الهيئة السعودية للتخصصات الصحية
Saudi Commission for Health Specialties

Radiology Technology and Medical Imaging in Nuclear Medicine


بسم الله الرحمن الرحيم

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ABBREVIATIONS

Abbreviation	Description
SBRT&MI	Saudi Board of Radiology Technology and Medical Imaging
SBSRT&MI-NM	Saudi Board of Radiology Technology and Medical Imaging in Nuclear Medicine
RT&MI	Radiology Technology & Medical Imaging
CT	Computed Tomography
MRI	Magnetic Resonance Imaging
US	Ultrasonography, Ultrasound
NM	Nuclear Medicine
IPEM	Institute of Physics and Engineering in Medicine
ABSNM	American Board of Science in Nuclear Medicine
CanMEDS	Canadian Medical Education Directives for Specialists
SCFHS	Saudi Commission for Health Specialties
KFMC	King Fahad Medical City
KSMC	King Saud Medical City
KAUH	King Abdulaziz University Hospital
RPS	Retropharyngeal Space
PBL	Practice-Based Learning
WBL	Work-Based Learning

Abbreviation	Description
PACS	Picture Archiving and Communication System
ALARA	As Low As Reasonably Achievable
QC	Quality Control
RIS	Radiology Information System

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INTRODUCTION

The goal of the Saudi Board of Radiology Technology and Medical Imaging (SBRT&MI) is to cultivate highly skilled technologists who can practice safely and meet the healthcare needs of society. This program is designed to help new graduates to gradually improve their field-specific skills and achieve promotion to a higher academic grade upon completion of their courses.

In several Western countries, fellowship programs have been implemented for health science graduates. Some of these fellowship programs may extend up to six years. For example, the Institute of Physics and Engineering in Medicine (IPEM) in the UK offers fellowships that are designed for clinical scientists and clinical technologists. In the USA, several specialty boards exist such as the American Board of Science in Nuclear Medicine (ABSNM) providesimilar programs.

The SBRT&MI program is unique and follows the Canadian Medical Education Directives for Specialists (CanMEDS) framework, which is widely adopted in postgraduate training programsglobally. It offers a competency model that emphasizes not only Radiology Technology & Medical Imaging expertise but also multiple additional non-Radiology Technology & Medical Imaging expert roles that competently address the healthcare needs of society. The Saudi Commission for Health Specialties (SCFHS) has adopted the CanMEDS framework to establish a core curriculum for all training programs. RT&MI residents will function in seven CanMEDS roles, i.e., Radiology Technology & Medical Imaging, communicator, collaborator, manager, health advocate, scholar, and professional.

The SBRT&MI program consists of four years of full-time supervised residency training in radiology technology and medical imaging (RT&MI) and related fields. The training institution must be accredited by the SCFHS to offer the SBRT&MI programs. The RT&MI residents will benefit from comprehensive training and be actively involved in patient care. Their responsibilities will increase with their increasing experience and competency. The rules and regulations of the training program are to be followed.

Upon successful completion of the training program, RT&MI residents will be awarded the “Saudi Board in RT&MI” qualification. At this stage, they will

have a degree of competency and experience considered adequate for the practice of clinical radiographic technology and will become eligible for positions in radiology departments as technical consultants after fulfilling the requisite years of experience required by the SCFHS. Residents will be consulted regarding exam selection and post-processing, education of residents and staff, research on the development of new methods for protocol optimization, and implementation of quality patient care.

The SBRT&MI program is designed to cover four major areas of RT&MI that exhibit the highest demand:

1. Computed tomography (CT);
2. Magnetic resonance imaging (MRI);
3. Ultrasonography (US); and
4. Nuclear medicine (NM).

The program includes both theoretical and practical aspects to introduce candidates to very advanced techniques in each proposed specialty. The first part (first and second years) of the program covers generic, basic, and overall knowledge and understanding of RT&MI modalities of cross-sectional imaging such as general X-ray, angiography, fluoroscopy, NM, US,CT, and MRI. All techniques and relevant physics are included. The second part (third and fourth years) is dedicated to one specialty (NM, US, CT, or MRI).

The purpose of this curriculum is to define the training process and competencies required for the SBRT&MI certification. After training, the RT&MI specialists will be able to work as senior technologists in RT&MI departments and will be promoted to consultant technologists after three years of experience. This curriculum will be reviewed every four years or at any time, if necessary. All trainees having satisfactorily completed the program are eligible to take the SBRT&MI examination Part 2.

TRAINING PROGRAM STRUCTURE

The SBRT&MI-NM program is a four-year, full-time residency program that takes place in accredited institutions. The program comprises training to acquire cognitive and technical skills and to understand how they relate to patient care, safety, physics, applied anatomy, pathology, and the physiology of health and diseases. The training involves practical procedures and interpretation methods taught in a sequential and integrated manner through lectures, tutorials, seminars, and hands-on experience.

Objectives

The overall objective is to guide RT&MI residents through a well-structured comprehensive training program certified by the SCFHS in clinical RT&MI. After successfully completing the training and final certification exam, graduates will function as independent first specialists in the RT&MI fields.

The SBRT&MI-NM program prepares residents to:

- plan and provide both routine and complex RT&MI care for a wide variety of patients by applying advanced knowledge and clinical skills;
- acquire competencies and confidence in various RT&MI exams;
- be able to interpret submitted RT&MI exams accurately and efficiently with the best image quality using effective protocols;
- keep abreast of modern technology regarding RT & MI;
- communicate, understand, and function effectively with other healthcare professionals to understand their organizational systems; and
- acquire experience in teaching and research to upgrade clinical knowledge. At the end of the program, RT&MI residents will have acquired the CanMEDS framework competencies and will be able to function effectively in the following roles:
  - radiology & medical imaging expert,
  - communicator,
  - collaborator,
  - leader,

- health advocate,
- scholar, and
- professional.

Admission Requirements for Candidates

Please refer to the updated executive policy of SCFHS on admission and registration.
Website: www.scfhs.org.sa

General Training Requirements

- RT&MI residents shall obey the training regulations and obligations established by the SCFHS and their training centers.
- RT&MI residents shall be enrolled in full-time continuous education for the entire duration of the program.
- Training is to be conducted in institutions accredited by the SCFHS.
- Training should be comprehensive and include general clinical education in the first part and specialized education in US, NM, CT or MRI in the second part.
- RT&MI residents should be actively involved in examination requests, patient histories, and clinical examinations to achieve diagnoses, with gradually increasing responsibility regarding clinical and technical aspects.

Contents of Training

First Year (R1)

The first year of training consists of six months of rotation for general X-ray, two months for angiography, and four months for fluoroscopy. The rotations introduce RT&MI residents to areas of general imaging, which can entail performing routine examinations and on-call duties. During this time, residents will receive training in the necessary radiological examinations of the aforementioned specialties.

A key component of the introductory phase includes the understanding the basics of Picture Archiving and Communication Systems (PACS), image manipulation, and communication skills.

Students should concentrate on mastering the basics, including PACS, Radiology Information System (RIS), imaging-based anatomy, imaging physics, radiation safety, contrast administration, and all related issues, with afocus on general radiography, angiography, fluoroscopy, and radiographic techniques during their respective rotations.

Second Year (R2)

The second year of this program concentrates on intensifying the knowledge and technical experience of RT&MI residents regarding the physics of cross-sectional imaging (CT and MRI), US, and NM. RT&MI residents are also introduced to specific pediatric imaging techniques that help them acquire the necessary skills to serve the population. Moreover, RT&MI residents are introduced to breast imaging.

During the second year, RT&MI residents are encouraged to enroll in courses to conduct research and evidence-based medical imaging courses, which will prepare them for the research project in the following year.

The typical rotation program of the second year, including hands-on scanning of patients, is asfollows:

- three months: physics and general US procedures;
- three months: physics and general MRI procedures;
- three months: physics and general CT procedures; and
- three months: physics and general NM procedures.

Third Year (R3)

The third year includes rotations with hands-on training in the NM field.

The third year also introduces residents to more detailed physics and imaging. The learning period consists of a comprehensive rotation program, wherein the residents work closely with senior technologists and radiologists, covering basic and advanced imaging procedures.

Moreover, RT&MI residents dedicate two weeks to research and quality improvements. They are given the opportunity to either conduct a research project under faculty supervision with the aim of producing publishable materials or to undertake a departmental quality improvement project. There are two weeks during R3 in which residents can select an education program. If desired, they could attend local or international medical imaging courses.

The typical rotation program is as follows:

- two weeks: research, quality courses, and rotation;
- two weeks: medical imaging courses and conferences; and
- eleven months: rotation in one of the fields chosen by the RT&MI residents (CT and MRI, US and NM).

Fourth Year (R4)

In the fourth year, residents perform advanced rotations in the NM field. The fourth year is intended to deepen the skills of senior RT&MI residents and serve as a foundation for reviewing content relevant to examination and certification purposes. In this year, RT&MI residents are encouraged to tailor their rotation programs to areas that best suit their personal learning objectives and career directions. This flexibility is implemented by offering two months of elective rotations in advanced imaging or a chosen subspecialty.

These rotations consolidate technical and clinical skills in a single modality of medical imaging. They permit graded responsibilities and independent scanning under staff supervision. During these months, senior RT&MI residents aim to perform the responsibilities and carry the workload of junior staff technologists. A review of the core materials for exam preparation through on-the-job exposure to important aspects of imaging modalities is emphasized.

The fourth year begins with exposure to advanced imaging during rotation. RT&MI residents are expected to familiarize themselves with advanced physics and the technical aspects of the chosen imaging modality, including imaging protocols, indications, contraindications, patient preparation, and image interpretation.

The rotation design for the fourth year includes ten-month rotations in one of the modalities chosen by the RT&MI residents in R3. The year offers two months of elective subspecialty rotations that can be performed at any time with the approval of the program director.

The R4 RT & MI residents should supervise and teach junior residents and start conducting clinical–radiological meetings under staff supervision.

Minimum Training Requirements for SBRT&MI Residents

The SCFHS requires four years of training and completion of the allocated requirements to be eligible to participate in the SBRT&MI-NM examination, including:

- clinical rotations,
- research activities, and
- participation in teaching activities.

Furthermore, RT&MI residents should rotate between more than one training center during theirresidency.

Minimum Research Requirements for SBRT&MI Residents

During the second part of the program (third and fourth years), RT&MI residents will be trained as clinical researchers with in-depth knowledge of statistical and analytical skills regarding population-based clinical studies or research outcomes. The guiding principle of clinical research education is to teach RT&MI residents to perform clinical research projects while under mentorship.

RT&MI residents need to have a research mentor, who will be selected by RT&MI resident but must be approved by the director of the SBRT&MI program. Furthermore, RT&MI residents will have to submit a written research proposal, which will be reviewed by the committee of the SBRT&MI

program.

The residents are expected to complete **one** of the following research activities during their educational programs:

- submit a case report for presentation at a local or international specialty conferences;
- write a review paper as first author; and
- conduct an original research project.

It is expected that the results will be presented as an abstract at a scientific meeting and subsequently published in a peer-reviewed journal.

RT & MI residents will have achieved most of the knowledge-based research objectives by the end of the fourth year.

SPECIFIC LEARNING OBJECTIVES AND COMPETENCIES

1. Radiology Technology & Medical Imaging Expert:

Definition:

As Radiology Technology & Medical Imaging experts, RT&MI residents assume all CanMEDS roles, applying RT&MI knowledge, clinical skills, and professional attitudes to provide patient-centered care. Being an RT&MI expert is the central role of technologists educated in the CanMEDS framework.

Elements:

- integrate and apply all CanMEDS roles for patient care;
- recognize basic and advanced radiological anatomy;
- understand the basic and advanced physical principles behind radiological techniques;
- understand basic and advanced imaging techniques and technical problem-solving approaches;
- learn the indications and absolute and relative contraindications for various contrast media;
- recognize the appropriate indications and contraindications of various radiological techniques;
- recognize and manage radiological emergency procedures and common pathologies;
- list the most important differential diagnoses for various imaging findings;
- recognize unusual imaging presentations of common pathologies;
- understand post-processing, image manipulation, and protocol optimization;

- understand rules of health informatics in radiology and optimal PACS utilization;
- apply ethical principles for patient care; and
- respect principles of patient safety and avoid adverse events.

Key and Enabling Competencies:

RT&MI residents are able to:

1. Function effectively as RT&MI residents and assume the following CanMEDS roles to provide optimal, ethical, and patient-centered medical care:
    - effectively perform radiological procedures and case discussions, including assessments, diagnoses, and recommendations in written and/or verbal form;
    - demonstrate effective use of all CanMEDS competencies relevant in RT&MI;
    - identify and respond appropriately to relevant ethical issues arising in patient care;
    - prioritize professional duties appropriately and effectively when facing multiple patients and problems; and
    - demonstrate compassionate patient-centered care.

2. Establish and maintain clinical and technical radiological knowledge, skills, and attitudes appropriate for RT&MI:
    - apply knowledge of clinical, socio-behavioral, and fundamental biomedical sciences relevant to RT&MI specialties, including:
        - the characteristics of all RT&MI types including, but not limited to, physical and technical aspects, patient positioning, and the use of contrast media;
        - the theoretical, practical, and legal aspects of radiation safety including, but not limited to, alternative imaging techniques and their possible harmful side-effects;
        - human anatomy at all ages, both conventional and multiplanar, with an emphasis on imaging applications;
        - all aspects of RT&MI including, but not limited to, normal anatomical variants and disease processes, factors affecting the interpretation of imaging and differential diagnoses, correlation of imaging with pathology, and complications

including, but not limited to, contrast media reactions. This entails the appropriate application of general radiography, fluoroscopy, US, CT, MRI, NM, other imaging modalities, and interventional procedures relevant to imaging of the following regions:

- Abdominal/pelvic area
- Gastrointestinal (GI) system
- Hepato–pancreatico–biliary system
- Renal and urinary tract
- Male reproductive system
- Spleen, lymphatic system, and bone marrow
- Retroperitoneum
- Chest (cardiac imaging)
- Air spaces
- Airways
- Interstitium

- Mediastinum including, but not limited to, great vessels and esophagus
- Pleura
- Heart and pericardium
- Chest wall
- Head and neck
- Nose, sinuses, and facial bones
- Orbits
- Temporal bone, cerebellopontine angle, and skull base
- Larynx, hypopharynx, and trachea
- Oral cavity and pharyngeal mucosal space
- Submandibular space
- Carotid space
- Masticator space
- Retropharyngeal space (RPS) and prevertebral space
- Parotid gland, thyroid gland, and esophagus
- Dental and maxillofacial region
- Brain
- Pituitary and parasellar region
- Skull
- Spinal cord and related structures including, but not limited to, peripheral nerves
- Cranial nerves
- Intracranial and extracranial cerebral vessels
- Musculoskeletal imaging
- Shoulder, clavicle, and upper arm
- Elbow and forearm
- Hand and wrist
- Pelvis, hip, and thigh
- Knee and leg
- Ankle and foot
- Spine
- Bone
- Development
- Marrow

- Peripheral nerves
- Breast
- Malignant diseases
- Benign diseases
- Gynecological imaging
- Ovaries
- Non-ovarian adnexa
- Non-pregnant uterus and cervix
- Endometrium
- Vagina and labia
- Obstetrical imaging
- Uterus, placenta, cord, and adnexa
- Fetus
- Pediatric area
- Head, neck, and spine
- Chest/cardiac system
- Musculoskeletal system
- Abdomen and pelvis
- Vascular and interventional radiology
- Lymphatic system
- Cardiac system
- Arterial and venous vascular systems
- Abdominal area
- Chest and neck
- Peripheral area
- Interventional procedures
- Upper and lower urinary system
- GI system
- Hepatobiliary system
- Respiratory system
- Musculoskeletal system.

Residents are also expected to:

- describe the CanMEDS framework for competencies relevant in the RT&MI specialties;

- obtain lifelong relevant learning skills, implement a personal program to remain abreast of current issues, and enhance areas of professional competency; and
- contribute to the enhancement of quality care and patient safety by integrating the best practices available in RT & MI.

3. Perform complete and appropriate assessment of patients necessary before, during, and after radiological procedures to:
    - effectively identify and explore issues requiring attention by including patient preferences and the context of their complaints;
    - perform a focused physical examinations for to ensure safety, prevention, diagnosis, and/or management;

- select medically appropriate radiological procedures in a resource-effective and ethical manner to ensure medical examinations with minimal exposure to contrast agents and radiation. This is particularly important for pregnant and pediatric patients, those of childbearing age, and medically compromised patients; and
- demonstrate effective clinical and technical problem-solving skills and judgment.

4. Use radiological diagnostic procedures effectively to:
   - implement effective radiological diagnostic procedures in collaboration with patients and their families;
   - demonstrate effective, appropriate, and timely application of radiological diagnostic procedures relevant in RT&MI practice;
   - demonstrate knowledge of acceptable and expected results of investigations and/or interventions, as well as unacceptable and unexpected results, including the knowledge of and ability to manage radiological imaging-related complications;
   - ensure that appropriate informed consent is obtained for radiological imaging procedures; and
   - ensure that patients receive appropriate end-of-life care.
5. Demonstrate proficient and appropriate use of radiological-imaging-procedure skills to:
   - demonstrate effective, appropriate, and timely performance of relevant radiological imaging procedures;
   - ensure that appropriate informed consent is obtained for procedures; and
   - demonstrate appropriate documentation and dissemination of information related to the performed procedures and their outcomes.

6. Seek appropriate consultations from other health professionals and recognize the limitations of their expertise by:
    - demonstrating insight into the limitations of one's own expertise via self-assessment and
    - seeking and including the knowledge of another health professional, if required, for an effective, appropriate, and timely consultations to achieve optimal patient care.

2. Communicator:

Definition:

As communicators, RT&MI residents can form appropriate relationships with patients and their families to facilitate the gathering and sharing of essential information for conducting effective radiological imaging.

Elements:

- patient-centered approach to communication;
- rapport, trust, and ethics;
- build satisfying relationships with patients, their families, and caregivers;
- shared decision-making;
- mutual understanding;
- elicit and synthesize information for patient care;
- convey effective oral and written information for patient care; and
- use of verbal and non-verbal professional communication.

Key and Enabling Competencies:

RT&MI residents are able to:

1. Develop professional relationships with patients and their families to:
    - recognize that being a good communicator is a core clinical skill for RT&MI residents, communicate effectively to foster patient satisfaction, adhere to treatment plans, and improve clinical outcomes;
    - establish positive relationships characterized by understanding, trust, respect, honesty, and empathy with patients and their families;
    - respect patient confidentiality, privacy, and autonomy; and
    - be aware of and responsive to non-verbal cues.
2. Accurately obtain and synthesize relevant information and perspectives of patients, their families, colleagues, and other professionals by:
    - seeking and synthesizing relevant information from other sources such as the families of patients, caregivers, and other professionals.
3. Accurately convey relevant information and explanations to patients, their families, colleagues, and other professionals by:
    - delivering information to patients, their families, colleagues, and other professionals in a humane and understandable manner that encourages discussion and participation in the decision-making process.
4. Develop a common understanding of issues, problems, and plans with patients, their families, colleagues, and other professionals to develop shared care plans to:
    - effectively identify and explore problems that require attention, including the context of the patient's complaint and their responses, concerns, and preferences during medical imaging procedures;
    - encourage questions, discussions, and interaction during medical imaging procedures;
    - include patients, their families, include relevant healthcare professionals in the decision-making process; and
    - effectively address challenging communication issues, such as obtaining informed consent and addressing anger, confusion, and misunderstandings.
5. Effectively convey oral and written information regarding medical imaging procedures:

- maintain clear, accurate, and appropriate records (e.g., written or electronic) of medical imaging procedures
- effectively present the findings of medical imaging procedures in verbal or written reports; and
- develop oral skills for individual consultations, case presentations, radiology conferences, and scholarly work.

3. Collaborator:

Definition:

As collaborators, RT&MI residents work within a healthcare team to provide optimal patient care.

Elements:

- collaborative care, culture, and environment;
- shared decision-making;
- shared knowledge and information;
- delegation;
- effective teams;
- respect for other RT&MI residents and members of healthcare teams;
- leadership based on patient needs;
- constructive negotiation;
- organizational structures that facilitate collaborations;
- understand roles and responsibilities;
- recognize his or her own roles and limits; and
- effective collaborations between primary care providers and specialists.

Key and Enabling Competencies:

RT&MI residents are able to:

1. Interact effectively and appropriately with other healthcare teams to:
    - clearly describe their roles and responsibilities to other professionals;
    - describe the roles and responsibilities of other professionals within the imaging team;
    - recognize and respect the diversity of roles, responsibilities, and competencies of other professionals in relation to their own;

- work with others to assess, plan, provide and integrate care for individual patients (orpatient groups);
- work with others to assess, plan, provide, and review other tasks such as research problems, educational work, program reviews, or administrative responsibilities;
- effectively participate in meetings/settings of other teams;
- provide quality care;
- describe the principles of team dynamics;
- respect team ethics including confidentiality, resource allocation, and professionalism; and
- when appropriate, demonstrate leadership in imaging teams.

2. Work effectively with other health professionals to prevent, negotiate, and resolve conflicts to:
   - demonstrate a respectful attitude toward other colleagues and members;
   - work with other professionals to prevent conflicts;
   - conduct collaborative negotiations to resolve conflicts;
   - respect differences, misunderstandings, and limitations regarding other professionals;
   - recognize personal differences, misunderstandings, and limitations; and
   - reflect on interprofessional team functions.

4. Manager:

Definition:

As managers, RT&MI residents engage with others to contribute to the vision of a high quality RT&MI healthcare system and take responsibility for delivering excellent patient care through their activities as clinicians, administrators, scholars, and teachers.

Elements:

RT&MI residents are active participants in the RT&MI healthcare system who engage in the following:

- collaborative decision-making;
- quality assurance and improvement;

- organize, structure, and finance the RT&MI healthcare system;
- manage changes;
- leadership;
- Supervising others;
- administration;
- consideration of justice, efficiency, and effectiveness in the allocation of finite RT&MI healthcare resources for optimal patient care;
- budgeting and finances;
- priority setting;
- practice management;
- human resources for RT&MI health;
- time management;
- negotiations;
- career development;
- use information technology for RT&MI healthcare; and
- effectively in meetings and committees.

Key and Enabling Competencies:

RT&MI residents are able to:

1. Participate in activities that contribute to the effectiveness of RT&MI healthcare organizations and systems by:
    - working collaboratively with other people from different organizations;
    - participating in systematic quality process evaluations and improvements such as those involving patient safety initiatives;
    - describing the structure and functions of the healthcare system regarding specialties, including the roles of RT&MI residents and technologists;
    - describing the principles of healthcare finances, including the remuneration of technologists, budgeting, and organizational funding.
2. Manage resident practice and careers effectively by:
    - establishing priorities and manage their time wisely to balance patient care, practice requirements, outside activities, and personal life;
    - managing finances and human resources;

- implementing processes to ensure personal practice improvement; and
- employing information technology appropriately for patient care.

3. Allocate finite RT&MI healthcare resources appropriately by:
   - recognize the importance of allocation of healthcare resources, balanced effectiveness, efficiency, and access to optimal patient care;
   - apply evidence and management processes to provide cost-appropriate care.
4. Appropriately serve in administration and leadership roles to:
   - effectively chair or participate in committees and meetings;
   - lead or implement changes in the RT&MI healthcare system; and
   - plan the relevant elements of RT&MI healthcare delivery (e.g., work schedules).

5. Health Advocate:

Definition:

As health advocates, RT&MI residents contribute their expertise to improve RT&MI health through their work within communities or patient populations. They work with those they serve to determine and understand needs, speak on behalf of others when required, and support the mobilization of resources for effective change.

Elements:

- support for individual patients, populations, and communities;
- role of RT&MI professionals in society;
- responsible use of authority and influence;
- Mobilization of resources according to demand;
- adapt practice, management, and education to the needs of individual patients;
- provide a safe environment for patients and staff members;
- minimize risks for patients undergoing radiological studies;
- apply as-low-as-reasonably achievable (ALARA) principles and the implications for RT&MI health policy; and
- interactions with other CanMEDS professionals and competencies in advocacy.

Key and Enabling Competencies:

RT&MI residents are able to:

1. Respond to individual RT&MI healthcare needs and issues of a patient by:
   - identifying the RT&MI healthcare needs of individual patients;
   - identifying opportunities for advocacy, RT&MI health promotion, and disease prevention for individuals to whom care is provided; and
   - incorporating disease prevention, health promotion, and surveillance of RT&MI health in interactions with individual patients.
2. Respond to RT&MI healthcare needs of the communities they serve by:
   - describing the practice to communities;
   - identifying opportunities for advocacy, RT&MI health promotion, and disease prevention in communities and respond appropriately; and
   - appreciating the possibility of competing interests between different communities and populations.
3. Promote the RT&MI health of individual patients, communities, and populations by:
   - describing approaches for the implementation of changes in determinants of RT&MI health in populations;
   - describing how public policy affects the RT&MI health of the specified populations;
   - identifying points of influence in the RT&MI healthcare system and its structure;
   - describing the ethical and professional issues inherent in RT&MI health advocacy;
   - appreciating the possible conflicts between RT&MI health advocates and managers or gatekeepers when serving patients or communities; and
   - realizing the role of an RT&MI professional by collectively advocating RT&MI health and patient safety.

6. Scholar:

Definition:

As scholars, RT&MI residents are expected to demonstrate a lifelong commitment to excellent practice through continuous learning, evidence

evaluation, teaching others, and making scholarship contributions.

Elements:

- engage in continuous enhancement of professional activities through lifelong learning;
- reflection on all aspects of RT&MI practice;
- self-assessment;
- Identification of gaps in RT&MI knowledge;
- access information for RT&MI practice;
- Translation of knowledge into professional competencies;
- enhance professional competencies;
- use a variety of learning methods;
- assess learners;
- provide feedback;
- mentoring;
- Maintenance of teacher–student ethics, carefully resolution of power issues, and maintenance of confidentiality and appropriate boundaries;
- conducting research and scientific inquiries; and
- Coping with research ethics, disclosures, conflicts of interest, human subjects, and industry relations.

Key and Enabling Competencies:

RT&MI residents are able to:

1. Maintain and enhance professional activities via lifelong learning to:
    - know principles of competency maintenance;
    - know principles and strategies for implementing a personal RT&MI knowledge management system;
    - recognize and reflect on learning issues in RT&MI practice;
    - conduct personal RT&MI practice audits;
    - pose appropriate learning questions;
    - integrate new RT&MI learning techniques into practice;
    - evaluate impact of changes on RT&MI practice; and
    - document the learning process.
2. Critically evaluate RT&MI information and its sources and apply it to practice decisions appropriately:

- describe the principles of critical appraisal;
- critically appraise retrieved evidence in order to address clinical questions; and
- integrate critical appraisal conclusions into clinical care.

3. Appropriately facilitate learning for patients, their families, students, residents, other health professionals, the public, and others by:
   - knowing the learning principles relevant in the RT & MI education program;
   - collaboratively identifying the learning needs and desired learning outcomes of others;
   - selecting effective teaching strategies and content to collectively facilitate the learning process;
   - giving effective lectures and presentations;
   - assessing and reflecting on teaching encounters;
   - providing effective feedback; and
   - describing the principles of ethics with respect to teaching.
4. Contribute to the development, dissemination, and translation of new RT&MI knowledge and practices to:
   - describe the principles of research and scholarly inquiries;
   - describe the principles of research ethics;
   - pose scholarly questions;
   - conduct systematic research for evidence; and
   - select and apply appropriate methods for addressing questions.

Professional

Definition:

As professionals, RT&MI residents are committed to the RT&MI health and well-being of individuals and society through ethical practices, profession-led regulations, and high personal standards regarding their behavior.

Elements:

- humanity;
- integrity and honesty;
- compassion and caring;
- ethics and codes of behavior;

- responsibilities to society;
- responsibilities to the profession;
- responsibilities to oneself;
- commitment to excellent RT&MI practice and proficiency in the discipline;
- commitment to the promotion of public goods in RT&MI healthcare;
- accountability to professional regulatory bodies;
- commitment to professional standards;
- bioethical principles and theories;
- self-awareness;
- sustainable practice and RT&MI healthcare;
- self-assessment; and
- disclosure of errors and adverse events.

Key and Enabling Competencies:

RT&MI residents are able to:

1. Demonstrate commitment to patients by applying best practice and adhering to high ethical standards to:
   - exhibit appropriate professional behavior by including honesty, integrity, commitment, compassion, respect, and humanity in RT&MI practice;
   - demonstrate commitment to deliver the highest quality of care and maintain competence;
   - recognize and respond appropriately to ethical issues encountered in RT&MI practice;
   - manage conflicts of interest appropriately;
   - recognize the principles and limits of patient confidentiality; and
   - maintain appropriate relationships with patients.
2. Demonstrate a commitment to society by recognizing and responding to societal expectations regarding RT&MI healthcare by:
   - demonstrating a commitment to patients, society, and the profession by responding to societal expectations regarding RT&MI; and
   - demonstrating a commitment to patient safety and quality improvement.
3. Demonstrate a commitment to RT&MI health and sustainable practice to:

- balance personal and professional priorities to ensure personal health and a sustainable practice;
- strive to heighten personal and professional awareness and insights; and
- recognize professionals in need and respond appropriately.

TEACHING AND LEARNING ACTIVITIES

RT&MI residents will gain the competencies described in the curriculum through a variety of learning methods. The program comprises training to acquire cognitive and technical skills and understand how they relate to physics, applied anatomy, pathology, and the physiology of health and disease. Moreover, the training involves practical procedures and interpretation methods taught in a sequential and integrated manner through lectures, tutorials, seminars, and apprenticeships that provide hands-on experience.

1. Formal Teaching and Learning Activities:
   - *core specialty topics (70%),*
   - *universal topics (10%),*
   - *topics selected by RT&MI resident (20%).*
2. Practice-Based Learning (PBL):
   - *journal club,*
   - *discussion (logbook),*
   - *guest speakers on core specialty topics,*
   - *weekly academic half-day, and*
   - *tutorials.*
3. Work-Based Learning (WBL):
   - *on-call-based learning,*
   - *clinic-based learning, and*
   - *courses and workshops.*
4. Self-Directed Learning

1) Formal Teaching and Learning Activities:

Core Specialty Topics (70%)

General Skills Needed for All Specialties:

- patient positioning;
- awareness of sterile concept;
- radiation protection;

- understanding of quality control (QC), radiology information systems (RIS), and PACS
- human anatomy and physiology;
- patient safety and care;
- radiological pathology;
- basic Life support; and
- basic knowledge of medical physics (X-ray, CT, MRI, NU, and US).

GENERAL X-RAY SECTION

Training Rotation

The training rotation content will be comprehensive, as RT&MI residents will be exposed to all areas of general X-ray imaging in the first part of the program (R1).

Objective:

provide RT&MI residents with the capability to perform X-ray scans.

Acquired Skills:

- perform imaging-related non-interventional procedures;
- perform post-processing procedures and image analysis;
- practice skills related to basic imaging informatics;
- produce high-quality diagnostic radiographs without supervision at the end of rotation; and
- improve image quality and respond appropriately to critique.

Rotation Duration:

- Six months minimum;
- This can be extended if the RT&MI resident does not meet the minimum requirements after the initial period.

Training Rotation Plan:

Six months of rotation (see competency list for clinical rotations regarding general X-ray in Appendix 5):

- enter patient data;
- explain procedure before examination;
- correlate patient to requisition;
- stock and leave rooms clean and tidy;
- practice proper infection control techniques;

- acquire a basic understanding of universal precautions and isolation techniques;
- knowledge the location of all portable units in wards and surgical areas;
- practice proper radiation protection techniques for the patient and hospital staff;
- be able to prepare patients for examinations;
- be capable of obtaining allergic history from patients;
- understand how to enter patient exam information into computers;
- read requisitions and perform required tests;
- understand the effects of adjusting exposure factors on film;
- complete most examinations under direct supervision;
- have general knowledge of contrast materials used in the department;
- load and unload C-arm cassettes;
- perform portable chest X-rays on wards and ICUs under direct supervision;
- demonstrate proficiency while correlating patient requisitions;
- know locations and have a basic understanding of emergency drugs;
- knowledge of medical terminology;
- perform most examinations under indirect supervision, including fluoroscopic procedures and portable devices, with proper radiation protection;
- be aware of safe use of and care for equipment;
- correctly identify projection/views and anatomical parts on general radiographs;
- examine images with the ability to correctly adjust exposure factors; and
- complete the following examinations with indirect supervision (in accordance with the clinical rotation competency checklist provided for all examinations, adults, and pediatric patients).

CHEST & THORAX

Chest routine

Chest AP (wheelchair/stretcher) Chest–lateral decubitus

Ribs Sternum

Upper airway (soft-tissue neck)

UPPER EXTREMITY

Thumb or finger Hand

Wrist Scaphoid Forearm Elbow Humerus Shoulder

Trauma: shoulder (scapular Y or axillary view) Clavicle

Scapula AC joints

Trauma: upper extremity (non-shoulder)

LOWER EXTREMITY

Femur Knee

Trauma: knee Patella

Tibia–fibula

Ankle

Foot Forefoot Toe Calcaneus

ABDOMEN

Abdomen supine (KUB) Abdomen upright Abdomen decubitus

PELVIS

Pelvis Hip

Hip (cross-table lateral) Sacroiliac joint

SPINE

Cervical spine

Trauma: cervical spine (cross-table lateral) Oblique cervical spine

Cervical spine flexion/extension Thoracic spine

Scoliosis spine Lumbar spine

Sacrum and/or coccyx

HEAD

Skull

Paranasal sinuses Facial bones Orbits

Nasal bones Mandible

PEDIATRICS (age 6 years or younger)

Chest routine Upper extremity Lower extremity Abdomen Pelvis

Mobile study

SURGICAL C-ARM PROCEDURES

Orthopedic c-arm procedures Non-orthopedic c-arm procedures

GENERAL PATIENT CARE

Transfer of patients

Care for medical equipment of patients (oxygen tank, IV tubing)

INTERVENTIONAL RADIOLOGY AND FLUOROSCOPY

Training Rotation

The training rotation content will be comprehensive as RT&MI residents will be exposedto interventional radiology in a hands-on environment. In the first year (R1), the rotation segments cover the entire spectrum of interventional radiological examinations.

Objective:

- provide RT & MI residents with the capability to perform all procedures requested during angiography and fluoroscopy.

Acquired Skills:

- perform imaging-related angiography and fluoroscopy procedures and
- basic understanding of indications, techniques, and risks of fluoroscopy.

Program Duration:

- Six months minimum (four months of fluoroscopy; two months of angiography);
- This can be extended if the RT&MI resident does not meet the minimum requirements after the initial period.

Training Rotation Plan:

Six months of rotations (see competency list for clinical rotations regarding angiography and fluoroscopy in Appendix 6):

- knowledge department policies (e.g., working hours, uniform policy, sign-in and sign-out regulations);
- operate the angiography unit;
- be aware of different types of catheters and guide wires and different applications of both;
- correlate patient to requisition;
- prepare major parts of a procedure tray;
- knowledge of pre- and post-procedure care;
- recognize the differences between guidewires and their applications;
- proper handling of sterilized supplies;
- prepare and select catheters or special sets for different procedures;
- coordinate with nurses and physicians in different areas of the hospital for procedures;
- provide proper post-examination care and instructions to patients and nursing staff when necessary;
- work in special procedure areas and perform the entire range of examinations and procedures without supervision; and
- demonstrate the ability to complete the following examinations under indirect supervision (in accordance with the clinical rotation competency checklist provided for all examinations, adults, and pediatric patients).

FLUOROSCOPY PROCEDURES

Upper gastric imaging

Small bowel series/follow through

Air contrast examination of colon Arthrography

QUALITY CONTROL

Basic radiographic equipment Shielding devices

ADDITIONAL TASKS

Prepare contrast media Format/optimize images Ensure radiation safety

Maintain sterile/isolation precautions Insert enema tip

GENERAL PATIENT CARE

Transfer of patients

Care for medical equipment of patients (oxygen tank, IV tubing)

MAGNETIC RESONANCE IMAGING (MRI)

Training Program

Objective:

- provide RT&MI residents with the capability to master all MRI scans.

Acquired Skills:

- understand and master the physics and principles of magnetic resonance (MR);
- perform imaging-related MRI procedures; and
- understand indications, techniques, and risks of MRI.

Program Duration:

- three months of the first part of the program (second year, R2).

Training Rotation Plan

Three months for the first rotation (R2) (see competency list for clinical rotations regarding MRI in Appendix 7):

- orientation of the department;
- orientation of the physics of MRI;
- orientation of magnets including coils;
- orientation of basic departmental policies and procedures; and
- training in MR safety.

The training in patient care skills includes:

- communication with patients and explanation of examinations;
- MR screening sheets and questionnaires; and
- practice of proper patient transfer techniques to ensure proper body mechanics.

Residents should also:

- interpretation requests and understand their correlation to patients;
- observe and assist scanning technologists;
- be familiar with the Cross-sectional anatomy of the brain, neck, and spinal cord;
- understand basic MR physics;
- know the correct positioning of coils for routine examinations;
- conduct routine scanning under direct supervision (routine scans of the brain, cervical,thoracic, lumbar, and knees); and
- complete the following examinations under indirect supervision (in accordance with the clinical rotation competency checklist provided for all examinations, adults, and pediatric patients).

BODY PROCEDURES (ABDOMEN & PELVIS)

Routine liver scanRoutine MRCP scan

NEURO & ENT PROCEDURES

Routine brain scan (infants, children, and adults) Orbits/PNS

Routine (cervical, thoracic, and lumbar) spine scan

PEDIATRIC MSK PROCEDURES

Knee meniscus/trauma Routine shoulder scan Routine ankle scan Routine foot scan Routine elbow scan Routine wrist/hand scan

MSK PROCEDURES

Routine wrist/hand scan Routine shoulder scan Routine elbow scan Routine knee scan Routine ankle scan Routine foot scan

NUCLEAR MEDICINE (NM)/PET IMAGING

Training Program

Objectives:

- provide RT&MI residents with the capability to master all NM scans.

Acquired Skills:

- be familiar with Saudi Arabian regularity frameworks related to the practice of radionuclide radiology;
- be familiar with the NCCN guidelines for the regulation of PET/CT practice indications; and
- understand and master NM physics and principles.

Program Duration:

- three months of the first part of the program (second year, R2)

Training Rotation Plan:

Three months for the first rotation (R2) (see competency list for clinical rotations regarding NM in Appendix 8):

- manage radiation accidents related to radionuclide radiology;
- recognize different pharmaceuticals;
- conduct assessments for radiation dose from radiopharmaceuticals;
- understand general NM physics and principles;
- know the principles of quality assurance in radiopharmacy;
- understand the role of comparative imaging tests;
- comprehend radiation protection issues regarding tracer choice; and
- understand the role of PET/CT in the staging of malignancies.

The following examinations are completed under indirect supervision (in accordance with the clinical rotation competency checklist provided for all examinations, adults, and pediatric patients).

BONE SCAN

Metastasis Osteomyelitis

Stress fracture/shin splint

Prosthesis evaluation (osteomyelitis vs. loosing) AVN of bones

RENAL SCAN

Obstruction/function (MAG 3) Transplanted kidney (MAG 3) DMSA scan of the cortical scar

DMSA scan of pyelonephritis

DMSA scan of absolute split renal function Testicular imaging with flow

ENDOCRINE IMAGING

MIBI scan of parathyroid adenoma

Thyroid uptake scan (I-123)

Thyroid nodule evaluation (I-123)

WBS of thyroid carcinoma (I-123)

Thyroid scan with ^{99m}TcO4

Adrenal imagining of cortex/medulla

Two years for the second rotation (R3 & R4) (see competency list for clinical rotations regarding NM in Appendix 9):

- knowledge of advanced NM physics and principles;
- knowledge of principles of single-photon emission tomography (SPECT),
- proficiency in all routines and advanced procedures;
- knowledge of computer data analysis;
- knowledge of radiation protection;
- assessment of imaging procedures;
- departmental management;
- work as independent technologist; and
- work without supervision;

The following examinations are completed under indirect supervision (in accordance with the clinical rotation competency checklist provided for all examinations, adults, and pediatric patients).

BONE SCAN

Metastasis Osteomyelitis

Stress fracture/shin splint

Prosthesis evaluation (osteomyelitis vs. loosing) AVN of bones

RENAL SCAN

Obstruction/function (MAG 3) Transplanted kidney (MAG 3) DMSA scan of the cortical scar DMSA scan of pyelonephritis

DMSA scan of absolute split renal function Testicular imaging with flow

ENDOCRINE IMAGING

MIBI scan of parathyroid adenoma Thyroid uptake scan (I-123) Thyroid nodule evaluation (I-123) WBS of thyroid carcinoma (I-123)

Thyroid scan with ^{99m}TcO4

Adrenal imagining of cortex/medulla

HEPATOBILIARY SCINTIGRAPHY

HIDA scan of gallbladder ejection fraction HIDA scan of acute cholecystitis

HIDA scan of biliary atresia RBC study of liver hemangioma Liver and spleen imaging

INFECTION IMAGING

WBC labeled (whole body)

FDG PET/CT (whole body)

Gallium-67 scan

PULMONARY IMAGING

Lung V/Q scan

Quantitative differential study

THERAPEUTIC PROCEDURES

Therapy for Graves' disease (I-131), thyroid carcinoma (I-131), and MIBG (I-131)

Zevalin therapy for NHL Y-90 joint injection

Lu-177 DOTATOC therapy for NET Y-90 microspheres for HCC

ONCOLOGY IMAGING

PET/CT (FDG) for:

distinguishing benign from malignant diseases; assessing the stage of a disease; and

assessing whether there is a recurrent or residual disease, determining the site of the disease when tumor markers are rising and establishing response to therapy.

Identifying the primary site of biopsy in a large tumor: PET/CT ^{68}Ga-DOTATOC scan for NET tumors.

PET/CT ^{68}Ga-PSMA scan for prostate cancer: MIBG scan (I-123).

BRAIN IMAGING

PET/CT for:

determining whether diseases are benign or malignant;

search for dementia causes;

search for epileptic foci (interictal); CSF flow imaging;

CSF shunt evaluation; CSF leakage detection; vascular flow; and

Single-Photon Emission CT (SPECT).

GI IMAGING

Gastroesophageal reflux study/milk scan for children Meckel's scan

Gastric emptying study Acute GI bleeding

GI protein loss

Salivary gland function study Urea breath test (C-14)

CARDIAC IMAGING

Myocardial perfusion scintigraphy (stress/rest) Myocardial viability scan

Multigated acquisition (MUGA) Cardiac shunt detection Myocardial viability with FDG PET

COMPUTER TOMOGRAPHY (CT)

Training Program

Objective:

- provide RT&MI residents with the capability to master all CT scans.

Acquired Skills:

- understand and master CT physics and principles;
- perform imaging-related CT procedures; and
- know the indications, techniques, and risks of CTs.

Program Duration:

- Three months of the first part of the program (second year, R2).

Training Rotation Plan

Three months for the first rotation (R2) (see competency list for clinical rotations regarding CT in Appendix 10):

- know patient preparation for CT examinations;
- safely move the patient from chair and trolley to the CT table;
- explain the examination to the patient;
- ensure the safety of the patient and attached equipment (e.g., IV line, oxygen, and monitors);
- know contrast media used in the department and recording contrast reactions;
- know contrast media (IV and oral) volumes to be used for different CT examinations (adult and pediatric patients);
- operate IV contrast injectors;
- know proper infection control techniques;
- know radiation protection for patients and staff;
- position patients properly for different studies;

- operate machines independently and perform daily warm-ups and calibrations;
- perform all requested CT examinations as ordered by the attending physician or supervisor;
- address CT machine faults and report them to the biomedical engineer;
- coordinate with other staff members to ensure appropriate patient care is provided; and
- know basic cross-sectional abdominal, chest, head, and neck anatomy.

The following examinations were completed under indirect supervision (in accordance with the clinical rotation competency checklist provided for all examinations, adults, and pediatric patients).

ABDOMEN PROCEDURES

Anatomy CAP protocol

Abdomen–pelvis protocol Renal stones protocol

NEURO & ENT PROCEDURES

Anatomy

Brain (adult) exam Brain (pediatric) exam Sinuses

Head and neck Cervical spine Thoracic spine Lumbar spine

THORAX

Anatomy

Routine chest scan without IV contrast media Routine chest scan with IV contrast media

ULTRASOUND (US)

Training Program

Objective:

- Provide RT&MI residents with the ability to master all US scans.

Acquired Skills:

- Have a basic understanding of US artifacts;
- Understand and master US physics and principles;
- Perform imaging-related US procedures; and
- Know indications, techniques, and risks of US.

Program Duration:

- Three months for the first part of the program (second year, R2)

Training Rotation Plan

Three months for the first rotation (R2) (see competency list for the clinical rotations regarding US in Appendix 11):

- explain procedure to patient;
- knowledge of basic scanning technique for the abdomen;
- optimize imaging resolution and document images;
- deal with patients on beds and emergency cases;
- prioritize different US requests;
- correlate clinical data with scanning techniques;
- interpret US findings;
- recognize and document normal and abnormal findings;
- write report on scan findings; and
- analyze clinical data of patients.

The following examinations were completed under indirect supervision (in accordance with the clinical rotation competency checklist provided for all examinations, adults, and pediatric patients).

ABDOMEN PROCEDURES

Upper GI tract Liver/biliary tract Pancreas/spleen Renal/urinary system

SMALL PARTS PROCEDURES

Abdominal wall Thyroid

Universal Topics (10%)

These are high-value interdisciplinary topics of utmost importance to trainees. The reason for teaching these topics centrally is to ensure that every trainee receives high-quality teaching and develops essential core knowledge. These topics are common across all specialties.

The included topics meet one or more of the following criteria:

- impactful: topics that are common or life-threatening;
- interdisciplinary: topics that are difficult to teach within a single discipline;
- orphan: topics that are poorly represented in the undergraduate curriculum; and
- practical: topics that trainees will encounter during hospital practice.

Development and Delivery:

The core topic content for the postgraduate curriculum will be developed and delivered centrally by the commission through an e-learning platform. A set of preliminary learning outcomes will be developed for each topic. In collaboration with the central team, content experts can modify the learning outcomes.

These topics will be didactic with a focus on the practical aspects of patient care, comprising more content than workshops or other interactive face-to-face sessions. The suggested duration of each topic is 90 min.

The topic content will be delivered in a modular manner. A formative online assessment will be conducted at the end of each learning session. Furthermore, a combined summative assessment in the form of a context-rich MCQ will be performed after completion of all topics. All trainees must attain at least a specified minimum level during the summative assessment. Alternatively, topics can be completed in a summative manner along with a specialty examination.

1) Hospital-Acquired Infections (HAI):

At the end of the learning unit, RT&MI residents should be able to:

a) discuss the epidemiology of HAIs with special reference to Saudi Arabia;
b) recognize HAIs as one of the major emerging threats in healthcare;
c) identify the common sources HAIs;
d) describe the risk factors for common HAIs, such as ventilator-associated pneumonia, MRSA, central line-associated bloodstream infection.

CLABSI, and vancomycin-resistant enterococcus (VRE);

a) identify the role of healthcare workers in the prevention of HAIs;
b) determine appropriate pharmacological (e.g., selected antibiotics) and non-pharmacological (e.g., removal of indwelling catheters) measures for the treatment of HAIs; and
c) propose a plan to prevent HAIs in workplaces.

2) Abnormal ECG:

At the end of the learning unit, RT&MI residents should be able to:

a) recognize common and important ECG abnormalities and
b) provide immediate management, if necessary.

3) Care for the Older Individuals:

At the end of the learning unit, RT&MI residents should be able to:

a) describe the factors that need to be considered when planning patient care for older individuals;
b) recognize and include the needs and well-being of caregivers;
c) identify the local and community resources available for the care of the

elderly; and

d) develop an individualized care plan for older adult patients by including ideas from other healthcare professionals.

4) Occupational Hazards of Healthcare Workers (HCWs):

At the end of the learning unit, RT&MI residents should be able to:

a) recognize common sources and risk factors of occupational hazards among HCWs;
b) describe common occupational hazards in workplaces;
c) develop familiarity with legal and regulatory frameworks governing occupational hazards for HCWs;
d) develop a proactive attitude to promote workplace safety; and
e) protect themselves and colleagues against potential occupational hazards in workplaces.

5) Patient Advocacy:

At the end of the learning unit, RT&MI residents should be able to:

a) define patient advocacy;
b) recognize patient advocacy as a core value governing medical practice;
c) describe the role of patient advocates in patient care;
d) develop a positive attitude toward patient advocacy;
e) be a patient advocate in conflicting situations; and
f) be familiar with local and national patient advocacy groups.

6) Ethical Issues: Treatment Refusal, Patient Autonomy:

At the end of the learning unit, RT&MI residents should be able to:

a) predict situations in which a patient or family member is likely to decline prescribed treatment;
b) describe the concept of a rational adult in the context of patient autonomy and treatment refusal;
c) analyze key ethical, moral, and regulatory dilemmas regarding treatment refusal;
d) recognize the importance of patient autonomy in the decision-making process; and
e) counsel patients and families declining medical treatment in the best interests of patients.

By RT&MI Residents Selected Topics (20%)

1. RT&MI residents from each specialty can choose any topic that fits their

needs

2. All topics must be planned and cannot be random
3. All topics need to be approved by the local education committee
4. Institutions can also work with RT&MI residents to determine the topics.

7) Practice-Based Learning (PBL)

The activities listed below prepare and encourage RT&MI residents to independently conduct RT&MI practices and health service research.

Practice-Based Learning	Objectives	CanMEDS Competencies
Journal club	• Journal articles are pre-selected, and the activity is prepared and discussed by residents under supervision to: ○ Promote continuing professional development; ○ Stay up-to-date with recent literature; and ○ Learn and practice critical appraisal skills.	Radiology Technology & Medical Imagingexpert Scholar Health Advocate
Tutorials	• Tutorials provide a foundation for high-quality knowledge regarding radiological interpretations; • Discussion and review of imaging appearances and approaches for the diagnosis of various radiological conditions; and • Develop confidence in handling clinical discussions.	Manager Radiology Technology & Medical Imaging expert Professional Scholar
Discussion (case logbook)	• List all problems identified in RT&MI examinations; • Develop a proper solution for each problem; and • Present a follow-up of the problem.	Manager Radiology Technology & Medical Imaging expert Professional Scholar
Guest speaker Joint specialty meeting	• Increase medical-imaging and resident knowledge and skills, and improve patient care; • Understand and apply current practice guidelines in medical imaging; • Describe the latest advances in the field of medical imaging and research; and • Identify and explain areas of arguments in the field of medical imaging.	Radiology Technology & Medical Imaging expert Professional
Academic half-day	• Provide the knowledge, technical skills, and experience necessary for residents to interpret and correlate clinical findings; • Promote effective communication and sharing of expertise with peers and colleagues; • Promote the development of investigative and technical skill processes for individual patients and patient populations; and	Radiology Technology & Medical Imaging expert Scholar Health Advocate Professional

Practice-Based Learning	Objectives	CanMEDS Competencies
	• Advise colleagues from their and other specialties with regard to problems related to medical imaging.	

WORK-BASED LEARNING (WBL)

Work-Based learning	Objectives	CanMEDs
On-call-based learning	• Perform the basic procedures necessary for imaging and management; • Appropriately perform required radiological examinations; • Recognize imaging techniques and initial findings; and • Perform basic post-processing proceduresand image analyses.	Radiology Technology & Medical Imaging expert Scholar Health Advocate Professional
Clinic-based learning	• Obtain patient histories and conductphysical examinations; • Present briefly the initial findings or notes to attending radiologists; • Discuss differential and management plans with colleagues; • Discuss the need for special procedures with attending radiologists; and • Supervise resident notes and orders; interpret and discuss report results with attending radiologists.	Radiology Technology & Medical Imaging expert Communicator Health Advocate

Courses

Several courses will be organized for RT&MI residents to augment their training in various important areas.

Radiological Physics Course

Goals:

- gain professional competence in radiation and applied physics and their clinical applications in RT&MI;

- knowledge of various fundamentals of imaging modalities and their concept variations;
- knowledge of basic imaging-related mathematics, calculations, and dosimetry applications;
- clearly understand radiation principles to properly deal with radiation hazards and implement radiation protection measures according to international guidelines and recommendations;
- differentiate between modality-specific imaging chains and associated technology;
- recognize technical parameters that can affect image quality and radiation dose;
- knowledge of principles and practice of digital image processing techniques;
- recognize modality-specific image artifacts;
- be up-to-date on the impact of emerging technologies on current practices;
- knowledge of salient aspects of radiobiology and safe practice of radiation protection principles.

Training Methods:

An annual four-week course in imaging-related physics that must be attended by all RT&MI residents. The required curriculum is listed below in the course content list:

- discussion with radiology staff during case readout and tutorial sessions on applied physical principles that influence image quality and patient and staff safety.
- training centers optionally provide additional lectures or activities to their residents.

Evaluation:

The attendance rate for the four-week physics course will be incorporated into the overall performance evaluation score, including:

- incorporation of radiological knowledge, skills, and safety aspects in rotation evaluations and
- annual promotion exams.

Course Content

Radiation Physics—PART ONE (R1)

- Diagnostic Radiology
  - Conventional and digital X-ray imaging
  - Introduction to X-ray production
  - Particulate radiation
  - Interactions of particulate radiation with matter
  - Characteristic X-rays
  - Brems radiation
- X-Ray Generators
  - Transformers and production of high voltages
  - Control of tube voltage, tube current, and exposure time
  - Conventional single- and three-phase X-ray generators
  - High-frequency X-ray generators
- X-Ray Tubes and Source Assemblies
  - Modern diagnostic X-ray tubes
  - Line focus principle
  - Heel effect
  - Heat units and rating charts
- X-Ray Beam: Radiation Quantities and Units
  - Beam intensity and exposure
  - Absorbed dose and kerma
  - Exposure, energy fluence, photon fluence, and absorbed dose
  - Measurement techniques and ionization chamber
- X-Ray Beam: Geometrical Properties
  - Principles of shadow formation
  - Inverse-square law
  - Magnification and distortion collimator design and off-focus radiation
- X-Ray Beam: X-Ray Spectrum
  - X-ray spectrum
  - Duane–Hunt law
- Effects of kV, mA, and Filtration
  - Intensity of characteristic and Brems radiation

- Interaction of X-Rays with Matter: Concepts
  - Photon attenuation
  - Scattering
  - Absorption
- Interaction of X-Rays with Matter: The Patient
  - Incident and transmitted X-ray spectra
  - Effects of kVp on Compton scattering and absorption
- Effects of kVp, mA, and Filtration on Transmitted Spectra
  - Absorption edges and contrast media
- X-Ray Image: Basics
  - Subject contrast
  - Effects of scattering on subject contrast
- Scatter Control
- X-Ray Image: Digital Radiographic Systems
  - Basics
  - Digitizers (digitizing an analog film image)
- Computed Radiography
  - Digital flat-panel systems
- X-Ray Image: Conventional Fluoroscopy
  - Conventional fluoroscopy systems
  - X-ray image intensifier
- Lens System
  - Video camera
  - Video monitor
- Automatic Brightness Control (ABC)
- Automatic Gain Control (AGC)
- Digital Fluoroscopy
- Digital Fluorography
- Digital Subtraction Angiography (DSA)
- Angiography with Fluoroscopic Digital Image Processing
- X-Ray Image Quality: Digital-Image Quality
  - Digital image fundamentals and pixel size
  - Pixel size in digital fluoroscopy

- Digital Image Quality
  - Digital subtraction angiography and noise
  - Noise sources in digital X-ray imaging
- Equipment Design Considerations
- X-Ray Tube and Geometry
- Grid
- AEC
- Screen/ Film Processing Considerations

Radiation Physics—PART ONE (R2)

Computed Tomography (CT)

- CT Image Formation
- CT Scan Configuration
- Source Detector Configuration
- Multi-Row Detector vs. Single-Row Detector
- Axial Scanning vs. Helical Scanning
- Detectors
- X-Ray Tube
- CT Image Quality
  - Noise
  - Low-contrast detectability
  - High-contrast resolution
  - Field of view (FOV)
- CT Scan Artifacts

Ultrasound Physics

- Characteristics of Sound Waves
- Interactions of US with Matter
- Introduction to Image Acquisition
- U/S Components
- Transducers
- Image Properties and Qualities
- Spatial Resolution (axial, lateral, and elevational)

- Image Formation (e.g., transmission power, gain, TGC, frame rate)
- Discussion of Artifacts (all types of US artifacts) and Diagnosis

Magnetic Resonance Imaging (MRI)

- Introduction and Principles of MRI
- Image Weighting
- Parameters
- Pulse Sequences
- Artifacts
- MRI Safety

Nuclear Medicine Physics (NM)

- Principles of NM Physics
- Radioactive Decay
- Atomic and Nuclear Structures
- Interaction of Radiation with Matter
- Production of Radioisotopes
- Principles of Mo-99/Tc-99m Generators
- Components of Gamma Cameras

Radiation Biology

- Linear Energy Transfer (LET) and Relative Biologic Effectiveness (RBE)
- Direct and Indirect Effects of Radiation
- Types of Radiation Effects
- Types of Radiation Exposure
- Radiation Protection Quantities and Units
- Justification
- Optimization
- Dose/Risk Optimization
- Protection of Pregnant Workers/Patients

Radiation Physics—PART TWO (R3 & R4)

- Radiation
- Definition

- Forms
  - Electromagnetics
    - Wave model
    - Photon model
      - Frequency
      - Wavelength
      - Energy
      - Spectrum
  - Particulate Radiation
    - Mass—energy equivalence
- Atom
- Structure
  - Orbit cloud
    - Composition
- Non-ionized Atom
  - Ionized atom
  - Excited atom

- Electron-Binding Energy and Energy Levels
  - Electron transitions
    - Characteristic X-ray
    - Auger electron
- Nucleus
  - Composition
  - Nuclear force and energy levels
  - Classification of nuclides
  - Nuclear stability
  - Radioactivity
    - Decay (transformation)
      - Alpha decay
      - Beta-minus decay
      - Beta-plus decay
      - Electron capture
      - Isomeric transition
    - Decay scheme
    - Decay law
    - Half-life
  - Gamma rays
  - Internal-conversion electrons
- Nuclear Binding Energy and Mass Defect
- Nuclear Fission and Fusion
- Interactions of Radiation with Matter
  - Energy transfer
  - Scattering
  - Interactions of particulate radiation
    - Electron interaction
    - Positron annihilation
    - Neutron interaction
    - Alpha
    - Proton
  - Interactions of X-rays and gamma rays (photons)
    - Coherent or Rayleigh scattering

- Compton scattering
- Photoelectric effect
- Pair production

Radiation Biology

- Teaching Content
- Human Response to Ionizing Radiation: Sequence of Events
- Linear Energy Transfer (LET) and Relative Biologic Effectiveness (RBE)
- Direct and Indirect Effects of Radiation
- Formation of Free Radicals
- Effects on Cells: DNA and Chromosomes
- Cell Sensitivities
- Sensitivities in Different Cycles
- Factors Affecting Cell Sensitivity: Dose Rate, Fractionation, Chemicals
- Modifiers (Oxygen Effect and Radioprotectors)
- Cell Survival, Repair, and Death
- Sources of Information on Biological Effects
- Types of Radiation Effects
- Deterministic Effects
- Skin Effects
- Effects on Eye Lens

- Doses for Different Deterministic Effects
- Acute Radiation Syndromes
- Stochastic Effects
- Cancer Induction
- Hereditary Effects
- Early and Late Effects of Radiation
- Lethal Dose of LD 50/30
- Risk Estimation
- Sources of Radiation Exposure
- Natural Sources
- Artificial Sources
- Medical Sources
- Types of Radiation Exposure
    - External exposure
    - Internal exposure
- Categories of Radiation Exposure
    - Occupational exposure
    - Public exposure
    - Medical exposure
- Radiation Protection Bodies; Historical Events in Radiation Protection
- Radiation Protection Quantities and Units
    - Equivalent dose
    - Effective dose
    - Committed dose
    - Collective dose
- System of Radiological Protection
- Justification
- Optimization
- Dose/Risk Optimization
- Annual Limit of Intake
- Protection of Pregnant Workers/Patients
- Protection of Apprentices

- Categories of Work Areas
- Cardinal Principles of Radiation Protection
- Radiation Protection in Diagnostic X-ray Imaging
- Sources of Exposure in Diagnostic X-ray Procedures: Staff, Patients, and the Public
- Conventional Radiography
- Fluoroscopy and Interventional Radiology
- CT
- Mammography
- Radiation Protection in NM
- Sources of Exposure in NM: Staff, Patients, and the Public
- Receipt of Radioactive Materials
- Safe Handling and Administration of Radiopharmaceuticals
- Storage and Transfer of Radioactive Materials
- Radioactive Waste Management
- Surveys and Decontamination
- Handling Radiation Incidents
- Handling of Radioactive Patients

- Local and International Rules
- Protection of Lactating Mothers
- Protection of Pregnant Patients
- Radiation Protection in Radiotherapy
- Sources of Exposure for Staff and Public
- Protection of Patients, Staff, and the Public
- Interlock Checks
- Radiation Emergencies
- Shielding
- Factors to Consider in Shielding
- Primary and Secondary Shielding
- Testing of Shielding Thickness
- Shielding Requirements in Diagnostic X-ray, NM, and Radiation Therapy
- Rationale for New ICRP Recommendations
    - Objectives
    - Phases
- Types of Exposure Regarding New Recommendations
    - Planned exposures
    - Existing exposures
    - Emergency exposures
- New Dose Limits
    - Pregnancy
    - Eye dose
- Dose Constraints and Reference Levels
- Radiation Weighting Factors
- Protection of Environment
- New IAEA Basic Safety Standards
- Rationale
- Phases of Development
- Dose Limits and Standards
- Specific Requirements
- Objectives for Patient Dosimetry

- Patient Dose Calculations in X-ray Procedures
- Output Measurement: Method and Use in Patient Dose Calculation
- TLD Dosimetry: Method, Calibration, and Advantages
- Film Dosimetry: Method, Calibration, and Advantages
- EDR Films
- Radiochromic Films
- Patient Skin Dosimeter: Use and Testing
- Patient Dosimetry in CT
- Effective Dose Calculation
- Patient Dose Calculation in NM
- Diagnostic Procedures
- Therapeutic Procedures
- Fetal Dose

Nuclear Medicine (NM) Physics

- Radionuclide Production
- Nuclear Reactor-Produced Radionuclides
  - Neutron activation
  - Fission
- Cyclotron-Produced Radionuclides
- Considerations in the Production of Radionuclides
- Radionuclide Generators
- Principles of Generators
- Mo-99/Tc-99m Generators
- Quality Control of Generators
- Radiopharmaceuticals
- Radionuclide Characteristics
- Chemical Selection
- Quality Control of Radiopharmaceuticals
- Radiation Detectors
- Gas-Filled Detectors
- Ionization Chambers
- Proportional Chambers

- Geiger–Müller Counter
- Dose Calibrators
- Principles
- Quality Control
- Scintillation Detectors
- Scintillators
- Sodium Iodide (NaI)
- Advantages of NaI
- Disadvantages of NaI
- Photomultiplier (PM) Tube
- Preamplifiers
- Amplifiers
- Pulse Height Analyzers
- Pulse Height Spectrometry
- Factors Affecting Pulse Height Spectra
- Scintillation Detector Examples
- Well Counters
- Thyroid Uptake Probe
- Liquid Scintillators
- Thermoluminescent Dosimeters
- Counting Statistics
- Errors in Measurements
    - Systematic errors
        - ❖ Random errors
        - ❖ Blunders
        - ❖ Definitions
        - ❖ Accuracy
        - ❖ Precision
        - ❖ Bias
        - ❖ Examples
- Statistical Tests
    - Chi-square test
    - t-test

- Scintillation Cameras
- Components of Gamma Cameras
- Collimators
- Types and Characterization
- Performance
- NaI Crystal (Tl)
- Description
- Specifications
- Light guide
- Photomultiplier Tubes (PMTs)
- Description
- Performance
- Position Electronics
- Computer
- Characteristics of Scintillation Cameras
- Uniformity
- Spatial Resolution
- Linearity
- Energy Resolution
- Sensitivity
- Quality Control
- Important Tests and their Frequencies
- Image Characteristics and Quality
    - Spatial resolution
    - Contrast
    - Image quality (noise)
- Digital Imaging in NM
- SPECT
- Review
- Filtered Back Projection (FBP)
- Iterative Reconstruction
- Advantages and Disadvantages of SPECT

- Image Quality in SPECT
- Resolution
- 3D
- Number of Views
- Noise
- Orbits
- Motion
- Number of Camera Heads
- Counts
- Quality Control in SPECT
  - Uniformity
  - Center of rotation (COR)
  - Total performance
- Special Collimators
- Attenuation Correction
- Artifacts in SPECT Imaging
- PET
- Operating Principles
- 2D Acquisition
- 3D Acquisition
- Crystal and Detector
- Calibration Procedures
- Image Quality Issues
- Attenuation Correction
- Artifacts in PET Imaging
- PET/MRI
- Quality Control in PET
- Daily Procedures
- Quarterly Procedures

Examples of useful reading material

- The Essential Physics of Medical Imaging, 3rd edition, by Jerrold T. Bushberg et al.
- Review of Radiologic Physics, 4th edition, by Walter Huda.
- ICRP Publication 103, Good Reference for International Radiation Protection Standards, 1stedition, by ICRP.

OTHER COURSES

Residents are required to present “Certificates of Completion” for the following courses from an accredited training center during the years of training:

- Basic Life Support (BLS)
- Infection Control

Residents are advised to coordinate with their program director to fulfill these courses.

Quality Improvement (QI)

General Objective:

RT&MI residents receive training based on the basic principles of QI. Training is implemented in a dedicated course and/or comprehensive rotation.

Goals:

- Familiarization with QI terminology and available tools and methodology for improving the quality of technical and clinical performance in a radiology department [e.g., key performance indicators (KPIs) and the plan–do–study–act (PDSA) cycle];
- Familiarization with the workflow of a radiology department and other departments (surgery, medicine, and emergency medicine) and quality assurance (QA) systems; participation in QI activities of hospitals;
- Understand and apply audit procedures, including problem identification, action planning, and reassessment;
- Familiarization with tools for quality management of radiology services;
- Understand how performance improvements relate to patient safety in radiology;
- Complete a mentored research project and present the results at departmental QI rounds;
- Participate in departmental and hospital QI activities by attending committee meetings;

- Participate in hospital QA committee and departmental morbidity and mortality (M&M) meetings;
- Knowledge of current research topics on quality in radiology: initiate and complete a project and participate in ongoing departmental QA audits;
- Acquire the necessary skills for scientific presentations and public discussions; and
- Recognize opportunities for improvement regarding the radiology department functions.

The elective part includes online learning sessions with a list of independent study materials provided to each RT&MI resident. Some examples are provided below:

http://www.ihi.org/ www.patientsafety.va.gov www.RMF.org, www.jointcommission.org, www.apiweb.org.

Specific Objectives:

Patient safety

- Improve the accuracy of patient identification;
- Improve the effectiveness of communication among caregivers and ensure that they report critical test results and diagnostic procedures on a timely basis;
- Improve the safety of medication use and ensure that all medications, medication containers, and other solutions are labeled on and off the sterile field in perioperative and other procedural settings;
- Minimize the risk of healthcare-associated infections;
- Follow safety procedures and be familiar with patient safety QI project topics, particularly those relevant to radiology, including the following:
    - safe use of iodinated contrast materials and
    - radiation safety.

The appropriate completion of these courses will be considered in the overall annual evaluation scores.

Workshop

RT&MI residents are encouraged to attend at least two workshops per year. These workshops will be conducted locally and internationally during the training program, and should be related to the NM field. Approval from the

program director is required. The major tracks of the symposium and workshop can constitute, but are not limited, to:

- appropriateness criteria for radiology: awareness, utilization, implementation, and impact;
- diagnostic reference levels in MI: protocol optimization and patient dose reduction;
- quality control of SPECT systems;
- radiotherapy treatment planning;
- radiation safety officer course;
- 3D printing in radiation medicine.

Self-Directed Learning

Item	Objectives	CanMEDs
Self-Directed Learning	• Maintenance of personal portfolio (self- assessment, reflective learning, and personal development plan); • Achieving personal learning goals beyond the essential and core curriculum; • Reading (includes web-based material); • Auditing and conducting research projects; • Attending national and international conferences.	Professional Radiology Technology & Medical Imaging expert Scholar

SUGGESTED REFERENCE BOOKS:

General books

- Getting Started in Clinical Radiology: From Image to Diagnosis, Paperback, 2005, by George W. Eastman. Thieme.
- Radiologic Science for Technologists: Physics, Biology, and Protection, Hardcover, 11th edition, by Stewart C. Bushong. Mosby.
- Radiography: Technology, Environment, Professionalism. Paperback, 1998, by Frances E. Campeau. Lippincott Williams & Wilkins.
- The Practice of Radiology Education: Challenges and Trends. Hardcover, 2009, by Teresa van Deven. Springer-Verlag Berlin Heidelberg.
- The Essential Physics of Medical Imaging, Hardcover, 3rd edition, by Jerrold T. Bushberg. Lippincott Williams & Wilkins.
- Patient Care in Radiography: With an Introduction to Medical Imaging, Paperback, 9th edition, by Ruth A. Ehrlich. Mosby.

CT books

- Computed Tomography for Technologists: A Comprehensive Text, 2018, by Lois E. Romans. Lippincot Williams & Wilkins.
- Computed Tomography: Physical Principles, Clinical Applications, and Quality Control. Paperback, 3rd edition, by Euclid Seeram. Saunders.
- Computed Tomography, Paperback, 1st edition, by Stewart C. Bushong. McGraw-Hill Education.
- Computed Tomography for Technologists: Exam Review. Paperback, 1st edition, by Lois E. Romans. Lippincott Williams & Wilkins.
- CT & MRI Pathology: A Pocket Atlas. Paperback, 1st edition, by Michael L. Grey and Jagan M. Ailinani. McGraw-Hill Education.

X-ray books

- Bontrager's Handbook of Radiographic Positioning and Techniques. Spiral-bound, 8th edition, by Kenneth L. Bontrager. Mosby.
- Clark's Positioning in Radiography. Hardcover, 13th edition, by Stewart Whitley. CRC Press.
- Radiographic Pathology for Technologists. Paperback, 6th edition, by Nina Kowalczyk. Mosby.

MRI books

- Handbook of MRI Technique. Paperback, 4th edition, by Catherine Westbrook. Wiley-Blackwell.
- MRI in Practice, Paperback, 5th edition, by Catherine Westbrook. Wiley-Blackwell.
- Handbook of MRI Scanning. Spiral-bound, 1st edition, by Geraldine Burghart Mosby.
- MRI Parameters and Positioning, Paperback, 2nd edition, by Torsten B. Möller. TPS.
- CT & MRI Pathology: A Pocket Atlas. Paperback, 1st edition. by Michael L. Grey. McGraw-Hill.

US books

- Ultrasound Scanning: Principles and Protocols. 4th edition, by Betty Bates Tempkin. Saunders.
- Workbook for Textbook of Diagnostic Sonography paperback, 8th edition, by Sandra L. Hagen–Ansert. Mosby.
- Sonography: Introduction to Normal Structure and Function. Paperback, 4th edition, by Betty Tempkin and Reva Arnez Curry. Saunders.

NM books

- Nuclear Medicine and PET/CT: Technology and Techniques. Hardcover, 7th edition, by Paul E. Christian. Mosby.
- Nuclear Medicine Physics: The Basic. Paperback, 7th edition, by Ramesh Chandra. Lippincott Williams & Wilkins.
- Fundamentals of Nuclear Pharmacy. Hardcover, 7th edition, by Gopal B. Saha. Springer.
- PET/MRI: Methodology and Clinical Applications. Paperback, 1st edition, by Ignasi Carrio, and Pablo R. Ros. Springer.

Radiology learning websites

https://radiopaedia.org/ https://www.radiologymasterclass.co.uk/
http://www.radiologyassistant.nl/

ASSESSMENTS

1. Purpose of Assessments

Assessments play a vital role in the success of postgraduate training. They will guide trainees and trainers to achieve the targeted learning objectives. In addition, reliable and valid assessments will provide an excellent means for training improvement as they inform the following aspects: curriculum development, teaching methods, and the quality of the learning environment. These assessments serve the following purposes:

a. **Assessment for learning**: Trainers will use information from trainees' performances to inform their learning to improve.

b. **Assessment as learning**: Assessment criteria will drive trainees' learning.

c. **Assessment of learning**: Assessment outcomes will represent quality metrics that can improve the learning experience.

For the sake of the organization, assessments will be further classified into two main categories:

2. Formative and Summative.

2. 1 General Principles

Trainees, as adult learners, should strive for feedback throughout their journey of competency from "novice" to "mastery" levels. *Formative assessment* (also referred to as continuous assessment) is the component of assessment that is distributed throughout the academic year, aiming primarily to provide trainees with effective feedback. The input from the overall formative assessment tools will be utilized at the end of the year to promote each individual trainee from the current to the next training level. A formative assessment will be based on scientific committee recommendations (usually updated and announced at the start of the academic year). According to the executive policy on continuous assessment (available online at www.scfhs.org), formative assessments will include the following features:

a. multisource: minimum four tools;
b. comprehensive: covering all learning domains (knowledge, skills, and attitude);
c. relevant: focusing on workplace-based observations; and
d. competency milestone oriented: reflecting the trainee's expected competencies that match the trainee's developmental level.

Trainees actively seek feedback during training. Furthermore, trainers are expected to provide timely and formal assessments. The SCFHS provides an e-portfolio system to enhance the communication and analysis of data arising from formative assessments.

2.2 Formative Assessment Tools

Residents' performance will be jointly evaluated by the respective staff members by applying the following:

A. In-training evaluation reports (ITER)

CanMEDS-based competencies "In-training Evaluation Report (ITER)" form (Appendix 2) must be completed (preferably in electronic format), with the signatures of at least two senior technologists, within two weeks of the end of each rotation.

The program director discusses the evaluations with RT&MI residents, if necessary. The evaluation form is submitted to the SCFHS training supervisory committee within four weeks of the conclusion of the rotation. The ITERs should be conducted at least three times, covering nine training months per year.

B. Workplace Assessment

- Performance of RT&MI residents during daily work;
- Performance in a direct observational assessment of 10–20 min regarding trainee–patient interactions;
- Direct observation of procedural skills (DOPS): Diagnostic and therapeutic procedural skills;
- Timely and specific feedback from the trainer to RT&MI residents is mandatory after each procedure.

C. The end-of-year examination will be limited to R1, R2, and R3 residents. The number of examinations, eligibility, and passing scores are established in accordance with the Commission's training and examination rules and regulations. The examination details are published on the Commission's website, www.scfhs.org.sa.

   A. The format shall include 100–150 multiple-choice questions (MCQ) in which the four best options must be chosen (or A-type).

   B. The examination shall contain K1 and K2 cognitive-level questions (recall and comprehension), usually delivered as questions with scenarios (interpretation, analysis, decision making, reasoning, and problem solving) in accordance with a test blueprint.

   C. The examination shall include questions from medical sciences, including anatomy, physiology, pathology, and physics.

   D. Below is a summary table of the formative assessment tools:

Gen.	Level	Knowledge					Skills							Professional Behavior (Attitude)
		SOE	EYPT-In't	Academic Activities	CbD	EYPT-Local	OSCE/OSPE	Research	DOPS	Logbook	Volunteering	mini - CEX	Other	Evaluation - ITERS
Radiology Technology & Medical Imaging	R1	✓		✓	✓	✓	✓		✓	✓	✓	✓		✓
	R2	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
	R3	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
	R4			✓	✓			✓	✓	✓	✓	✓		✓

Tools' Abbreviations:

- **R1:** Residency year one
- **R2:** Residency year two
- **R3:** Residency year three
- **R4:** Residency year four
- **SOE:** Structured Oral Exam
- **CbD:** Case-based Discussion
- **EYPT-Local:** End of year progress test (local)
- **EYPT-In't:** End of year progress test (International)
- **DOPS:** Direct Observation of Procedural Skills
- **Mini-CEX:** mini -Clinical Evaluation Exercise
- **ITER:** In-training Evaluation Report

Description table of formative assessment tools:

Nuclear Medicine Radiology Technology			
	Assessment & Teaching Requirements	Requirements	Definitions & Descriptions
Knowledge	**Academic Activities***	**R1–R4:** Trainees are required to attend 40 academic half-day lectures during the Academic Activity sessions.	Trainees are required to attend all the lectures in the weekly half-academic days (and any excused absence must be approved by the program director). The academic half-day duration must be a minimum of two hours. Lectures should cover all topics mentioned in all rotations (Appendix 5,6,7,8,9,10 and 11). Trainees' attendance must be logged and comply with the SCFHS rules and regulations. (see "Evaluation of the presenter by staff supervisor" in Appendix 3)
	Educational Activities	**R1–R4 During Academic Half-Day**: • Trainees are required to do at least one presentation/academic year from the topic presentations.	

Nuclear Medicine Radiology Technology			
	Assessment & Teaching Requirements	Requirements	Definitions & Descriptions
		• Trainees are required to review and present at least two journal clubs/academic year. • Trainees are required to do at least one case-study from their rotations.	
	SOE	**R1–R3:** Trainees are required to take the SOE.	SOE is used to assess the trainee's knowledge and as a practice/mock exam similar to the final SOE to better prepare the trainees for it.
	EYPT-Intl (progress test)	N/A	NA
	EYPT-Local (progress test)	**R1–R3:** Trainees are required to take a written progress test according to the SCFHS regulations.	Trainees are required to take the End-of-Year Progress Test composed of a minimum of 100 MCQs based on the exam blueprint.
	CbD	**R1–R4:** Trainees are required to do a minimum of six CBD/academic year. Results on forms are for formative feedback purposes.	CBD is a workplace-based assessment (WPBA) tool used to assess the trainee's clinical decision making and reasoning skills for patient management. It helps to understand the logic behind their decisions made in the clinical setting, as well as to understand how trainees compile, prioritize and apply their knowledge. The form is initiated from the trainee's side on assessment system (or PDF if the assessment systemwas not activated yet) and it is sent by them to their preceptors. The form is then filled out by the preceptor during the discussion with the trainee (it is a one-on-one discussion). It usually takes 15 min, followed by 5–10 min of feedback.

Nuclear Medicine Radiology Technology			
	Assessment & Teaching Requirements	Requirements	Definitions & Descriptions
Skills	**OSCE/OSPE**	**R1–R3:** Trainees are required to take the OSCE/OSPE. The results on forms are for formative feedback purposes.	The OSCE/OSPE is used to assess the trainee's clinical/practical performance and application of knowledge skills and as a practice/mock exam similar to the final OSCE/OSPE to better prepare them for it.
	Research	**Required activities trainees must complete: Regarding the E-Module (R2)** **R2:** Trainees are required to complete the SCFHS Research and the SCFHS Evidence-based Practice (EBP) e-module and provide proof of completion to the program director. **Regarding the Research Proposal (R3 & R4):** 1. Prepare the study design and methodology within the accepted research types, which are mentioned in the description section. 2. Complete the proposal and have it approved by the program director and training program committee (TPC). **R3:** Trainees are required to submit a research proposal with the IRB approval letter or TPC (Appendix 12) **R4:** Trainees are required to submit at least one abstract for poster OR oral presentation OR submit the research according to the SCFHS criteria in order to graduate from the program. (Appendix 13)	The research must be original work in radiology technology in their fields, the trainee conducts all research steps. Topics must be approved by the program director according to the SCFHS criteria, and the research proposal needs to be approved from the IRB or Training Program Committee (TPC). The following research types are **NOT** accepted: review articles, case reports, case series, meta-analyses, editorials, and basic science topics.

Nuclear Medicine Radiology Technology			
	Assessment & Teaching Requirements	Requirements	Definitions & Descriptions
	DOPS	**R1–R4:** Trainees are required to perform at least six DOPS/academic year, cases can be from the logbook cases. Results on forms are for formative feedback purposes.	This is a workplace-based assessment (WPBA) tool used to assess the trainee's procedural, practical and technical skills. The form is initiated from the trainee's side on assessment system, and it is sent by them to their preceptors. The form is then filled in by the preceptor who supervised the trainee after discussing the performance with the trainee. It usually takes 15 min, followed by 5–10 min of feedback.
	Logbook	**Logbook Cases (R1–R4):** 1. Trainees must achieve the required number of procedures according to the logbook table below according to level. 2. The cases must meet the competencies checklist as per each rotations(Appendix 1)	Logbooks are used to document procedural activities.
	Volunteering	R1–R4: Trainees are required to participate in volunteering-based activity of **at least 10** volunteer hours related to the field on the health volunteer platform. OR participate in activities such as awareness campaigns, presenting a lecture to the community, etc. Trainees **must** provide a certificate or proof of participation.	
	Mini-CEX	**R1–R4**: Trainees must complete **at least** six mini-CEX/academic year. The results are used for formative feedback purposes.	This is a workplace-based assessment (WPBA) tool used to assess the trainee's skills during the daily rounds regarding the communication, patient counseling and medication reconciliation. The form is initiated from the trainee's side on assessment system, and it is sent by them to their preceptors. The form is then filled in by the preceptor who supervised the trainee after discussing the performance with the

Nuclear Medicine Radiology Technology			
	Assessment & Teaching Requirements	Requirements	Definitions & Descriptions
			trainee. It usually takes 15 min, followed by 5–10 min of feedback.
Professional Behavior (Attitude)	**ITERS**	**R1-R4:** ITERs are used as end of rotation evaluations. ITERs must be completed, fulfilling its requirements following the SCFHS regulations.	ITERS is the evaluation completed at the end of each rotation that assesses the trainee's performance in all competencies throughout the rotation using the SCFHS approved ITER form set up in assessment system.

Nuclear Medicine Logbook:

Level	Modality	Case per day
R1	X-ray	10
	Fluoroscopy	2
	IR	2
R2	CT	5
	US	4
	MRI	3
	NM	2

R3	NM	5
R4	NM	5

The final scoring will align with the updated bylaws related to formative assessments and educational activities. Hence, some wording may change accordingly. Trainees are required to fulfill all training and assessment requirements. Not complying with these will subject the trainee to disciplinary actions according to the SCFHS bylaws and regulations.

In summary, formative assessment aims to ensure that all residents fulfill the CanMEDS competency requirements at the end of each training rotation and for the academic year evaluation. Academic and clinical assignments are documented annually using an electronic tracking system (e-logbook when applicable) (Appendix 1). Evaluations are based on accomplishing the minimum requirements of procedures and clinical skills, as determined by the program.

3. Summative Assessment

3.1 General Principles

A summative assessment is the component of an assessment that primarily aims to make informed decisions about trainees' competency. Unlike formative assessment, *summative assessment* does not aim to provide constructive feedback. For further details, please refer to the general bylaws and the executive policy of assessment (available online: www.scfhs.org). To be eligible to sit for final exams, a trainee must first be granted a "*Training-Completion Certificate.*"

3.2 Principles of RT&MI Examination (Saudi Board Examination: Part I):

It is a written exam that permits the trainee to be promoted from "junior" to "senior" level of training.

This examination is conducted in written MCQ format and held at least once per year. The number of examinations, eligibility, and passing scores are established in accordance with the Commission's training, examination rules, and regulations (available online at www.scfhs.org). Examination details and a blueprint are published on the Commission's website.

3.3 Training-Completion Certificate

To be eligible to take the final specialty examinations, each trainee must first obtain a "Training-Completion Certificate." Based on the training bylaws and executive policy (please refer to www.scfhs.org) trainees will be granted a "Training-Completion Certificate" once the following criteria are fulfilled:

a. Successful completion of all training rotations;
b. Final In-Training Evaluation Report (FITER)/Comprehensive Competency Report (CCR) (Appendix 4). The program directors prepare a FITER for each RT&MI resident at the end of the year R4. Clinical or oral examinations or completion of other academic assignments can be involved. Completion of training requirements is outlined by the scientific council/committee of each specialty (e.g., logbook, research, and others); and
c. Clearance from the SCFHS training affairs to ensure compliance with tuition payments and completion of universal topics.

The “Training-Completion Certificate” will be issued and approved by the local supervisory committee or its equivalent, according to the SCFHS policies.

3.4 Final RT&MI Board Examination (Saudi Board Examination: Part II):

The final specialty examination is the summative assessment component that grants trainees certification of the specialty. It has two elements:

A. Final written examination:

B. To be eligible for this exam, trainees must first obtain the “Training-Completion Certificate.” This examination assesses the trainee’s theoretical knowledge (including recent developments) and problem-solving abilities regarding their specialty. The examination is conducted in a multiple-choice format and held at least once a year. The number of exams, exam format, eligibility, and passing scoreswill be in accordance with the Commission’s training, examination rules, and regulations. More details on the examination and blueprints are published on the Commission’s website: www.scfhs.org.sa.

C. Clinical examination:

D. This examination assesses a broad range of high-level clinical skills, including data gathering, patient management, communication, and counseling. This examination is held at least once every year, preferably scanning a real patient at any chosen center. The OSCE concerns patient management problems (PMPs). Trainees are required to pass the final written examination to be eligible for the final clinical examination. Eligibility and passing scores are evaluated in accordance with the Commission’s training and examination rules and regulations.

Examination details and a blueprint are published on the Commission website,www.scfhs.org.sa.

Format:

Station number: 12–15 stations

Stations: A mixture of skill stations and patient management format

For further details on the final examinations, please refer to the general bylaws and executive policy of the assessment (available online at www.scfhs.org).

3.5 Certification:

The certificate for training completion will be awarded to RT&MI residents only upon successful fulfillment of all program requirements. Candidates need to pass both written and clinical examinations independently (i.e., no compensation for unsatisfactory results). Candidates passing all components of the final specialty examination will be awarded the “Saudi Board of Radiology Technology & Medical Imaging” certificate.

EXAMINATION BLUEPRINTS

Part One Examination Blueprint Outlines:

No.	Sections	Percentage
1	Radiation protection	10%
2	X-ray physics and instruments	10%
3	Radiographic anatomy, pathology, and positioning	10%
4	PACS and quality control	5%
5	Fluoroscopy machine and procedure	8%
6	Angiography machine and procedure	8%
7	Ultrasound physics and instruments	7%
8	Ultrasound abdominal procedure and technique	6%
9	Nuclear medicine physics and instruments	6%
10	Nuclear medicine hot lab and pharmaceutical preparation	5%
11	CT physics and instruments	6%

No.	Sections	Percentage
12	CT brain anatomy, procedure, and technique	6%
13	MRI physics and instruments	7%
14	MRI brain anatomy, procedure, and technique	6%
Total		100%

Promotion Examination Blueprint Outlines:

R1:

No.	Section	Percentage
1	General X-ray Physics	20%
2	X-ray technique	20%
3	Fluoroscopy	15%
4	Angiogram	15%
5	Radiation protection	15%
6	Image quality	15%
Total		100%

R2:

No.	Section	Percentage
1	CT imaging (physics & instrumentation)	20%
2	MRI (physics & instrumentation)	20%
3	Ultrasound imaging (physics & instrumentation)	20%
4	Molecular and nuclear imaging (physics & instrumentation)	20%
5	Neuro and abdomen techniques	10%
6	Radiology informatics	10%
Total		100%

R3:

No.	Section	Percentage
1	NM-Bone	15%
2	NM-Renal	15%
3	NM-Endocrine	10%
4	NM-Hepatobiliary	10%
5	NM-Infection	5%
6	NM-Oncology	15%
7	NM-Neuro	10%
8	NM-GI	10%
9	NM Advanced physics	10%
Total		100%

Final Examination Blueprint Outlines:

No.	Sections	Percentage
1	Physics and instruments	15%
2	Radiopharmacy lab (Hot Lab)	28%
3	SPECT-CT procedures	11%
4	Conventional procedures WB + Statics + Dynamic	12%
5	Therapy	11%
6	Cardiac procedures	11%
7	PET-CT	12%
Total		100%

Final Clinical Blueprint Outlines:

No.	Sections
1	Physics and instruments
2	Radiopharmacy lab (Hot lab)
3	SPECT-CT procedures
4	Conventional procedures WB + Statics + Dynamic
5	Therapy
6	Cardiac procedures
7	PET-CT

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APPENDICES

APPENDIX 1/logbook

SCOPE OF THE LOGBOOK:

- to maintain records and document all academic activities (e.g., procedures, lectures, meetings, training courses, workshops, symposia, and presentations) undertaken during the training program;
- to assist RT&MI resident in identifying their deficiencies in specific areas;
- to assist the program director/evaluator in documenting the contributions and evaluations of RT&MI residents;
- to provide the evaluator with guidance regarding appropriate and fair assessment of RT&MI residents; and
- to provide the program director with guidance regarding deficiencies in training.

GUIDELINES FOR RT&MI RESIDENTS:

- RT&MI residents are required to maintain logbooks during the entire training period;
- logbook entries concerning recorded activities should be completed on the day the activities occur;
- all entries must be signed by a mentor within one week of completion;
- RT&MI residents should discuss their training progress with mentors and/or program director every month, as indicated in the logbook;
- RT&MI residents should submit their completed logbooks to the program director at the end of their rotations and training sessions for subsequent submission to the regional supervisory committee;
- If a program director does not sign a logbook, RT&MI resident will be ineligible for the end-of-training certification and final examinations.

Example of an RT&MI Logbook				
Comments			Activity	Date

APPENDIX 2

In-Training Evaluation Report (ITER) FORM

Not applicable	Exceeds expectations (4)	Clear pass (3)	orderline case (2)	Clear failure (1)	
					A. Radiology Technology & Medical Imaging expert
					Clinical & Technical Knowledge
					1. Understands the technical and clinical sciences in RT&MI
					2. Understands the clinical presentation and natural history of common pathologies seen via imaging
					3. Demonstrates expertise in all technical and clinical aspects and management of common radiological procedures
					4. Avoids unnecessary or harmful investigations or management
					5. Provides care
					6. Demonstrates appropriate knowledge, skills, and attitude
					7. Formulates appropriate differential RT&MI techniques
					8. Develops an appropriate plan of RT&MI investigations and interprets the results

Not applicable	Exceeds expectations (4)	Clear pass (3)	orderline case (2)	Clear failure (1)	
					Procedural skills
					9. Understands the indications, contraindications, and complications of specific RT&MI procedures
					10. Demonstrates mastery of specific RT&MI procedure techniques
					B. Communicator
					11. Records appropriate progress notes
					12. Communicates with medical staff in an appropriate manner
					13. Communicates with patients in an appropriate manner
					14. Communicates with patient families in an appropriate manner

Not applicable	Exceeds expectations (4)	Clear pass (3)	orderline case (2)	Clear failure (1)	
					15. Delivers understandable information to patients and their families
					16. Maintains professional relationships with other healthcare providers
					17. Provides clear and complete records, reports, and informed and written consent
					C. Collaborator
					18. Works effectively in a team environment
					19. Is able to work with allied healthcare staff
					20. Is able to work with nursing staff
					21. Is able to work with attending and junior medical staff
					22. Consults effectively with other physicians and healthcare providers

Not applicable	Exceeds expectations (4)	Clear pass (3)	orderline case (2)	Clear failure (1)	
					D. Manager
					23. Participates in activities that contribute to the effectiveness of healthcare organizations and systems
					24. Manages their practice and career effectively
					25. Allocates finite healthcare resources appropriately
					26. Serves appropriately in administration and leadership roles
					27. Uses information technology to optimize patient care, lifelong learning, and other activities
					E. Health advocate
					28. Is attentive to preventive measures
					29. Demonstrates adequate patient education regarding compliance and medication
					28. Is attentive to issues in public health policy

Not applicable	Exceeds expectations (4)	Clear pass (3)	orderline case (2)	Clear failure (1)	
					29. Recognizes important social, environmental, and biological determinants of health
					30. Ensures that patients have access to appropriate support, information, and services
					31. Offers advocacy on behalf of their patients and general population levels
					F. Scholar
					32. Attends and contributes to rounds, seminars, and other learning events
					33. Discusses and presents selected topics in an appropriate manner
					34. Demonstrates adequate ability to conduct a literature search
					35. Demonstrates efforts to increase knowledge
					36. Accepts and acts on constructive feedback
					37. Is informed about patient cases and takes an evidence-based approach to management problems

Not applicable	Exceeds expectations (4)	Clear pass (3)	orderline case (2)	Clear failure (1)	
					38. Contributes to the education of patients, house staff, students, and other health professionals
					39. Contributes to the development of new knowledge
					G. Professional
					40. Recognizes their personal limitations and seeks advice and consultation when necessary
					41. Understands the professional, legal, and ethical obligations of physicians
					42. Delivers evidence-based care with integrity, honesty, and compassion
					43. Demonstrates appropriate insight into their personal strengths and weaknesses
					44. Shows initiative within the limits of his or her knowledge and training
					45. Discharges duties and assignments responsibly and in a timely and ethical manner
					46. Reports facts accurately, including their own errors

Not applicable	Exceeds expectations (4)	Clear pass (3)	orderline case (2)	Clear failure (1)	
					47. Maintains appropriate boundaries in work and learning situations
					48. Respects diversity in race, age, gender, disability, intelligence, and socioeconomic status
Total score = _____ x 25 =100% Number of evaluated items=					TOTAL SCORE

Program Director:____

Comments:

_____

_____

_____

_____

I certify that I have read all parts of this evaluation report and discussed it with theevaluators.

Resident name: _____Signature: _____

Evaluator name: _____Signature: _____

Evaluator name: _____Signature: _____

Program Director: _____Signature:_____

APPENDIX 3

RT&MI Resident Presentation Evaluation by Staff Supervisor

RT&MI Resident name: _____ Level: _____

Staff Supervisor: _____

Date of Presentation: _____ Topic: _____

Very Good (5)	Good(4)	Acceptable (3)	Weak(2)	Very Weak (1)	**Radiology Technology & Medical Imaging expert**
					Demonstrated thorough knowledge of the topic
					Presented at an appropriate level and withadequate details
					Comments (optional)
					Communicator
					Provided objectives and an outline
					Clear and organized presentation
					Used clear, concise, and legible materials

Very Good (5)	Good(4)	Acceptable (3)	Weak(2)	Very Weak (1)	**Radiology Technology & Medical Imaging expert**
					Used effective methodsand presentation style
					Established good rapportwith audience
					Collaborator
					Included comments from learners and led discussions
					Worked effectively withstaff supervisor in the session preparation
					Comments (optional)
					Health advocate
					Managed time effectively
					Addressed preventive aspects of care when relevant
					Comments (optional)

Very Good (5)	Good(4)	Acceptable (3)	Weak(2)	Very Weak (1)	**Radiology Technology & Medical Imaging expert**
					Scholar
					Posed appropriate learning questions
					Accessed and interpreted relevant literature
					Comments (optional)
					Professional
					Maintained patient confidentiality when clinical material was used
					Identified and managed relevant conflicts of interest
					Comments (optional)

APPENDIX 4

Final In-Training Evaluation Report (FITER)/Comprehensive Competency Report (CCR)		
RT&MI Resident name:		
SCFHS number:		
NO	YES	**Evaluation covering the last year of the resident:** According to the committee of the fellowship program, the aforementioned trainee has acquired competencies in pediatric hematology/oncology as prescribed by the training objectives. The resident is able to practice as a specialist. (Please tick the appropriate box.)
The following information sources were used for the evaluation:		
NO	YES	Items
		Written exams
		Clinical rotations
		Feedback from healthcare professionals
		Completion of scholarly project
		Other evaluations

Final In-Training Evaluation Report (FITER)/Comprehensive Competency Report (CCR)
Note: If, during the period between the date of the signature of this document and completion of the training, the residency program committee judges that the demonstrated competencies of the candidate are inconsistent with the present evaluation, the residency program committee can declare the document null and void and replace it with an updated FITER. In that case, eligibility for the examination depends on the updated FITER.
Comments:
Name of Program Director:
Date: Signature:
I certify that I have read this document.
Name of Resident: SCFHS number: Date: Signature: Resident Comments:

APPENDIX 5

X–ray Clinical Rotation Competency Checklist R1

NAME: _____TODAY'S DATE:_____

ACTIVE SCHS #: _____

__

TYPES OF EXAMS PERFORMED: Please put "X" next to your level of skills and experience as an X- Ray Technologist.

PROFICIENT RATINGS:
(1) No Clinical Experience, (2) Observed and Assisted, (3) Limited Experience, (4) Competent, (5) Very Proficient

CHEST & THORAX	No Clinical Proficient				
	1	2	3	4	5
Chest-Routine					
Chest-AP (Wheelchair/Stretcher)					
Chest-Lateral Decubitus					
Ribs					
Sternum					
Upper Airway (Soft-Tissue Neck)					

CHEST & THORAX	No Clinical Proficient				
	1	2	3	4	5
UPPER EXTREMITY	**1**	**2**	**3**	**4**	**5**
Thumb or Finger					
Hand					
Wrist					
Scaphoid					
Forearm					
Elbow					
Humerus					
Shoulder					
Trauma: Shoulder (scapular Y or Axillary) *					
Clavicle					
Scapula					

CHEST & THORAX	No Clinical Proficient				
	1	2	3	4	5
AC Joints					
Trauma: Upper Extremity (Non-shoulder)					
LOWER EXTREMITY	**1**	**2**	**3**	**4**	**5**
Femur					
Knee					
Knee-Trauma					
Patella					
Tibia-Fibula					
Ankle					
Foot					
Fore Foot					
Toe					

CHEST & THORAX	No Clinical Proficient				
	1	2	3	4	5
Calcaneus					
ABDOMEN	**1**	**2**	**3**	**4**	**5**
Abdomen-Supine (KUB)					
Abdomen-Upright					
Abdomen-Decubitus					

X – RAY Clinical Rotation
Competency Checklist R1

PELVIS	**1**	**2**	**3**	**4**	**5**
Pelvis					
Hip					
Hip (cross-table lateral)					
Hip Jaudette					
Sacroiliac Joints					
SPINE	**1**	**2**	**3**	**4**	**5**
Cervical Spine					
Cervical Spine Trauma (cross table lateral)					
Cervical Spine Oblique's					
Cervical Spine Flexion / Extension					
Thoracic Spine					
Scoliosis Series					
Lumbar Spine					
Sacrum and / or Coccyx					
HEAD	**1**	**2**	**3**	**4**	**5**
Skull					
Paranasal Sinuses					
Facial Bones					
Orbits					
Nasal Bones					
Mandible					
PEDIATRICS (age 6 or younger)	**1**	**2**	**3**	**4**	**5**
Chest Routine					
Upper Extremity					
Lower Extremity					
Abdomen					
Pelvis					
Mobile Study					
SURGICAL PROCEDURES C-ARM	**1**	**2**	**3**	**4**	**5**
C-Arm Procedure (Orthopedic)					
C-Arm Procedure (non- Orthopedic)					
GENERAL PATIENT CARE	**1**	**2**	**3**	**4**	**5**
Transfer of patient					
Care of patient medical equip (oxygen tank, IV tubing)					
				YES	**NO**
I have experience in the following equipment (please list).					
1. Picture Archiving & Communication System (PACS)					
2. SECTRA Radiology Information System (RIS)					
3. ICIS Hospital Information System (HIS)					

This information I have provided in this checklist is true and accurate to the best of my knowledge.

Signature/Date

APPENDIX 6

Fluoroscopy & Angiography Clinical Rotation Competency Checklist R1

NAME: _____TODAY'S DATE: _____

ACTIVE SCHS #: _____

TYPES OF EXAMS PERFORMED: Please put "X" next to your level of skills and experience as an X-ray technologist.

PROFICIENT RATINGS:
(1) No Clinical Experience, (2) Observed and Assisted, (3) Limited Experience, (4) Competent, (5) Very Proficient

PROCEDURES	No Clinical Proficient				
	1	2	3	4	5
Upper Gastric Imaging					
Small Bowel Series/Follow through					
Air Contrast Colon					
Arthrography					
QUALITY CONTROL OF:	**1**	**2**	**3**	**4**	**5**

PROCEDURES	No Clinical Proficient				
	1	2	3	4	5
Basic Radiographic Equipment					
Shielding Devices					
ADDITIONAL TASKS	**1**	**2**	**3**	**4**	**5**
Prepare Contrast Media					
Format/Optimize Images					
Ensure Radiation Safety					
Maintain Sterile/Isolation Precautions					
Insert Enema Tip					
GENERAL PATIENT CARE	**1**	**2**	**3**	**4**	**5**
Transfer of Patient					
Care of patient medical equip (oxygen tank, iv tubing)					
				YES	**NO**

PROCEDURES	No Clinical Proficient				
	1	2	3	4	5
I have experience in the following equipment (please list).					
1. Picture Archiving and Communication System (PACS)					
2. SECTRA Radiology Information System (RIS)					
3. ICIS Hospital Information System (HIS)					

The information I have provided in this knowledge and skills checklist is true and accurate, to the best of my knowledge.

_____

Signature/Date

APPENDIX 7

Magnetic Resonance Imaging Clinical Rotation Competency Checklist R2

NAME: _____TODAY'S DATE: _____

ACTIVE SCHS #:_____

TYPES OF EXAMS PERFORMED: Please put "X" next to your level of skills and experience as an MRI Technologist.

PROFICIENT RATINGS:
(1) No Clinical Experience, (2) Observed and Assisted, (3) Limited Experience, (4) Competent, (5) Very Proficient

BODY PROCEDURES (ABDOMEN & PELVIS)	No Clinical Proficient				
	1	2	3	4	5
Routine Liver					
Routine MRCP					
NEURO & ENT PROCEDURES	**1**	**2**	**3**	**4**	**5**
Routine Brain (Infants, Children, and Adult)					
Orbits/PNS					
Routine (Cervical, Thoracic, and Lumbar) Spine					
PEDIATRIC MSK PROCEDURES	**1**	**2**	**3**	**4**	**5**
Knee Meniscus/Trauma					
Shoulder (Routine)					
Routine Ankle					
Routine Foot					
Routine Elbow					
Routine Wrist/Hand					
MSK PROCEDURES	**1**	**2**	**3**	**4**	**5**
Wrist/Hand (Routine)					

Shoulder (Routine)					
Routine Elbow					
Knee (Routine)					
Routine Ankle					
Routine Foot					

		YES	NO
I have experience in the following equipment (please list).			
1. Picture Archiving and Communication System (PACS)			
2. SECTRA Radiology Information System (RIS)			
3. ICIS Hospital Information System (HIS)			

The information I have provided in this knowledge and skills checklist is true and accurate, to the best of my knowledge.

_____

Signature/Date

APPENDIX 8

Nuclear Medicine Clinical Rotation Competency Checklist R2

NAME: _____ TODAY'S DATE: _____

ACTIVE SCHS #:_____

TYPES OF EXAMS PERFORMED: Please put "X" next to your level of skills and experience as an MRI Technologist.

PROFICIENT RATINGS:
(1) No Clinical Experience, (2) Observed and Assisted, (3) Limited Experience, (4) Competent, (5) Very Proficient

BONE SCAN	No Clinical Proficient				
	1	2	3	4	5
Metastasis					
Osteomyelitis					
Stress Fracture/Shin Splint					
Prosthesis Evaluation (Osteomyelitis vs. Loosing)					
AVN Of Bone					
RENAL SCAN	**1**	**2**	**3**	**4**	**5**

BONE SCAN	No Clinical Proficient				
	1	2	3	4	5
Obstruction / Function (MAG 3)					
Transplanted Kidney (MAG 3)					
Cortical Scar (DMSA)					
Pyelonephritis (DMSA)					
Absolute Split Renal Function (DMSA)					
Testicular Imaging with Flow					
ENDOCRINE IMAGING	**1**	**2**	**3**	**4**	**5**
Parathyroid Adenoma(MIBI)					
Thyroid Uptake Scan (I-123)					
Thyroid Nodule Evaluation (I-123)					
WBS For Thyroid Carcinoma(I-123)					
Thyroid Scan with ^{99m}Tco4					
Adrenal Imagining Cortex/Medulla					

BONE SCAN	No Clinical Proficient				
	1	2	3	4	5
				YES	NO
I have experience in the following equipment (please list)					
1. Picture Archiving and Communication System (PACS)					
2. SECTRA Radiology Information System (RIS)					
3. ICIS Hospital Information System (HIS)					

The information I have provided in this knowledge and skills checklist is true and accurate, to the best of my knowledge.

_____

Signature/Date

APPENDIX 9

Nuclear Medicine Clinical Rotation Competency Checklist R3 & R4

NAME: _____TODAY'S DATE: _____

ACTIVE SCHS #:_____

TYPES OF EXAMS PERFORMED: Please put "X" next to your level of skills and experience as an MRI Technologist.

PROFICIENT RATINGS:
(1) No Clinical Experience, (2) Observed and Assisted, (3) Limited Experience, (4) Competent, (5) Very Proficient

BONE SCAN	No Clinical				Proficient
	1	2	3	4	5
Metastasis					
Osteomyelitis					
Stress Fracture/Shin Splint					
Prosthesis Evaluation (Osteomyelitis vs. Loosing)					
AVN of Bone					

BONE SCAN	No Clinical Proficient				
	1	2	3	4	5
RENAL SCAN	**1**	**2**	**3**	**4**	**5**
Obstruction / Function (MAG 3)					
Transplanted Kidney (MAG 3)					
Cortical Scar (DMSA)					
Pyelonephritis (DMSA)					
Absolute Split Renal Function (DMSA)					
Testicular Imaging with Flow					
ENDOCRINE IMAGING	**1**	**2**	**3**	**4**	**5**
Parathyroid Adenoma(MIBI)					
Thyroid Uptake Scan (I-123)					
Thyroid Nodule Evaluation (I-123)					
WBS For Thyroid Carcinoma(I-123)					
Thyroid Scan with ^{99m}Tco4					

BONE SCAN	No Clinical Proficient				
	1	2	3	4	5
Adrenal Imaging Cortex/Medulla					
HEPATOBILIARY SCINTIGRAPHY	**1**	**2**	**3**	**4**	**5**
GB Ejection Fraction(HIDA Scan)					
Acute Cholecystitis (HIDA Scan)					
Biliary Atresia (HIDA Scan)					
Liver Hemangioma (RBC Study)					
Liver and Spleen Imaging					
INFECTION IMAGING	**1**	**2**	**3**	**4**	**5**
WBC labeled Scan (Whole Body)					
FDG PET-CT (WB)					
Gallium -67 Scan					
PULMONARY IMAGING	**1**	**2**	**3**	**4**	**5**
Lung V/Q Scan					

BONE SCAN	No Clinical Proficient				
	1	2	3	4	5
Pulmonary Quantitative Differential Study					
THERAPEUTIC PROCEDURES	**1**	**2**	**3**	**4**	**5**
I-131 Grave's Therapy					
I-131 Thyroid Carcinoma Therapy					
I-131 MIBG Therapy					
Zevalin for NHL					

Y-90 Joint Injection					
Lu-177 DOTATOC for NET					
Y-90 Microspheres for HCC					
ONCOLOGY IMAGING	**1**	**2**	**3**	**4**	**5**
PET-CT (FDG) For: Distinguishing Benign from Malignant Disease					
Establishing Stage of the Disease					
Establishing Whether There is Recurrent or Residual Disease					
Establishing the Site of Disease when Tumor Markers are Rising					
Establishing Response to Therapy					
Identification for the Primary Site of Biopsy in a Large Tumor					
PET-CT 68 Ga-DOTATOC Scan for NET					
PET-CT 68 Ga-PSMA Scan for Prostate Cancer					
I-123 MIBG Scan					
BRAIN IMAGING	**1**	**2**	**3**	**4**	**5**

PET-CT for: Benign vs. Malignant Disease					
Look for Dementia Causes.					
Look for Epileptic Focus (Interictal).					
CSF Flow Imaging					
CSF Shunt Evaluation					
CSF Leakage Detection					
Brain imaging VASC Flow+ SPECT					
GI IMAGING	**1**	**2**	**3**	**4**	**5**
Gastroesophageal Reflux Study or Milk Scan for Children					
Meckal's Scan					
Gastric Emptying Study					
Acute GI Bleed					
GI Protein Loss					
Salivary Gland Function Study					
Urea Breath Test (C-14)					

CARDIAC IMAGING	1	2	3	4	5
Myocardial Perfusion Scintigraphy (Stress/ Rest)					
Myocardial Viability Scan					
Multigated Acquisition (MUGA)					
Cardiac Shunt Detection					
Myocardial Viability with FDG PET					

						YES	NO
I have experience in the following equipment (please list).							
1. Picture Archiving and Communication System (PACS)							
2. SECTRA Radiology Information System (RIS)							
3. ICIS Hospital Information System (HIS)							

The information I have provided in this knowledge and skills checklist is true and accurate, to the best of my knowledge.

_____

Signature/Date

APPENDIX 10

Computed Tomography Clinical Rotation Competency Checklist R2

NAME: _____TODAY'S DATE: _____

ACTIVE SCHS #:_____

TYPES OF EXAMS PERFORMED: Please put "X" next to your level of skills and experience as an Ultrasound/Sonographer Technologist.

PROFICIENT RATINGS:
(1) No Clinical Experience, (2) Observed and Assisted, (3) Limited Experience, (4) Competent, (5) Very Proficient

	No Clinical				Proficient
	1	2	3	4	5
ABDOMINAL – PROCEDURE					
Anatomy					
CAP Protocol					
ABDO Pelvis Protocol					
Renal Stones protocol					

	No Clinical				Proficient
	1	2	3	4	5
NEURO & ENT	1	2	3	4	5
Anatomy					
BRAIN (Adult) Exam					
BRAIN (Pediatric)					
Sinuses					
Head Neck					
C – Spine					
T – Spine					
L – Spine					
THORACIC	1	2	3	4	5
Anatomy					
Routine Chest Without IV Contrast					
Routine Chest With IV Contrast					

	No Clinical				Proficient
	1	2	3	4	5

I have experience in the following equipment (please list).					YES	NO
PACS (Picture Archiving and Communication System)						
SECTRA Radiology Information System (RIS)						
ICIS Hospital Information System (HIS)						

The information I have provided in this knowledge and skills checklist is true and accurate, to the best of my knowledge.

_____

Signature/Date

APPENDIX 11

Ultrasound / Sonographer Clinical Rotation Competency Checklist R2

RESIDENT'S NAME: _____TODAY'S DATE: _____

ACTIVE SCHS #: _____

TYPES OF EXAMS PERFORMED: Please put "X" next to your level of skills and experience as an Ultrasound/Sonographer Technologist.

PROFICIENT RATINGS:
(1) No Clinical Experience, (2) Observed and Assisted, (3) Limited Experience, (4) Competent, (5) Very Proficient

	No Clinical Proficient				
	1	2	3	4	5
ABDOMINAL– PROCEDURE					
Appendix/Intusseption					
GI Tract					
Liver/Biliary Tract					
Pancreas/Spleen					

	No Clinical Proficient				
	1	2	3	4	5
Renal/Urinary System					
SMALL PARTS– PROCEDURE	**1**	**2**	**3**	**4**	**5**
Abdominal Wall					
Thyroid					
				YES	**NO**
I have experience in the following equipment (please list).					
1. Picture Archiving and Communication System (PACS)					
2. SECTRA Radiology Information System (RIS)					
3. ICIS Hospital Information System (HIS)					

The information I have provided in this knowledge and skills checklist is true

and accurate, to the best of my knowledge.

_____

Signature/Date

APPENDIX 12

Research Evaluation R3

NAME: **Hospital:**

Proposal		N/A	Below Expectations	Borderline	Meets Expectations	Above Expectation
Idea:						
1	Proposed Research idea					
2	Attractive title reflecting content of the research					
Introduction:						
3	Background					
4	Literature Review					
5	Rational					
6	Problem / Gap					
7	Research Question, Objective and Aims					
Methods:						
8	Study Design					
9	Study Settings					
10	Study Population					
11	Sample size / Sampling technique					
12	Data collection methods					
13	Analysis methods and programs					
14	Timeframes					
Conclusion:						
15	Conclusion					
16	References					
IRB:						
17	Submission to IRB					
18	IRB Approval					
Overall:						

APPENDIX 13

Research Evaluation R4

Research		N/A	Below Expectations	Borderline	Meets Expectations	Above Expectation
Introduction:						
1	Background					
2	Literature Review					
3	Rational					
4	Problem / Gap					
5	Research Question, Objective and Aims					
Methods:						
6	Study Design					
7	Study Settings					
8	Study Population					
9	Sample size / Sampling technique					
10	Data collection methods					
11	Analysis methods and programs					
12	Timeframes					
IRB:						
13	Submission to IRB					
14	IRB Approval					
Manuscript:						
15	Attractive title reflecting content of the research					
16	Authors					
17	Abstract					
18	Discussion					
19	Results					
20	Conclusions					
21	References					
22	The candidate's role in the research					
Overall:						

NAME: **Hospital:**