirometry
  - PFT's
  - Chest X-ray, CT, High resolution CT
  - Venous Doppler
  - central line insertion
  - thoracentesis, pleural drain
  - bronchoscopy +/- washing, biopsy



**COMMUNICATOR:**

- Provide a verbal and written summary of the patient's medical problems, and keep legible and accurate records of inpatient as well as outpatient care.
- Explain to the patient his/her medical/surgical condition and the proposed plan for investigation and management.
- Dictate concise discharge summary, consult / clinic note.
- Outline the potential risks and benefits of any treatment.
- Obtain informed consent for procedures.
- Demonstrate effective communication skills when dealing with patients (during consent, bedside assessments or procedures), patient's families, as well as with consulting clinicians, nursing and clerical staff.

**COLLABORATOR:**

- Develop a collaborative patient centered approach with members of respiratory team.
- Make yourself a valuable team member by consulting effectively with other health care professionals and contributing effectively to interdisciplinary team activities.

**LEADER:**

- Develop time management skills and organizational skills to ensure you complete tasks on time, for effective surgical team functioning.
- Make effective use of information technology to optimize patient care.
- Allocate healthcare resources wisely.

**HEALTH ADVOCATE:**

- Function as an advocate for their patient to obtain adequate care corresponding to the priority of their conditions.
- Provide information on prevention programs (e.g. smoking cessation).

**PROFESSIONAL:**

- Demonstrate consistent professional behavior in all encounters with patients, clerical and nursing staff, and physicians from surgical and referring teams.
- Demonstrate understanding of the basic principles of medical ethics including patient autonomy, beneficence, confidentiality, conflict of interest, and advance directives.
- Demonstrate honesty and confidentiality with respect to patients, their families and colleagues.
- Demonstrate awareness of own limitations, seeking advice when necessary.
- Demonstrate respect when providing feedback and also be accepting of feedback from colleagues and peers.

**SCHOLAR:**

- Set personal learning goals and reading plan during rotation.
- Contribute to the learning of others, with teaching/supervision of medical students on rotation, where appropriate.
- Accept the responsibility for self-directed learning as a life-long goal; attend rounds, seminars and other learning events.
- Read around cases and demonstrate ability to apply critical appraisal and evaluation of relevant literature.

***PGY1 RADIOLOGY ROTATION***

**PREAMBLE**

This is a rotation to be scheduled in the last 4-week period (Block 13) and is required to be completed at the Foothills Medical Centre.

The intention of this rotation is to guide the resident through the transition from clinical rotations into radiology and provide the basic skills and tools required to begin core radiology specific rotations in PGY2.

This rotation will provide a comprehensive understanding of the scope and complexity of diagnostic imaging to provide a foundation for an economical and rational approach to guide clinical investigations. By the end of this rotation, the resident should have a basic understanding of the indications and contraindications of each different imaging technique and its relationship to other modalities and be able to weigh the risks of common procedures against the need for information and the patient's best interest.

The rotation will also serve as an introduction to the Department of Diagnostic Imaging at the Foothills Medical Centre. An orientation will be provided to IT resources such as PACS and dictation programs. Login IDs will be assigned. Orientation to other departmental resources will also be provided, including film library and transcription services. It is expected that the resident will be capable of reporting, and will have reported several studies by the end of the rotation.

**GOALS AND OBJECTIVES:**

**MEDICAL EXPERT/CLINICAL DECISION-MAKER:**

- Develop a basic understanding of the indications and contraindications of each different imaging technique and its relationship to other modalities.
- Develop a basic understanding of how different procedures are performed (e.g. x-rays, barium studies, CT, US, MR).
- Develop a basic understanding of patient safety as it relates to diagnostic imaging techniques and procedures.

**COMMUNICATOR:**

- Understand the components of a radiology report and how to use the reporting system (Nuance PS 360).
- Demonstrate effective communication skills when dealing with patients and their families (during consent, bedside assessments or procedures) while maintaining patient privacy and confidentiality.
- Learn to communicate effectively using the electronic medical record (the radiology report) to optimize clinical decision-making and patient safety.

**COLLABORATOR:**

- Develop a collaborative patient centered approach with members of diagnostic radiology team.
- Make yourself a valuable team member by consulting effectively with other health care professionals and contributing effectively to interdisciplinary team activities.

**LEADER:**

- Develop the skill of triaging time and resources according to patient need.
- Develop time management skills and organizational skills to ensure you complete tasks on time, for effective diagnostic radiology team functioning.
- Make effective use of information technology and health informatics to optimize patient care.
- Allocate healthcare resources wisely.

**HEALTH ADVOCATE:**

- Function as an advocate for the patient to obtain adequate care corresponding to the priority of their conditions.
- Develop an understanding of radiation safety.

**PROFESSIONAL:**

- Demonstrate consistent professional behaviour in all encounters with patients, clerical and nursing staff, and physicians from referring teams.
- Demonstrate understanding of the basic principles of medical ethics including patient autonomy, beneficence, confidentiality, conflict of interest, and advance directives.
- Demonstrate honesty and confidentiality with respect to patients, their families and colleagues.
- Demonstrate awareness of own limitations, seeking advice when necessary.
- Demonstrate respect when providing feedback and also be accepting of feedback from colleagues and peers.
- Demonstrate a commitment to patient safety and quality improvement.
- Develop a commitment to physician health and well-being to foster optimal patient care.

**SCHOLAR:**

- Set personal learning goals and reading plan during rotation.
- Contribute to the learning of others, with teaching/supervision of medical students on rotation, where appropriate.
- Accept the responsibility for self-directed learning as a life-long goal; attend rounds, seminars and other learning events.
- Read around cases and demonstrate ability to apply critical appraisal and evaluation of relevant literature.

# **PART VII - EDUCATIONAL GOALS & OBJECTIVES**

**BODY COMPUTED TOMOGRAPHY****PREAMBLE**

All residents receive at least two blocks in body computed tomography (CT) with additional exposure in the ER, CTGU and GI/GU rotations. First rotation will be within the first six months of the PGY2 year. Other rotations will be spread throughout the residency.

**ROTATION SPECIFIC GOALS AND OBJECTIVES:*****MEDICAL EXPERT/CLINICAL DECISION MAKER*****PGY2/Foundations of Discipline****Competencies:**

1. Proficiency in using the physician's console for scan reviews, obtaining measurements, and enhancing/manipulating images.
2. Ability to perceive and distinguish the major abnormalities from normal structures on most examinations.
3. Ability to apply clinical and radiologic knowledge to CT scan interpretation, arriving at a short list of valid differential diagnoses.
4. Development of time and people management skills in directing the day-to-day scanning of elective and emergency patients.
5. Development of a concise and structured reporting style.

**Specific Objectives:**

1. Obtain basic knowledge of the normal cross-section anatomy of the chest, abdomen and pelvis.
2. Be familiar with the common protocols used in body CT imaging including patient preparation.
3. Have a thorough knowledge of contrast used and routes of administration in body CT examinations.
4. Obtain basic knowledge of the various components of a CT unit and the workings of the physician's diagnostic console.
5. Obtain a framework of clinical knowledge regarding common diseases encountered during rotation.
6. Have a thorough knowledge of the applications of multiplanar reformatting for diagnosis in the chest, abdomen and pelvis.

**PGY3/Core of Discipline 1****Competencies:**

1. Enhancement of skills previously specified.
2. Ability to perceive most major and minor findings on each examination.
3. Ability to present and communicate effectively and succinctly scan finding and offering an extended differential where appropriate.
4. Ability to provide basic consultative service to clinical staff.
5. Enhancement of reporting style giving appropriate weight to important findings and improving structure to enhance readability.

**Specific Objectives:**

1. Enhancement of knowledge in areas described for PGY2 rotation.
2. Obtain knowledge to increase understanding of more complex abdominal/pelvic anatomy including peritoneal and retroperitoneal spaces and routes of disease spread.
3. Obtain knowledge of normal cross-section anatomy of the musculoskeletal system, in particular the extremities and joints.

4. Obtain a thorough knowledge of artifacts relating to body computed tomography, their creation and solutions.
5. Acquire a basic knowledge of the cardiovascular applications of multidetector CT.
6. Obtain a thorough clinical knowledge of commonly encountered diseases stressing the role of CT in diagnosis, management planning, treatment, and follow-up, including recommendations for management of incidental findings.

## **PGY4/Core of Discipline 2**

### **Competencies:**

1. Enhancement of skills described for PGY3.
2. Ability to perceive major and minor findings without help in most examinations.
3. Ability to organize and present findings, offering a valid differential and recommendations without prompting.
4. Ability to hold a discussion on technical and current issues regarding CT examination in commonly encountered diseases.

### **Specific Objectives:**

1. Enhancement of knowledge described for PGY3.
2. Extend depth of knowledge base in common diseases.
3. Extend breadth of knowledge base to include less common diseases with pathognomonic findings on CT, specific findings that may mimic common conditions, or syndromes that CT has an important contribution in diagnosis, management or prognosis.
4. Able to discuss the strengths of CT versus other imaging modalities in the diagnosis of diseases in the chest, abdomen and pelvis.
5. Possession of a basic knowledge of the principles of CT enterography and CT colonography.

## **PGY5/Transition to practice**

### **Competencies:**

1. Enhancement of skills described for PGY4.
2. Ability to pick up major and minor findings with confidence.
3. Ability to make the appropriate first diagnosis in most examinations and include appropriate diseases in the differential.
4. Ability to act independently as a junior consultant in most situations in directing the day-to-day operations in the body CT area and providing consultations to clinical colleagues with appropriate recommendations for further imaging or management.

### **Specific Objectives:**

1. Enhancement of knowledge in areas described for PGY4.
2. Obtain thorough knowledge of the range application of CT in body imaging.

## **COMMUNICATOR**

1. Be able to obtain appropriate information from the health care team in order to properly protocol a CT exam or recommend a more appropriate imaging modality.
2. Understand the importance of communication with referring physicians, including an understanding of when the results of a CT must be urgently communicated.
3. Be able to discuss CT protocols with the technologist and address their questions or concerns about patient management.
4. Have the ability to produce a radiologic report which appropriately describes imaging findings in a concise manner, provides an accurate differential diagnosis and when appropriate recommends further tests or management.

**COLLABORATOR**

1. Have the ability to act as a junior consultant when reviewing CT exams with clinical colleagues.
2. Provide interpretation of CT findings when attending multidisciplinary rounds.
3. Function as a contributing member of a multidisciplinary health care team, interacting with technologists, nurses and clinical colleagues to provide the optimal patient care.

**LEADER**

1. Utilize the resource of CT effectively, determining the indications and urgency of the scan from information during consultation with the referring physicians.
2. Develop time and people management skills in directing the “day to day” scanning of elective and emergency patients.

**HEALTH ADVOCATE**

1. Understand the benefits and risks of CT for the general population (and when used for screening).
2. Be aware of the radiation dose the patient receives for standard body CT exams.
3. Recognize when a CT exam would be detrimental to the health of a patient.

**SCHOLAR**

1. Have the ability to be an effective teacher in body CT to junior residents, medical students, technologists and clinical colleagues.
2. Develop competency in evaluation of the medical literature in radiology, including that related to body CT.
3. Participate in an audit or research project.

**PROFESSIONAL**

1. Demonstrate appropriate personal and professional behavior when interacting with colleagues, technologists and patients.
2. Deliver the highest quality care with integrity, honesty and compassion.

**BODY CT RECOMMENDED READING**

1. Fundamentals of Body CT. 5<sup>th</sup> Edition. W. Richard Webb, William Brant, Nancy Majo
2. Meyers' Dynamic Radiology of the Abdomen. 6<sup>th</sup> Edition. Morton A. Meyers, Chusilp Charnsangavej, Michael Oliphant
3. Abdominal Imaging: The Core Requisites. 1<sup>st</sup> Edition. Joseph R. Grajo & Dushyant V Sahani & Anthony E Samir
4. Diagnostic Imaging: Emergency. 2nd Edition. R. Brooke Jeffrey Jr. MD (Author), B. J. Manaster MD PhD FACR (Author), Anne G. Osborn MD (Author), Melissa L. Rosado-de-Christenson MD FACR (Author), Paula J. Woodward MD
5. Computed Body Tomography with MRI Correlation - 2nd edition. Lee, Sagel, Stanley. CT and Sonography of the Acute Abdomen. R. Brooke Jeffrey, Jr.
6. Computed Tomography of the Thorax. Naidich, Zerhouni, Siegelman.
7. Thoracic Imaging, Second Edition, W. Richard Webb and Charles B. Higgins.

**BODY MR****PREAMBLE**

Each resident will do a minimum of 2 blocks (4-weeks per block) in Body MR, typically in the PGY4 and/or PGY5 years. This short exposure to body MR is intended to familiarize the residents with the scope of studies performed in body MR (including breast MR), the indications for the studies and common disease entities seen.

**ROTATION SPECIFIC GOALS & OBJECTIVES****PGY-4/5 (Core of Discipline and Transition to Practice)*****MEDICAL EXPERT/CLINICAL DECISION MAKER***

1. Understand basic MR physics.
2. Demonstrate knowledge of anatomy in three dimensions of commonly imaged abdominal organs.
3. Demonstrate knowledge of normal arterial and venous anatomy of the body and extremities.
4. Demonstrate knowledge of pathology of the liver, gallbladder, biliary tree, pancreas, adrenal glands, spleen and kidneys.
5. Demonstrate knowledge of gynecologic pathology, including congenital, physiologic and neoplastic processes as well as cancer staging.
6. Demonstrate knowledge of pathology of the breasts including the principles of breast MRI.
7. Demonstrate knowledge of common diseases/congenital abnormalities of the heart and peripheral vascular system.
8. Understand the indications for imaging of the liver, gallbladder, biliary tree, pancreas, adrenal glands, spleen and kidneys with MR and be familiar with the common protocols used in body MR, including patient preparation.
9. Understand the indications, contra-indications, and limitations of imaging of body MR and be familiar with the common protocols used in body MR.
10. Have knowledge of common artifacts and MR imaging, their creation, and possible solutions.

***COMMUNICATOR***

1. To be able to obtain appropriate information from the health care team in order to properly protocol an MR exam or recommend a more appropriate imaging modality.
2. Understand the importance of communication with referring physicians, including an understanding of when the results of a MR must be urgently communicated.
3. Be able to discuss MR protocols with the technologist and address their questions or concerns about patient management. Be able to adapt to limitations that have to do with motion, renal function hardware.
4. Have the ability to produce a radiological report, which appropriately describes imaging findings in a concise manner, provides an accurate differential diagnosis and when appropriate, recommends further tests or management.

***COLLABORATOR***

1. Have the ability to review important MR findings with clinical colleagues.
2. Function as a contributing member of the multi-disciplinary health care team, interacting with technologist, nurses and clinical colleagues to provide the optimal patient care.

***LEADER***

1. Utilize the resource of MR effectively, determining the indications and urgency of the scan from information during consultation with referring physicians.



**HEALTH ADVOCATE**

1. Understand the benefits and risks of MR for the general population. Be aware of when MR may be used as a problem solver in difficult, diagnostic cases.

**SCHOLAR**

1. Have the ability to be an effective teacher in MR to junior resident, medical students, technologist, and clinical colleagues.
2. Develop competency in evaluation of the medical literature and radiology including that related to MR.
3. Participate in an audit or research project involving MR when available.

**PROFESSIONAL**

1. Demonstrate appropriate personal and professional behavior when interacting with colleagues, technologist, and patients.
2. Deliver the highest quality of care with integrity, honesty, and compassion.

**RECOMMEND READING**

1. Computed Body Tomography with MRI Collation – 4<sup>th</sup> Ed. Lee, Sagel, Stanley, Heiken.
2. Fundamentals of Body MRI - 2d Ed, Roth, Deshmukh
3. Abdominal - Pelvic MRI - 4<sup>th</sup> Ed, Semelka
4. MRI of the Whole Body - 1<sup>st</sup> Ed, Bhuskute
5. Handbook of Breast MRI - 1<sup>st</sup> Ed Price
6. ARRS Body MRI: How to provide value-based care – Coakley and Mortelet
7. Magnetic Resonance Angiography Principles and Applications - 1<sup>st</sup> Ed, Carr, Carroll

**ULTRASOUND****PREAMBLE**

Over the course of their training radiology residents rotate through and supervise or participate in studies done in several locations (see below). The ultrasound rotations, in total, consist of a minimum of four blocks in the ultrasound Department at FMC with two additional blocks at the Maternal Fetal Medicine Centre focusing on obstetrical ultrasound. By the end of their residency program Residents will be expected to supervise and interpret studies done at these sites. Residents also attend “rounds” related to these specific services.

Ultrasound imaging at the Foothills Medical Center (FMC) Campus is performed in the following locations:

- “Main Ultrasound Department” (Special Services Building at FMC)
  - Coordinates and performs most of the ultrasound imaging done at FMC.
  - There are seven scanning rooms in the main department utilized for interventional, first trimester ultrasound, small parts, and general abdominal imaging.
- “Contrast Enhanced Ultrasound Department” (Special Services Building at FMC)
  - Adjacent to the Main US Department
  - There two scanning rooms which are dedicated to detailed “*bowel*” and *contrast enhanced ultrasound (CEUS)* imaging.
- “ER/ICU Ultrasound Department (McCaig Tower at FMC)
  - A satellite ultrasound-imaging site (2 ultrasound rooms) is located adjacent to the Emergency Department and the main Intensive Care Unit in the McCaig Building.
  - Patients from ICU and ER requiring ultrasound imaging 7 days a week (0800-2300h), weekend are scanned in this location.
- Portable ultrasounds
  - Performed on various wards and departments as required.
- Neonatal Intensive Care Unit
  - Portable ultrasound imaging is performed twice-a-week.
- Breast Imaging Center
  - A dedicated breast-imaging department has been developed with its own ultrasound equipment used for breast imaging and interventional studies. The resident will learn breast ultrasound during the Mammography and Breast Imaging rotation.

The Main Department at FMC has a staff of ~20 certified ultrasound technologists and is also a major training center of the Regional Ultrasound Technologist Training Program (Southern Alberta Institute of Technology—SAIT).

- **NICU Imaging studies:** The radiologist in the Ultrasound Department reviews the x-ray and cranial ultrasound imaging performed in the NICU.
- **Daily Reading of NICU X-rays:** Residents doing their ultrasound rotation are encouraged to review the assigned “plain film” imaging studies from the NICU. The radiologist will then review these cases with the resident.
- **Weekly NICU Rounds:** These rounds are conducted with the NICU staff. During these rounds, most of the NICU imaging (including cranial ultrasound and x-rays) are reviewed with the NICU Consultant Staff and/or the Residents/Fellows.

## **ROTATION SPECIFIC GOALS AND OBJECTIVES:**

### ***MEDICAL EXPERT/CLINICAL DECISION MAKER***

#### **GENERAL ULTRASOUND**

#### **First 2 Rotations—(PGY2)/ Foundations of Discipline**

1. Development of basic scanning skills.
  - Residents are assigned daily or weekly to a particular technologist and radiologist who are responsible for teaching the resident scanning skills.
2. Knowledge of ultrasound equipment and performing of ultrasound study independently.
  - This includes ultrasound survey studies of the abdomen, pelvis and small parts imaging of the thyroid and scrotum for example. Breast ultrasound is primarily learned separately during the “breast-imaging” rotation.
3. Knowledge of the utility, indications, and limitations of various ultrasound studies.
  - Development of this skill set is required as preparation for the assumption of on-call responsibilities, which begin six months into the radiology residency training program.
4. Basic reporting skills.
  - Throughout the course of their first two blocks in ultrasound, basic reporting skills are developed and refined.
  - By the end of the first two blocks, residents are reporting most general ultrasound imaging studies (all reports are reviewed with the attending radiologist).
5. Basic interventional skills.
  - Using ultrasound for initial diagnosis, planning ultrasound guided interventions, and performance of ultrasound-guided procedures is also developed during this rotation. These skills are developed under close supervision by the attending radiologists and/or physician assistant. Only when their skill set is sufficiently refined do the radiology residents begin performing these procedures. Residents hone their interventional skills by initially performing ultrasound-guided **paracentesis**, and **thoracentesis**. More advanced interventions are performed in late rotations.

- The resident must be competent in performing an ultrasound-guided **paracentesis** and **thoracentesis** prior to starting call.
6. Consult with referring clinicians.
- Residents are encouraged by the end of their first two-month rotation to consult with referring clinicians requesting ultrasound services as well as triaging of written referrals.

### **Third Rotation—(PGY3 or PGY4)/ Core of Discipline**

1. Enhance skills developed in PGY2.
2. Re-evaluation of the resident's scanning technique.
  - Depending on the level of the resident ultrasound scanning skills, remedial time (during the first two weeks of this rotation) may be spent with departmental technologists refining their ultrasound "scanning skills".
3. More advanced or complicated invasive ultrasound procedures.
  - These are done only when the resident's scanning and interpretive skills are at a level where the staff radiologist feels comfortable allowing the resident to perform these examinations and procedures. In all cases, the staff radiologist is available to review and/or revise the resident's ultrasound-guided interventional strategy.
  - Residents are expected to have a safe and independent approach to performing a thoracentesis and paracentesis independently during their initial ultrasound rotations in PGY2.
  - LIVER & THYROID Biopsies:
    - Residents are encouraged to begin performing liver biopsies, thyroid fine needle aspirations and small parts/MSK biopsies.
  - RENAL Biopsies:
    - Renal biopsy interventions are generally not performed until their last two block rotations in ultrasound.
  - LIVER & RENAL **TRANSPLANT** Biopsies:
    - Biopsy of renal transplants and liver transplants are only performed by the **staff** radiologist.
    - Residents are free to observe.
4. Development of increasing responsibility for supervision of the daily ultrasound imaging consultations and technologist/case supervision.
  - The level of independent supervision of these studies is commensurate with the resident's skill as determined by the attending staff radiologists.
5. Further development of reporting skills.
  - During this phase of their ultrasound training, the resident is expected to report all his/her exams to the satisfaction of the staff radiologists.
6. Development of skills necessary to perform and/ or supervise endocavitary imaging.
  - This includes transvaginal/endovaginal ultrasound. Endorectal ultrasound is rarely performed in hospital setting. Resident may choose to participate in such a study under supervision.
  - The resident is expected to have the necessary technical skill to be able to perform these exams independently.

#### **Fourth Rotation – (PGY4 or PGY5)/Core of Discipline and Transition to Practice**

1. Refinement of advanced ultrasound skills:
  - Including Doppler and transplant organ ultrasound.
2. Ability to supervise the department.
  - The resident should be able to consult, triage, and supervise virtually all cases referred to ultrasound.
3. Echocardiography.
  - Adult and fetal echocardiography is not part of the routine Ultrasound rotations but can be done as part of an elective.
4. “Contrast Enhanced Ultrasound service (CEUS) and Bowel Ultrasound.”
  - At FMC, a dedicated “Contrast Enhanced Ultrasound service (CEUS) and ultrasound imaging service for bowel related illness, primarily inflammatory bowel disease, is available as an elective block for residents to develop a basic understanding of contrast enhanced ultrasound and ultrasound imaging of bowel. Experience in these areas is also available during the afternoons of the Senior Resident’s Clinic block.
5. Gynecologic Imaging.
  - The resident’s primary experience in gynecologic ultrasound occurs at the Foothills Medical Centre Ultrasound Department which provides ultrasound services for the management of various oncologic and non-oncologic gynecology referrals from the major Southern Alberta Cancer Centre, a large urban emergency and trauma center, and from a busy general gynecology service.
6. Obstetrical Imaging.
  - During the general ultrasound rotation, the resident will focus on obstetrical imaging that is most commonly seen in emergency cases (e.g. first trimester bleeding, ectopic pregnancy). Anatomic scans and knowledge of the anatomy and pathology pertaining to these scans is learned in the context of MFM rotations.

#### **COMMUNICATOR**

1. When performing an ultrasound exam, residents learn to establish an appropriate “physician-consultant” relationship with the patient, their family, and the healthcare team. Importance of informed consent, and appropriate/sensitive disclosure of results is stressed.
2. The resident learns to communicate effectively with the patient when performing an invasive ultrasound-guided procedure. This includes providing the necessary information to the patient to allow meaningful informed consent, as well as addressing any concerns during a diagnostic or interventional ultrasound procedure.
3. The “real-time” nature of ultrasound exams requires that the resident learn to effectively address patient’s immediate concerns in a sensitive, and accurate fashion.
4. Triage of studies: given the huge demand placed on Diagnostic Imaging resources, it is vital that residents develop skills in communicating with the referring healthcare team such that the most appropriate study is performed within a timeframe commensurate with the acuity of the illness. This involves developing skills in obtaining relevant clinical information necessary to determine if ultrasound is the appropriate examination in a particular circumstance. The resident is expected to be able to recommend, and as necessary arrange the appropriate imaging investigations.
5. The integral role played by ultrasound technologist is stressed and residents learn to interface with the technologist team so as to maximize their performance and accuracy.

6. There are a number of regularly scheduled rounds including weekly MFM and NICUE rounds and regularly scheduled Noon rounds. Residents are periodically required to present these rounds or contribute case presentations.

#### ***COLLABORATOR***

1. When ultrasound studies are requested residents learn to effectively communicate with the ultrasound technologist team, the referring healthcare team/consultants, and as necessary the patient and/or family.
2. Unscheduled operative ultrasound examinations, and requests for portable ultrasound studies frequently occur. Residents are encouraged to develop a collaborative but appropriate and patient centered strategy in managing these circumstances.
3. Residents develop the skill to function as a team member in the Ultrasound Department working with staff radiologists, and technologists to provide optimum patient care.

#### ***LEADER***

1. Utilize the resources of ultrasound (both technology and technologist) effectively both during regular working hours and on call, to optimize health care for the patient. Residents develop an understanding of health care costs relevant to ultrasound, including equipment cost, maintenance cost and human resource cost, and are encouraged to be appropriately sensitive to these issues.
2. Be able to supervise the department. The resident should be able to consult, triage, and supervise virtually all cases referred to ultrasound.
3. Be competent in using PACS systems.
4. When available, the resident is encouraged to participate in quality assurance studies in ultrasound.

#### ***HEALTH ADVOCATE***

1. Understand the benefits and risks of an ultrasound exam with regard to different patient populations including: the fetus, neonate, child, and adult.
2. Understand the benefits and limitations of ultrasound in evaluating various medical conditions.
3. Developing efficient, useful and value-added algorithms in evaluating various medical conditions.
4. Recognizing when an ultrasound exam or ultrasound-guided interventional procedure may be detrimental to the health of the patient.
5. Recruiting the necessary human resource (technologists and staff radiologists) and equipment resources to perform studies in appropriate time-frame.

#### ***SCHOLAR***

1. Through rounds, journal club and attendance at critical appraisal courses learn to critically evaluate sources of medical information.
2. Be an effective teacher of ultrasound to junior residents, medical students, technologists, and technologist students.
3. Actively contribute to general ultrasound, NICU and/or MFM rounds by preparing and presenting cases.
4. Participate in radiology research projects that may involve ultrasound.
5. Develop, implement, and monitor personal continuing education strategy.

#### ***PROFESSIONAL***

1. When interacting with patients, their families, technologists, and any member of the healthcare team, demonstrate appropriate personal and professional behavior.
2. Deliver the highest quality care in ultrasound with integrity, honesty, and compassion.

**RESOURCES (PGY-2 to PGY-5):**

1. Ultrasound: The Requisites, 3rd Ed - Hertzberg B, Middleton W, Elsevier
2. Diagnostic Ultrasound, 4<sup>th</sup> Ed - Rumack, Wilson, Levine, Charbonneau
3. Vascular Ultrasonography, 7<sup>th</sup> Ed – Pellerito, Polak
4. On-line resources: RadPrimer, STATdx.
5. Online resident Library – collection of online presentations and core articles
6. Ultrasound technology training supervisors.
7. Thursday afternoon resident lecture series.
8. In-house physics teaching, and teaching coordinator.

## **THORACIC IMAGING**

### **PREAMBLE**

Each resident will complete a minimum of six 4-week blocks doing thoracic radiology during the residency training program. These will occur between the PGY2 to PGY5 years. Further exposure to thoracic radiology can be obtained electively.

Cardiac imaging is covered on the following rotations:

- Cardiac CT/MRI
- Thoracic
- Nuclear Medicine

Interventional thoracic techniques are learned on interventional rotations.

### **ROTATION SPECIFIC GOALS AND OBJECTIVES:**

#### ***MEDICAL EXPERT/CLINICAL DECISION MAKER***

##### **PGY2/Foundations of Discipline**

1. Ability to determine if a chest radiograph is technically adequate and how to correct common technical problems - i.e. quality assurance.
2. Knowledge of how the various thoracic imaging methods are performed.
3. Emphasis should be on general approach to chest radiograph interpretation.
4. Knowledge of anatomy and normal variants of thoracic structures on CXR and CT.
5. Ability to recognize and give basic differential diagnosis of major patterns of thoracic diseases.
6. Ability to recognize and interpret disease processes in the chest for acutely sick and injured patients (e.g. trauma, pulmonary embolism, empyema, etc.)

##### **PGY3/Core of Discipline 1**

1. To learn the pathologic basis of lung disease as well as the clinical and radiographic manifestations of all major thoracic diseases.
2. Knowledge of the indications and contraindications of the various thoracic imaging methods.
3. Ability to recognize disease on Chest radiography, CT, including HRCT, and thoracic MRI and to give a differential diagnosis based on the pattern(s) seen.
4. Gain familiarity with the most up to date clinical practice guidelines necessary in the diagnosis and management of interstitial lung disease:
  - Fleischner society and ATS guidelines on UIP/IPF
  - ATS clinical practice guideline on diagnosis/management of hypersensitivity pneumonitis

##### **PGY4/Core of Discipline 2**

1. Further development of year 3 skills.
2. Be able to hold an organized discussion of findings and give a rank-ordered list of differentials without prompting for most chest cases at radiology rounds.
3. Begin tackling more challenging thoracic imaging cases (for example: lung cancer staging, CT follow-up of lung cancer patients post-radiation or immunotherapy, and thoracic MRI cases including thymic MRI).
4. Further develop consultative skills.

##### **PGY5/Transition to Practice**



1. Consolidate the above and improve on all weaknesses.

### **COMMUNICATOR**

#### **PGY2/Foundations of Discipline**

1. Communicate effectively with medical imaging technologists in protocolling and triaging thoracic imaging requests.
2. Understand the importance of communication with referring physicians, including an understanding of when the results of an investigation or procedure should be urgently communicated.
3. Generate a radiologic report that will appropriately describe the imaging findings and includes an appropriate differential diagnosis.
4. Communicate effectively with patients and their families and have an understanding of the impact disease will have on the patient and their family.

#### **PGY3/Core of Discipline 1**

1. Further development of PGY2 skills.
2. Be able to discuss appropriate information with the health care team.

#### **PGY4/Core of Discipline 2**

1. Further development of PGY3 skills.
2. Be comfortable with discussing cases at clinical rounds.
3. Be able to obtain appropriate information during consultation with referring physicians to be able to provide recommendations regarding the most appropriate investigation and/or management of the patient.
4. Develop ability to teach thoracic imaging to clinical as well as more junior radiology residents.

#### **PGY5/Transition to Practice**

1. Consolidate above skills.

### **COLLABORATOR**

#### **PGY2 to PGY5/Foundations to Transition to Practice Stages**

1. Begin to learn at the PGY1 level and perfect at the PGY5 level how to consult effectively with other physicians and health care professionals.
2. Attend and contribute effectively at interdisciplinary rounds.

### **LEADER**

#### **PGY2 to PGY5/Foundations to Transition to Practice Stages**

1. Learn to prioritize cases to best utilize limited resources.
2. Work effectively and efficiently with the pulmonary, thoracic and general surgery teams to provide the optimal patient care.
3. Utilize information technology in thoracic, cardiac to optimize patient care, life-long learning and other activities.

### **HEALTH ADVOCATE**

#### **PGY2 to PGY5/Foundations to Transition to Practice Stages**

1. Understand the benefits and risks of radiological investigations of the chest (radiography, US, CT, MRI, angiography) including population screening.
2. Recognize when radiologic investigation or treatment would be detrimental to the health of the patient.
3. Recognize external factors that may cause or contribute to pulmonary, cardiac or disease (smoking, pollution, allergens, organisms, etc.)
4. Recognize and respond to those issues where advocacy is appropriate.

## **SCHOLAR**

### **PGY2/Foundations of Discipline**

1. Demonstrate willingness to share knowledge learned in the teaching of technical students.

### **PGY3 to PGY5/Core of Discipline to Transition to Practice**

1. Be an effective teacher of radiology to medical students, junior residents, technologists and clinical colleagues.
2. Learn to critically appraise the medical literature.
3. Understand and partake in the learning tools available (computers, literature searches, conferences, etc.) to provide ongoing and life-long continued medical education.
4. Consider conducting an audit or research project in an area of thoracic imaging.

## **PROFESSIONAL**

### **PGY2 to PGY5/Foundation to Transition to Practice Stages**

1. Exhibit appropriate professional behavior in interaction with patients, colleagues and staff.
2. Provide the highest quality of care with integrity, honesty and compassion.

## **THORACIC IMAGING SUGGESTED READING LIST**

### **PGY2/Foundation of Discipline**

1. Goodman L. Felson's Principles of Chest Roentgenology, (5<sup>th</sup> Ed). Saunders. 2019.
2. Webb W, Major N, Brant W. Fundamentals of Body CT (5<sup>th</sup> Ed). Saunders. 2019
3. Brant W, Helms C. Fundamentals of Diagnostic Radiology (5<sup>th</sup> Ed). Lippincott Williams & Wilkins, 2018
4. Webb RW, Higgins CB. Thoracic Imaging: Pulmonary and Cardiovascular Radiology, 3<sup>rd</sup> Ed. Lippincott Williams & Wilkins. 2016.
5. [Chest Radiology: Plain Film Patterns and Differential Diagnoses, Expert Consult - Online and Print, 7e](#) by James C. Reed (Dec 6 2017)

### **PGY3 to PGY5/Core of Discipline to Transition to Practice**

1. Webb RW, Higgins CB. Thoracic Imaging: Pulmonary and Cardiovascular Radiology, 3<sup>rd</sup> Ed. Lippincott Williams & Wilkins. 2016.
2. Shepard, J. Thoracic Radiology, the Requisites, 3<sup>rd</sup> Ed. Elsevier, 2018
3. Webb, Muller, Naidich. High Resolution CT of the Lung, 6<sup>th</sup>. Ed, Lippincott Williams & Wilkins, 2021.
4. Fundamentals of High Resolution Lung CT: Common findings, Common Patterns, Common Diseases and Differential Diagnosis (2<sup>nd</sup> Ed). Wolters Kluwer, 2018.
5. Muller's Imaging of the Chest: Expert Radiology Series (2<sup>nd</sup> Ed.) Elsevier, 2018.
6. [Thoracic Imaging: Case Review Series, 2e](#) by Theresa C. McLoud, Phillip M. Boiselle and Gerald F. Abbott (Nov 12 2010)
7. Hobbs, Cox C. Thoracic Imaging: A Core Review (2<sup>nd</sup> Ed.) Wolters Kluwer, 2020.

**CARDIAC IMAGING****PREAMBLE**

Cardiac imaging experience occurs on several different services. There is one dedicated Cardiac CT/MRI block, typically during the PGY3 year. Mondays, Wednesdays Fridays, residents are assigned to the Cardiac MRI service at the Stephenson Cardiac Imaging Centre in the basement floor of FMC Main Building. Tuesdays and Thursdays will be dedicated to Cardiac CT in the Special Services Building Ground floor by the Siemens FORCE scanner.

Normal cardiac anatomy and plain film interpretation are covered on Thoracic and Body CT rotations each year. Nuclear cardiac imaging is taught as part of the nuclear medicine experience. Pediatric cardiac imaging is taught as part of the pediatric rotation. Echocardiography is available as an elective.

**ROTATION SPECIFIC GOALS AND OBJECTIVES:*****MEDICAL EXPERT/CLINICAL DECISION MAKER*****PGY-2/Foundations of Discipline**

Initial cardiac experience is gained on several rotations including Body CT, Chest and nuclear medicine.

General cardiovascular anatomy, and emergencies/urgencies:

1. Identify anatomy of the heart, coronary arteries, and great vessels amongst different modalities including: CT, radiographs, and MRI.
2. Learn imaging modalities available and appropriate for assessing different cardiac pathology.
3. Identify radiographic features of pulmonary edema, acute aortic injury/transection, and valvular heart disease.
4. Approach to enlarged cardiac/pericardial silhouette including: technique, cardiomegaly and pericardial effusion.
5. Distinguish between common cardiac and mediastinal calcifications on radiographs (pericardial, myocardial, valvular, and aortic).
6. Identify acute aortic syndromes: (aortic dissection, intramural hematoma, penetrating ulcer, and transection).
7. Identify pulmonary emboli and secondary features of increase right-sided pressures.
8. Identify left atrial appendage thrombus vs. artifact.

**PGY-3/Core of Discipline 1**

Cardiac experience in PGY3 primarily occurs on the Cardiac CT/MR rotation. However, additional cardiac imaging experience will continue to occur on the Chest, Body CT and Nuclear Medicine rotations.

***Ischemic heart disease:***

1. Understand the technical parameters of cardiac CTA, including: spatial and temporal resolution, prospective vs. retrospective ECG-gating, dose.
2. Identify appropriate patients for Cardiac CTA according to CAR guidelines.
3. Learn indications and contraindications of pharmacologic heart rate control prior to CTA.
4. Describe the anatomy of the coronary arteries and identify the following on a coronary CT angiogram: right coronary artery, left main coronary artery, left anterior descending coronary artery, left circumflex coronary artery.
5. Describe the common late complications of myocardial infarction, including ischemic cardiomyopathy, left ventricular aneurysm, left ventricular pseudoaneurysm, coronary-cameral fistula, dyskinesis and akinesis and recognize CT findings that may indicate these.

6. Describe CT and MRI role on characterization of myocardial viability and understand its clinical applications
7. Define ejection fraction and state the normal left ventricular ejection fraction
8. Gain familiarity and learn about the use of Cardiac CT in the planning of minimally invasive procedures, or post-procedure complications for example:
  - a. Transcatheter aortic valve replacement/intervention (TAVR/TAVI)
  - b. Minimally invasive aortic and mitral valve repair
  - c. Left atrial appendage mapping and planning for closure devices
  - d. Pulmonary vein anatomy for catheter directed pulmonary vein ablation
  - e. Complications related to prosthetic valve (paravalvular leak, abscess or pseudoaneurysm)

***Non-ischemic acquired heart disease:***

1. State the most common benign and malignant primary cardiac tumors.
2. Distinguish cardiac tumor from thrombus on CT and MR.
3. State the advantages and disadvantages of echocardiography, CT, and MR in the evaluation of cardiomyopathy and cardiac tumors.
4. Identify and describe findings of valvular heart disease on radiographs and CT.
5. Recognize MR findings to differentiate constrictive pericarditis from restrictive cardiomyopathy.
6. Identify endocarditis and/or complications of endocarditis on radiographs, chest CT and chest MRI.

**PGY-4/Core of Discipline 2**

Cardiac experience is gained on the Chest, Body MRI, Body CT and Pediatrics rotations.

***Congenital heart disease:***

1. Recognize increased vascularity, decreased vascularity and shunt vascularity on a chest radiograph and state the common causes of each.
2. Heart failure in the infant or child – give a differential diagnosis for pulmonary edema in the following situations: Newborn, 3 months of age, 6 months of age, 2 years of age, 6 years of age.
3. State the differential diagnosis of dextrocardia.
4. State the definition and describe the abnormalities associated with isomerism.
5. Recognize devices in the postoperative patient with congenital heart disease including PDA ligation clip, pulmonary artery band, mesh closure of ASD, embolization of Blalock or aortopulmonary collateral, pulmonary conduit.
6. Recognize CT and MRI findings of the following congenital heart diseases:
  - a) Left-to-right shunts and Eisenmenger physiology
  - b) Atrial septal defect
  - c) Ventricular septal defect
  - d) Partial anomalous pulmonary venous connection
  - e) Patent ductus arteriosus
  - f) Coarctation of aorta
  - g) Tetralogy of Fallot and pulmonary atresia with ventricular septal defect
  - h) Transposition of the great arteries
  - i) Persistent left superior vena cava
  - j) Truncus arteriosus
  - k) Ebstein anomaly
  - l) Cardiac malposition, including abnormal situs
  - m) Complete transposition of the great arteries
  - n) Congenitally corrected transposition of the great arteries
  - o) Truncus arteriosus
  - p) Commonly performed surgical corrections for congenital heart disease

### **PGY-5/Transition to Practice**

Cardiac experience is gained on the Chest, Body MRI and Body CT rotations.

#### ***Ischemic Heart Disease:***

1. Define the role of angiography, echocardiography, stress perfusion scintigraphy, CT, and MRI in the evaluation of a patient with suspected ischemic heart disease, including the advantages and limitations of each modality.

#### ***Non-ischemic acquired heart disease:***

1. Identify and describe findings of valvular heart disease on MRI.
2. Recognize MR findings to differentiate constrictive pericarditis from restrictive cardiomyopathy.
3. List the MR findings suggestive of the most common cardiomyopathies including hypertrophic, dilated and restrictive cardiomyopathies.
4. Identify the MR findings suggestive of ARVD.
5. Understand principles and limitations of cardiac MR.

### **COMMUNICATOR**

#### **PGY-2/Foundations of Discipline**

1. Understand the importance of communication with referring physicians, including an understanding of when the results of an investigation or procedure should be urgently communicated.
2. Generate a radiologic report that will appropriately describe the imaging findings and includes an appropriate differential diagnosis.
3. Communicate effectively with patients and their families and have an understanding of the impact disease will have on the patient and their family.

#### **PGY-3/Core of Discipline 1**

1. Further development of PGY2 skills.
2. Be able to discuss appropriate information with the health care team.

#### **PGY-4/Core of Discipline 2**

1. Further development of PGY3 skills.
2. Be comfortable with discussing cases at clinical rounds.
3. Be able to obtain appropriate information during consultation with referring physicians to be able to provide recommendations regarding the most appropriate investigation and/or management of the patient.
4. Develop ability to teach thoracic, cardiac and breast imaging to clinical as well as more junior radiology residents.

#### **PGY-5/Transition to Practice**

1. Consolidate above skills.

### **COLLABORATOR**

#### **PGY-2 to PGY-5/Foundations of Discipline to Transition to Practice Stages**

1. Begin to learn at the PGY1 level and perfect at the PGY5 level how to consult effectively with other physicians and health care professionals.
2. Contribute effectively at interdisciplinary rounds.

### **LEADER**

#### **PGY-2 to PGY-5/Foundations of Discipline to Transition to Practice Stages**

1. Learn to prioritize cases to best utilize limited resources.
2. Work effectively and efficiently with the pulmonary, thoracic, cardiac and general surgery teams to provide the optimal patient care.
3. Utilize information technology in thoracic, cardiac and breast imaging to optimize patient care, life-long learning and other activities.

## **HEALTH ADVOCATE**

### **PGY-2 to PGY-5/Foundations of Discipline to Transition to Practice Stages**

1. Understand the benefits and risks of radiological investigations of the heart (radiography, US, CT, MRI, mammography, angiography) including population screening.
2. Recognize when radiologic investigation or treatment would be detrimental to the health of the patient.
3. Recognize external factors that may cause or contribute to cardiac disease (smoking, etc.).
4. Recognize and respond to those issues where advocacy is appropriate.

## **SCHOLAR**

### **PGY-2/Foundations of Discipline**

1. Demonstrate willingness to share knowledge learned in the teaching of technical students.

### **PGY-3 to PGY-5/Core of Discipline to Transition to Practice Stages**

1. Be an effective teacher of radiology to medical students, junior residents, technologists and clinical colleagues.
2. Learn to critically appraise the medical literature.
3. Understand and partake in the learning tools available (computers, literature searches, conferences, etc.) to provide ongoing and life-long continued medical education.
4. Consider conducting an audit or research project in an area of cardiac imaging.

## **PROFESSIONAL**

### **PGY-2 to PGY-5/Foundations of Discipline to Transition to Practice Stages**

1. Exhibit appropriate professional behavior in interaction with patients, colleagues and staff.
2. Provide the highest quality of care with integrity, honesty and compassion.

## **CARDIAC IMAGING SUGGESTED READING LIST:**

1. [Cardiac Imaging: The Requisites, 4e](#) by Suhny Abbara and Lawrence Boxt (Oct 14 2015)
2. Webb RW, Higgins CB. Thoracic Imaging: Pulmonary and Cardiovascular Radiology, 3<sup>rd</sup> Ed. Lippincott Williams & Wilkins. 2016.
3. [MRI and CT of the Cardiovascular System 3<sup>rd</sup> Ed.](#) by Charles B. Higgins and Albert de Roos MD (Aug 12 2013)
4. [Radiology of the Heart: Cardiac Imaging in Infants, Children, and Adults](#) by Hugo Spindola-Franco, Bernard G. Fish, Robert Eisenberg and Charles B. Higgins (Dec 14 2011)
5. [CT and MR Angiography: Comprehensive Vascular Assessment](#) by Geoffrey D. Rubin MD and Neil M. Rofsky MD (Aug 6 2008)
6. [Cardiovascular Magnetic Resonance, 2e](#) by Warren J. Manning and Dudley J. Pennell (Apr 5 2010)
7. [Cardiac Imaging](#) by Charles S. White, Linda B. Haramati, Joseph Jen-Sho Chen and Jeffrey M. Levsky (Mar 25 2014)
8. [Clinical Cardiac MRI](#) by A.L. Baert, N. Al-Saadi, J. Bogaert and H. Bosmans (Sep 21 2005)
9. Cardiovascular MRI: Physical principles to practice protocols. Lee, Vivian. 2006.

## Suggested Articles:

1. [Describing Congenital Heart Disease by Using Three-Part Segmental Notation](#). Erica K. Schallert, Gary H. Danton, Richard Kardon, and Daniel A. Young. *RadioGraphics* 2013 33:2, E33-E46.
2. [Quantification in Cardiovascular MRI: A Primer for Radiology Residents](#) Kevin R. Kalisz and Kianoush Ansari-Gilani. *RadioGraphics* 2020 40:7, 1832-1833
3. [A Pattern-based Approach to Assessment of Delayed Enhancement in Nonischemic Cardiomyopathy at MR Imaging](#). Kristopher W. Cummings, Sanjeev Bhalla, Cylen Javidan-Nejad, Andrew J. Bierhals, Fernando R. Gutierrez, and Pamela K. Woodard. *RadioGraphics* 2009 29:1, 89-103.
4. [Anomalous Coronary Arteries That Need Intervention: Review of Pre- and Postoperative Imaging Appearances](#) Prachi P. Agarwal, Carole Dennie, Elena Pena, Elsie Nguyen, Troy LaBounty, Bo Yang, and Smita Patel. *RadioGraphics* 2017 37:3, 740-757
5. [Congenital Variants and Anomalies of the Aortic Arch](#). Kate Hanneman, Beverley Newman, and Frandics Chan. *RadioGraphics* 2017 37:1, 32-51
6. [Hypertrophic Cardiomyopathy from A to Z: Genetics, Pathophysiology, Imaging, and Management](#). Ameya Jagdish Baxi, Carlos S. Restrepo, Daniel Vargas, Alejandro Marmol-Velez, Daniel Ocazonez, and Horacio Murillo. *RadioGraphics* 2016 36:2, 335-354
7. [Pre- and Postoperative Imaging of the Aortic Root](#). Kate Hanneman, Frandics P. Chan, R. Scott Mitchell, D. Craig Miller, and Dominik Fleischmann. *RadioGraphics* 2016 36:1, 19-37
8. [Cardiac Physiology for Radiologists: Review of Relevant Physiology for Interpretation of Cardiac MR Imaging and CT](#). Pooja J. Sheth, Gary H. Danton, Yoel Siegel, Richard E. Kardon, Juan C. Infante, Jr, Eduard Ghersin, and Joel E. Fishman. *RadioGraphics* 2015 35:5, 1335-1351
9. [Building a Bridge to Save a Failing Ventricle: Radiologic Evaluation of Short- and Long-term Cardiac Assist Devices](#). Inas Mohamed, Charles T. Lau, Michael A. Bolen, Ahmed H. El-Sherief, Joseph T. Azok, Jamshid H. Karimov, Nader Moazami, and Rahul D. Renapurkar. *RadioGraphics* 2015 35:2, 327-356
10. [Preprocedural CT Evaluation of Transcatheter Aortic Valve Replacement: What the Radiologist Needs to Know](#). Rodrigo A. Salgado, Jonathon A. Leipsic, Bharati Shivalkar, Lenz Ardies, Paul L. Van Herck, Bart J. Op de Beeck, Christiaan Vrints, Inez Rodrigus, Paul M. Parizel, and Johan Bosmans. *RadioGraphics* 2014 34:6, 1491-1514
11. [Ascending Thoracic Aorta: Postoperative Imaging Evaluation](#). Julia A. Prescott-Focht, Santiago Martinez-Jimenez, Lynne M. Hurwitz, Jenny K. Hoang, Jared D. Christensen, Brian B. Ghoshhajra, and Suhny Abbara. *RadioGraphics* 2013 33:1, 73-85
12. [Complications of Aortic Valve Surgery: Manifestations at CT and MR Imaging](#). Nancy Pham, Hesham Zaitoun, Tan Lucien Mohammed, Erasmo DeLaPena-Almaguer, Felipe Martinez, Gian M. Novaro, and Jacobo Kirsch. *RadioGraphics* 2012 32:7, 1873-1892.
13. [Identifying, Characterizing, and Classifying Congenital Anomalies of the Coronary Arteries](#). Jabi E. Shriki, Jerold S. Shinbane, Mollie A. Rashid, Antereas Hindoyan, James G. Withey, Anthony DeFrance, Mark Cunningham, George R. Oliveira, Bill H. Warren, and Alison Wilcox. *RadioGraphics* 2012 32:2, 453-468
14. [Anatomy of the Heart at Multidetector CT: What the Radiologist Needs to Know](#). James P. O'Brien, Monvadi B. Srichai, Elizabeth M. Hecht, Daniel C. Kim, and Jill E. Jacobs. *RadioGraphics* 2007 27:6, 1569-1582
15. [MR Imaging of Cardiac Tumors](#). Patrick J. Sparrow, John B. Kurian, Tim R. Jones, and Mohan U. Sivananthan. *RadioGraphics* 2005 25:5, 1255-1276
16. CAD-RADS™ Coronary Artery Disease – Reporting and Data System. An expert consensus document of the Society of Cardiovascular Computed Tomography (SCCT), the American College of Radiology (ACR) and the North American Society for Cardiovascular Imaging (NASCI). Endorsed by the American College of Cardiology. *Journal of Cardiovascular Computed Tomography*, Volume 10, Issue 4, 2016. (<https://www.sciencedirect.com/science/article/pii/S193459251630048X>)

**EMERGENCY RADIOLOGY (BODY)****PREAMBLE**

All residents receive at least two blocks in Emergency Radiology. This rotation includes body CT, ultrasound, thoracic imaging, musculoskeletal imaging, and plain radiographs (as well as neuroimaging).

**ROTATION SPECIFIC GOALS AND OBJECTIVES:****PGY-2/Foundations of Discipline*****MEDICAL EXPERT/CLINICAL DECISION MAKER***

1. Use PACS for interpretation of imaging studies.
2. Resident should learn how to triage examinations related to their urgency and how to work efficiently to get required studies performed and interpreted.
3. Improve skills for advising Emergency Medicine physicians and other referring physicians on the most effective and appropriate method(s) of imaging patients in the Emergency Department
4. Learn basic and tailored CT protocols for the most common pathologic entities seen in emergency radiology (e.g. appendicitis, diverticulitis).
5. Learn advanced CT imaging protocols unique to emergency radiology (e.g. CT cystography for traumatic bladder rupture).
6. Demonstrate ability to integrate laboratory findings and other clinical parameters in recommending appropriate patient specific imaging strategies for diagnostic purposes.
7. Interpret chest, abdomen, spine and extremity radiographs performed for emergent traumatic and non-traumatic indications.
8. Protocol and interpret chest, abdomen, and pelvic CT scans performed for traumatic emergencies.
9. Understand the imaging algorithm of chest emergencies (such as pulmonary embolism and aortic dissection).
10. Understand the imaging algorithm of abdominal emergencies (such as bowel obstruction and urinary calculi).

***COMMUNICATOR***

1. Be able to obtain appropriate information from the health care team in order to properly protocol a CT exam or recommend a more appropriate imaging modality.
2. Understand the importance of communication with referring physicians, including an understanding of when the results of a CT must be urgently communicated.
3. Be able to discuss CT protocols with the technologist and address their questions or concerns about patient management.
4. Be able to produce a radiologic report which appropriately describes imaging findings in a concise manner, provides an accurate differential diagnosis and when appropriate recommends further tests or management.

***COLLABORATOR***

1. Communicate with more senior residents and staff for guidance regarding managing of an emergency seat during regular work hours.
2. In the earlier stages, observe more senior residents act in the role junior consultants when reviewing CT exams with clinical colleagues. Towards the end of the rotation, consult with clinical colleagues when reviewing CT exams.
3. Provide interpretation of imaging findings at your comfort level.
4. Function as a contributing member of a multidisciplinary health care team, interacting with technologists, nurses, and clinical colleagues to provide optimal patient care.



**LEADER**

1. Utilize the resource of CT effectively, determining the indications and urgency of the scan from information during consultation with the referring physicians.
2. Develop time and people management skills in directing the “day to day” scanning of elective and emergency patients.

**HEALTH ADVOCATE**

1. Understand the benefits and risks of CT for the general population (and when used for screening).
2. Be aware of the radiation dose the patient receives for standard body CT exams.
3. Recognize when a CT exam would be detrimental to the health of a patient.

**SCHOLAR**

1. Become an effective learner of body CT.
2. Become an effective teacher in body CT to other residents, medical students, technologists and clinical colleagues.
3. Develop competency in evaluation of the medical literature in radiology, including that related to body CT.
4. Participate in an audit or research project.

**PROFESSIONAL**

1. Demonstrate appropriate personal and professional behavior when interacting with colleagues and patients.
2. Deliver the highest quality care with integrity, honesty, and compassion.

**PGY-4 and PGY-5/ Core of Discipline/Transition to Practice****MEDICAL EXPERT/CLINICAL DECISION MAKER**

1. Demonstrate ability to integrate laboratory findings and other clinical parameters in recommending appropriate patient specific imaging strategies for diagnostic purposes.
2. Interpret chest, abdomen, spine and extremity radiographs performed for emergent traumatic and non-traumatic indications.
3. Protocol and interpret chest, abdomen, and pelvic CT scans performed for traumatic emergencies.
4. Understand the imaging algorithm of chest emergencies (such as pulmonary embolism and aortic dissection).
5. Understand the imaging algorithm of abdominal emergencies (such as bowel obstruction and urinary calculi).
6. Learn to cover the CT emergency seat independently.

**COMMUNICATOR**

1. Obtain appropriate information from the health care team in order to properly protocol a CT exam or recommend a more appropriate imaging modality.
2. Understand the importance of communication with referring physicians, including an understanding of when the results of a CT must be urgently communicated.
3. Discuss CT protocols with the technologist and address their questions or concerns about patient management.

4. Produce a radiologic report which appropriately describes imaging findings in a concise manner, provides an accurate differential diagnosis and when appropriate recommends further tests or management.

#### **COLLABORATOR**

1. Act as a junior consultant when reviewing CT exams with clinical colleagues.
2. Provide interpretation of imaging findings when attending multidisciplinary rounds.
3. Function as a contributing member of a multidisciplinary healthcare team, interacting with technologists, nurses, and clinical colleagues to provide the optimal patient care.
4. Provide guidance to junior residents on rotation with regards to troubleshooting protocols, imaging interpretation, and communication of results.

#### **LEADER**

1. Utilize the resource of CT effectively, determining the indications and urgency of the scan from information during consultation with the referring physicians.
2. Develop time and people management skills in directing the “day to day” scanning of elective and emergency patients.

#### **HEALTH ADVOCATE**

1. Understand the benefits and risks of CT for the general population (and when used for screening).
2. Be aware of the radiation dose the patient receives for standard body CT exams.
3. Recognize when a CT exam would be detrimental to the health of a patient.

#### **SCHOLAR**

1. Become an effective teacher in body CT to other residents, medical students, technologists and clinical colleagues.
2. Develop competency in evaluation of the medical literature in radiology, including that related to body CT.
3. Participate in an audit or research project.

#### **PROFESSIONAL**

1. Demonstrate appropriate personal and professional behavior when interacting with colleagues and patients.
2. Deliver the highest quality care with integrity, honesty, and compassion.

### **ER BODY CT CASE LIST**

These are some pathologies that are commonly seen at the FMC while on your ER rotation. Some are obviously more common than others; but combined with your all experience you should become familiar with the imaging and clinical issues surrounding most of these pathologies over the course of your residency.

#### **CHEST TRAUMA:**

- Rib fractures
- Sternal and manubrial fractures
- Hemothorax
- Pneumothorax and pneumomediastinum
- Mediastinal hemorrhage
- Pulmonary contusion, laceration, hematoma
- Tracheobronchial injury

- Esophageal tear
- Diaphragm injury
- Pulmonary embolism
- Acute pulmonary infections
- Aspiration pneumonia
- Airway foreign bodies
- Obstructive airway disease
- ARDS: near-drowning, fat embolism syndrome
- Esophageal rupture

CARDIOVASCULAR EMERGENCIES:

- **Cardiac**
  - Pericardial effusion—tamponade
  - Pneumopericardium—tamponade
- **Aorta**
  - Aortic trauma
  - Aortic dissection
  - Aortic aneurysm
- **Pulmonary Edema - various etiologies**
- **Thrombo-embolic disease**
  - Deep venous thrombosis
  - Pulmonary embolism

ABDOMINAL TRAUMA:

- Hemoperitoneum and intraperitoneal fluid
- Hemodynamic status assessment
- Retroperitoneal hemorrhage
- Gas collections: intraperitoneal and retroperitoneal
- Active arterial extravasation on CT
- Splenic injuries
- Liver injuries
- Gallbladder and biliary injuries
- Bowel injuries
- Mesenteric injuries
- Pancreatic injuries
- Renal injuries
- Adrenal injuries
- Bladder injuries: intraperitoneal and extraperitoneal
- Abdominal wall injuries and diaphragmatic hernias

NON-TRAUMATIC ABDOMINAL EMERGENCIES:

- **The peritoneal cavity**
  - Ascites
  - Peritonitis
  - Abdominal abscess
- **Liver and biliary tract**
  - Jaundice: obstructive and non-obstructive
  - Cholecystitis

- **Pancreatitis**
- **Urinary tract**
  - Urinary stones
  - Infection
  - Pyelonephritis
  - Renal abscess
- **Adrenal hemorrhage**
- **Gastrointestinal tract**
  - Gastrointestinal hemorrhage
  - Bowel obstruction
  - Bowel infarction
  - Bowel infection
  - Appendicitis
  - Diverticulitis
  - Infectious enteritis and colitis
- **Eiploic appendagitis**
- **Inflammatory bowel disease**
  - Crohn disease
  - Ulcerative colitis

#### **ER CT (BODY) RECOMMENDED READING**

1. Diagnostic Imaging: Emergency. 2nd Edition - Brooke Jeffrey Jr., Manaster, Osborn, Rosado-de-Christenson,, Woodward.
5. Computed Body Tomography with MRI Correlation - 2nd edition - Lee, Sagel, Stanley.
3. CT and Sonography of the Acute Abdomen. Brooke Jeffrey, Jr.
4. Computed Tomography of the Thorax. Naidich, Zerhouni, Siegelman.
5. Thoracic Imaging, Second Edition, W. Richard Webb and Charles B. Higgins.

***EMERGENCY RADIOLOGY (NEURO)***

**PREAMBLE**

All residents receive at least two blocks in Emergency Radiology. This rotation includes neuro CT and plain radiographs (as well as body CT, ultrasound, thoracic imaging, musculoskeletal imaging).

**RESIDENT GOALS & OBJECTIVES**

***MEDICAL EXPERT/CLINICAL DECISION MAKER***

**General Competencies:**

The resident should:

1. Be able to use the PACS for interpretation of imaging studies.
2. Learn how to triage examinations related to their urgency and how to work efficiently to get required studies performed and interpreted.
3. Improve their skills for advising Emergency Medicine physicians and other referring physicians on the most effective and appropriate method(s) of imaging patients in the Emergency Department
4. Learn basic and tailored CT protocols for the most common pathologic entities seen in emergency radiology (e.g. strokes).
5. Learn advanced CT imaging protocols unique to emergency radiology (e.g. CT/CTA protocols for strokes).
6. Demonstrate ability to integrate laboratory findings and other clinical parameters in recommending appropriate patient specific imaging strategies for diagnostic purposes.

**Specific Goals & Objectives for PGY2/3 (Foundations of Discipline/Core of Discipline 1):**

The resident should learn:

1. Basic neuroanatomy (see below). Refer to Emergency Radiology reading list (located on departmental computer "U-Drive").
2. How to distinguish mass effect and brain herniation associated with acute processes from volume loss associated with more chronic processes.
3. CT pattern of pathologies associated with head trauma; especially subdural hematoma; epidural hematoma; subarachnoid hemorrhage; diffuse axonal injuries; parenchymal contusions; hemorrhagic parenchymal contusions; non-hemorrhagic parenchymal contusions; calvarial, facial and spinal fractures; cerebral edema.
4. CT patterns of arterial and venous infarction with an understanding of major vascular territories; learn to determine age (i.e., acute versus chronic).
5. How to perform and interpret CT angiograms of the carotid and vertebral arteries, and the appearance of cerebrovascular disease, including acute stroke, traumatic dissection, and atherosclerotic disease.
6. How to perform a lumbar puncture.
7. How to identify a mass on head CT, and determine its location whether it is intra-axial or extra-axial. Locations to be learned include pineal region; sellar; suprasellar; parasellar; cerebello-pontine angle, lobar, cerebellar, callosal; skullbase; intraventricular. Begin to learn differential diagnoses.
8. The CT appearance of :
  - a. Major vascular lesions such as arteriovenous malformations (AVMs), aneurysms, cavernous malformations, venous anomalies.
  - b. Cerebritis, abscess, meningitis, empyema.
  - c. Multiple sclerosis, acute disseminated encephalomyelitis (ADEM).
  - d. Different types of non-traumatic hemorrhage and the differential diagnoses.

- e. Degenerative spine disease including disc herniation, spinal stenosis and neural foramen encroachment on CT.
  - f. Spinal fractures.
9. Learn the radiological approach to investigate “non-traumatic neuroradiological emergencies”, and how to protocol and triage these exams according to clinical need. Non-traumatic neuroradiological emergencies include: acute stroke syndromes; PRES, herpes encephalitis, cauda equina syndrome, spinal cord compression, and sinovenous occlusive disease and herniation syndromes. The resident should become familiar with the most important clinical evaluations.

**Specific Goals & Objectives for PGY4-5/Core of Discipline 2 and Transition to Practice:**

1. The resident should build on the knowledge acquired in PGY2/3.
2. The resident is expected to develop basic knowledge of the anatomy and pathology of the head and neck, including soft tissue infections, and malignancy. The resident should also become familiar with the most important clinical evaluations.
3. The resident should develop a more comprehensive radiological approach to investigate “non-traumatic neuroradiological emergencies”, and how to protocol and triage these exams according to clinical need. Non-traumatic neuroradiological emergencies include: acute stroke syndromes; PRES, herpes encephalitis, cauda equina syndrome, spinal cord compression, sinovenous occlusive disease and herniation syndromes. The resident should become familiar with the most important clinical evaluations.

**COMMUNICATOR**

The resident should:

1. Be able to obtain appropriate information from the health care team in order to properly protocol a CT exam or recommend a more appropriate imaging modality.
2. Be able to discuss CT protocols with the technologist and address their questions or concerns about patient management.
3. Know the importance of accurate, timely, and professional communication.
4. Notify the referring clinician of urgent, emergent or unexpected findings of clinical significance, and document in dictation.
5. Learn to dictate clear, concise and complete reports, provides an accurate differential diagnosis and, when appropriate, recommends further tests or management.
6. Be able to communicate effectively with patients and their families when participating in interventional procedures (e.g., lumbar puncture).
7. Review, correct, and sign reports promptly. Acute trauma spine clearance is a priority. Ideally, all reports should be signed by the staff within 24 hours.

**COLLABORATOR**

The resident should:

1. Act as the primary consultant to residents/staff in the Emergency Department and other clinical services in the planning of neuroradiological investigations and their interpretation.
2. Have the ability to act as a junior consultant when reviewing CT exams with clinical colleagues.
3. Function as a contributing member of a multidisciplinary health care team, interacting with technologists, nurses, and clinical colleagues to provide the optimal patient care.

**LEADER**

The resident should:

1. Learn to utilize the resource of CT effectively, determining the indications and urgency of the exam from information during consultation with the referring physicians.
2. Develop time and people management skills in directing the “day to day” scanning of elective and emergency patients.

3. Recognize urgent and emergent imaging findings in studies of the head, neck, and spine, and appropriately contact the referring clinician without being prompted.
4. Become facile with PACs and utilize available information technology to manage patient information and examinations.

### **HEALTH ADVOCATE**

The resident should:

1. Understand the risks and benefits of CT for the general population (and when used for screening).
2. Be aware of the radiation dose the patient receives for standard Neuro-CT examinations.
3. Recognize when a CT exam might be detrimental to the health of a patient.
4. The resident *must* recognize limitations of personal competency and ask for guidance from fellows or Neuroradiology staff when appropriate.

### **SCHOLAR**

The resident should:

1. Have the ability to be an effective teacher, and facilitate the learning of neuroradiology to junior residents, medical students, technologists, clinical colleagues, and other health care professionals.
2. Be expected to demonstrate independent self-study using various resources including texts, journals, teaching files, and other resources on the internet.
3. Develop competency in evaluation of the medical literature in radiology, including that related to neuroradiology.
4. Resident involvement is encouraged in basic research activities and clinical practice audits or other internal reviews.

### **PROFESSIONAL**

1. The resident should demonstrate appropriate personal and professional behavior when interacting with patients, clinical colleagues, technologists, and other medical staff.
2. The resident should deliver the highest quality patient care with integrity, honesty and compassion.

### **HOURS OF WORK**

The resident should report to the ER Radiology interpretation area by 0800h or immediately following morning rounds.

The resident should stay until all daily work is complete, usually approximately between 1700-1715h.

**The resident must notify (or have the chief resident notify) the appropriate neuroradiology staff of any expected or sudden absence from clinical duties to ensure that adequate rotation coverage and patient care is maintained.**

### **NEURORADIOLOGY TECHNIQUES**

***Due to the nature and scope of the problems encountered in the ER department, the Radiology resident knowledge base and skills are primarily directed towards CT-based neuroimaging.***

### **PLAIN RADIOGRAPHS**

The resident will be expected to interpret as many routine skull and spine films as possible, primarily those accompanying or relevant to Neuro CT studies.

### **COMPUTED TOMOGRAPHY (CT)**

The resident will assist in screening and protocolling all head, neck, and spine CT requests, and in interpretation and reporting of ER Neuro CT examinations (except during those times when he/she is involved in special procedures or is attending educational rounds).

The resident will interpret and report all CT studies under neuroradiology staff supervision. Standard protocols for head, neck and spine imaging, and indications for IV contrast should be understood.

### **ER NEURO CT CASE LIST**

In addition to trauma, a number of non-traumatic neurologic conditions which are associated with high morbidity and mortality may be encountered at the Foothills Medical Centre while you are on your ER rotation. These conditions often have a sub-acute clinical presentation, which can lead to delay in performing appropriate imaging studies.

Some conditions are more common than others. It is very important for radiology residents to become familiar with the imaging and clinical features surrounding these traumatic and non-traumatic neurologic emergencies to ensure that these studies are interpreted both promptly and accurately.

However, it must be stressed that this document is simply provided to act as a learning template to build upon as radiology residents prepare for ER and on-call duties. This list of teaching cases is not meant, in any way, to be inclusive of all neurologic conditions that may be encountered on-call and necessary for the radiology resident to master over the course of your residency.

- Acute Ischemic Stroke
- Non-Traumatic Intracranial Hemorrhage
- Acute Sinovenous Thrombosis
- Cerebral Edema and Swelling
- Traumatic Brain Injury
- Traumatic and Other Extracerebral Collections
- Traumatic Blunt Cerebrovascular Injuries
- Skullbase and Calvarial Fractures
- Maxillofacial (Mid-face) Fractures
- Traumatic Bony Craniocervical Distraction Injury
- Spine Fractures
- Tension Pneumocephalus
- Acute Hydrocephalus
- Central Nervous Infections
- Cerebral Fat Embolism
- Posterior Reversible Encephalopathy Syndrome
- Orbital & Deep Soft Tissue Neck Infections
- Spinal Discitis / Osteomyelitis
- Spinal Cord Compression & Cauda Equina Syndromes
- Tubes, Drains and Other Support Lines



## **BIBLIOGRAPHY:**

### ***Recommended Reading:***

Holmes EJ, et al. Interpretation of emergency head CT: A Practical handbook. Cambridge University Press, Cambridge, 2008. ISBN: 978-0-521-68242-8.

Soto JA and Lucey BC. Emergency radiology, The Requisites, Mosby, Philadelphia, 2009. ISBN-13: 978-0-323-05407-2.

Jeffrey RB, Manaster BJ, Osborn AG, Rosado-de-Christenson ML. Diagnostic Imaging: Emergency, 2<sup>nd</sup> ed. Amirsys Publishing, 2013. ISBN: 978-1-931884-76-1.

Gean AD (guest editor). Neuroradiology emergencies. Neuroimag Clin N Am 2010; 20(4). ISBN-13: 978-1-4557-0629-0.

### ***Supplemental Reading:***

Raby N, et al. Accident and emergency radiology: A survival guide, 2<sup>nd</sup> Ed, Elsevier Saunders, 2005. ISBN: 978-0-7020-2667-6.

Salvolini U, Scarabino T, and Jinkins R (Editors). Emergency neuroradiology. Springer 2006. ISBN 10: 3-540-29626-3.

Rabinstein AA and Resnick SJ. Practical neuroimaging in stroke: A case-based approach. Saunders 2009. ISBN: 978-0-7506-7537-6.

## **BASIC NEUROANATOMY FOR PGY2 RESIDENTS**

### **BRAIN:**

Deep Nuclei

Caudate head & body  
Putamen  
Globus pallidus  
Thalamus

Basal cisterns

Quadrigeminal  
Ambient  
Suprasellar  
Cerebellopontine angle  
Interpeduncular fossa

Ventricular System

Lateral  
Third  
Fourth  
Cerebral aqueduct

Gray and White matter

Brainstem / Cerebellum Midbrain (including peduncles, etc.)

Pons  
Medulla (including pyramids, etc.)  
Dentate nucleus, cerebellum

	Cerebellar hemispheres and peduncles
Major landmarks	Sylvian fissures Central sulcus Interhemispheric fissure Horizontal fissure, cerebellum
<b><u>VASCULAR ANATOMY:</u></b>	
Intracranial arteries	ICA, ACA, MCA, PCA, vertebrobasilar
Circle-of-Willis	including common variations
Major extracranial arteries	Aortic arch and major vessels Common carotid artery Carotid bifurcation Main external carotid artery (not individual branches) Internal carotid artery, cervical Vertebral arteries
Intracranial venous system	Major dural sinuses Deep venous system (internal cerebral veins, basal vein Rosenthal, vein Galen, straight sinus, thalamostriate veins, septal veins)
<b><u>SKULL &amp; SKULLBASE:</u></b>	
Cranial fossa	
Skull base foramina	
Major sutures	Coronal, lambdoid, sagittal, metopic
Mastoid sinus	
Basic middle and inner ear	
<b><u>ORBITS:</u></b>	
Globes and lenses	
Main ocular structures	Ocular muscles Fat Lacrimal glands Vessels (mainly superior ophthalmic veins) Optic nerves
Bony orbital margins	
<b><u>PARANASAL SINUSES:</u></b>	
	<ul style="list-style-type: none"> <li>• Maxillary (including osteomeatal units)</li> <li>• Ethmoid</li> <li>• Sphenoid</li> <li>• Frontal</li> </ul>
<b><u>SPINE:</u></b>	
Basic vertebral anatomy	Body Pedicles Laminae Lateral masses (including foramen transversarium) Spinous process

Articular facets (inferior and superior)

Craniocervical junction      Occipital condyles  
Atlas  
C2

### **ER EVALUATION PROCESS**

Daily teaching will be at the PACS workstations from Body and Neuroradiology preceptors, and will be centered on the cases interpreted by the resident.

Daily feedback will be provided to the resident by the assigned preceptor. EPAs/Milestones/Evaluations will be filled out by staff and co-residents at the request of the trainee.

Mid rotation and final evaluations of the resident's rotation will be provided as per requirements.

The Competence Committee will review residents in the CBD cohort at regular intervals and will provide comments/recommendations on resident progress to the Program Director, who will then notify the Residency Program Sub-Committee.

### **RESIDENT PRE-DICTATIONS**

The process of pre-dictating radiology cases before reviewing with staff radiologists is recognized as an important component in radiology resident training. This practice encourages organizational skills, independence and work efficiency, and the pre-dictation frequency is expected to increase with progressive training and resident comfort of imaging findings.

At the same time, it must be recognized by the resident that any radiology report, even those labeled 'preliminary', are still medico-legal documents that may be viewed by clinicians, printed, and placed on the patient's medical chart, and possibly acted upon. A 'preliminary' report is dictated under a staff radiologist. This staff radiologist who may be unaware of the exam's existence or the resident's preliminary interpretation until they review the case together. It is encouraged to review cases often and promptly in the beginning, to avoid situations where errors in interpretation have consequences for the patient.

All resident pre-dictations must be clearly labeled as such, to avoid interpretive misunderstandings that may negatively impact patient care.

It is recommended that the following statement be added to all resident pre-dictations, and placed under the report Impression:

**\*\*\* This exam has not yet been discussed/reviewed with a staff radiologist \*\*\***

This statement can then be removed after exam review with a staff radiologist, and once all necessary report changes are made.

## **PRELIMINARY VERBAL RESIDENT INTERPRETATIONS**

If the resident has also discussed the radiologic findings and provided a preliminary verbal opinion to the requesting clinician, it is recommended that the following statement be added to all pre-dictations, and placed under the report Impression:

**The PRELIMINARY resident interpretation (with respect to the patient's acute presentation) was discussed with the requesting physician at [enter time] on [enter date].**

If there are any significant changes made concerning the radiographic findings of the report after staff radiologist review, this comment regarding the earlier verbal discussion of any findings must be amended or removed, and a discrepancy report then provided, as per the current DISCREPANCY REPORT POLICY.

**GENITOURINARY AND GASTROINTESTINAL RADIOLOGY****PREAMBLE**

Each resident will spend a minimum of four rotations doing GI/GU radiology and CT Colonography during the residency program. These will occur during the PGY2 to PGY5 years. Further exposure to GI/GU radiology can be obtained electively. Ultrasound, CT, MR and interventional procedures are learned on other rotations.

**1. Daily Procedures**

Fluoroscopy starts promptly at 0800 hours 5 days per week. The caseload is to be shared with the assigned staff radiologist. The resident is encouraged to perform as many procedures as possible and to consult with the staff radiologist when necessary. Every effort is made to complete all scheduled procedures during the morning.

CT Colonography (CTC) starts promptly at 0800h every day of the week, but the resident will participate in CTC in the afternoon. After consultation with the staff preceptor, a few days should be spent in CTC at 0800h to learn how the procedure is done. The resident must keep a logbook of all CTC cases post-processed and reported (minimum 50 cases over entire residency).

**2. Reporting**

Prior to reporting the examinations, the resident should review all examinations and form a brief initial impression. The resident shall review the examinations with the staff radiologist and then dictate the examinations.

**3. Teaching**

The residents will be expected to participate in the teaching of radiography to medical students. Interesting cases will be discussed with the x-ray technologists at designated rounds.

**ROTATION SPECIFIC GOALS & OBJECTIVES*****MEDICAL EXPERT/CLINICAL DECISION MAKER*****PGY-2/Foundations of Discipline**

1. Understand the indications for the radiographic studies of the gastrointestinal and genitourinary tract, listed below.
2. Have knowledge of the indications and contraindications to contrast agents used in the investigation of the gastrointestinal and genitourinary tract.
3. Develop proficiency in basic interpretation of the following gastrointestinal fluoroscopic procedures:
  - Ssophagogram
  - Modified barium swallow
  - Upper G.I. series
  - Small bowel follow through
  - Enteroclysis
  - Single and double contrast studies of the colon
  - Video proctograms
  - Joint aspirations
  - Cholangiograms
  - Urethrograms
  - Sialograms

- Fistulograms/sonograms
4. Develop basic competency in assessing bowel obstructions and bowel perforations.
  5. Develop proficiency in basic interpretation of the following genitourinary procedures:
    - cystograms
    - hysterosalpingograms
  6. Have knowledge of potential adverse reactions to the use of intravenous contrast and the treatment of the complications.
  7. Understand the indications and contraindications of CT Colonography and how the study is performed.
  8. Develop proficiency in basic interpretation, including post-processing of cases, of CT Colonography studies.
  9. Develop basic knowledge about radiation doses to the patient for common GI & GU procedures as well as CT Colonography.

### **PGY-3/Core of Discipline 1**

1. Enhance and refine the basic procedural and diagnostic skills learned in PGY2.
2. Develop proficiency in additional procedures including:
  - enteroclysis or small bowel enema
  - video proctograms
3. Development of consultative skills including preliminary emergency reports.
4. Obtain basic knowledge of the clinical and radiographic manifestations of all major GI/GU diseases.

### **PGY-4/Core of Discipline 2**

1. Enhance skills as described for PGY3.
2. Demonstrate sound knowledge base when discussing cases at clinical rounds.

### **PGY-5/Transition to Practice**

1. Be proficient in and enhance technical and procedural skills as described for PGY4.
2. Consolidate knowledge base.
3. Achieve a minimum of 50 CT Colonography cases (interpreting, post-processing and reporting) by the end of residency.

### ***COMMUNICATOR***

1. Establish a therapeutic relationship with patients and their families by providing a clear & thorough explanation of the requested procedure, possible complications and subsequent therapy.
2. Be able to obtain appropriate information from the patient, patient's family or health care team to properly perform a GI/GU exam or CT Colonography study or to recommend a more appropriate modality.
3. Have a thorough knowledge of IV contrast and potential adverse reactions and treatment to obtain informed consent for IV contrast administration.
4. Have the ability to produce a radiologic report that appropriately describes the imaging findings in a concise manner, provides an accurate differential diagnosis and when appropriate recommends further investigation.

### ***COLLABORATOR***

1. Demonstrate an increasing ability to act as a junior consultant when reviewing fluoroscopic exams and CT Colonography studies with clinical colleagues.
2. Function as a contributing member of a multidisciplinary health care team, interacting with technologists, speech pathologists, nurses and clinicians to provide the optimal patient care.

**LEADER**

1. Utilize the resource of fluoroscopy and CT Colonography effectively, determining the indications and urgency of the study from consultation with the referring clinician.
2. As a PGY4 and PGY5 resident in both a hospital and clinic setting, develop time and people management skills to optimize professional performance.
3. Develop an understanding of quality assurance with respect to all GI and GU studies.

**HEALTH ADVOCATE**

1. Understand the benefits and risks of GI and GU fluoroscopic procedures and CT Colonography for the general population and also when used for screening.
2. Recognize when a fluoroscopic exam would be of limited or no diagnostic value to the patient.

**SCHOLAR**

1. Have the ability to be an effective teacher in GI/GU radiology and CT Colonography to junior residents, medical students, technologists and clinical colleagues.
2. Develop competency in evaluation of the medical literature in radiology, including that related to GI/GU radiology and CT Colonography.

**PROFESSIONAL**

1. Demonstrate appropriate personal and professional behavior when interacting with patients and their families, technologists and clinicians.
2. Demonstrate reliability, enthusiasm and conscientiousness.
3. Demonstrate an awareness of one's own limitations, seeking advice and assistance when necessary.

**GI Radiology Recommended Reading:**

- Gastrointestinal Radiology: the Requisites. Halpert and Feczko. Mosby.
- Double Contrast Gastrointestinal Radiology. Laufer
- Gastrointestinal Radiology. Eisenberg
- Atlas of Virtual Colonoscopy Dachmann, and A. Laghi
- CT Colonography : Principles and Practice of Virtual Colonoscopy Pickhardt and Kim
- Dynamic Radiology of the Abdomen. Morton Meyers.

**Reference Texts:**

- Textbook of Gastrointestinal Radiology, 3<sup>rd</sup> Ed, Gore, Levine, Laufer
- Clinical Imaging of Small Bowel, Halinger

**MAMMOGRAPHY AND BREAST IMAGING****PREAMBLE**

Each resident will complete four blocks of breast imaging in the PGY-2 to PGY-5 years. Two of the four blocks will be completed at the FMC North Tower and the other two blocks will be completed at the EFW Advanced Medical Imaging Centre community clinic to gain more experience with screening mammography.

**Learning Opportunities during the Rotation**

- Working with mammographic and breast US technologists.
- Supervision of cases in North Tower and in Clinic Practice
- Attendance at all reading sessions.
- Teaching file review and case submission.
- ACR file.
- Pathology report review.
- Presentation at breast tumour board rounds Tuesday 4:30-5:30 pm
- Experience with the BIRADS reporting and data base system.
- Breast ultrasound.
- Case review binder for additional exposure to various pathologies
- Breast MRI.
- Experience with ultrasound-guided and mammotome large core needle biopsy and localization techniques.

**Primary Radiologist Contact for the Rotation:**

Dr. Tracy Elliot pager 08537; [Tracy.Elliot@albertahealthservices.ca](mailto:Tracy.Elliot@albertahealthservices.ca)  
For urgent matters please copy to [tracy.elliott@efwrad.com](mailto:tracy.elliott@efwrad.com)

**ROTATION SPECIFIC GOALS AND OBJECTIVES (PGY-2 to PGY-5):*****MEDICAL EXPERT/CLINICAL DECISION MAKER***

1. Demonstrate understanding of quality assurance, technical aspects of proper position for a mammogram (recommend observing technologist acquiring both routine and diagnostic mammographic views) and physical factors that might interfere with optimal position
2. Know the CAR allowed mean glandular dose for standard screening digital mammogram and debate around mammographic radiation dose and breast cancer induction
3. Demonstrate an understanding of normal breast anatomy including normal anatomic variants and a basic understanding of breast pathology.
4. Demonstrate an understanding of breast tissue density including thorough knowledge of the ACR breast density reporting system and how parenchymal composition affects the sensitivity of mammography and US for detection of masses and cancer
5. Know the national and provincial (Alberta) breast cancer screening guideline recommendations for average risk women and recommendations for screening above average and high risk women/transgender/men
6. Have an understanding of guideline development methodology as it relates to age of eligibility for participation in screening programs and screening intervals
7. Be fully versed on the BIRADS categories of breast disease and their usage.
8. Be familiar with the ACR Bi-RADS 5<sup>th</sup> Edition lexicon for description of mammographic, US and MRI findings
9. Demonstrate an ability to distinguish benign from malignant features on mammography, US and MRI



10. Demonstrate ability to develop an approach to the assessment of breast calcifications and breast masses
11. Demonstrate the ability to make preliminary assessment of mammographic images, advising the technologist on the need for additional views, as necessary
12. Demonstrate the ability to establish a plan for management or follow-up of probably benign disease/lesions.
13. Demonstrate an understanding of the role of ultrasound in breast imaging for both supplemental screening and diagnostic imaging
14. Be comfortable performing breast US and technical parameters to optimize image quality including patient position
15. Demonstrate an understanding of the typical appearance of benign and malignant disease on US, including subtypes of invasive duct Ca, high grade and triple negative cancers
16. Demonstrate familiarity with the evaluation of the post-surgical breast (including complications, post-surgical and post-radiation appearances).
17. Demonstrate an understanding of approach to breast disease in pregnancy and lactation
18. Be familiar with approach imaging of the male breast, be familiar with the appearance of gynecomastia on both mammography and US, risk factors for and imaging features of male breast cancer
19. Demonstrate an understanding of approach to evaluation of and management of palpable lesions depending on patient age
20. Demonstrate understanding of breast radiology-pathology correlation and understand patient management when there is discordance with the histologic and imaging findings
21. Demonstrate basic understanding of the indications for and interpretations of breast MRI studies.
22. Mammographic techniques including US and stereotactic biopsies, grid and US guided wire and seed localizations and galactography.
23. Demonstrate ability to perform simple localization and breast biopsy procedures.
24. Demonstrate ability to discuss findings with patients and to obtain informed consent for procedure.

### **Rotation 1 (Mammo)/Foundations of Discipline and Core of Discipline**

The first rotation will provide an introduction to basic breast anatomy, epidemiology and risk factors for breast cancer, the routine views, technique and basic physics, the viewing format, an introduction to the evaluation of calcifications and masses, the classic features of malignancy, post-operative and post-radiation changes and gynecomastia. Instructions on the format of the mammogram report and integrating the ACR lexicon will be provided. The complementary role of ultrasound, the technique and indications will be introduced. The resident will learn the classic features of a cyst, carcinoma, implants and potential pitfalls. The resident will be directed to key articles and be able to undertake literature searches where indicated. Procedures will be introduced on this rotation.

### **Rotation 2 (Mammo II)/Core of Discipline and Transition to Practice**

The resident continues to develop knowledge about benign and malignant diseases of the breast including clinical presentation, pathology, mammographic and ultrasound appearance. The differential diagnoses of mammographic and sonographic lesions are expanded. The resident should know the common supplementary views and how to use them to problem solve. The resident will develop an understanding of the staging TNM system for breast cancer and the principles of treatment and be aware of the psycho-social issues of breast cancer. The resident improve skills and understanding of the post treatment breast and appearance of local recurrence. During this rotation, consent-taking and procedural skills will be developed. The resident will be trained in both stereotactic and US- guided biopsies and by the end of rotation the resident should be able to perform simple breast ultrasound localization and biopsy procedures and stereotactic biopsies while under supervision, for uncomplicated patients. The resident is expected to follow-up with radiologic-pathologic correlation.

### **Rotation Responsibilities:**

#### **PGY-2 to PGY-3/Foundations of Discipline and Core of Discipline 1**

- Arrive 8:00 AM to Women's Imaging Centre, basement of North Tower FMC, advise preceptor if you will be late, on vacation, late start or post call
- Residents should review screening exams prior to reading them with the staff radiologists. 10 per day (200 for each block)
- Can access the EFW Radiology site and review additional screening exams to meet daily goal
- Resident should participate in all diagnostic work up cases including planning additional views/US and management planning, independently (when time permits) or in conjunction with the preceptor.
- Residents are expected to review biopsy pathology reports and determine rad-path correlation and next steps if the pathology is discordant
- Residents should review the biopsy requests and determine appropriateness and protocol to review with the preceptor
- Resident should participate in the weekly tumour board rounds-pull and review the cases Friday or Monday (printed list available on Friday on clipboard in the same file cabinet as the screening exams and pathology), with the goal to present once during PGY3 rotation.
- Residents must demonstrate familiarity with and appropriate use of the BIRADS reporting system and its significance of BIRADS for QA and audit function.
- Assigned plain films
- Review breast MRI and participate in read out with the staff
- Help as time permits with staff assigned CT CAP

#### **Rotation PGY-4 to PGY-5/Core of Discipline 2 and Transition to Practice**

Greater independent consulting skills, problem-solving skills and the ability to detect subtle cancers will be developed. Sequencing of tests and appropriateness criteria are emphasized. The resident is expected to manage an increasing volume of diagnostic cases. The elements of a QC program and an awareness of elements of the CAR accreditation program are expected. The resident should develop sensitivity to bioethical and medical-legal issues and maintain consideration for the patient's needs. The resident will be expected to develop a basic understanding of the indications for and interpretation of breast MRI.

### **Rotation responsibilities:**

- Arrange to have IT set up prior to the rotation – call 403-210-9070
- Arrive at the Cambrian EFW Radiology site, main floor to Radiology offices in the US technologist area 8:00
- Co-ordinate with the screening or Seton based radiologists for timing of screening case review- Target 15-20/day, 300-400 per rotation for this block
- Participate in all of the diagnostic cases
- Co-ordinate with the PGY-2/PGY-3 resident to arrange 3-4 half days (days they might be late start or post call) to go to North Tower to improve procedure skills and read MRI's (let the preceptor know)
- Check the AMI biopsy list for rad-path correlation
- Check the AMI MR list for Breast MRI studies
- Participate in some of the AWBUS read outs with the preceptor, can also access an Invenia workstation in the Screening room (3<sup>rd</sup> floor on the FWI side)

## **COMMUNICATOR**

### **PGY-2/Foundations of Discipline**

1. Understand the importance of communication with referring physicians, including an understanding of when the results of an investigation or procedure should be urgently communicated.
2. Demonstrate ability to dictate well-organized succinct reports, describing relevant findings, relevant differential diagnosis and recommendations with appropriate report format and use of ACR lexicon.
3. Communicate effectively with patients and their families and have an understanding of the impact disease will have on the patient and their family.
4. Demonstrate ability to communicate effectively with the support staff and technologists

### **PGY-3/Core of Discipline 1**

1. Further development of PGY-2 skills.
2. Be able to discuss appropriate information with the health care team.
3. Demonstrate ability to obtain informed consent for procedures.

### **PGY-4/Core of Discipline 2**

1. Further development of PGY-3 skills.
2. Be comfortable with discussing cases at clinical rounds.
3. Be able to obtain appropriate information during consultation with referring physicians to be able to provide recommendations regarding the most appropriate investigation and/or management of the patient.
4. Develop ability to teach breast imaging to clinical as well as more junior radiology residents.

### **PGY-5/Transition to Practice**

5. Consolidate above skills.

## **COLLABORATOR**

### **PGY-2 to PGY-5 (Foundations of Discipline to Transition to Practice)**

1. Begin to learn at the PGY-1 level and perfect at the PGY-5 level how to consult effectively with other physicians and health care professionals.
2. Contribute effectively at interdisciplinary rounds.
3. Demonstrate ability to interact appropriately with other radiology department staff with a team approach to patient care.

## **MANAGER**

### **PGY-2 to PGY-5 (Foundations of Discipline to Transition to Practice)**

1. Demonstrate awareness of the indications for various breast imaging modalities and ability to consider appropriateness of requested examinations and patient referrals.
2. Learn to prioritize cases to consider available imaging resources when planning and recommending patient care, using them effectively and efficiently.
3. Utilize information technology in breast imaging to optimize patient care, life-long learning and other activities.

## **HEALTH ADVOCATE**

### **PGY-2 to PGY-5 (Foundations of Discipline to Transition to Practice)**

1. Understand the benefits and risks of radiological investigations of the breast (radiography, US, CT, MRI, mammography, angiography) including population screening.
2. Recognize when radiologic investigation or treatment would be detrimental to the health of the patient.
3. Recognize external factors that may cause or contribute to breast disease (smoking, hormones, etc.).
4. Demonstrate an understanding of the importance of advocacy with patients, with primary care physicians and with the community for the role of breast screening.
5. Understand the most recent breast screening recommendations

## **SCHOLAR**

### **PGY-2 (Foundations of Discipline)**

1. Demonstrate willingness to share knowledge learned in the teaching of visiting medical students.

### **PGY-3 to PGY-5 (Core of Discipline to Transition to Practice)**

- Be an effective teacher of radiology to medical students, junior residents, technologists and clinical colleagues.
- Learn to critically appraise the medical literature.
- Understand and partake in the learning tools available (computers, literature searches, conferences, etc.) to provide on-going and life-long continued medical education.
- Demonstrate ability to set personal learning goals and objectives during rotation.
- Consider conducting an audit or research project in an area of breast imaging.

## **SUGGESTED READING LIST**

### **Radiographics:**

1. Pictorial Review of Changes Bi-RADS 5<sup>th</sup> Edition 2016, 36: 623
2. Male Breast Disease: Pictorial Review with Rad-Path Correlation 2013, 33: 763
3. Male Br Ca in the Age of Genetic Testing 2018, 38: 1289
4. Invasive Lobular Carcinoma of the Breast: Spectrum of Mammographic, US and MR Imaging Findings 2009, 29: 165
5. Paget Disease of the Breast 2011, 31: 1973
6. Update on Imaging the Post-Surgical Breast 2014, 34: 642
7. Imaging of Breast Implant Associated Complications and Pathologic Conditions (digital presentation) 2017, 37: 1603

### ***Additional Recommended Reading***

#### ***Radiology Journal:***

Axillary Nodal Evaluation in Br Ca: State of the Art 2020, 295: 500

#### ***AJR:***

Mesenchymal Lesions of the Breast: What a Radiologist Needs to Know 2018, 211: 224.

Current Recommendations for Breast Imaging of the Pregnant and Lactating Patient 2021, 216:1462

#### ***World Journal of Radiology:***

Imaging of the treated breast post breast conservation surgery/oncoplasty: 2017 9(8): 321

## **PROFESSIONAL**

### **PGY-2 to PGY-5 (Foundations of Discipline to Transition to Practice)**

- Exhibit appropriate professional behaviour in interaction with patients, colleagues, and staff.
- Provide the highest quality of care with integrity, honesty, and compassion.
- Demonstrate ability to practice patient centred care accepting responsibility for duties, respect for confidentiality and sensitivity to cultural, age, gender and disability issues of patients.
- Demonstrate awareness of own limitations
- Demonstrate good work ethic with enthusiasm and motivation.
- Demonstrate professional work habits with punctuality, dependability, organization and efficiency, including attendance at clinical duties, teaching sessions, rounds, and lectures. Informing preceptor of lateness, absences from the rotation to facilitate work flow.
- Demonstrate ability to incorporate feedback into improved personal performance.

### **MAMMOGRAPHY SUGGESTED READING LIST**

#### **PGY-2 & PGY-3 (Foundations of Discipline and Core of Discipline 1)**

1. The Requisites Breast Imaging. Ikeda, DM and Miyake KK 3<sup>rd</sup> edition
2. Clinical Breast Imaging the Essentials Breast. Gardenosa, G. 2015
3. Breast Ultrasound. Stavros, TA, 2004.
4. Breast Pathology. O'Malley, FP.
5. Teaching Atlas of Mammography, 2nd Edition. Tabar and Dean.

#### **PGY-4 & PGY-5 (Core of Discipline 2 and Transition to Practice)**

1. Diagnostic Breast Imaging Berg, WA and Leung, JWT 3<sup>rd</sup> Edition
2. Breast Ultrasound, Stavros TA, 2004.
3. Breast MRI Teaching Atlas Ha R, Comstock, CE, Morris EA
4. Breast MRI A Comprehensive Imaging Guide Raza, S and Birdwell, R.

#### **Journal Review Articles including:**

##### **Radiographics:**

1. Pictorial Review of Changes Bi-RADS 5<sup>th</sup> Edition 2016, 36: 623
2. Male Breast Disease: Pictorial Review with Rad-Path Correlation 2013, 33: 763
3. Male Br Ca in the Age of Genetic Testing 2018, 38: 1289
4. Invasive Lobular Carcinoma of the Breast: Spectrum of Mammographic, US and MR Imaging Findings 2009, 29: 165
5. Paget Disease of the Breast 2011, 31: 1973
6. Update on Imaging the Post-Surgical Breast 2014, 34: 642
7. Imaging of Breast Implant Associated Complications and Pathologic Conditions (digital presentation) 2017, 37: 1603

##### **Radiology Journal:**

1. Axillary Nodal Evaluation in Br Ca: State of the Art 2020, 295: 500

##### **AJR:**

1. Mesenchymal Lesions of the Breast: What a Radiologist Needs to Know 2018, 211: 224.
2. Current Recommendations for Breast Imaging of the Pregnant and Lactating Patient 2021, 216: 1462

##### **World Journal of Radiology:**

1. Imaging of the treated breast post breast conservation surgery/oncoplasty: 2017 9(8): 321

**On Line Resources and symposia:**

1. Society of Breast Imaging E-Learning:

<https://www.sbi-online.org/EDUCATION/E-Learning.aspx>

2. Canadian Society of Breast Imaging Education Link:

<https://csbi.ca/education/>

3. ELS Breast Imaging CME:

[https://cme.elfsystems.com/?keyword\\_session\\_id=vt~adwords|kt~breast%20imaging%20cme|mt~b|ta~568011427603&gclid=Cj0KCQiAw9qOBhC-ARIsAG-rdn6-CznhARSCiJiZeqJaBhly-kRPznpj\\_KP5TseSwl7DR6rIwsNuXoW4aAlEcEALw\\_wcB](https://cme.elfsystems.com/?keyword_session_id=vt~adwords|kt~breast%20imaging%20cme|mt~b|ta~568011427603&gclid=Cj0KCQiAw9qOBhC-ARIsAG-rdn6-CznhARSCiJiZeqJaBhly-kRPznpj_KP5TseSwl7DR6rIwsNuXoW4aAlEcEALw_wcB)

4. ARRS on line Courses:

Clinical Case Based Review of Breast Imaging

Breast Imaging Pearls and Pitfalls

<https://arrs.org/ARRSLIVE/Education/OnlineCourses/ARRSLIVE/Education/OnlineCourses/OnlineCourses.aspx?hkey=d974fd78-086e-46bf-83d4-a2affb3bede>

**MUSCULOSKELETAL RADIOLOGY****PREAMBLE**

Each resident is to spend a minimum of six rotations doing musculoskeletal radiology during the Residency Training Program. These will occur between the PGY2 to PGY5 years. Elective rotations may provide additional exposure to musculoskeletal radiology. Part of musculoskeletal imaging will be covered on the nuclear medicine, plain film and ER rotations and the role of ultrasound for imaging of tendons and soft tissue abnormalities will be obtained during the ultrasound rotation and hands-on teaching session on MSK ultrasound. Interventional techniques (arthrograms, bone and soft tissue biopsy) will be learned on the MSK and interventional rotations. More advanced bone interventional procedures may be observed and learned on MSK intervention days.

**PROCESS**

As many of you already know we have been implementing MSK US experiences into the MSK and MSKII rotations. Here are the full details for each rotation. If you have any questions please feel free to contact the rotation supervisors as indicated.

**MSK Rotation**

Dr. Dave McDougall is the coordinator for the MSK ultrasound portion of the MSK rotation. He can be reached at David.Mcdougall@efwrad.com

MSK ultrasound will take place the last week of your 4 week rotation.

On your first day ask at the 2nd floor front reception desk to be taken to the MSK US radiologist and they will assist getting you oriented to the clinic and US technologists.

**Location & Parking:**

Advanced Medical Imaging, 2nd Floor Cambrian Business Center 2000 Veterans Place NW (Same tower as Mammo II rotations, MFM is located in Tower 1)

- Parking (Same as Mammoll and MFM rotations):
- All residents are to park in the EFW staff church parking lot just off Memorial Drive/Parkdale Blvd up the street from the clinic for their rotations
- An EFW hang tag will be required.
- You may pick up your parking hang tag at the main reception desk at AMI (FIRST FLOOR) on the first day of your rotation, the head receptionists name is Fahima Muradali.
- You are responsible for ensuring the parking hang tag is returned at the end of your rotation. If parking tags are lost or destroyed you are responsible for the cost of replacement.

**MSK II Rotation**

Dr. Arden Lee is the rotation coordinator, arlee@radiology.ca (don't use AHS or personal email)

- MSK Ultrasound will take place on Wednesdays of the MSKII rotation
- Ask the front desk reception to be taken to the MSK1 Radiologist, who can then introduce them to the MSK techs, including our lead MSK US tech, Luke McLeod.

**Location & Parking:**

Mayfair Diagnostics at Mayfair Place, 6707 Elbow Dr SW, Calgary AB

There is underground parking. Residents should park in a yellow stall and then talk to Rob, the parking attendant, at the front entrance of the clinic. Your parking will be subsidized.

## **ROTATION SPECIFIC GOALS & OBJECTIVES**

### ***MEDICAL EXPERT/CLINICAL DECISION MAKER***

#### **PGY2/Foundations of Discipline**

1. Knowledge of bone and soft tissue anatomy and normal variants.
2. Knowledge of the standard radiographic views obtained for commonly imaged bones and joints as well as an understanding of how the views are obtained.
3. Knowledge of the various modalities used for imaging the musculoskeletal system.
4. Development of an approach to plain film interpretation of bone and joint pathology.
5. Ability to recognize common fractures.
6. Learn the key features in determining whether a bone lesion is non-aggressive or aggressive.
7. Learn the key features used in characterizing arthropathies.
8. Ability to determine if a plain radiograph is technically adequate and how to correct for common technique problems, i.e. quality assurance.
9. Learn how to perform an arthrogram.
10. Learn the indications for and how to perform a joint aspiration.

#### **PGY2 and/or PGY3 (Foundations of Discipline and Core of Discipline 1)**

1. Continue to refine an approach to the plain film interpretation of all major bone and joint disorders.
2. Knowledge of fracture patterns, mechanism of injury, associated injuries and possible complications. The resident should also recognize those fractures requiring reduction or internal fixation and become familiar with orthopedic hardware.
3. Be able to recognize non-aggressive and aggressive features of bone lesion and give a basic differential diagnosis for their etiology.
4. Be able to recognize features of the various inflammatory and non-inflammatory arthropathies and give a basic differential diagnosis.
5. Ability to recognize bone and joint pathology on MRI.
6. Knowledge of the use of imaging modalities other than plain film in the assessment of bone and joint disorders, i.e. tomography, CT, MRI and ultrasound.
7. Learn normal MRI anatomy of the major joints in the body.

#### **PGY4/Core of Discipline 2**

1. Further development of PGY3 skills.
2. Begin to be comfortable discussing bone cases with clinicians in the ER department.
3. Ability to recognize as well as to provide an organized and concise report of bone and joint pathology seen on MRI.
4. Ability to provide an organized discussion of findings on musculoskeletal cases seen during rounds as well as to provide an appropriate short, differential diagnosis.
5. Demonstrate willingness and ability to teach musculoskeletal imaging to medical students and more junior residents.

#### **PGY4 and/or PGY5 (Core of Discipline 2 and Transition to Practice)**

1. Further refinement of PGY4 skills.
2. Provide consultative assistance to clinicians for musculoskeletal cases.



**COMMUNICATOR**

1. Develop and refine consultative skills as the resident progresses through training.
2. Communicate effectively with patients when performing an invasive procedure (i.e. arthrogram) to explain the procedure, its indications, its risks and possible complications.
3. Be aware of the psychological needs of patients when they are undergoing an interventional procedure.
4. Obtain appropriate information from the health care team when they request cross-sectional imaging (CT, MR, US) or an interventional procedure on bone/joint to provide the best imaging to answer the clinical question.

**COLLABORATOR**

1. Have the ability to function as a team member in MSK imaging, working with staff radiologists and clinicians to provide the optimum patient care.
2. Consult effectively with the health care team to provide the best patient care.
3. Contribute effectively to MSK rounds by preparing and presenting cases.

**MANAGER**

1. Utilize the resources for cross-sectional imaging (MR, CT & US) of bone or joint effectively to optimize patient care and health care costs.
2. When available, participate in quality assurance studies in MSK imaging.
3. Work effectively and efficiently as part of an MSK imaging team.
4. Use resources on the internet (David, Atlas of Human Anatomy; Wheeless' Textbook of Orthopaedics) to increase knowledge in MSK imaging.

**HEALTH ADVOCATE**

1. Understand the benefits and risks of radiological investigations of bone and joint pathology.
2. Recognize when a radiologic investigation or interventional procedure may be detrimental to the health of the patient.
3. Understand how bone and joint pathology affects activities of daily living in patients and how imaging and interventional procedures may assess and treat the findings respectively.

**SCHOLAR**

1. Learn to be an effective teacher in MSK imaging to junior residents, off-service residents and medical students.
2. Actively contribute to MSK rounds and the teaching file by preparing and presenting cases.
3. Participate in a radiology research project that may involve MSK imaging.
4. Through rounds, attendance at critical appraisal courses and journal club, learn to critically appraise sources of medical information.
5. Develop, implement and monitor a personal continuing education strategy.

**PROFESSIONAL**

1. When interacting with patients, clinicians and other members of the health care team, demonstrate appropriate personal and professional behavior.
2. Deliver the highest quality care in MSK imaging and intervention with integrity, honesty and compassion.

## **Musculoskeletal Imaging Suggested Reading List:**

### **PGY2/Foundations of Discipline**

1. Helms, C: Fundamentals of Skeletal Radiology. 5th Edition. Elsevier, 2019.
2. Manaster B. et al: Musculoskeletal Imaging: The Core Requisites. 5th Edition. Elsevier, 2021.

### **PGY3 to PGY5 (Core of Discipline and Transition to Practice)**

1. Brower, A.: Arthritis in Black and White. 3rd Edition. Elsevier, 2012.
2. Greenspan, A et al.: Orthopedic Imaging: A Practical Approach. 7th Edition. Lippincott Williams &Wilkins. 2020.
3. Rogers, L.F.: Imaging of Skeletal Trauma. 4th Edition. Elsevier, 2014. Major, N. et al.: Musculoskeletal MRI. 3rd Edition. Elsevier, 2019.
4. Crim, J. Specialty Imaging: Arthrography. 2nd Edition. Elsevier, 2019.
5. Jacobson, J. Fundamentals of Musculoskeletal Ultrasound. 3rd Edition. Elsevier, 2017.
6. McNally, E. Practical Musculoskeletal Ultrasound. 2nd Edition, Churchill Livingstone Elsevier, 2019.

### **Reference Texts:**

1. Resnick, D. et al.: Bone and Joint Imaging. 3rd Edition. Elsevier. 2004.
2. Stoller, D.: Magnetic Resonance Imaging in Orthopaedics and Sports Medicine. 3rd Edition. Wolters Kluwer. 2020.
3. Resnick, D. et al.: Internal Derangement of Joints. 2nd Edition. Elsevier. 2013.
4. Chung, C. et al.: MRI of the Upper Extremity: Shoulder, Elbow, Wrist and Hand. Lippincott Williams and Wilkins. 2012.

### **Suggested On-Line Reference Sites and Resources**

1. Rad Source MRI Web Clinics.
2. Society for Skeletal Radiology and International Society of Skeletal Radiology - Musculoskeletal Imaging Core Lectures.
3. RADPrimer.
4. StatDx.
5. Imaios e-anatomy.
6. Orthobullets

## NEURORADIOLOGY

### (Neuro CT and Neuro MRI)

#### Expanded Section Topics to Facilitate Setting our Core Curriculum

##### Contributors:

Muneeer Eesa (ME)  
Kathy Jacobs (KJ)  
James Scott (JS)  
Zarina Assis (ZA)

Mayank Goyal (MG)  
Manish Joshi (MJ)  
Rob Sevick (RS)

William Hu (WH)  
John Lysack (JL)  
Carla Wallace (CW)

Mark Hudon (MH)  
William Morrish (WM)  
Morgan Willson (MW)

#### CRANIAL ANATOMY

- Cross-Sectional Application of Cerebral Angiography (MH)
- Neurovascular Anatomy and use of Multi-Modality Imaging Techniques (ME)

#### NEOPLASMS of the BRAIN

- Radiogenomics: Understanding the Imaging Correlates of Adult Glioblastoma Genotypes (JS)
- Low-Grade Gliomas (MW)
- Meningiomas: The Essentials (RS)

#### VASCULAR DISEASES of the BRAIN

- Imaging of Brain Death (MJ)
- Imaging Approach of the Acute Stroke Patient (MJ)
- Multiphase CTA in Stroke Investigation (MJ)
- Comparative Effectiveness of CT in Stroke (MJ)
- Imaging of Hypoxic Ischemic Brain Injury (MJ)
- Endovascular Management of Intracranial Vascular Disorders (WM)
- SyNC: Symptomatic Non-Stenotic Carotid Vascular Disease (MG)
- Case Discussion of Neurovascular Disorders (ME)

#### TRAUMA and EMERGENCY NEURORADIOLOGY

- Traumatic Spinal Emergencies (MW)
- Imaging-Based Approach to Spine Infections (MW)
- Non-Traumatic Emergencies of the Brain, Head & Neck: A Case-Based Approach (JS)
- Imaging in Acute Stroke (MG)
- Intervention in Acute Stroke (MG)

#### INFECTIOUS and NON-INFECTIOUS INFLAMMATORY CONDITIONS of the BRAIN

- Radiologic Imaging of Recreational-Related Substance Use and Overdose (JS)
- Neuroimaging of Human Immunodeficiency Virus Related Conditions (MW)

#### WHITE MATTER DISEASES

- Multiple Sclerosis and Demyelinating Disorders (MW)

#### NEURODEGENERATIVE DISEASES and HYDROCEPHALUS

- CSF Dynamics and Hydrocephalus (MW)
- Imaging of Dementias: CT, MRI with PET Correlation (MJ)

#### CONGENITAL DISORDERS of the CENTRAL NERVOUS SYSTEM

- Practical Imaging in Epilepsy: A Case-Based Approach (JS)
- Review of Neuroimaging-Related Phakomatoses (MW)

## ORBIT

## SELLA and CENTRAL SKULL BASE

- Imaging of Sella and Suprasellar Pathology (WM)
- Imaging of the Skull Base (JL)

## TEMPORAL BONE

- Imaging of the Temporal Bone (JL)

## SINONASAL DISEASE

- Imaging of the Nasal Cavity and Paranasal Sinuses (JL)

## MUCOSAL and NODAL DISEASE of the HEAD and NECK

- Basic Applications of Head and Neck Anatomy (MH)
- Imaging of the Oral Cavity and Related Spaces (JL)
- Imaging of the Oropharynx (JL)
- Imaging of the Hypopharynx and Larynx (JL)

## EXTRAMUCOSAL DISEASES of the HEAD and NECK

- US-guided Biopsy of Neck Lesions: The Head and Neck Neuroradiologist's Perspective & Workshop (JS)
- ACR Thyroid Imaging, Reporting and Data System (TI-RADS) (JS)
- FNA in Post-Operative Management of Patients with Thyroid Cancer: Thyroid Bed and Cervical Lymph Nodes (JS)
- Head and Neck Pathology: Case-Based Approach to Diagnosis and Management (MH)
- The Spaces of the Neck (JL)
- The Parapharyngeal Space (JL)

## ANATOMY and DEGENERATIVE DISEASES of the SPINE

- Spine Intervention in Low-Back Pain: When to Consider (MJ)
- Cases in Spine Imaging: Degenerative Diseases (WH)

## NON-DEGENERATIVE DISEASES of the SPINE

- Lumbar Puncture and Post-Dural Puncture Headache (MW)
- Post-Operative Spine Imaging (MW)
- Cases in Spine Imaging: Mass Lesions by Compartment (WH)
- Cases in Spine Imaging: Vascular Lesions (WH)
- Cases in Spine Imaging: Infectious and Inflammatory Disorders (WH)
- Cases in Spine Imaging: Disorders of CSF Flow (WH)
- Imaging and Management of Non-Degenerative Disorders of the Spine (WM)

## NEONATAL NEURORADIOLOGY

- Diagnoses and Classification of Preterm Brain Injury from Cranial Ultrasound: Canadian Consensus Viewpoint (JS)
- Evaluating Extreme Pre-Term Brain Injury: Case-Based Problem Solving Beyond the Standards (JS)
- MRI Evaluation of Pre-Term and Term Newborns (MJ)

## PEDIATRICS

- Neuroimaging Pediatric Metabolic Disorders: A Case-Based Approach (JS)
- Congenital Malformations of Cortical Development: A Case-Based Approach (JS)
- Head and Neck Imaging – Pediatric Lesions (JL)

## APPROACH and PITFALLS in NEUROIMAGING

- MR Spectroscopy of the Brain: Clinical Applications (JS)
- Diffusion-Weighted and Diffusion Tensor Imaging (MW)
- Introduction to Functional MRI (MW)
- MR Cerebral Perfusion Imaging: A Case-Based Approach (MW)
- Radiation Risk in Medical Imaging (MJ)
- Artificial Intelligence in Diagnostic Imaging (MJ)
- Bone Lesions for the Neuroradiologist (MH)
- Head and Neck Imaging – Principles and Protocols (JL)
- Technical Approaches to Cerebral and Spinal Angiography (ME)
- Susceptibility-Weighted Imaging (SWI) and its Practical Applications (RS)

## CANMEDS / Medical Expert; Family Medicine Expert; Communicator; Collaborator; Leader; Health Advocate; and Scholar

- Emergency Neuroradiology and How to Report Critical Findings (JS)
- Neuroradiology Discrepancy Reports, Lectures I – VII (JS)
- Evidence-Based Medicine and Research (MG)
- An Academic Career in Medicine: Trials and Tribulations (MG)
- Bioethics – An Introduction for Neuroradiologists (JL)
- Medical Malpractice – A Neuroradiology Perspective (JL)
- Medical Professional Regulation – A Neuroradiology Perspective (JL)
- Information Technology and Privacy in Health Law – A Neuroradiology Perspective (JL)
- Leadership and Professionalism in Radiology Practice (RS)
- Management of MRI in Patients with Pacemakers (CW)
- Update on the Use of MR for Assessment of Psychiatric Diseases: Case-Based Approach (JS)

### Neuroradiology Education Curriculum

#### DISCLAIMER

The neuroradiology curriculum is meant as a general guide to assist with learning the fundamentals of neuroradiology in an organized manner. The objectives of the curriculum are purposely limited to the fundamentals so that the individual will acquire a level of knowledge that will enable them to confidently deal with neuroradiology as it is reflected within the general practice of diagnostic radiology. It should not replace the practice of reading around cases encountered while on call or during daily rotations which is an important component of radiology residency training within all subspecialty sections.

#### RECOMMENDED RESOURCES

1. Textbook Resources
  - a. *Essentials of Osborn's Brain: A fundamental guide for residents and fellows*. Anne Osborn 2019 (Hardcopy available for use while on rotation) or the full version of *Osborn's Brain: Imaging, Pathology and Anatomy*. Anne Osborn 2013 (UofC library hardcopy available)
  - b. *Neuroradiology: The Requisites 4<sup>th</sup> Edition*. David Yousem 2016 (UofC Library full text available electronically)
  - c. *Brandt and Helms' Fundamentals of Diagnostic Radiology 5<sup>th</sup> Edition*. Jeffery Klein, Emily Vinson, William Brand and Clyde Helms 2018 (UofC Library full text available electronically – 4<sup>th</sup> edition)
2. Supporting Articles
  - a. *Safe Use of Contrast Media: What the Radiologist Needs to Know*. Radiographics 2015; 35:1738-1750

- b. *Lumbar Disc Nomenclature: Version 2.0 Recommendations of the combined task forces of the North American Spine Society, the American Society of Spine Radiology and the American Society of Neuroradiology.* The Spine Journal 14 (2014) 2525-2545.
  - c. *Multidetector CT of Blunt Cervical Spine Trauma in Adults.* Radiographics 34 (2014) 1842-1865.
  - d. *Traumatic Thoracolumbar Spine Injuries: What the Spine Surgeon Wants to Know.* Radiographics 33 (2013) 2031-2046.
  - e. *Infections of the Spine: A review of clinical and imaging findings.* Applied Radiology 45 (2016) 10-20.
  - f. *Spectrum of Critical Imaging Findings in Complex Facial Skeletal Trauma.* Radiographics 33 (2013) 3-19.
  - g. *Temporal Bone Trauma and the Role of Multidetector CT in the Emergency Department.* Radiographics 31 (2011) 1741-1755.
  - h. *Face and Neck Infections What the Emergency Radiologist Needs to Know.* Radiol Clin N Am 53 (2015) 827-846.
  - i. *Emergency Imaging Assessment of Acute, Non-traumatic Conditions of the Head and Neck.* Radiographics 30 (2010) 1335-1352
  - j. *Spinal Neuroarthropathy: Pathophysiology, Clinical and Imaging Features and Differential Diagnosis* Radiographics 2016; 36: 783-799
  - k. *MRI in Seronegative Spondyloarthritis: Imaging Features and Differential Diagnosis in the Spine and Sacroiliac Joints* AJR 2013; 200: 149-157
  - l. *Scoliosis Imaging: What Radiologists Should Know* Radiographics 2010; 30:1823-1842
  - m. *Imaging of Head and Neck Lymph Nodes.* Radiol Clin N Am 53 (2015) 115-132
  - n. *Imaging of the Paranasal Sinuses and Nasal Cavity: Normal Anatomy and Clinically Relevant Anatomical Variants.* Semin Ultrasound CT MRI 30 (2009) 2-16.
  - o. *Imaging Review of the Temporal Bone: Part 1. Anatomy and Inflammatory and Neoplastic Processes* Radiology 2013; 269: 17-33
  - p. *Imaging Review of the Temporal Bone: Part 2. Traumatic, Postoperative, and Noninflammatory Non Neoplastic Conditions* Radiology 2013; 276: 655-672
3. Online Resources
- a. RADPrimer (<https://www.radprimer.com/>) and StatDx (<https://my.statdx.com/>) subscriptions paid through the Diagnostic Radiology Residency Program (PGY2-5)
  - b. E-anatomy (<https://www.imaios.com/en/e-Anatomy>) subscription paid through the Diagnostic Radiology Residency Program or Canadian Association of Radiologists
  - c. Fundamental Neuroscience for Neuroimaging – Johns Hopkins University <https://www.coursera.org/learn/neuroscience-neuroimaging>
  - d. CT Brain Anatomy Tutorial Radiology Masterclass [https://www.radiologymasterclass.co.uk/tutorials/ct/ct\\_brain\\_anatomy/ct\\_brain\\_anatomy\\_start](https://www.radiologymasterclass.co.uk/tutorials/ct/ct_brain_anatomy/ct_brain_anatomy_start)
  - e. Acute CT Brain Tutorial Radiology Masterclass [https://www.radiologymasterclass.co.uk/tutorials/ct/ct\\_acute\\_brain/ct\\_brain\\_start](https://www.radiologymasterclass.co.uk/tutorials/ct/ct_acute_brain/ct_brain_start)
  - f. ASPECT Score in Acute Stroke <http://www.aspectsinstroke.com/>
    - 1. Basics in Acute Stroke
      - a. Clinical Presentation of Acute Stroke
      - b. Potential Causes of Stroke
      - c. Radiologic Imaging Modalities in Diagnosis of Acute Stroke
    - 2. Non Contrast CT Head Imaging
      - a. Non Contrast CT Head Findings
      - b. Calculating the ASPECT Score
      - c. ASPECTS Case Scenarios
    - 3. Vascular and Multiphase Imaging Stroke

- a. Vascular and CTA Imaging in Acute Stroke
- b. What is Multiphase CTA and Collateral Scoring
- c. mCTA Case Scenarios

## **PGY 1-2/Foundations of Dicipline**

### Techniques in Neuroimaging

- Plain films
- CT
- MR
- Fluoroscopy/Myelography
- Ultrasound

### Contrast agents and Contrast reactions

- Iodinated contrast
- Gadolinium based contrast

### Anatomic Foundations of Neuroimaging - Basics

- Brain
  - Scalp, calvarium and skull base, meninges
  - Supratentorial brain
  - Infratentorial brain
  - Cranial arteries
  - Cranial veins and venous sinuses
  - CSF spaces
- Head and Neck
  - Aortic arch and cervical vessels
  - Facial bones and paranasal sinuses
  - Orbit
  - Temporal bone
  - Mucosal spaces of head and neck (nasopharynx, oropharynx, oral cavity, hypopharynx, larynx)
  - Suprahyoid neck spaces
  - Salivary glands
- Spine
  - Craniocervical junction
  - Cervical, thoracic and lumbar vertebra
  - Ligamentous and supporting structures
  - Spinal cord, conus and cauda equina nerve roots

### Resources:

Fundamental Neuroscience for Neuroimaging – Johns Hopkins University

<https://www.coursera.org/learn/neuroscience-neuroimaging>

## **FIRST HALF OF PGY-2/Foundations of Discipline**

- 1<sup>ST</sup> ER CT AND NCT ROTATIONS

### **Common and Emergency Neuroimaging Pathology Brain**

- CNS Trauma
- Non-Traumatic Brain Bleeds
- Stroke

### **Common and Emergency Neuroimaging Pathology Spine**

- Introduction to Spine Trauma
- Introduction to Spine Infection
- Introduction to Degenerative Spine

### **Common and Emergency Neuroimaging Pathology Head and Neck**

- Introduction to Facial and Temporal Bone Trauma
- Introduction to Face and Neck Infections

## **HALFWAY THOUGH PGY-2 TO END OF PGY-4/Foundations of Discipline, Core of Discipline**

- 1<sup>ST</sup> NCT, 1<sup>ST</sup> NMR, 2<sup>ND</sup> ER CT, 2<sup>ND</sup> NCT

### **Anatomic Foundations of Neuroimaging - Intermediate**

- Brain
  - Pia and perivascular spaces
  - Normal skull variants
  - Sella and pituitary
  - CSF spaces normal variants
- Head and Neck
  - Infrahyoid neck
  - Lymph node levels
  - Cranial nerves and skull base
  - Temporal bone
- Spine
  - Spinal vascular anatomy
  - Plexuses

### **Common Pathologies in Neuroimaging Brain**

- Acute Hydrocephalus
- Aneurysms and Non aneurysmal Subarachnoid Hemorrhages
- Vascular Malformations
- CNS Infections
- Demyelinating Disease
- Common CNS Neoplastic Disease and Non Neoplastic Cysts
  - Astrocytomas, Meningiomas, Metastatic Disease
- Epilepsy/Seizures



#### Common Pathologies in Neuroimaging Spine

- Demyelination and Inflammatory Spine Disorders
- Introduction to Spine Neoplastic Disease: Extradural and Bone Tumors
- Spine Trauma Continued
- Spine Infection Continued
- Degenerative Spine Continued and Introduction to Spinal Arthritis

#### Common Pathologies in Neuroimaging Head and Neck

- Introduction to Head and Neck Cancer
- Introduction to Sinonasal Inflammatory Disease
- Facial and Temporal Bone Trauma Continued
- Facial and Neck Infection Continued

#### **HALFWAY THROUGH PGY-2 TO END OF PGY-4/ Foundations of Discipline, Core of Discipline**

- 1<sup>ST</sup> AND 2<sup>ND</sup> NMR, 2<sup>ND</sup> NCT

#### Less Common but Important Pathologies in Neuroimaging Brain

- Nonastrocytic Gliomas, Neuronal and Glioneuronal Tumors
- Pineal and Germ Cell Tumors
- Embryonal Neoplasms
- Nerve Sheath Tumors
- Lymphomas and Hematopoietic and Histiocytic Tumors
- Sellar Neoplasms and Tumor Like Lesions
- Nonneoplastic Cysts

#### Less Common but Important Pathologies in Neuroimaging Spine

- Spine Neoplastic Disease Continued: Intradural Extramedullary
- Spine Nonneoplastic Cysts
- Inherited and Acquired Metabolic Spine Disorders
- Spinal Cord Infarction

#### Less Common but Important Pathologies in Neuroimaging Head and Neck

- Introduction to Salivary Gland Imaging, Infection and Neoplastic Conditions
- Introduction to Orbital Imaging, Infection and Neoplastic Conditions
- Introduction to Temporal Bone Infection and Neoplastic Conditions
- Head and Neck Cancer Continued
- Sinonasal Inflammatory Disease Continued

## **PGY-5 (Transition to Practice)**

- *FINAL NMR ROTATION*

### **Less Common but Important Pathologies in Neuroimaging Brain Part 2**

- Toxic Encephalopathy
- Acquired Metabolic and Systemic Disorders
- Dementias and Brain Degenerations
- Hydrocephalus and CSF Disorders
- Congenital Malformations of the Brain
- Familial Tumor (Cancer Predisposition) Syndromes
- Anomalies of the Skull and Meninges
- Posterior Fossa Malformations
- Neurocutaneous Syndromes

### **Less Common but Important Pathologies in Neuroimaging Spine Part 2**

- Congenital Anomalies of the Spine and Spinal Cord
- Vascular Malformations of the Spine
- Spine Neoplastic Disease Continued: Intramedullary Tumors

### **Less Common but Important Pathologies in Neuroimaging Head and Neck Part 2**

- Head and Neck Cancer Continued
- Salivary Gland Imaging Continued: Inflammatory and Nonneoplastic Conditions
- Orbital Imaging Continued: Inflammatory and Nonneoplastic Conditions
- Temporal Bone Imaging Continued: Inflammatory and Nonneoplastic Conditions
- Temporal Bone Imaging Continued: Post Op and Noninflammatory Nonneoplastic Conditions

Currently, the Royal College of Physicians and Surgeons requires the equivalent of 6 blocks of Neuroradiology throughout residency. Residents at the University of Calgary obtain this training during rotations in ER CT, Neuro CT and Neuro MR although parts of neuroradiology will also be covered during plain film rotations, MSK (eg. inflammatory spondyloarthropathies) or nuclear medicine (eg. Spine - Bone scan, SPECT/CT, and PET imaging). Residents are also extensively involved in Neuroradiology after hours coverage in the evenings, weekends and overnight which forms an important part of their training.

## **1. GENERAL CONSIDERATIONS**

### **a. RESIDENT PRE-DICTATIONS**

The process of pre-dictating radiology cases before reviewing with staff radiologists is recognized as an important component in radiology resident training. This practice encourages organizational skills, independence and work efficiency, and the pre-dictation frequency is expected to increase with progressive training and resident comfort of imaging findings.

At the same time, it must be recognized by the resident that any radiology report, even those labeled 'preliminary', are still medico-legal documents that may be viewed by clinicians, printed and placed on the patient's medical chart, and possibly acted upon. A 'preliminary' report is dictated under a staff radiologist – a radiologist who may be unaware of the exam's existence or the resident's preliminary interpretation until they review the case together.

As a result, all resident pre-dictations must be clearly labeled as such, to avoid interpretive misunderstandings that may negatively impact patient care.

It is recommended that the following statement be added to all resident pre-dictations, and placed under the report Impression:

*\*\*\* This exam has not yet been discussed/reviewed with a staff radiologist \*\*\**

This statement can then be removed after exam review with a staff radiologist, and once all necessary report changes are made.

## **b. PRELIMINARY VERBAL RESIDENT INTERPRETATIONS**

If the on-call resident has also discussed the radiologic findings and provided a preliminary verbal opinion to the requesting clinician, it is recommended that the following statement be added to all pre-dictations, and placed under the report Impression:

*The PRELIMINARY resident interpretation (with respect to the patient's acute presentation) was discussed with the requesting physician at [enter time] on [enter date].*

If there are any significant changes made concerning the radiographic findings of the report after staff radiologist review, this comment regarding the earlier verbal discussion of any findings must be amended or removed, and a discrepancy report then provided (see below).

## **c. DISCREPANT RADIOLOGY RESIDENT REPORTS**

A radiology resident's preliminary interpretation may occasionally differ from the final interpretation after study review with a staff radiologist. Most differences are very minor and will not significantly impact the radiology report or change patient care. However, on occasion, a "missed" finding may impact patient care if important imaging features were initially not recognized or their significance not fully understood or reported by the resident.

This issue is of particular concern on-call, as verbal radiological impressions or preliminary dictations are often provided by the resident when there may be a larger time period before exam review with staff radiologists.

Any discrepant interpretation that is felt potentially significant by the responsible staff radiologist or requesting physician must be clearly documented in the final radiology report. This declaration is absolute since the Preliminary Impression may have influenced clinical management and patient care in directions different than indicated from the Final Impression.

A simple example is a patient who suffered minor head trauma, but who had a small subdural hematoma on Head CT that was initially not recognized by the resident until review with a staff radiologist. If the resident issued a Preliminary Impression of "no acute pathology" and the patient was discharged from hospital prior to final radiology review, the report must then disclose that there was a reporting discrepancy and explain any significant difference between the Preliminary and Final Impression. The discrepant findings must be then verbally communicated with the requesting, or responsible physician.

In such instances, it is recommended that the dictating resident include the following items to their radiology report:

*PRELIMINARY ON-CALL RADIOLOGY RESIDENT IMPRESSION:*

*[... Resident Impression ...]*

*Preliminary findings were reported to Dr. (... enter NAME ...) on (... enter DATE ...).*

**FINAL IMPRESSION AFTER STAFF RADIOLOGIST REVIEW:**

*[... Staff Radiologist Impression ...]*

*The discrepancy between above Preliminary and Final Impressions was phoned to, and discussed with Dr. (... enter NAME ...) on (... enter DATE ...).*

**d. NEURORADIOLOGY WORKLISTS**

- i. Neuro ER and Neuro CT
  - 1. FMC CT ER NEURO
  - 2. FMC CT IP NEURO
  - 3. EFW CT OP NEURO
    - a. FMC, RICHMOND ROAD, HIGH RIVER, SOUTH HEALTH CAMPUS\* (SHC)
- ii. Neuro MR
  - 1. FMC MR ER\_IR NEURO
  - 2. EFW MR OP NEURO
    - a. FMC, RICHMOND ROAD, SOUTH HEALTH CAMPUS\*, SOUTH CALGARY HEALTH CENTER\* (SCHC)
- iii. On Call and after hours
  - 1. EFW Resident Call

**\* STUDIES FROM SOUTH HEALTH CAMPUS (CT AND MR) and SOUTH CALGARY HEALTH CENTER (MR)**

- i. Outpatient imaging from these sites is shared between EFW and Mayfair radiology groups
- ii. EFW is responsible for only cases in which the accession number ends in an **ODD** number.
- iii. If more than one study was performed at the same time (multiple accession numbers) then the lowest accession number of all the cases must be **ODD** - then all the studies associated with that patient belong to EFW.

**2. NEURORADIOLOGY RESIDENT ROTATIONS**

**a. NEURO ER ROTATION**

- i. Daily Workflow
  - 1. Neuroradiology Staff Coverage
    - a. Residents review with the staff in FMC Neuro CT2
    - b. If no staff is assigned in FMC Neuro CT2 then residents review with staff in FMC Neuro CT1
  - 2. In general the typical day runs from 0800 to 1700 hrs.
    - a. Protected time for rounds (Mon 7am, Wed MFM, Noon Rounds and Academic Half Day etc.)
  - 3. When you first arrive, check the ER and IP list to see if there are cases left over from the morning that the overnight resident did not read (typically cases done near or after 0700).
  - 4. Inform CT technologists of your extension in case they have questions about protocols.
- ii. Rotation Evaluations
  - 1. The evaluations are completed by Dr. Mark Hudon after consultation with other members of the Neuroradiology subgroup.
- iii. Responsibilities

1. Neuro CT Protocolling
  - a. Emergency/Inpatients
    - i. Assist with online protocolling of all inpatient and emergency neuro CT studies
2. All ER Neuro cases
  - a. Important or unexpected findings should be discussed directly with the referring ER physician and documented in the report.
  - b. It may be helpful to discuss cases with the ER physician in which the history is limited or not provided to ensure you are able to provide a report that is comprehensive and reflects the clinical situation.
  - c. All ER cases should be reviewed promptly so a final report can be completed to assist with ER patient disposition, discharge or referrals.
3. Assist with IP neuro exams (if there is no resident on Neuro CT that day)
4. The Neuroradiology section is responsible for ER plain films (FMC/High River/Okotoks/Airdrie/Cochrane) from 1100-1130hrs and 1400-1500hrs Mon-Fri. If you are interested in reading ER cases during this time you are welcome. In most cases let the staff know you would like to read ER plain films and they will let you know if they are available during that time since these are time sensitive cases that need to be finalized quickly. They will also let you know if they want you to draft cases so they can sign them off directly (without a temporary prelim resident report going to PACS) or if they prefer you send a temporary prelim report to PACS.

## **b. NEURO CT ROTATION**

- i. Daily Workflow
  1. Neuroradiology Staff Coverage
    - a. Residents review with the staff in FMC Neuro CT2
    - b. If no staff is assigned in FMC Neuro CT2 then residents review with staff in FMC Neuro CT1
  2. In general the typical day runs from 0800 to 1700 hrs.
    - a. Protected time for rounds (Mon 7am, Wed MFM, Noon Rounds and Academic Half Day etc.)
  3. When you first arrive, check the ER and IP list to see if there are cases left over from the morning that the overnight resident did not read (typically cases done near or after 0700).
  4. Check in with the Fellow on Neuro CT
  5. Inform CT technologists of your extension in case they have questions about protocols.
  6. Let the staff neuroradiologist you are on service for the day and any times that you may be unavailable to make a plan for the day.
  7. Neuro CT Pager 00917 coverage - Wednesdays during Neuroradiology fellows academic half day or other instances when Neuroradiology fellows are away.
  8. Suggested Neuroradiology Rounds
    - a. Stroke Rounds - Thursday 0730-0830
    - b. Neuroscience Grand Rounds - Friday 0800-0900 (Case Presentations), 0900-1000 (Lecture)
- ii. Rotation Evaluations
  1. The evaluations are completed by Dr. Mark Hudon after consultation with other members of the Neuroradiology subgroup.
- iii. Responsibilities
  1. Neuro CT Protocolling
    - a. Emergency/Inpatients

- i. Assist with online protocolling of all inpatient and emergency neuro CT studies
  - b. Outpatients
    - i. Primarily the resident's responsibility, fellow or staff available to assist with questions
    - ii. If there is no resident on Neuro CT, Neuro MR resident covers CT protocols
    - iii. If no resident on Neuro CT or Neuro MR – fellow covers CT protocols
- 2. Neuroimaging Case Priority
  - a. Inpatient CT Neuro exams
  - b. Assigned plain films
  - c. Outpatient CT Neuro exams
    - i. Note that although your primary responsibility is to ensure Inpatient cases are completed you should take some time each day to read relevant outpatient imaging, even if there are inpatient cases that have not yet been read, to ensure you have exposure to a breadth of neuroimaging during your rotation.
    - ii. On second or third Neuro CT rotations it is expected that you will be able to manage inpatient exams with greater efficiency and this will allow more time for outpatient exams across the spectrum of neuroimaging to round out your experience and you may pick cases specifically to address areas of interest or perceived knowledge gaps.
  - d. Assist with ER Neuro exams
  - e. The Neuroradiology section is responsible for ER plain films (FMC/High River/Okotoks/Airdrie/Cochrane) from 1100-1130hrs and 1400-1500hrs Mon-Fri. If you are interested in reading ER cases during this time you are welcome. In most cases let the staff know you would like to read ER plain films and they will let you know if they are available during that time since these are time sensitive cases that need to be finalized quickly. They will also let you know if they want you to draft cases so they can sign them off directly (without a temporary prelim resident report going to PACS) or if they prefer you send a temporary prelim report to PACS.
  - f. Lumbar punctures (suggestion to try and tag along with neuroradiology Fellows or Staff if they have a case)

**c. NEURO MR ROTATION**

- i. Daily Workflow
  - 1. Neuroradiology Staff Coverage
    - a. Residents review with the staff in FMC Neuro MR2
    - b. If no staff is assigned in FMC Neuro MR2 then residents review with staff in FMC Neuro MR1
  - 2. In general, the typical day runs from 0800 to 1700 hrs.
    - a. Protected time for rounds (Mon 7am, Wed MFM, Noon Rounds and Academic Half Day)
  - 3. Check in with the Fellow on Neuro MR
  - 4. Suggested Neuroradiology Rounds
    - a. Stroke Rounds - Thursday 0730-0830
    - b. Neuro Oncology - Wednesday 1500-1600
    - c. Neuroscience Grand Rounds - Friday 0800-0900 (Case Presentations), 0900-1000 (Lecture)
- ii. Rotation Evaluations

- a. The evaluations are completed by Dr. Morgan Willson after consultation with other members of the Neuroradiology subgroup.
- iii. Responsibilities
  - 1. Neuro MR Protocolling – primarily the fellows responsibility
    - a. For residents on their 2<sup>nd</sup> or 3<sup>rd</sup> Neuro MR rotation please check in with the fellow on Neuro MR and help with outpatient protocols (grab a stack of 10-15) and review with fellow or staff
    - b. If there is no resident on Neuro CT that rotation or that day, Neuro MRI resident covers Neuro CT protocols
  - 2. Suggested Case Selections
    - a. 1st Rotation
      - i. Outpatient MR
        - 1. MR Brain – headache, MS, tumor
        - 2. MR Angiogram – rule out aneurysm, follow up aneurysm, assess head and neck vessels
      - ii. Emergency/Inpatient Stroke Exams (typically performed after CTA Head and Neck and IV/endovascular treatment if applicable) Brain (protocol 5E), or Brain and Angiogram (protocols 5A/5B).
      - iii. Emergency/Inpatient Spine Exams – “Trauma” (40C, 40T, 40L protocols)

\* this selection of emergency/inpatient imaging has been selected since there are almost always preceding CTA Head and Neck or CT Spine Trauma exams. This allows the resident to review the prior imaging in the context of follow up MRI and will improve detection and interpretation of CT cases while on call.

- iv. Emergency/Inpatient Spine Exams - “R/O Cauda Equina/Cord Compression” (typically 32B lumbar or 35 C/T/L protocols) and “R/O Discitis-Osteomyelitis/Epidural Abscess” (typically 33C, 33T and 33L protocols)

\* this has been selected because it is the most common emergency imaging request performed after hours. Although residents are not expected to read MR overnight it is important to become familiar with the nomenclature and urgent imaging findings

- b. 2nd or 3rd Rotations
  - i. On second or third Neuro MR rotations it is expected that you will be able to read exams with greater efficiency and this will allow exposure to outpatient exams across the spectrum of neuroimaging to round out your experience and you may pick cases specifically to address areas of interest or perceived knowledge gaps.
- c. Neuroradiology is responsible for ER plain films (FMC/High River/Okotoks/Airdrie/Cochrane) from 1100-1130hrs and 1400-1500hrs Mon-Fri. If you are interested in reading ER cases during this time you are welcome. In most cases let the staff know you would like to read ER plain films and they will let you know if they are available during that time since these are time sensitive cases that need to be finalized quickly. They will also let you know if they want you to draft cases so they can sign them off directly (without a temporary prelim resident report going to PACS) or if they prefer you send a temporary prelim report to PACS.

### **3. NEURORADIOLOGY ON CALL EVENINGS, WEEKENDS, OVERNIGHT**

#### **a. GENERAL CALL CONSIDERATIONS**

- i. All PGY2 Residents undergo pre-call assessments and are reviewed by the Residency Training Program, in consultation with the division of Neuroradiology, prior to undertaking on-call duties, which typically begin in the second half of PGY2.
- ii. The details of call hours and shifts are as outlined by the Residency Program Committee.
- iii. On Call Neuroradiology coverage primarily includes CT and plain films, and occasional diagnostic lumbar punctures.
- iv. On call resident duties are under Neuroradiology staff supervision, and include clinical consultation, exam protocolling, interpretation and review. The on call resident will also assist in arranging for studies to be performed at other suitable times or site locations, based on clinical need.
- v. Residents provide preliminary reports to the ER and other requesting clinical services, and are expected to review and report all cases with Neuroradiology staff.

#### **b. NEURORADIOLOGY STAFF COVERAGE (QGENDA)**

- i. Neuroradiology in house weekday evening coverage 5pm until 11pm
  1. **Neuro Late Stay** Staff Neuroradiologist
- ii. Neuroradiology in house weekend coverage Saturday, Sunday and Holidays
  1. **Neuro Day** Neuroradiologist (0800-1530hrs)
  2. **Neuro Eve** Neuroradiologist (1530-2300hrs)
- iii. Overnight Neuroradiology Coverage
  1. Neuroradiology Fellow on call - virtual pager 1975
  2. **FMC Neuro Night Call** Neuroradiologist
  3. **FMC Neuro IR Call** Neuroradiologist - virtual pager 4975
  4. For residents reporting cases overnight, cases are to be reviewed with the Neuro CT1 Neuroradiologist scheduled for the following day (weekdays) or the Neuro Day Neuroradiologist scheduled for the following day (weekends and holidays)

### **4. ROTATION GOALS AND OBJECTIVES**

#### **a. NEURO ER and NEURO CT**

- i. All residents receive at least two blocks in Emergency Radiology. This rotation includes neuro CT and plain radiographs (as well as body CT, ultrasound, thoracic imaging, musculoskeletal imaging). Each Diagnostic Imaging resident will also do rotations in Neuro CT and Neuro MRI as outlined by the residency training program. A minimum of 6 blocks will be completed in neuroradiology. These will occur between the PGY2 to PGY5 years. Elective rotations may provide additional exposure to neuroradiology. Parts of neuroradiology will also be covered during plain film rotations, MSK (inflammatory spondyloarthropathies) or nuclear medicine (Bone scan, SPECT/CT, and PET). The objectives of the neuroradiology rotations will be limited to the fundamentals of neuroradiology so that the individual will acquire a level of knowledge that will enable the resident to confidently deal with this field as it is reflected in a general practice of diagnostic radiology.
- ii. Resident Goals and Objectives
  1. General Competencies (All Years) - The resident should:
    - a. Be able to use the PACS for interpretation of imaging studies.
    - b. Learn how to triage examinations related to their urgency and how to work efficiently to get required studies performed and interpreted.



- c. Improve their skills for advising Emergency Medicine physicians and other referring physicians on the most effective and appropriate method(s) of imaging patients
  - d. Learn basic and tailored CT protocols for the most common pathologic entities.
  - e. Demonstrate ability to integrate laboratory findings and other clinical parameters in recommending appropriate patient specific imaging strategies for diagnostic purposes.
  - f. Learn how to dictate a concise and complete CT report.
  - g. Over the course of residency training there should be general progression of competency starting with emergency and common pathologies expanding to less common but important pathologies and finally rare diagnoses and uncommon manifestations of common disorders.
2. Specific Goals & Objectives for PGY-2/3 (Foundations of Discipline and Core of Discipline 1) - The resident should learn:
- a. Basic neuroanatomy (See suggested Neuroradiology Curriculum).
  - b. How to distinguish mass effect and brain herniation associated with acute processes from volume loss associated with more chronic processes.
  - c. CT pattern of pathologies associated with head trauma; especially subdural hematoma; epidural hematoma; subarachnoid hemorrhage; diffuse axonal injuries; parenchymal contusions; hemorrhagic parenchymal contusions; non-hemorrhagic parenchymal contusions; calvarial, facial and spinal fractures; cerebral edema.
  - d. CT patterns of arterial and venous infarction with an understanding of major vascular territories; learn to determine age (i.e., acute versus chronic).
  - e. How to perform and interpret CT angiograms of the carotid and vertebral arteries, and the appearance of cerebrovascular disease, including acute stroke, traumatic dissection, and atherosclerotic disease.
  - f. Learn advanced CT imaging protocols unique to neuroradiology radiology (e.g. CT/CTA protocols for strokes and basics of CT Perfusion).
  - g. How to perform a lumbar puncture.
  - h. How to identify a mass on head CT, and determine its location whether it is intra-axial or extra-axial.
  - i. Learn the radiological approach to investigate “non-traumatic neuroradiological emergencies”, and how to protocol and triage these exams according to clinical need. Non-traumatic neuroradiological emergencies include: acute stroke syndromes; PRES, herpes encephalitis, cauda equina syndrome, spinal cord compression, and sinovenous occlusive disease and herniation syndromes.
  - j. Learn the CT appearance of major vascular lesions such as arteriovenous malformations (AVMs), aneurysms, cavernous malformations, venous anomalies.
  - k. Learn the CT appearance of cerebritis, abscess, meningitis, empyema.
  - l. Learn the CT appearance of multiple sclerosis, acute disseminated encephalomyelitis (ADEM).
  - m. Learn the CT appearance of different types of non-traumatic hemorrhage and the differential diagnoses.
  - n. Learn the CT appearance of degenerative spine disease including disc herniation, spinal stenosis and neural foramen encroachment on CT.
  - o. Learn the CT appearance of spinal fractures.

- p. The resident is expected to develop basic knowledge of the anatomy and pathology of the head and neck, including soft tissue infections, malignancy. The resident should also become familiar with the most important clinical evaluations.
3. Specific Goals & Objectives for PGY-4/5 (Core of Discipline 2 and Transition to Practice) - The resident should:
    - a. Build on the knowledge acquired in PGY-2/3.
    - b. Build on basic knowledge of the anatomy and pathology of the head and neck, including soft tissue infections, and malignancy. The resident should also become familiar with the most important clinical evaluations.
    - c. Learn the anatomy of the temporal bone, orbit, skull base, sinuses, oral cavity, larynx, neck and temporomandibular joint.
    - d. Learn the typical appearances of nasopharyngeal carcinoma and squamous cell carcinomas of the oropharynx, oral cavity, hypopharynx and larynx. Have a basic understanding of staging for head and neck cancer
    - e. Learn the CT appearance of normal pediatric brain.
    - f. Develop a more comprehensive radiological approach to spinal trauma and subtle features CT that may suggest the presence of ligamentous injury requiring further investigation with MR.
    - g. Develop a more comprehensive radiological approach to investigate “non-traumatic neuroradiological emergencies”, and how to protocol and triage these exams according to clinical need. Non-traumatic neuroradiological emergencies include: acute stroke syndromes; PRES, herpes encephalitis, cauda equina syndrome, spinal cord compression, sinovenous occlusive disease and herniation syndromes. The resident should become familiar with the most important clinical evaluations.
    - h. Develop a more comprehensive approach to intracranial masses and learn differential diagnoses based on location. Locations to be learned include pineal region; sellar; suprasellar; parasellar; cerebello-pontine angle, lobar, cerebellar, callosal; skull base; intraventricular.
  4. MEDICAL EXPERT
    - a. See suggested Neuroimaging Curriculum
  5. COMMUNICATOR - The resident should:
    - a. Be able to obtain appropriate information from the health care team in order to properly protocol a CT exam or recommend a more appropriate imaging modality.
    - b. Be able to discuss CT protocols with the technologist and address their questions or concerns about patient management.
    - c. Know the importance of accurate, timely, and professional communication.
    - d. Notify the referring clinician of urgent, emergent or unexpected findings of clinical significance, and document in dictation.
    - e. Learn to dictate clear, concise and complete reports, provides an accurate differential diagnosis and, when appropriate, recommends further tests or management.
    - f. Be able to communicate effectively with patients and their families when participating in interventional procedures (e.g., lumbar puncture).
    - g. Review, correct, and sign reports promptly. Acute trauma spine clearance is a priority. Ideally, all reports should be signed by the staff within 24 hours.
  6. COLLABORATOR - The resident should:

- a. Act as the primary consultant to residents/staff in the Emergency Department and other clinical services in the planning of neuroradiological investigations and their interpretation.
  - b. Have the ability to act as a junior consultant when reviewing CT exams with clinical colleagues.
  - c. Function as a contributing member of a multidisciplinary health care team, interacting with technologists, nurses, and clinical colleagues to provide the optimal patient care.
7. LEADER - The resident should:
- a. Learn to utilize the resources of CT effectively, determining the indications and urgency of the exam from information during consultation with the referring physicians.
  - b. Develop time and people management skills in directing the “day to day” scanning of elective and emergency patients.
  - c. Recognize urgent and emergent imaging findings in studies of the head, neck, and spine, and appropriately contact the referring clinician without being prompted.
  - d. Become facile with PACs and utilize available information technology to manage patient information and examinations.
8. HEALTH ADVOCATE - The resident should:
- a. Understand the risks and benefits of CT for the general population (and when used for screening).
  - b. Be aware of the radiation dose the patient receives for standard Neuro-CT examinations.
  - c. Recognize when a CT exam might be detrimental to the health of a patient.
  - d. Recognize limitations of personal competency and ask for guidance from fellows or Neuroradiology staff when appropriate.
9. SCHOLAR - The resident should:
- a. Have the ability to be an effective teacher, and facilitate the learning of neuroradiology to junior residents, medical students, technologists, clinical colleagues, and other health care professionals.
  - b. Be expected to demonstrate independent self-study using various resources including texts, journals, teaching files, and other resources on the internet.
  - c. Develop competency in evaluation of the medical literature in radiology, including that related to neuroradiology.
  - d. Resident involvement is encouraged in basic research activities and clinical practice audits or other internal reviews.
10. PROFESSIONAL
- a. The resident should demonstrate appropriate personal and professional behavior when interacting with patients, clinical colleagues, technologists, and other medical staff.
  - b. The resident should deliver the highest quality patient care with integrity, honesty and compassion.

**b. NEURO MRI**

- i. Each Diagnostic Imaging resident will do rotations in Emergency Neuro CT, Neuro CT and Neuro MRI as outlined by the residency training program. A minimum of 6 blocks will be completed in neuroradiology. These will occur between the PGY2 to PGY5 years. Elective rotations may provide additional exposure to neuroradiology. Elective rotations may provide additional exposure to neuroradiology. Parts of neuroradiology will also be covered during plain film rotations, MSK (inflammatory spondyloarthropathies) or nuclear medicine (Bone scan, SPECT/CT, and PET). The objectives of the neuroradiology rotations will be limited to the fundamentals of neuroradiology so that the individual will acquire a level of knowledge that will

enable the resident to confidently deal with this field as it is reflected in a general practice of diagnostic radiology.

ii. Resident Goals and Objectives

1. General Competencies (All Years) - The resident should:
  - a. Use the PACS for interpretation of imaging studies
  - b. Learn how to triage examinations related to their urgency and how to work efficiently to get required studies performed and interpreted
  - c. Improve skills for advising referring physicians on the most effective and appropriate method(s) of imaging patients for inpatients, outpatients and emergency patients.
  - d. Learn basic and tailored MRI protocols for the most common pathologic entities.
  - e. Demonstrate ability to integrate laboratory findings and other clinical parameters in recommending appropriate patient specific imaging strategies for diagnostic purposes.
  - f. Learn how to dictate a comprehensive MR report.
  - g. Over the course of residency training there should be general progression of competency starting with emergency and common pathologies expanding to less common but important pathologies and finally rare diagnoses and uncommon manifestations of common disorders.
2. Specific Goals and Objectives for PGY-2/3 (Foundations of Discipline and Core of Discipline 1) - The resident should:
  - a. Learn when to image a patient with MR versus CT.
  - b. Learn basic neuroanatomy.
  - c. Introduction to MR imaging, and learn to recognize images that are T1-weighted, T2 and FLAIR-weighted, susceptibility-weighted, fat saturated, diffusion-weighted, gadolinium-enhanced.
  - d. Learn when and why to obtain images with these characteristics and learn how to read them.
  - e. Learn how to read MRA's of the head and neck, and the basics of time-of-flight angiography.
  - f. Understand the indications and role of MRI in the investigation of neurological disease. The resident should begin to learn what basic pathologies should look like on MRI (e.g., intra- vs. extra-axial; neoplasms, infection, stroke); and when MRI should be recommended, especially for non-traumatic neuroradiological emergencies (e.g., herpes encephalitis, cauda equina syndrome, spinal cord compression).
  - g. Learn how to distinguish mass effect and brain herniation associated with acute processes from volume loss associated with more chronic processes.
  - h. Learn the indications of MR in trauma patients. Understand susceptibility imaging. Learn MR pattern of pathologies associated with head trauma; especially subdural hematoma; epidural hematoma; subarachnoid hemorrhage; diffuse axonal injuries; parenchymal contusions; hemorrhagic parenchymal contusions; nonhemorrhagic parenchymal contusions; calvarial, facial and spinal fractures; cerebral edema.
  - i. Learn the MR pattern of different stages of hemorrhage. Learn which stages of hemorrhage demonstrate susceptibility artifact.
  - j. Learn MR patterns of arterial and venous infarction with an understanding of major vascular territories; learn to determine age; i.e., acute versus chronic.

- k. Learn how to perform and interpret MR angiograms of the carotid and vertebral arteries, and the appearance of cerebrovascular disease, including acute stroke, traumatic dissection, and atherosclerotic disease.
  - l. Learn the MR appearance of intra-axial and extra-axial masses. Learn how to identify a mass on MRI, and determine whether it is intra-axial or extra-axial.
  - m. Be aware of advanced MRI imaging protocols such as perfusion, functional MR, and spectroscopy.
  - n. Learn the MR appearance of major vascular lesions such as arteriovenous malformations (AVMs), aneurysms, cavernous malformations, venous anomalies.
  - o. Learn the MR appearance of cerebritis, abscess, meningitis, empyema.
  - p. Learn the MR appearance of multiple sclerosis, acute disseminated encephalomyelitis (ADEM).
  - q. Learn the MR appearance of different types of non-traumatic hemorrhage and the differential diagnoses.
  - r. Learn the MR appearance and reporting structure of degenerative spine disease including disc herniation, spinal stenosis and neural foramen encroachment.
  - s. Learn the MR appearance of spinal fractures and traumatic ligamentous injury.
  - t. The resident is expected to develop basic knowledge of the anatomy and pathology of the head and neck, including soft tissue infections, malignancy. The resident should also become familiar with the most important clinical evaluations.
  - u. Learn the radiological approach to investigate “non-traumatic neuroradiological emergencies”, and how to protocol and triage these exams according to clinical need. Non-traumatic neuroradiological emergencies include: acute stroke syndromes; PRES, herpes encephalitis, cauda equina syndrome, spinal cord compression, sinovenous occlusive disease and herniation syndromes.
3. Specific Goals and Objectives for PGY-4 and PGY-5 (Core of Discipline 2 and Transition to Practice) - The resident should:
- a. Be responsible for the duties and assignments as outlined above in the PGY3 rotation.
  - b. Review and advance understanding of neuroimaging anatomy of the brain, head and neck, and spine
  - c. Hone in on reviewing and learning all of the major diseases of, and differential diagnoses involving, the brain and spine, and the CT and MR appearances of them.
  - d. Review all of the basics of MR and learn the uses of newer MR software such as FLAIR, Spectroscopy, and including diffusion-weighted imaging and perfusion-weighted imaging.
  - e. Learn how the imaging appearance of different pathologies influences patient management and treatment options. This understanding should be reflected in the dictated reports. An example might be to recommend a carotid Doppler ultrasound or neck CTA if a CT head exam shows asymmetric “watershed-type” cerebral ischemic changes, or to recommend PET-CT in cases of equivocal recurrent tumor on neuro-CT/MR exams.
  - f. Learn differential diagnoses based on location. Locations to be learned include pineal region; sellar; suprasellar; parasellar; cerebello-pontine angle, lobar, cerebellar, callosal; skull base; intraventricular. Begin to learn differential diagnoses.

- g. )
- h. Further develop and practice a comprehensive approach to radiological patient care. This would include review of all pertinent previous imaging studies (e.g., search for recent CT chest/abdo/pelvis if suspected cerebral metastases are discovered on head CT/MRI), and obtain other relevant patient information (e.g., biopsy results) that is important for current study interpretation.
- i. Learn the MR appearance of radiation necrosis.
- j. Learn how PET and perfusion imaging are used to distinguish recurrent tumor from radiation necrosis.
- k. Refine the MR appearance of major vascular lesions, including aneurysms, AVM's, cavernous malformations, venous anomalies.
- l. Learn the MR appearance of infectious processes – cerebritis, abscess, meningitis, empyema, encephalitis.
- m. Learn how major organisms (bacteria, virus, fungus, parasite) infect the brain and their MR appearances.
- n. Learn the MR appearance of congenital infections.
- o. Learn the basic MR appearance of the normal infant and pediatric brains.
- p. Learn the basic MR appearance of common congenital anomalies: Dandy-Walker, Chiari, agenesis of the corpus callosum, schizencephaly and basic migration abnormalities. (Pediatric CT and MR imaging will be covered in detail during Pediatric Radiology rotations
- q. Learn how the brain myelinates and the pattern on MR.
- r. Learn the appearance of major developmental anomalies of the brain and spine.
- s. Learn the MR appearance of major neurodegenerative diseases.
- t. Learn the MR appearance of major white matter diseases.
- u. Learn the MR appearance of phakomatoses.
- v. Learn the major spinal intramedullary, intradural, extramedullary, and extradural lesions, and their MR appearances.
- w. Learn how to evaluate cord compression and the major pathologies causing it.
- x. Develop knowledge of the anatomy and pathology of the head and neck. The resident is expected to learn the anatomy of the temporal bone, orbit, skull base, sinuses, oral cavity, larynx, neck and temporomandibular joint.
- y. Attend and participate in the Neuroradiology-related conferences.
- 4. MEDICAL EXPERT
  - a. See suggested Neuroimaging Curriculum
- 5. COMMUNICATOR - The resident should:
  - a. Be able to obtain appropriate information from the health care team in order to properly protocol a CT/MR or recommend a more appropriate imaging modality.
  - b. Be able to discuss basic MR protocols with the technologist and address their questions or concerns about patient management.
  - c. Know the importance of accurate, timely, and professional communication.
  - d. Notify the referring clinician of urgent, emergent or unexpected findings of clinical significance, and document in dictation.
  - e. Learn to dictate clear concise reports, provide an accurate differential diagnosis and, when appropriate, recommend further tests or management.

- f. When participating in interventional procedures (e.g., lumbar puncture), the resident should be able to communicate effectively with patients and their families.
  - g. Review, correct, and sign reports promptly.
6. COLLABORATOR - The resident should:
- a. Act as the primary consultant to residents in the Clinical Neurosciences and other clinical services in the planning of neuroradiological investigations and their interpretation.
  - b. Have the ability to act as a junior consultant when reviewing MR exams with clinical colleagues.
  - c. Learn to provide interpretation of MR findings when attending multidisciplinary rounds.
  - d. Function as a contributing member of a multidisciplinary health care team, interacting with technologists, nurses, and clinical colleagues to provide the optimal patient care.
7. LEADER - The resident should:
- a. Learn to utilize the resource of MR effectively, determining the indications and urgency of the exam from information during consultation with the referring physicians.
  - b. Develop time and people management skills in directing the “day to day” scanning of elective and emergency patients.
  - c. Recognize urgent and emergent imaging findings in studies of the head, neck, and spine, and appropriately contact the referring clinician without being prompted.
  - d. Become facile with PACS and utilize available information technology to manage patient information and examinations.
8. HEALTH ADVOCATE - The resident should:
- a. Understand the risks and benefits of MR for the general population (and when used for screening).
  - b. Recognize when an MR exam might be detrimental to the health of a patient.
  - c. Recognize limitations of personal competency and ask for guidance from fellows or Neuroradiology staff when appropriate.
9. SCHOLAR - The resident should:
- a. Have the ability to be an effective teacher, and facilitate the learning of neuroradiology to junior residents, medical students, technologists, clinical colleagues, and other health care professionals.
  - b. Demonstrate independent self-study using various resources including texts, journals, teaching files, and other resources on the internet.
  - c. Develop competency in evaluation of the medical literature in radiology, including that related to neuroradiology.
  - d. Resident involvement is encouraged in basic research activities and clinical practice audits or other internal reviews.
10. PROFESSIONAL - The resident should:
- a. Demonstrate appropriate personal and professional behavior when interacting with patients, clinical colleagues, technologists, and other medical staff.
  - b. Deliver the highest quality patient care with integrity, honesty and compassion.

**NEURORADIOLOGY RESIDENT AND FELLOW CONFERENCES:**

Daily Radiology resident conferences (excluding Thursdays): 12:05 – 13:00

Epilepsy Conference, Thursdays: 07:30 – 09:00

Neurointerventional Vascular Rounds, 1<sup>st</sup> Monday of month: 17:00 – 18:00

Head & Neck Oncology Rounds, Wednesdays: 07:00 – 08:00

Neuropathology Review, alternate Wednesdays: 08:00 – 09:00

Spine Rounds, Wednesdays: 07:00 – 08:00

Neuroradiology Review, alternate Wednesdays: 08:00 – 09:00

Neuro-Oncology / TBCC Rounds, Wednesdays: 15:00 – 16:00

Dementia Rounds, Wednesdays: 16:30 – 17:30

Stroke Rounds, Thursdays: 07:30 – 08:30

Clinical Neuroscience Grand Rounds, Fridays: 08:00 – 09:00

NICU Neuroradiology Rounds, Fridays, Quarterly TBA: 08:00 – 09:00



## **BASIC NEUROANATOMY FOR PGY2 RADIOLOGY RESIDENTS**

### **BRAIN**

Deep Nuclei	Caudate head & body Putamen Globus pallidus Thalamus
Basal cisterns	Quadrigeminal Ambient Suprasellar Cerebellopontine angle Interpeduncular fossa
Ventricular System	Lateral Third Fourth Cerebral aqueduct
Gray and White matter	
Brainstem / Cerebellum Midbrain (including peduncles, etc.)	Pons Medulla (including pyramids, etc.) Dentate nucleus, cerebellum Cerebellar hemispheres and peduncles
Major landmarks	Sylvian fissures Central sulcus Interhemispheric fissure Horizontal fissure, cerebellum
<b><u>VASCULAR ANATOMY</u></b>	
Intracranial arteries	ICA, ACA, MCA, PCA, vertebrobasilar
Circle-of-Willis	including common variations
Major extracranial arteries	Aortic arch and major vessels Common carotid artery Carotid bifurcation Main external carotid artery (not individual branches) Internal carotid artery, cervical Vertebral arteries
Intracranial venous system	Major dural sinuses Deep venous system (internal cerebral veins, basal vein Rosenthal, vein Galen, straight sinus, thalamostriate veins, septal veins)

## **SKULL & SKULLBASE**

Cranial fossa

Skull base foramina

Major sutures                      Coronal, lambdoid, sagittal, metopic

Mastoid sinus

Basic middle and inner ear

## **ORBITS**

Globes and lenses

Main ocular structures              Ocular muscles  
   Fat  
   Lacrimal glands  
   Vessels (mainly superior ophthalmic veins)  
   Optic nerves

Bony orbital margins

## **PARANASAL SINUSES**

Maxillary (including osteomeatal units)

Ethmoid

Sphenoid

Frontal

## **SPINE**

Basic vertebral anatomy              Body  
   Pedicles  
   Laminae  
   Lateral masses (including foramen transversarium)  
   Spinous process  
   Articular facets (inferior and superior)

Craniocervical junction              Occipital condyles  
   Atlas  
   C2

**NUCLEAR MEDICINE****PREAMBLE**

Each resident spends a minimum of 12 weeks (three 4-week blocks) in the Department of Nuclear Medicine during radiology residency training, taken between the PGY-3 and PGY-5 years. This will include two consecutive nuclear medicine rotations in the PGY3 year, and a third rotation in the PGY-4 or PGY-5 years. Further exposure to nuclear medicine, including PET/CT to meet the requirements of the American Board of Radiology (for examination purposes) must be obtained during elective blocks.

This rotation is not intended to produce fully qualified nuclear medicine physicians as there are separate two and five year training programs that lead to full qualification. The main purpose is to familiarize the residents with the scope and types of studies performed in nuclear medicine, particularly concentrating on the relative advantages and disadvantages of these procedures as applied to the differential diagnosis of specific clinical problems. Correlation with results of other imaging modalities is also stressed.

**ROTATION SPECIFIC GOALS & OBJECTIVES*****GENERAL (ALL YEARS)***

1. The resident should review all nuclear medicine requisitions that require specific tailored protocols and establish an imaging protocol for the patient in advance. Staff is available for consultation.
2. Throughout the day, the resident is expected to monitor patient studies, recognizing when an examination is complete and suggesting additional scintigraphic and/or radiographic views to enable diagnosis of the patient's problem.
3. During the rotation, the resident is expected to assist in researching interesting and unusual cases, and may be asked to incorporate these into the nuclear medicine teaching file.
4. The resident is expected to arrange and present (with staff assistance) nuclear medicine cases during general rounds or designated nuclear medicine case rounds taking place during the nuclear medicine rotation.

***MEDICAL EXPERT/CLINICAL DECISION MAKER*****PGY3 – First Rotation (Core of Discipline 1)**

1. Understand the nuclear events leading to the production of gamma rays.
2. Understand the basic workings of nuclear medicine instruments (gamma cameras, SPECT/CT cameras, PET/CT cameras and the associated computers and software).
3. Gain exposure to computer processing, including image fusion and quantification techniques.
4. Understand basic radiopharmacy principles (preparation and quality control of radiopharmaceuticals).
5. Begin to learn characteristics of radionuclides (Technetium-99m, Indium-111, Iodine-131, Gallium-67 etc.) and radiopharmaceuticals (MDP, MAA, DTPA, Sulphur Colloid, MAG3, FDG, Dotatate etc.).
6. Understand indication and contra-indications of the various imaging procedures.
7. Develop knowledge of normal scintigraphic anatomy and normal variant appearances.
8. Recognize if an image is technically adequate and request additional scintigraphic projections, if warranted.
9. Begin to recognize abnormalities on nuclear medicine studies, including PET/CT, forming an appropriate differential diagnosis.
10. Learn special injection techniques (lymphoscintigraphy, sentinel node mapping, VP shunt patency)..

### **PGY-3 – Second Rotation (Core of Discipline 1)**

1. Further develop skills acquired during first PGY3 rotation.
2. Gain exposure to a variety of other nuclear medicine and related procedures (see terminal objectives). Review and report PET/CT cases.
3. Begin to develop competency in interpretation and reporting of basic nuclear medicine studies, especially those requiring radiographic correlation (lung imaging for pulmonary embolus, screening for active bone lesions, liver and biliary imaging, oncologic imaging).
4. Understand the role of nuclear medicine in the differential diagnosis of specific clinical problems.
5. Begin to develop consultative skills

### **PGY-4/PGY-5 (Core of Discipline 2 and Transition to Practice)**

1. Further develop skills from previous rotations, consolidating knowledge and improving on all weaknesses.
2. Further develop correlative/interpretive skills combining anatomical and functional imaging
3. An excellent resident may elect to spend some early mornings in the radiopharmacy lab, observing and/or performing radiopharmaceutical preparation and quality control procedures.
5. Upon completion of the Radiology Residency Program, the resident:
  - demonstrates an ability to determine an appropriate imaging protocol based upon the provided indications for a certain nuclear medicine examination. The resident should provide competent interpretation of scintigraphic studies likely to be encountered in radiologic practice as well as those requiring correlative imaging (e.g. lung, hepatobiliary, and bone imaging, oncologic imaging).
  - Understands the technical aspects of nuclear medicine imaging including basic physics, instrumentation, quality control (of cameras and radiopharmaceuticals), and radiation protection.
  - Understands the role of nuclear medicine as a functional correlative imaging modality, integrating results with those of other diagnostic imaging studies.
  - Understands a variety of other nuclear medicine procedures and non-imaging tests. Specifically included in this list are:
    - radionuclide therapies (e.g. iodine-131 for benign and malignant thyroid disease)
    - Thyroid uptake
    - lymphoscintigraphy injections
    - CSF flow and leakage studies
    - bone mineral densitometry
    - Selenium-75 bile acid malabsorption
  - Understands computer-based imaging and computer processing of nuclear medicine studies.

### ***COMMUNICATOR***

1. Be able to obtain appropriate information from the health care team in order to properly protocol a nuclear medicine exam or recommend a more appropriate imaging modality.
2. Understand the importance of communication with referring physicians, including an understanding of when the results of a nuclear medicine exam must be promptly communicated.
3. Be able to discuss imaging protocols with the technologist and address their questions and concerns.
4. Have the ability to produce a radiologic report which appropriately describes imaging findings in a concise manner, provides an accurate differential diagnosis and when appropriate recommends further tests or management.

### **COLLABORATOR**

1. Have the ability to act as a junior consultant when reviewing nuclear medicine exams with clinical colleagues.
2. Function as a contributing member of a multidisciplinary health care team, interacting with technologists, nurses and clinical colleagues to provide the optimal patient care.

### **LEADER**

1. Utilize the resources in nuclear medicine effectively, especially in timing of exams with more rare, more expensive isotopes by obtaining appropriate information from referring physicians.
2. Understand basic radiopharmacy principles (preparation & quality control) of radiopharmaceuticals.
3. Demonstrate competence in use of computer technology as it pertains to nuclear medicine.

### **HEALTH ADVOCATE**

1. Be aware of the radiation dose the patient receives for common nuclear medicine exams.
2. Understand the benefits and risks of nuclear medicine exams for the general population as well as for specific patient populations (i.e. pregnant or lactating women, children).
3. Recognize when a nuclear medicine exam would be detrimental to the health of a patient.

### **SCHOLAR**

1. Have the ability to be an effective teacher in nuclear medicine to junior residents, medical students, technologists and clinical colleagues.
2. Develop competency in evaluation of the medical literature in radiology, including that related to nuclear medicine.
3. Participate in an audit or research project involving nuclear medicine.

### **PROFESSIONAL**

1. Demonstrate appropriate personal and professional behavior when interacting with colleagues, technologists and patients.
2. Deliver the highest quality care with integrity, honesty and compassion.

### **NUCLEAR MEDICINE SUGGESTED READING LIST**

#### **PGY-3 to PGY-5 (Core of Discipline and Transition to Practice)**

1. Mettler FA, Guiberteau MJ. Essentials of Nuclear Medicine Imaging, 6<sup>th</sup> Ed. WB Saunders Co., Philadelphia 2012.
2. O'Malley JP, Ziessman H, Thrall JH. Nuclear Medicine and Molecular Imaging: The Requisites, 5<sup>th</sup> Ed. Elsevier, 2020.
3. Cherry SR, Sorenson JA. Physics in Nuclear Medicine, 4<sup>th</sup> Ed. Elsevier, 2012.
4. Saha GB. Fundamentals of Nuclear Pharmacy, 7<sup>th</sup> Ed. Springer, 2018.
5. Hall EJ, Giaccia AJ. Radiobiology for the Radiologist, 8<sup>th</sup> Ed. Wolters Kluwer, 2018.
6. Lin EC, Alavi A. PET and PET/CT: A Clinical Guide, 3<sup>rd</sup> Ed. Thieme Co. 2019
7. Nuclear Medicine Protocols – on Radiology Education U Drive – Core Rotations – Nuclear Medicine.

#### **REFERENCE TEXTS**

1. Freeman LM. Freeman and Johnson's Clinical Radionuclide Imaging. Vol 1 to 3. WB Saunders Co., Philadelphia 1984 (new edition in 1995).
2. Gerson, MC. Cardiac Nuclear Medicine, 2nd Ed. McGraw-Hill Inc., New York 1991.
3. von Schulthess GK. Molecular Anatomic Imaging: PET/CT, PET/MR and SPECT/CT, 3<sup>rd</sup> Ed. Wolters Kluwer, 2015.

#### **EDUCATIONAL GOALS**

## ***OBSTETRICAL ULTRASOUND (Maternal Fetal Medicine)***

### **PREAMBLE**

Each resident will complete a minimum of two 4-week blocks of dedicated obstetrical ultrasound and maternal fetal medicine during the residency training program. The first block will occur in the latter half of the PGY-2 year and the second block in the first half of the PGY5 year. Additional exposure to obstetrical ultrasound occurs on the Senior Resident's Clinic rotation and during the General Ultrasound rotation.

The two blocks of obstetrical ultrasound training currently occur at the Maternal Fetal Medicine Clinic located in the Cambrian Wellness Center, adjacent to the Foothills Medical Center within walking distance. For IT questions you can contact Poonam Sanghera @ psanghera@altapacs.com to confirm you have access to everything you need (AltaPacs, Powerscribe, Astraia).

### **MSK Ultrasound, MFM and MAMMO II Parking**

All residents are to park in the EFW staff church parking lot just off Memorial Drive/Parkdale Boulevard up the street from the clinic for their rotations (see attached photo yellow)

An EFW hang tag will be required.

- You may pick up your parking hang tag at the main reception desk at AMI on the first day of your rotation, the head receptionists name is Fahima Muradali.
- You are responsible for ensuring the parking hang tag is returned at the end of your rotation. There is a waiver/consent that needs to be signed to obtain your parking hang tag and the data is entered into a spreadsheet for record purposes.
- If parking tags are lost or destroyed you are responsible for the cost of replacement.

### **MFM CONTACTS**

If you plan to be absent on any day(s) of the rotation (e.g. vacation, pre-/post-call days, VP's, Physics, exams, etc), PRIOR to your absence contact:

- Dr. David Somerset (david.somerset@efwrad.com),
- Contact Jill Schwarzenberger, head US technologist, by e-mail (jill.schwarzenberger@efwrad.com)

At the MFM Clinic, the resident will encounter routine and high-risk obstetrical screening and diagnostic cases from Calgary and the immediate surrounding area as well as all of the high risk obstetrical cases from Southern Alberta.

The MFM Clinic at FMC has a staff of ~11 ultrasound technologists who are specialized in obstetrical ultrasound. It is also a major training center of the Regional Ultrasound Technologist Training Program (Southern Alberta Institute of Technology—SAIT). There are also 3 Perinatologists on-site daily as well as a Pediatric Cardiologist and fetal echocardiography specialized Radiologist on-site ~1.5 days a week. Medical Genetics (at least 1 physician and 2-3 genetics counselors) are also on-site daily.

The resident will work one-on-one with an ultrasound technologist during the first rotation as he/she learns how to scan. During part of the first rotation and the entire second rotation, the resident will work one-on-one with a perinatologist.

The MFM Clinic has the latest technology for digital imaging and reporting. This clinic is fully equipped with digital imaging using state-of-the-art PACS workstations and a Voice Recognition (VR) dictation system, which are the same as those at the Foothills Medical Centre. There is also the use of the Astraia system

for obstetrical ultrasound reporting. The Clinic is digitally “linked” with the hospital PACS systems in Calgary and surrounding areas, therefore allowing more timely patient care.

### **Weekly Multidisciplinary Rounds:**

*Location:* Thursdays at 0800h in the TRW Clinic Library

Each week, the resident will attend the multidisciplinary “FD&T” Rounds that address complex obstetrical cases from the prior week. These rounds are attended by Perinatologists, Obstetricians, Neonatologists, Radiologists, Medical Genetics, Pediatric Cardiologists as well as other key members of the multidisciplinary team such as Social Work, Nurses, and Ultrasound Technologists. The resident will learn about the medical diagnostic and therapeutic aspects of each complex case, but also the diagnosis and management of the many psychosocial aspects that each family experiences.

### **Monthly Obstetrical Ultrasound Rounds:**

*Location:* Every 3<sup>rd</sup> Wednesday (0800-0900h) in the TRW Clinic Library

Each month, the residents will attend obstetrical ultrasound rounds given by the Perinatologists in the Clinic. These rounds have been tailored for the Diagnostic Radiology Residents with respect to topics and how it applies to radiologists.

## **ROTATION SPECIFIC GOALS AND OBJECTIVES:**

### ***MEDICAL EXPERT/CLINICAL DECISION MAKER***

During all ultrasound rotations, the resident will have the opportunity to consult with the clinical obstetric service regarding the imaging of a large array of obstetrical imaging cases. Each resident will receive a workbook for the MFM rotation.

The Junior (PGY-2/Foundations of Discipline) MFM block will focus on:

- Detailed (18 week) OB ultrasound scanning
- Common abnormalities and Doppler ultrasound
- Nuchal Translucency study (First Trimester Screen)
- Twin pregnancies

The Senior (PGY-5/Transition to Practice) MFM block will focus on:

- Refreshing OB ultrasound scanning for biometry
- Refreshing knowledge of common abnormalities, Doppler ultrasound, nuchal translucency studies and twin/multiple pregnancies
- Reporting of studies on Astraia
- Counselling patients

The obstetrical imaging experience will include, but not be limited to, clinical experience in the following:

#### **1<sup>st</sup> TRIMESTER**

- Bleeding in pregnancy
- Threatened abortion/early pregnancy loss
- Ectopic pregnancy
- Diagnosis and imaging of gynecological/medical/surgical complications of pregnancy

## 2<sup>nd</sup> TRIMESTER

- The use of ultrasound vs. other modalities in diagnosis of various complications and features of pregnancy
- The role of ultrasound in routine imaging and screening in pregnancy
- The use of ultrasound in the diagnosis of various fetal abnormalities

## 3<sup>rd</sup> TRIMESTER

- Third trimester role of ultrasound in management and diagnosis of various fetal and maternal abnormalities
- Residents will gain experience in the use of ultrasound in the first, second and third trimester both at the Maternal Fetal Medicine Centre, Foothills Medical Centre Ultrasound Department, and when possible at one of a number of community ultrasound imaging clinics.

### **COMMUNICATOR**

1. When performing an ultrasound exam, residents learn to establish an appropriate “physician-consultant” relationship with the patient, their family, and the healthcare team.
2. The resident learns to communicate effectively with the patient when counseling a patient for the first trimester screening (nuchal translucency) study. This includes providing the necessary information to the patient to allow meaningful informed consent and delivering the results to the patient.
3. The “real-time” nature of ultrasound exams requires that the resident learn to effectively address patient’s immediate concerns in a sensitive, and accurate fashion.
4. The integral role played by ultrasound technologist is stressed and residents learn to interface with the technologist team so as to maximize their performance and accuracy.
5. Attend the weekly MFM Rounds at TRW.

### **COLLABORATOR**

1. When ultrasound studies are requested residents learn to effectively communicate with the ultrasound technologist team, the referring healthcare team/consultants, and as necessary the patient and/or family.
2. Due to the multidisciplinary nature of the TRW MFM Clinic, the resident will be able to actively collaborate with various members of the team, as outlined above, to provide optimum patient care.

### **LEADER**

1. Utilize the resources of ultrasound (both technology and technologist) effectively to optimize health care for the patient. Residents develop an understanding of health care costs relevant to ultrasound, including equipment cost, maintenance cost and human resource cost, and are encouraged to be appropriately sensitive to these issues.
2. Develop an understanding of how to triage cases in the clinics.
3. Be competent in using PACS systems.
4. When available, the resident is encouraged to participate in quality assurance studies and research in the clinic.

### **HEALTH ADVOCATE**

1. Understand the benefits and risks of an ultrasound exam with regard to the fetus.
2. Understand the benefits and limitations of first trimester screening.
3. Developing efficient, useful and value-added algorithms in evaluating common conditions seen in the fetus.
4. Recognizing when an ultrasound exam or ultrasound-guided interventional procedure may be detrimental to the health of the patient.
5. Recruiting the necessary human resource (technologists and staff radiologists) and equipment resources to perform studies in appropriate time frame.



### **SCHOLAR**

1. Through rounds, journal club and attendance at critical appraisal courses learn to critically evaluate sources of medical information.
2. Be an effective teacher of ultrasound to junior residents, medical students, technologists, and technologist students.
3. Actively contribute to general ultrasound, NICU and/or MFM rounds by preparing and presenting cases.
4. Participate in radiology research projects that may involve ultrasound.
5. Develop, implement, and monitor personal continuing education strategy.

### **PROFESSIONAL**

1. When interacting with patients, their families, technologists, and any member of the healthcare team, demonstrate appropriate personal and professional behavior.
2. Deliver the highest quality care in ultrasound with integrity, honesty, and compassion.

### **RESOURCES (all years):**

1. Journal and On-line Resources (**Mandatory**):
  - ISUOG Practice Guidelines Article and Presentation. Salomon LJ, et al. Practice guidelines for performance of the routine mid trimester fetal ultrasound scan. *Ultrasound Obstet Gynecol* 2010.
  - SOGC Practice Guidelines for Fetal Soft Markers in Obstetric Ultrasound, *J Obstet Gynaecol Can*, 2005; 27(6):592K612.
  - Hyett J. Non-invasive prenatal testing for Down Syndrome. *Australian Prescriber*. April 2014, 37(2):51355.
  - Video Lecture on 2<sup>nd</sup> Trimester Ultrasound:  
[http://isuogonline.insync.com/Congress/Copenhagen2012/Lectures/20120909.Audi12.0830.09.40%20Dario%20Paladini\\_1/index.html](http://isuogonline.insync.com/Congress/Copenhagen2012/Lectures/20120909.Audi12.0830.09.40%20Dario%20Paladini_1/index.html)
  - First Trimester Screening (on-line video):  
<http://www.fetalmedicine.com/fmc/ultrasound/111131weeksiscan/>
2. *Ultrasound: The Requisites*, 2<sup>nd</sup> Ed. WD Middleton et al. Mosby. 2004.
3. *Diagnostic Ultrasound*, 4<sup>th</sup> Ed. Rumack CM, Charboneau JW, Wilson SR. Mosby. 2010.
4. Journals: *Journal of Ultrasound in Medicine and the Journal of Clinical Ultrasound*.
5. On-line resources: STATdx, RadPrimer
6. Resident Library.
7. Ultrasound technology training supervisors.
8. Wednesday morning resident lecture series.
9. Staff perinatologists.
10. In-house physics teaching, and teaching coordinator.

***PEDIATRIC RADIOLOGY*****PREAMBLE**

All residents will complete four consecutive 4-week blocks of Pediatric Radiology during the PGY- 3 and PGY-4 year (Core of Discipline). All training will occur at the Alberta Children’s Hospital. This rotation will enable the resident to develop in depth- knowledge, attitudes, and clinical reasoning skills to interpret and diagnose the most common pathology in Pediatric Radiology in all imaging modalities.

**ROTATION SPECIFIC GOALS AND OBJECTIVES:*****MEDICAL EXPERT/CLINICAL DECISION MAKER*****General Competencies:**

1. Thorough understanding of disease entities as applied to pediatric radiology. This includes order of utilization or radiological procedures, radiographic patterns, and differential diagnosis.
2. Interpretation of pediatric x-rays.
3. Experience with pediatric procedures, including fluoroscopy, CT, ultrasound, and nuclear medicine. Knowledge of indications, limitations, acquiring skill in performance of different radiographic techniques as applied to pediatrics.
4. Familiarity with interventional techniques unique to pediatrics (e.g. intussusception reduction, VCUG, diagnostic enema for Hirschsprung’s disease).

**Specific Goals & Objectives:**

1. Have knowledge of normal pediatric anatomy and to describe anatomy landmarks in all systems in newborns, infants, and children.
2. Have knowledge of normal anatomic variants:
  - Chest: variants in aortic branching, slings
  - MSK: variants in appearance of ossification centers, bone development by age
3. Develop skills to accurately interpret a pediatric chest x-ray.
4. Have a thorough understanding of disease entities as applied to pediatric radiology (please refer to the “Guide to the Essentials of Pediatric Radiology” at the end of this section)
5. Be familiar with common pediatric procedures and have knowledge of their indications and contraindications for fluoroscopy, CT, ultrasound, and nuclear medicine.
6. Acquire skills in the performance of different diagnostic imaging techniques as applied to pediatrics.
7. Have understanding of technical aspects and management of state-of-the-art equipment (e.g. fluoroscopic, ultrasound, CT, MRI machines) in a dedicated facility for pediatric care.
8. Be familiar with common interventional techniques unique to pediatrics.
  - Demonstrate a structured approach and perform the following procedures:
    - Intussusception reduction
    - UGI
    - SBFT
    - Enemas
    - VCUG

### **COMMUNICATOR**

1. Establish a therapeutic relationship with pediatric patients and their families. Be able to provide clear and thorough explanations of the procedure, its risks and complications to obtain informed consent.
2. Be able to obtain appropriate information from the health care team in order to best perform a procedure with the least risk and discomfort to the patient.
3. Establish a good working relationship with the healthcare team including referring physicians, technologists and nurses.
4. Have the ability to produce a radiologic report which appropriately describes imaging findings in a concise manner, provides an accurate differential diagnosis, and when appropriate, recommends further tests or management.

### **COLLABORATOR**

1. Have the ability to act as a junior consultant when reviewing exams with clinical colleagues.
2. Provide interpretation of imaging findings when attending multidisciplinary rounds (specifically gastroenterology, oncology, surgery, general pediatrics, neurosurgery/neurology, ER, child abuse and nephrology rounds).
3. Assist in multiple patient care sessions in the ICU (suggestion: 20 sessions).
4. Function as a contributing member of a multidisciplinary health care team, interacting with technologists, nurses, peers and clinical colleagues to provide optimal patient care.

### **LEADER**

1. Utilize the resources in pediatric radiology effectively, determining the indications and urgency of a scan from the information during consultation with the referring physician.
2. Demonstrate understanding of how to select the most appropriate imaging modality to improve the accuracy in diagnosis depending on the clinical scenario while taking into consideration radiation exposure to the patient.
3. Demonstrate leadership when clinicians are looking for clarification of imaging findings.
4. Suggest ways to improve the flow of patients in the department, when appropriate.
5. Demonstrate effective time management skills.
6. Demonstrate leadership in at least 4 clinical- problem solving meetings (Tumor board meeting, emergency department, morbidity/mortality rounds, surgical, GI, child abuse, rheumatology and pulmonary rounds).
7. Demonstrate proficiency in information technology (e.g. PACS workstations, literature searches).

### **HEALTH ADVOCATE**

1. Be aware of the radiation dose for common fluoroscopic and CT exams performed on the pediatric patient.
2. Recognize when an imaging study may be detrimental to the health of the patient.
3. Demonstrate integrative management of physics principles as well as inherited limitations and hazards/ complications of all imaging modalities (X-ray, fluoroscopy, ultrasound, nuclear medicine, CT, MRI, interventional/angiography).
4. Demonstrate an understanding of the use of contrast media according to the specific clinical situation while taking into consideration patient safety.
5. Demonstrate and emphasize radiation protection and safety for the patient for each procedure to be performed on a daily basis.
6. Actively participate in Morbidity and Mortality Rounds.

### **SCHOLAR**

1. Have the ability to be an effective teacher in pediatric radiology, teaching residents, medical students, technologists and clinical colleagues.
2. Will provide 1 ultrasound teaching rounds/conference for the sonographers.
3. Develop competency in evaluation of the medical literature in pediatric radiology.
4. Actively participate in Pediatric Journal Clubs at ACH (usually every 2 months).
5. Participate in an audit or research project when available.
6. Participate in Pediatric Rounds (Radiology and other departments) by assisting and/or leading teaching and discussions around difficult cases.
7. Participate in teaching Pediatric residents.
8. Develop an understanding of the obligation for continuing self-education, the importance of teaching others and medical research.

### **PROFESSIONAL**

1. Demonstrate appropriate personal and professional behavior when interacting with patients, their families.
2. Demonstrate appropriate personal and professional behavior when interacting with the healthcare team, including technologists, nurses, radiology colleagues and referring physicians.
3. Deliver the highest quality of care with integrity, honesty, respect and compassion.
4. Demonstrate a high level of responsibility and readiness help out in the department on a daily basis and while on call.

### **GENERAL RESIDENT RESPONSIBILITIES:**

#### **X-RAY FILM READING**

All films are to be reviewed with a staff radiologist. The resident should report as many films as possible, in conjunction with the assigned procedures for that week. In order to broaden knowledge base, films from all categories must be reviewed; e.g. inpatients (including unique ICU films), outpatients, clinics and emergency.

#### **PROCEDURES**

Each week the resident is assigned to cover either CT and Ultrasound or Fluoro and Nuclear Medicine. One staff radiologist is also assigned to the resident for that week.

- Duties include:
- a) supervising and tailoring each exam
  - b) Unusual procedures/requests to be checked with staff radiologist
  - c) Hands-on real time ultrasound scanning is strongly encouraged

#### **CONSULTATIONS**

As a radiologist's primary function is to provide useful information to the clinicians, the resident is encouraged to assist in consultation with pediatricians, emergency physicians, other residents, etc.

#### **ROUNDS**

##### ***Pediatric Resident Rounds (AM/PM)***

- Review radiographs of ward patients and provide radiographic instruction to house staff. Also attended by assigned staff radiologist.

### CALL

One in three home call based on the PARA Contract for the senior rotation. PGY-3 residents are not expected to take call.

Residents who cover call are responsible to choose their on-call shifts during the rotation based on the PARA contract.

### TIME OFF THE ROTATION

Time off from the rotation must be requested 8 weeks in advance of the rotation.

### HOLIDAYS

Maximum of 2 weeks during the 4 block rotation.

### RESEARCH DAYS

Maximum of 5 days during the 4 block rotation.

### CONFERENCE TIME

1 week during the 4 block rotation. A second week may be granted under special circumstances.

### RESEARCH IN PEDIATRICS

Encouraged with supervision of staff radiologist.

## **RESIDENT EVALUATIONS:**

### ***PRE- AND POST-ROTATION EXAM***

Since residents will have had minimal or no experience in pediatric radiology prior to the Pediatric Radiology rotation, there will be a Pre-rotation Exam at the start of the rotation to evaluate their basic knowledge in Pediatric radiology. This will be followed by a Post-rotation Exam to objectively demonstrate interval improvement in knowledge. The Post-rotation Exam will also serve as an evaluation tool for the final ITER.

The areas that will be covered in the Pre- and Post-rotation Exams are as follows:

- Emergency radiology (~10 questions)
- Chest radiology (~10 questions)
- Abdominal radiology (~10 questions)
- Neuroradiology (~10 questions)
- Musculoskeletal (~10 questions)

### ***INFORMAL DAILY AND WEEKLY EVALUATIONS***

As there is a different staff radiologist with the resident each week, an informal weekly evaluation will be completed with verbal feedback given to the resident.

Daily interpretations of plain films, procedural skills, accuracy and style of reports, interaction and consultation with house staff and consultants are all critiqued and informal feedback is given to the resident on a daily basis.

## **MID-ROTATION EVALUATION**

As this is a long rotation, a mid-rotation evaluation/ITER (after 2 blocks) will be given to the resident to allow for interval improvement. If a problem is perceived with the resident early on, this is discussed with him/her as soon as possible.

## **PORTFOLIO AND FINAL PRESENTATION**

### PORTFOLIO

The resident must keep a portfolio of cases that they have seen during the 4-block Pediatrics rotation. This Portfolio will be submitted by the last day of the rotation. This will be used as an evaluation tool for the final ITER.

### FINAL PRESENTATION

The resident will also make a presentation to the Pediatric Radiology staff on select pediatric emergency and/or complex cases (see below). This presentation will allow the staff to evaluate the knowledge, attitudes and skills about emergency and/or complex cases that the resident has developed over the 4-block Pediatrics rotation.

The cases presented must include findings, differential diagnosis and use of different imaging modalities. The resident must also discuss ways that the diagnostic approach could have been improved at the time of the emergency situation.

The resident will present at least one case of each of the following pathologies:

- Midgut rotation
- Mediastinal masses
- Retroperitoneal tumors
- Intussusception
- Ovarian torsion
- Testicular torsion
- Appendicitis
- Pneumonias
- Brain tumors
- Brain ischemia

All of the cases presented will be submitted to the Pediatric On-line Cases (currently under development).

## **FINAL EVALUATION**

A formal evaluation is performed at the end of the rotation. The staff radiologist(s) complete this form. If a problem is perceived with the resident early on, this is discussed with him/her as soon as possible and/or at the mid-rotation evaluation (after 2 blocks) to allow for interval improvement.

### **READING LIST:**

1. Practical Pediatric Imaging, 2nd edition by D. Kirks (the bone section should be supplemented by Ozonoff).
2. Pediatric Orthopedic Radiology - 2nd edition by Ozonoff (specific chapters on the spine (1) hip (3) foot (5) skeletal trauma (8) should be read, general topics on orthopedic disease (6) neuromuscular disorders (7) and orthopedic procedures (9) are useful for reference.
3. Emergency Radiology in Infancy and Childhood by L. Swischuk.

## **REFERENCES: (available in our department)**

### TEXTBOOKS

- Radiology of the Newborn and Young Infant - 4th edition by L. Swischuk
- Pediatric Cardiovascular Imaging - Ina Tonkin
- Pediatric X-ray Diagnosis by Caffey
- Pediatric Sonography - 2nd edition - Marilyn Siegel
- Ultrasonography of Infants and Children by Teele & Share (as ultrasound is so commonly used in pediatrics, specific chapters to read are cranial (1) renal screening (6) infection of the urinary tract (7) abdominal masses (8) abdominal pain (11). (Several other chapters are excellent and can be read as the need arises).
- Pediatric Gastrointestinal Imaging by D. Stringer
- Imaging of the Pediatric Head, Neck and Spine - Mauricio Castillo & Suresh Mukherji.
- Pediatric Neuroimaging by A. James Barkovich.
- Pediatric Body CT by A. Daneman.
- Radiology of Syndromes, Metabolic Disorders and Skeletal Dysplasias by H. Taybi and R. Lachman.
- Pediatric Nuclear Medicine by S.T. Treves
- Magnetic Resonance Imaging of Children by Cohen & Edwards.
- Atlas of Normal Roentgen Variants That May Stimulate Disease - 5th edition by Keats.

### JOURNALS

- Pediatric Radiology
- AJR
- Radiology
- Radiographics
- CAR Journal
- J. of Clinical Ultrasound
- J. of Nuclear Medicine
- Clinical Nuclear Medicine

### OTHER RESOURCES

- Interesting Care Card File

## GUIDE TO ESSENTIALS OF PEDIATRIC RADIOLOGY

By the end of the rotation, the resident must be knowledgeable about the following pathologies:

### 1. NORMAL ANATOMY AND NORMAL VARIANTS

For all systems.

### 2. SKULL AND BRAIN

- a) Congenital malformations
  - Agenesis of corpus callosum
  - Dandy Walker
  - Chiari malformation
  - Hydranencephaly
  - Holoprosencephaly
  - Migrational disorders
- b) Craniosynostosis
- c) Hydrocephalus
- d) Tumors
  - Craniopharyngioma
  - Astrocytoma
  - Medulloblastoma
  - Glioma
  - P.N.E.T.
  - Ependymoma
- e) Intracranial calcifications
- f) Neonatal intracerebral hemorrhage
- g) Trauma
- h) Infections
  - Abscess, meningitis and sequelae

### 3. SPINE

- a) Congenital malformations
  - Cervical, occipital anomalies
  - Vertebral body anomalies (butterfly vertebrae, sagittal and coronal clefts, hemivertebra, block vertebrae, and Klippel-Feil anomaly)
  - Spinal dysraphism (spectrum of spina bifida, diastematomyelia and tethered cord)
  - Caudal regression syndrome
- b) Atlantoaxial instability
- c) diskitis/osteomyelitis
- d) Tumors (spinal-intra and extra)
- e) Trauma

### 4. EYES

- a) Congenital anomalies
- b) Infection
- c) tumors (retinoblastoma)

### 5. EARS, NOSE AND THROAT

- a) croup/epiglottitis/retropharyngeal abscess
- b) Sinus development
- c) Choanal atresia
- d) Congenital anomalies of inner, middle and external ear



- e) Neck masses (cystic hygroma, thyroglossal duct cyst, branchial cleft, ectopic thyroid)
- f) Tracheomalacia

## 6. RESPIRATORY SYSTEM

- a) Congenital abnormalities
  - Foregut duplication cysts
  - Sequestration
  - Congenital lobar emphysema
  - Cystic adenomatoid malformation
- b) Neonatal respiratory distress
  - Wet lung disease
  - Hyaline membrane disease
  - Meconium aspiration
  - Neonatal pneumonia
  - Wilson Mikity syndrome
  - Pneumothorax
  - Pneumomediastinum
  - Interstitial emphysema
  - Diaphragmatic hernia
  - Bronchopulmonary dysplasia
  - Diaphragmatic paralysis/eventration
- c) Pneumonias  
(Bacterial, viral, TB)
- d) bronchiectasis/Kartagener's syndrome/immotile cilia syndrome)
- e) Cystic fibrosis
- f) Asthma
- g) Foreign bodies
- h) Lung fibrosis, e.g., idiopathic hemosiderosis

## 7. CARDIOVASCULAR - CONGENITAL HEART DISEASE

- a) Acyanotic with increased vascularity (left-right shunt)
  - VSD
  - ASD
  - PDA
  - AV canal
- b) Acyanotic with normal vascularity
  - Coarctation of the aorta
  - Aortic stenosis/regurgitation
  - Pulmonary stenosis/regurgitation
  - mitral stenosis/regurgitation
- c) Cyanotic with increased vascularity
  - Transposition of the great vessels/double outlet right ventricle
  - Truncus arteriosus
  - TAPVR
  - Tricuspid atresia
- d) Cyanotic with decreased vascularity
  - Tetralogy of Fallot
  - Tricuspid atresia
  - Pulmonary atresia
  - Ebstein anomaly
- e) Pulmonary venous hypertension
- f) Aortic arch anomalies

- g) Vascular rings
- h) Cardiac associations with types of situs (include asplenia/polysplenia)
- l) operative procedures

## 8. GASTROINTESTINAL SYSTEM

- a) esophagus
  - Esophageal atresia/TEF and complications
  - Vascular rings (see cardiovascular section)
  - Gastroesophageal reflux
  - Stricture
  - Esophageal foreign body
  - Achalasia
- b) Stomach and duodenum
  - Pyloric stenosis
  - Duodenal atresia/stenosis
  - Malrotation and volvulus
- c) Small bowel
  - Intussusception
  - Small bowel atresia
  - Meckel's diverticulum
  - Omphalocele/gastroschisis
- d) Appendix
  - Appendicitis
- e) Colon
  - Hirschsprung's disease/functional megacolon
  - Microcolon (meconium spectrum ileal atresia)
  - Anorectal malformation
  - necrotizing enterocolitis
  - Typhlitis
- f) General
  - Polyps and associated syndromes
  - Crohn's disease/ulcerative colitis
  - Henoch Schonlein purpura
  - Cystic fibrosis and complications
- g) Liver and biliary tree
  - Portal hypertension (portal vein thrombosis)
  - Fatty liver
  - Biliary atresia/neonatal hepatitis
  - Choledochal cyst
  - Gallstones
  - Kawasaki's disease
- h) Pancreas
  - Pancreatitis and complications
- l) spleen
  - Splenomegaly (causes)
- j) Abdominal trauma (include kidneys)
- k) Tumors of the GI tract and solid organs

## 9) GENITOURINARY SYSTEM

- a) Congenital renal anomalies
  - Anomalies of position and fusion

- Duplex kidney spectrum
- b) Renal cystic disease
- c) Obstruction
  - UPJ
  - UVJ
  - Ureteroceles
  - Posterior urethral valves
- d) UTI and reflux
- e) Echogenic medullary pyramids (including nephrocalcinosis)
- f) Neurogenic bladder
- g) Bladder exstrophy
- h) Urachal anomalies
- i) testicular torsion/epididymitis
- j) Tumors
  - Renal (Wilms, nephroblastomatosis and related lesions)
  - Adrenal (neuroblastoma, pheochromocytoma)
  - Bladder (rhabdomyosarcoma)
  - Testicular
  - Ovarian and vaginal
- k) Trauma (included under the GI section)

#### 10. SKELETAL SYSTEM

- a) trauma
  - fractures (greenstick, plastic bowing, toddler's, Salter types, common fractures at specific sites).
  - Child abuse
  - Leg lengthening
- b) Infections
  - STORCH/Caffey's disease
  - Osteomyelitis/septic arthritis
- c) metabolic bone disease
  - Rickets, etc.
  - renal osteodystrophy
- d) Hematologic disorders
  - Thalassemia/sickle cell anemia
  - Histiocytosis X
  - Leukemia
- e) Arthritides
  - Hemophilia
  - JRA
- f) Tumors
  - Nonossifying fibromas
  - Simple bone cysts
  - Aneurysmal bone cysts
  - Osteoid osteoma
  - Chondroblastoma
  - Chondromyxoid fibroma
  - Enchondroma
  - Osteochondroma
  - Osteogenic sarcoma
  - Ewing's sarcoma
- g) Hip abnormalities

- Congenital dislocation of the hips
- Legg-Perthes disease
- slipped capital femoral epiphyses
- h) Foot abnormalities
  - Clubfoot
  - Tarsal coalition
- i) osteochondritis dissecans
- j) scoliosis
- k) skeletal dysplasias
  - fibrous dysplasia
  - enchondromatosis
  - multiple cartilaginous exostoses
  - achondroplasia
  - Cleidocranial dysplasia
  - Osteogenesis imperfecta
  - Osteopetrosis
  - Storage diseases (e.g. mucopolysaccharidoses)

#### 11. MISCELLANEOUS SYNDROMES

- a) Beckwith Wiedemann Syndrome
- b) Down's Syndrome
- c) Turner's Syndrome
- d) Neurofibromatosis
- e) Tuberous Sclerosis
- f) Sturge Weber Syndrome
- g) Von Hippel Lindau Syndrome
- h) Marfan's Syndrome

## **PHYSICS COURSE**

### **PREAMBLE**

All residents spend a minimum of 11 lectures (three hour per lecture) in-person class at the Foothills Medical Centre during radiology residency training. The residents will be given physics lectures (from subject matter experts) on all the core imaging modalities, radiochemistry, and radiobiology. The main purpose is to introduce or reinforce each physics topic, so that the residents can independently prepare for their physics examination questions.

### **PHYSICS TOPICS GOALS & OBJECTIVES**

#### ***ATOMS, RADIATION and RADIOACTIVITY (ALL YEARS)***

1. Identify atomic structure and transitions.
2. Identify nuclear structure and key nuclear decays used in medical imaging.
3. Perform simple radiation decay calculations.
4. Define the principle of equilibriums achieved in chain nuclear decays.

#### ***RADIOGRAPHY, MAMMOGRAPHY and FLUOROSCOPY***

1. Learn x-ray tube components.
2. Understand the production of x-rays and filtration of x-ray beams
3. Learn the basic component of projection imaging.
4. Learn the effect of magnification and image blurring.
5. **Radiography**
  - a. Understand the image receptors for computed and digital radiography system.
  - b. Learn the principles of scatter rejection and the anti-scatter grid.
6. **Mammography**
  - a. Understand the basic component of a mammography unit.
  - b. Describe how a mammography system is optimized to reduce scatter.
  - c. Describe how a mammography system is designed to increase spatial resolution.
7. **Fluoroscopy**
  - a. Understand the construction, function, and operation of a fluoroscopy system.
  - b. Describe image intensifier and flat panel detector.
  - c. Describe the image artifact associated with fluoroscopy system.
  - d. Describe dose reduction strategies for fluoroscopy system.
  - e. Learn dose reduction for staff and operators.

#### ***RADIATION BIOLOGY AND SAFETY***

1. **Radiation Biology**
  - a. Sources of background radiation to the public
  - b. Classification of biological effects (stochastic effects, tissue reactions)
  - c. Dose-response models
  - d. Linear energy transfer, relative biological effectiveness, and oxygen enhancement ratio
  - e. Principles of direct and indirect action
  - f. Types of DNA damage and repair mechanisms
  - g. Radiosensitivity and radiation effects on human tissues/organs and the fetus
2. **Radiation Safety**
  - a. Federal and provincial regulations and licensing pertaining to the use of radioactive materials
  - b. Responsibilities of employers and staff
  - c. Principle of ALARA
  - d. Occupational dose limits for radiation workers and non-radiation workers

## **COMPUTED TOMOGRAPHY**

### **Goals:**

Radiology residents will have the fundamental, basic physics, computed tomography (CT) knowledge to (1) understand the processes and factors by which a CT image is generated and affected by; (2) know the benefits and limitations of CT imaging; and (3) have the ability to succinctly and accurately explain CT imaging to other clinicians, patients, and colleagues.

### **Learning Objectives:**

1. Identify the main components of current CT systems.
2. Understand the main distinctions between single slice, multi-slice, dual-source, and one beam systems.
3. Identify the primary acquisition parameters (e.g., kVp, mAs, pitch, slice thickness). Residents should be able to answer the following:
  - a. How is image quality defined and measured?
  - b. What variables significantly influence image quality?
  - c. How do acquisition parameters affect acquired images?
4. Understand the processes and reconstruction algorithms that are involved in CT image formation
5. Understand the relationship between physical attenuation and CT number
6. Understanding the various operating modes that can be provided by CT scanners (e.g. helical, axial, localizer (scout), fixed mA, variable mA, dynamic, and fluoroscopic imaging modes)
7. Understanding radiation dose
  - a. Why is dose reduction important?
  - b. How does dose reduction affect the acquired image?
  - c. How do we calculate and measure radiation dose?
  - d. What factors affect radiation dose?

## **ULTRASOUND**

1. Understand the nature and properties of ultrasound.
2. Understand the propagation and interaction of ultrasound in matter.
3. Describe the scattering of ultrasound waves.
4. Describe the piezoelectric effect.
5. Identify the main components of ultrasound transducers.
6. Understand the difference between continuous and pulsed wave ultrasound.
7. Describe the Doppler effect.
8. Understand the difference between A-mode and B-mode imaging in ultrasound.
9. Learn the basics of time-gain compensation.
10. Understand the construction, function and operation of a real-time B-mode scanner including M-mode.
11. Describe image acquisition and reconstruction.
12. Understand the measurement of flow with continuous and pulsed Doppler ultrasound.
13. Describe Duplex scanners.
14. Understand Color-flow and power Doppler imaging.
15. Understand the physical effects - heating, streaming, cavitation, and mechanical damage.
16. Learn about the intensity and energy limits.
17. Describe the thermal and mechanical indices.

## **MAGNETIC RESONANCE IMAGING**

### **Overview:**

This two-part course covers the foundations of MR physics relevant for clinical radiology. Residents are expected to gain a functional understanding of MR physics to support effective referrals, protocol creation and adaptation, and image interpretation. The course covers a board range of topics ranging from nuclear spins to MR safety and will provide sufficient detail that residents will be prepared for additional clinical MR training and able to understand MR focused presentations.

### **Part 1 (3h)**

This first session describes the fundamentals of MR physics including MR signal, hardware, and spatial encoding. Specific topics covered in this lecture include:

1. Nuclear spins/signal
  - a. MR visible nuclei
  - b. Magnetic fields
  - c. Magnetic moments
  - d. Magnetization
  - e. Bloch equations
    - Relaxation times: T1, T2, T2\*
    - Precession
  - f. Signal measurement
  - g. Thermal and electrical noise
  - h. Signal-to-noise ratio and contrast-to-noise ratio
2. Hardware
  - a. Superconducting magnet
  - b. Gradient coils
  - c. Radiofrequency coils (including array coils)
    - Transmit fields
    - Receive fields
3. Spatial encoding
  - a. Fourier transforms
  - b. Gradient encoding and k-space
  - c. Resolution, field-of-view and corresponding k-space sampling requirements
  - d. Slice selection
    - Amplitude modulated RF pulses
    - Low-tip angle approximation for Fourier interpretation of RF design
  - e. 2D and 3D spatial encoding
4. Basics acquisition strategies
  - a. Pulse sequence diagram
  - b. Spoiled gradient echo
    - Signal equation (with respect to flip angle, repetition time, echo time, relaxation times)
    - Ernst angle
  - c. Spin echo
    - Signal equation
    - Insensitivity to off-resonance
5. Basic contrast weightings
  - a. T1, T2, PD with gradient echo and spin echo sequences

## Part 2 (3h)

This second session focuses on the application of the MR physics presented in the first session and includes pulse sequences, contrast mechanisms, and common artifacts. Specific topics covered in this lecture include:

1. Advanced acquisition methods and contrast weightings
  - a. Gadolinium-based contrast agents
    - Relaxivities
    - Macrocyclic vs linear
    - Contrast enhanced methods
      - T1, T2, T2\* weighted
      - Dynamic susceptibility contrast
      - Dynamic contrast enhanced
  - b. Fast spin echo
    - Effective echo time and view orderings
    - Single shot
    - Point spread function
  - c. Magnetization preparation
    - Inversion recovery
      - Short time inversion recovery (STIR)
      - Fluid attenuated inversion recovery (FLAIR)
      - T1 contrast manipulation (MPRAGE, double IR)
  - d. Fat water imaging
    - Chemical shift
    - Spectral fat saturation
    - Dixon based methods (FLEX)
  - e. Echo planar imaging
    - fMRI
      - Task based
      - Resting-state
    - Diffusion imaging
      - B-value
      - Diffusion directions
      - Common diffusion models
        - Diffusion weighted imaging (DWI)
        - Diffusion tensor imaging (DTI)
  - f. Magnetization transfer
    - Magnetization transfer ratio
    - Incidental MT in multi-slice imaging (particularly fast spin echo)
  - g. Time of flight angiography
    - Inflow effects
    - Ramped pulses
    - Multi-slab imaging
    - Saturation bands for venous suppression
    - Magnetization transfer
  - h. Phase contrast
    - Bipolar flow encoding
    - Phase contrast angiography
  - i. Susceptibility weighted imaging
    - Filtered phase images, combination with magnitude images
    - Unique contrast from iron rich tissues and calcium deposits
  - j. Propeller
    - Motion robust acquisition scheme



- Contrast weightings and limitations
  - k. Multispectral imaging near metal
  - l. Arterial spin labeling
    - Pulsed vs pseudo-continuous labeling
    - Post label delay time
    - Quantification of cerebral blood flow
- 2. Acceleration methods
  - a. Protocol optimization
    - Readout oversampling vs phase oversampling
    - Timings, slice orderings
  - b. Parallel imaging
    - SENSE
    - GRAPPA
    - G-factor
    - Multi-band
  - c. View sharing for dynamic imaging
  - d. Partial Fourier
    - Readout vs phase encode
  - e. Compressed sensing
  - f. Deep learning reconstruction
- 3. Artifacts
  - a. Motion
  - b. Flow
  - c. Susceptibility
    - Air/tissue
    - Implants
    - Sequence specific outcomes
      - Signal dropout (gradient echo)
      - Distortions (spin echo and gradient echo)
      - Banding (bSSFP)
  - d.
  - e. Fat/water shift (India ink)
  - f. EPI specific
    - Off-resonance based
      - Fat shift
      - Spatial distortions
    - N/2 ghosting
    - Eddy current distortions (particularity with diffusion)
  - g. External signal
    - Zipper, spike
  - h. Anefact/Cusp
- 4. Safety
  - a. Main magnet
    - 5 and 10 Gauss lines
    - Torque vs pull
      - Risk from shielded magnets
    - Cryogens
  - b. Gradients
    - Peripheral nerve stimulation
    - Acoustic noise
  - c. Radiofrequency coils
    - Contact heating

- Specific absorption rate
- d. Contrast agents
- e. MR suite and 4 safety zones

## **NUCLEAR MEDICINE PRODUCTION**

### **Objectives**

1. To learn the various production methods of radionuclides used in Nuclear Medicine
  - Understand the production methodology of isotopes used in Nuclear Medicine from a
    - nuclear reactor
    - cyclotron
    - generator
2. To understand the physics of Technetium ( $^{99m}\text{Tc}$ ) from a generator
  - to understand the general chemistry involved in preparing  $^{99m}\text{Tc}$ -kits, in particular
    - the concept of chelation chemistry using radiometals
    - the use of ligands, reducing agents, and stabilizing agents
3. To learn how  $^{18}\text{F}$  is prepared and used for the labelling of PET radiopharmaceuticals.
4. To learn of the quality control that is required for the release and use of radiopharmaceuticals
  - To learn how to test for chemical and radiochemical purity
    - To understand the general chromatographic methods used determine radiochemical purity.
  - To be aware of all the other quality control parameters required to release a product prior to use.
5. To gain an appreciation of the regulatory burden associated with the preparation and use of radiopharmaceuticals.
6. The basic pharmacokinetics of typical radiopharmaceuticals in vivo
  - the various mechanisms of radiopharmaceutical uptake.
  - the pharmacokinetics of  $^{18}\text{F}$ -labelled probes, in particular FDG.
7. To learn of other PET isotopes and radiopharmaceuticals
  - currently used in clinical practice
  - support clinical research
8. To understand how molecular imaging supports a Theragnostic program in Nuclear Medicine.

## **NUCLEAR MEDICINE IMAGING**

### **1. Gamma Camera**

- a. Learn about the mechanisms of radiopharmaceutical interaction in molecular imaging.
- b. Describe the construction, function and operation of a gamma camera.
- c. Understand the major components of the gamma camera:
  - i. Detectors
  - ii. Collimator
  - iii. Computer system
  - iv. Gantry
- d. Understand why a collimator is necessary in a gamma camera.
- e. Describe the best geometry for collecting nuclear medicine patient data.
- f. Describe how to peak a gamma camera.
- g. Discuss the quality assurance used for a gamma camera.

### **2. Single Photon Emission Computed Tomography**

- a. Describe the construction, function, and operation of a rotating multi-head gamma camera.
- b. Learn about image reconstruction and attenuation correction.
- c. Learn about the benefits and applications of SPECT/CT scanners.

### **3. Positron emission tomography**

- a. Describe the construction, function and operation of a multi-detector ring system.
- b. Understand the metabolic pathways underpinning Fluorine-18 FDG use (the Warburg effect).
- c. Understand coincidence detection.
- d. Understand factors affecting image resolution.
- e. Learn about the benefits of using time of flight in PET reconstruction.

### **4. Safety in nuclear medicine**

- a. Learn about radiation safety and factors affecting occupational dose.
- b. Learn about the typical activities and effective doses to patients, staff and the public.
- c. Learn about time, distance and shielding for dose reduction.
- d. Understand radiation safety precautions in children and during conception, pregnancy and breast-feeding in patients.

### ***IMAGE PROPERTIES***

1. Understand the perceptual and physical attributes of image quality, including contrast, noise, contrast resolution and spatial resolution.
2. Identify the basic techniques to assess image quality.
3. Explain differences and limitations of different image quality evaluation methods.
4. Assess the aspects of image quality which are not captured by resolution and noise measurements.
5. Image artifacts.

**SENIOR RESIDENTS CLINIC****PREAMBLE:**

The Senior Residents Clinic Rotation focuses on community ultrasound and radiography and is the only one of its kind in Canada. The senior resident functions independently similar to a junior radiologist does. The rotation takes place at the EFW Advanced Medical Imaging Centre Community Clinic.

This rotation has been designed for the senior (End of PGY-4 and PGY-5/ Transition to Practice) residents and is one-block (4 weeks) in length. The primary purpose of this rotation is to provide an advanced exposure to ultrasound (and some general radiography) in a community radiology clinic setting. The volume of cases has been reduced to allow the resident to scan patients and to consult with patients and referring physicians.

The Senior Residents Clinic has the latest technology for digital imaging and reporting. This clinic is fully equipped with digital imaging using state-of-the-art PACS workstations and a Voice Recognition (VR) dictation system, which are the same as those at the Foothills Medical Centre. There is also the use of the Astraia system for obstetrical ultrasound reporting. The EFW Clinics are digitally “linked” with the hospital PACS systems in Calgary and surrounding areas, therefore allowing more timely patient care.

**ROTATION SPECIFIC GOALS & OBJECTIVES****MEDICAL EXPERT/CLINICAL DECISION MAKER****GENERAL ULTRASOUND**

1. Final refinement of ultrasound scanning skills. The resident is encouraged to participate in scanning the patient.
2. Develop an understanding of community/outpatient ultrasound imaging, including the indications/contraindications for abdominal and pelvic imaging, small parts ultrasound (thyroids, scrotum), and vascular ultrasound (carotid arteries).
3. Develop an understanding of community/outpatient x-ray imaging.
4. Be able to supervise the clinic. The resident should be able to consult, triage, and supervise virtually all cases referred to the clinic.
5. Develop an understanding of managing the clinic: The resident will also gain experience in the management of patient scheduling, billing, optimal use of resources.

**OBSTETRICAL ULTRASOUND**

During all ultrasound rotations the resident will have the opportunity to consult with the clinical obstetric service regarding the imaging of a large array of obstetrical imaging cases. This outpatient clinic rotation will complement the experience in the use of ultrasound in the first, second and third trimester obtained at both the TRW MFM Centre and the FMC Ultrasound Department prior to this rotation.

The obstetrical imaging component of this rotation will include, but not be limited to clinical experience in the following:

**1<sup>st</sup> TRIMESTER**

- Dating OB ultrasounds
- Bleeding in pregnancy

**2<sup>nd</sup> TRIMESTER**

- The role of ultrasound in routine imaging and screening in pregnancy

### 3<sup>rd</sup> TRIMESTER

- The role of ultrasound in routine fetal growth and/or biophysical profile exams

### GYNECOLOGIC ULTRASOUND

The resident will be exposed to a variety of outpatient gynecologic ultrasound, such as pelvic pain, ovarian pathologies, post-menopausal bleeding.

#### **COMMUNICATOR**

1. When performing an ultrasound exam, residents learn to establish an appropriate “physician-consultant” relationship with the patient, their family, and the healthcare team.
2. The resident learns to communicate effectively when delivering sensitive information (e.g. fetal demise, fetal anomalies).
3. The resident learns how to communicate results to the referring physician in the report and verbally over the phone.
4. The “real-time” nature of ultrasound exams requires that the resident learn to effectively address patient’s immediate concerns in a sensitive, and accurate fashion.
5. Triage of studies: given the demand placed on Diagnostic Imaging resources, it is vital that Residents develop skills in communicating with the referring healthcare team such that the most appropriate study is performed within a timeframe commensurate with the acuity of the illness. This involves developing skills in obtaining relevant clinical information necessary to determine if ultrasound is the appropriate examination in a particular circumstance. The resident is expected to be able to recommend, and as necessary arrange the appropriate imaging investigations.
6. The integral role played by ultrasound technologist is stressed and residents learn to interface with the technologist team so as to maximize their performance and accuracy.

#### **COLLABORATOR**

1. The resident will learn to effectively communicate with the ultrasound technologist team, the referring healthcare team/consultants, and as necessary the patient and/or family.
2. The resident will develop the skill to function as a team member in the general radiology clinic working with staff radiologists, and technologists to provide optimum patient care.

#### **LEADER**

1. Utilize the resources of ultrasound (both technology and technologist) effectively in a community clinic setting to optimize health care for the patient.
2. Develop an understanding of health care costs relevant to ultrasound, including equipment cost, maintenance cost and human resource cost, and are encouraged to be appropriately sensitive to these issues.

3. *Be able to supervise the clinic.* The resident should be able to consult, triage, and supervise all cases referred to the clinic.
4. *Develop an understanding of managing a private community clinic.* The resident will also gain experience in the management of patient scheduling, billing, optimal use of resources (e.g. to ensure the patient is scheduled for their screening mammogram, bone density and pelvic ultrasound on the same day in a timely manner).
5. Be competent in using PACS systems.

#### **HEALTH ADVOCATE**

1. Understand the benefits and risks of an ultrasound exam for different patient populations including: the fetus, neonate, child, and adult.
2. Understand the benefits and limitations of ultrasound in evaluating various medical conditions.
3. Developing efficient, useful, and value-added algorithms in evaluating various medical conditions.
4. Recognizing when an ultrasound exam or ultrasound-guided interventional procedure may be detrimental to the health of the patient.
5. Recruiting the necessary human resource [technologists] and equipment resources to perform studies in appropriate timeframe.

#### **SCHOLAR**

1. Through rounds, journal club and attendance at critical appraisal courses learn to critically evaluate sources of medical information.
2. Be an effective teacher of ultrasound, x-ray and mammography to technologists and technologist students.
3. Develop, implement, and monitor personal continuing education strategy.

#### **PROFESSIONAL**

1. When interacting with patients, their families, technologists, and any member of the healthcare team, demonstrate appropriate personal and professional behavior.
2. Deliver the highest quality care in ultrasound with integrity, honesty, and compassion.

#### **RESOURCES:**

1. Ultrasound: The Requisites, 2<sup>nd</sup> Ed. WD Middleton et al. Mosby. 2004.
2. Diagnostic Ultrasound, 4<sup>th</sup> Ed. Rumack CM, Charboneau JW, Wilson SR. Mosby. 2010.
3. Journals: Journal of Ultrasound in Medicine and the Journal of Clinical Ultrasound.
4. On-line resources: STATdx.
5. Ultrasound technology training supervisors.
6. Staff radiologists.

## **Senior Residents Clinic – Process for Residents**

### **LOCATION:**

Advanced Medical Imaging Centre, first floor. Suite 100, 2000 Veterans Place NW.

### **OBJECTIVES:**

- This is primarily an US rotation. The case mix has been selected to expose you to cases that are not seen in the hospital setting, but are “bread & butter” cases for a general radiology clinic practice.
  - General detailed OB US, abdomen and pelvis US, thyroid US, carotid US, extremity DVTs and HCCs.
  - Unfortunately, no MSK US as the CPSA requires a staff radiologist to be on site.
- If time permits, please read plain films. Plain films are strongly encouraged in your PGY-5 year

### **SCHEDULING:**

***\*\*THIS CLINIC IS BOOKED EVERY DAY MONDAY-FRIDAY\*\****

- The Seniors Clinic is scheduled well in advance with the assistance of the Program Admins. Each resident is responsible for ensuring the schedule is correct for their rotation. You are responsible for covering the clinic or finding replacement coverage if you decide to take last minute vacation/days off or swap nights of call.
- Mandatory teaching sessions on any day that a resident absolutely cannot be available will be blocked off. This must be done well in advance when the Program Admins are organizing coverage for the clinic.
- If the resident is post-call or on vacation, someone else from your year MUST be a substitute for the day and cover the Clinic (please ask the current PGY-5s how they scheduled this). This must be a TEAM EFFORT and planned well in advance when the Program Admins are organizing coverage for the clinic.
  - 0800-1200h Monday-Friday: at Clinic
  - 1200-1300h Monday-Friday: Noon Rounds (except Thursdays)
  - 1300-1700h Monday-Friday: US dept at FMC or Stephanie Wilson’s clinic (except Thursday Academic Half-Day)
    - Confirm with the Program Director prior to your rotation. Alternatively, you can sit in any seat at FMC that is open or read plain films to gain additional experience
    - Please ensure that you check in with the relevant preceptor to ensure they know you will be working with them in the afternoon.

### **Study Day (Tuesdays) from January-June:**

The PGY5 resident will work at the Clinic in the morning and have their regular study time in the afternoon. PGY5 can choose another afternoon of the week, at their discretion. Please make sure that appropriate preceptor is aware that you are taking an alternative study afternoon.

### **PACS/IT**

- You must have EFW access including PACS and Powerscribe (most of you will have this set up from earlier Mammo II rotations)
- You must have Astraia access (some of you will have this training and set up from earlier MFM rotations)
- If you need to obtain training or access to these programs, please email AcctReq@EFWRad.com at least 2 weeks prior to your rotation:

### **REVIEW OF CASES:**

- The primary staff radiologist you will review with is the Seton US radiologist. Please phone the reviewing radiologist first thing in the morning. All phone numbers are in a PDF document available on all EFW clinic desktop computers (Document is titled “Internal and External Contact Numbers”). Typically, there is one remote review session at ~1130h each day. If you are starting the Clinic rotation at the end of PGY-4, there may be 2 review sessions. You are encouraged to contact the attending radiologist at any other time if you have questions or concerns with respect to any individual case.
- In the event that a Seton US radiologist is unavailable there is a back-up system in place to ensure appropriate supervision is maintained at all times, listed in order of priority:
  5. Sunridge DI Rad
  6. As a last resort you can speak with the onsite Cambrian Mammo/Nuc Med Radiologist
  7. In the unlikely scenario in which patient care requires a staff radiologist physically scan or assess a patient, you can ask the Cambrian Mammo or Nuclear Medicine Radiologist for assistance
  8. For questions pertaining to advanced obstetrical imaging, you may contact a perinatologist (Local numbers available of Contact Number PDF document)

**WHAT BLOCKS WILL YOU COVER IN THE SENIOR RESIDENT CLINIC?**

Each resident typically covers at least 2 blocks of the Seniors Clinic

- Some residents will have an “US\*” block, Blocks 12 & 13 in PGY-4 year
- Every resident has a “CLINIC” block in PGY-5 year.
- Some residents will have an “US\*” block in PGY-5 year.
- There is an “Elective” block for all PGY-5 residents, Block 11 of the PGY-5 year. This is again a TEAM EFFORT. All PGY-5 residents contribute to cover the Clinic this block—talk to the current PGY-5s, typically each of you will cover the Clinic approximately 1 day/week.



**INTERVENTIONAL RADIOLOGY****PREAMBLE**

The Interventional Radiology rotation is a total of three 4-week blocks completed at FMC. By the end of the rotation, the resident should be knowledgeable of the appropriate use of and proficient in performing common diagnostic and therapeutic interventions. Residents will be trained in general vascular radiology as well as fluoroscopic, sonographic, and CT-assisted non-vascular interventional procedures. Residents will acquire knowledge of other more sophisticated procedures to be able to make recommendations for these procedures, assist clinicians in preparing their patients and make appropriate referrals.

While residents should anticipate exposure to a variety of procedures, the rotation is not intended to provide the technical or academic proficiency sufficient for subspecialty IR qualifications as IR is an evolving and progressively sophisticated subspecialty that is best routinely practiced by those with dedicated training of appropriate duration, enough volume to maintain proficiency, and a commitment to lifelong continuing medical/procedural education. Residents interested in IR may request additional IR training through the Program Director.

**Duties and Responsibilities:**

The staff radiologist will closely supervise initial resident efforts and allow increasing responsibility consistent with demonstrated aptitude and motivation.

***The resident is responsible for:***

1. Pre-operative evaluation that includes chart review, relevant lab values, review of prior relevant imaging, patient evaluation, indication for the procedure, and discussion relevant for informed consent, and patient pre-procedural orders.
2. Tracking patients on procedure specific data sheets.
3. Assisting or performing various procedures, consistent with their level of ability, as directed by the staff radiologist. Residents will realize personal variations in procedural techniques unique to each radiologist and gain some appreciation for the individuality of procedural specialties.
4. All follow-up assessments regarding possible procedural complications. The resident is expected to act responsibly and perform at a standard that is consistent with their level of training unless otherwise discharged from duty by the staff radiologist.
5. Reporting the interpretation of the examination.
6. Keeping a log of all the cases he/she has been involved in, tracking his/her level of involvement, complications, and outcome.
7. Work up of at least two cases monthly for the teaching file with one of the staff radiologists.
8. Preparing for in-service, vascular/interventional and mortality-and-morbidity rounds as directed by the staff radiologist.
9. Preparing material to submit as case report, short papers, technical notes, or for the resident's corner.

The resident must appreciate that such a brief rotation may produce anomalous or inconsistent levels of experience with some procedures. The resident is therefore advised to follow an organized and deliberate reading schedule so to ensure proper knowledge.

## **ROTATION SPECIFIC GOALS AND OBJECTIVES:**

### ***MEDICAL EXPERT/CLINICAL DECISION MAKER***

1. Develop IR skills progressively from CT guided procedures in the first block to vascular procedures in the second and third blocks.
2. Acquire a good knowledge base in anatomy, including vascular anatomy.
3. Have a thorough knowledge of indications and contraindications for the common procedures performed (e.g. line placement, abscess drainage, biopsy, etc.) and to be familiar with the indications and contraindications of less commonly performed procedures (e.g. transcaval liver biopsy).
4. Be familiar with technique details relevant to the choice of procedure.
5. Acquire a basic knowledge of the equipment, such as guide wires, catheters, needles, imaging & contrast injection equipment.
6. Develop proficiency in common technical and procedural skills. Minimize risks and discomfort to the patient.
7. Develop a thorough knowledge of complications of procedures including adverse contrast reactions.
8. Demonstrate the ability to manage a patient independently during a procedure, including the management of complications.
9. Develop an understanding of conscious sedation.
10. Understand the risks of radiation exposure and develop the habit of observing recognized protective procedures & shielding to protect his/herself, support staff and the patient.
11. Have an understanding of the risks from exposure to blood products, particularly with regard to the transmission of infectious disease.
12. To keep a logbook of cases performed.

### ***COMMUNICATOR***

1. Establish a therapeutic relationship with patients and their families. Be able to provide clear and thorough explanations of the procedure, its risks and complications to obtain informed consent.
2. Be able to obtain appropriate information from the health care team in order to best perform a vascular or interventional procedure with the least risk to the patient.
3. Establish a good working relationship with technologists and nurses in the angio/interventional suites.
4. Be able to produce a succinct report that describes the findings, most likely diagnosis and, where appropriate, further management or imaging.

### ***COLLABORATOR***

1. Function as a contributing member of a multidisciplinary health care team, interacting with technologists, nurses, radiologists and clinicians to provide optimal patient care.

### ***LEADER***

1. Utilize the resources of vascular/interventional (people & equipment) wisely, determining the indications and urgency of a procedure from consultation with the referring physician.
2. Develop an understanding of the fundamentals of quality assurance/quality improvement with respect to vascular/interventional procedures.

### ***HEALTH ADVOCATE***

1. Understand the benefits and risks of procedures performed.
2. Understands when a procedure should be terminated to prevent/limit harm to a patient.

### ***SCHOLAR***

1. Begin to develop competency in evaluation of the medical literature in radiology, including that related to vascular/interventional radiology.
2. When projects are available, participate in an audit or research project involving vascular/interventional radiology.

## **PROFESSIONAL**

1. Demonstrate appropriate personal and professional behavior when interacting with patients, technologists, nurses, colleagues and clinicians.
2. Demonstrate an awareness of one's own limitations, seeking assistance and advice when necessary when doing procedures. Learn to accept advice graciously.
3. Deliver the highest quality care with integrity, honesty and compassion.

## **IR REQUIRED/MANDATORY READING LIST**

6. Kaufman, J., Lee, M.J. The Requisites Vascular and Interventional Radiology. 3<sup>rd</sup> Edition 2013. Mosby. (Excellent guide to basics of interventional radiology).

## **IR SUGGESTED READING LIST**

1. Kandarpa, Kirshna. Machan, Lindsay. Handbook of Interventional Radiologic Procedures, 4<sup>th</sup> Edition 2011, Little, Brown and Company.  
(A great little handbook to keep with you. Lists all the usual catheters, contrast volumes, and the usual preps and techniques for a wide range of interventional work.)
7. Geschwind, J.F., Dake, M. Abrams' Angiography, 3<sup>rd</sup> Edition, 2011, Lippincott Williams and Wilkins.
8. Mauro, M, et al. Image-Guided Interventions, 1<sup>st</sup> Edition 2008, Saunders Elsevier.

## **IR/ANGIO CASE LIST**

These are procedures that are performed by the angio-interventional radiologists at the FMC. Some procedures are obviously performed more commonly than others but on your angio-interventional rotation you should try to see and participate in as many as possible.

### CHEST:

- Pulmonary artery embolization
- Chest tube insertion for pneumothorax, hemothorax or pleural fluid drainage
- Lung biopsy
- Bronchial artery embolization

### CENTRAL LINES:

- CVC triple lumen arrow or cordis
- RAAF – triple or single
- Cook lines for chemo patients
- Temporary line, apheresis
- Permanent line
- PICC (rare)
- Line exchanges
- Line removals (perm, RAAF, Cook)
- Fibrin sheath stripping or disruption
- Port-a-Cath

### ANGIO:

- Arch angiogram
- Leg, arm angiogram
- Abdominal, splenic, hepatic, renal, uterine angiogram
- Catheter insertion for chemo agent infusion or TPA
- Venogram

- Shuntogram
- Fistulogram
- Angioplasty and stenting
- Embolization of bleeding vessels
- Embolization of peripheral AVM

ABDOMEN:

- Abscess drain
- Suprapubic catheter
- Liver biopsy – percutaneous and transjugular
- Hepatic chemoembolization/radioembolization
- Hepatic radiofrequency ablation
- TIPS

GASTROINTESTINAL:

- PEG, gastrostomy tube
- Gastro-jejunal tube
- NG tube
- Exchanges, reinsertions

BILIARY:

- Cholangiogram, internal/external drainage
- Cholecystostomy
- Gallbladder drain (internal/external)

# PART VIII –APPENDICES

**Appendix A – RC EPAs and Milestones**

**Appendix B – PARA Agreement**

Elective request

Vacation request

\*Elective and Vacation forms are also found in G29 and the Rad Ed Drive under “Forms”