الهيئة السعودية للتخصصات الصحية
Saudi Commission for Health Specialties

MEDICAL PHYSICS FOR THERAPEUTIC RADIATION

2024

بسم الله الرحمن الرحيم

PREFACE

- The primary goal of this document is to enrich the training experience of postgraduate trainees by outlining their learning objectives for becoming independent and competent future practitioners.
- This curriculum may contain sections outlining training regulations; however, such regulations must be obtained from the "General Bylaws of Training in Postgraduate Programs" and "executive policies" published by the Saudi Commission for Health Specialties (SCFHS), which can be accessed online through the official SCFHS website. In case of discrepancies in regulation statements, the one stated in the most updated bylaws and executive policies should be referred to.
- As this curriculum is subject to periodic refinement, please refer to the electronic version posted online for the most updated edition at: www.scfhs.org.sa

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II. COPYRIGHT STATEMENTS

We also acknowledge that the CanMEDS framework is a copyright of the Royal College of Physicians and Surgeons of Canada and that many of the descriptions' competencies have been acquired from their resources. (Please refer to: Frank JR, Snell L, Sherbino J, editors. CanMEDS 2015 Physician Competency Framework. Ottawa: Royal College of Physicians and Surgeons of Canada; 2015.)

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IV. INTRODUCTION

1. Context of Practice

Therapeutic radiology physics is a branch of medical physics that deals with the use of radiation to treat various diseases, especially cancer. Therapeutic medical physicists are responsible for ensuring the safe and effective delivery of radiation therapy as well as developing and implementing new technologies and techniques to improve patient outcomes. Therapeutic physicists work closely with radiation oncologists, dosimetrists, radiation therapists, and other healthcare professionals to provide optimal patient care.

The demand for therapeutic physicists is increasing globally and nationally owing to the rising incidence and prevalence of cancer and advancements in radiation therapy modalities. According to the World Health Organization (WHO), cancer is the second leading cause of death globally, accounting for approximately 10 million deaths in 2020 [1]. In Saudi Arabia, cancer is a major public health problem with an estimated 31,249 new cases and 16,209 deaths reported in 2020. The most common types of cancer in Saudi Arabia are breast, colorectal, lung, prostate, and thyroid. Radiation therapy, along with surgery and chemotherapy, is one of the main modalities used for cancer treatment. It is estimated that approximately 50% of all patients with cancer benefit from radiation therapy at some point during treatment. However, the availability and accessibility of radiation therapy services vary widely across regions and countries depending on the level of development, infrastructure, human resources, and financial resources [2]. The International Atomic Energy Agency (IAEA) developed a comprehensive methodology to assess the needs and gaps in radiation therapy, known as the integrated mission of the Programme of Action for Cancer Therapy (imPACT) Review. According to the latest imPACT Review for Saudi Arabia conducted in 2017, there were 11 radiation therapy centers in the country, with a total of 38 linear accelerators, one cobalt-60 unit, and six brachytherapy units. The imPACT Review also identified several challenges and recommendations for the improvement of radiation therapy services in Saudi Arabia, such as the need for additional equipment, staff, training, quality assurance (QA), and research [3,4].

The Saudi Medical Physics for Therapeutic Radiology Program was designed to address the national demands for the specialty of therapy medical physics (i.e. radiation oncology physics). There is a significant shortage of Saudi medical physics professionals specializing and trained in radiation oncology physics in both the current and newly established radiation oncology centers, highlighting the urgent need for structured training opportunities.

The Saudi Board of Medical Physics for Therapeutic Radiology is a residency program that aims to produce Qualified Medical Physicists (QMP) who practice radiation therapy safely and meet healthcare needs. Upon successful completion of this training program, medical physics residents will be awarded the "Saudi Board of Medical Physics for Therapeutic Radiology" qualification. Graduates will have a degree of competency and experience considered adequate to practice radiotherapy medical physics and will become eligible for positions in the radiotherapy department as Therapy Medical Physicist Consultants after fulfilling the requisite years of experience and classification requirements of the Saudi Commission for Health Specialties (SCFHS). The program is based on well-structured internationally accredited residency programs, such as the Commission on Accreditation of Medical Physics Education Programs (CAMPEP) [5] and the IAEA's Clinical Training of Medical Physicists Specializing in Radiation Oncology (IAEA-TCS-37) [6], which are widely recognized and adopted in several countries worldwide. The program consists of three years of supervised clinical training, covering the core competencies and learning objectives of therapeutic radiology medical physics, with exposure to other medical physics subspecialties that have increasing roles in radiotherapy planning and treatment. The program also includes academic activities such as lectures, seminars, journal clubs, and research projects. The program is evaluated through regular assessments, such as written and clinical examinations, case presentations, and portfolio reviews. The program is adapted from the Canadian Medical

Education Directives for Specialists (CanMEDS) framework [7] and follows the standards and regulations of the SCFHS.

The importance of a residency program in medical physics for therapeutic radiology is evident in the following aspects:

- It provides a structured and comprehensive curriculum that covers the theoretical and practical aspects of therapeutic medical physics, ensuring the quality and consistency of education and training.
- It prepares residents to be competent and confident in their clinical practice, thereby enhancing their professional skills and performance.
- It enables residents to obtain a recognized and reputable qualification, increasing their career opportunities and prospects.
- It contributes to the development and advancement of the therapeutic medical physics profession, addressing current and future needs and challenges in the field.
- It supports the improvement and expansion of radiation therapy services in Saudi Arabia, meeting the healthcare needs and expectations of society.

The practice of therapy medical physics covers a wide range of topics and procedures related to radiotherapy, including radiation dosimetry, treatment planning, quality control, radiation safety, radiation biology, radiation oncology, brachytherapy, stereotactic radiosurgery, intensity-modulated radiation therapy, image-guided radiation therapy, adaptive radiation therapy, and particle therapy.

The future needs and challenges of therapy physics include the following:

- Keeping up with the rapid development and innovation of radiation therapy technologies and techniques, which requires constant updating of knowledge and skills.
- Ensuring the quality and safety of radiation therapy services, which requires the implementation of standards, guidelines, and protocols.

- Addressing the shortage and uneven distribution of therapeutic medical physicists, which requires the development of education and training programs as well as the promotion of the profession.
- Enhancing collaboration and communication among therapeutic medical physicists and other stakeholders, such as radiation oncologists, dosimetrists, radiation therapists, and patients.
- Advancing the research and evidence base in therapeutic medical physics, which requires the establishment of research networks, platforms, and funding.

2. Goals and Responsibilities of Curriculum Implementation

This curriculum seeks to guide trainees to become *competent* medical physicists in the field of therapy medical physics. Accordingly, this goal requires significant effort and coordination from all stakeholders involved in postgraduate training. As *"adult-learners,"* trainees must be proactive, fully engaged, and exhibit the following: a careful understanding of the learning objectives, self-directed learning, problem solving, an eagerness to apply learning via reflective practice from feedback and formative assessment, self-awareness, and the willingness to ask for support when needed. The Program Director plays a vital role in ensuring the successful implementation of this curriculum. Moreover, training committee members, particularly the program administrator and chief resident, significantly impact program implementation. Trainees should be called upon to share the responsibility for curriculum implementation.

The strategic direction of the SCFHS applies a recognized competency model of training governance to achieve the highest quality of training, and postgraduate programs are also required to cover research and evidence-based practices in their curriculum. Additionally, academic affairs in training centers and regional supervisory training committees play major roles in training supervision and implementation. The Specialty Scientific Council/Committee guarantee that the content of this curriculum will be constantly updated to match the highest standards in the postgraduate education of the trainees' specialty.

The purpose of this curriculum is to define the training process and competencies required for the award of the Saudi Board Certification in Medical Physics for Therapeutic Radiology. After training, the medical physics graduate will have the competencies required to work as a Qualified Medical Physicist (QMP) in radiation oncology.

V. ABBREVIATIONS

Abbreviation	Description
ALARA	As Low As Reasonably Achievable
CAMPEP	Commission on Accreditation of Medical Physics Education Programs
CanMEDS	Canadian Medical Education Directives for Specialists
CT	Computed Tomography
CTV	Clinical Target Volume
DRRs	Digitally Reconstructed Radiographs
EUD	Equivalent Uniform Dose
gEUD	Generalized Equivalent Uniform Dose
GTV	Gross Tumor Volume
HDR	High Dose Rate (brachytherapy)
ICRU	International Commission on Radiation Unit and Measurements
imPACT	Integrated Mission of Programme of Action for Cancer Therapy
IMRT	Intensity-Modulated Radiotherapy
IORT	Intra-Operative Radiotherapy
ITV	Internal Target Volume

Abbreviation	Description
LDR	Low Dose Rate (brachytherapy)
LET	Linear Energy Transfer
LINAC	Linear Accelerator
MIP	Maximum Intensity Projection
MRI	Magnetic Resonance Imaging
NTCP	Normal Tissue Complication Probability
PBL	Practice-based Learning
PDR	Pulsed Dose Rate (brachytherapy)
PET	Positron Emission Tomography
PRV	Planning Organ at Risk Volume
PTV	Planning Target Volume
QA	Quality Assurance
QC	Quality Control
QMP	Qualified Medical Physicist
RBE	Relative Biological Effectiveness
RT	Radiotherapy
SAD	Source-to-Axis Distance
SBRT	Stereotactic Body Radiation Therapy
SCFHS	Saudi Commission for Health Specialties

Abbreviation	Description
SPECT	Single-Photon Emission Computed Tomography
SRS	Stereotactic Radiosurgery
SSD	Source-to-Surface Distance
TBI	Total Body Irradiation
TCP	Tumor Control probability
TSET	Total Skin Electron Treatment
US	Ultrasonography OR Ultrasound
VMAT	Volumetric Modulated Arc Therapy

VI. PROGRAM ENTRY REQUIREMENTS

Residents applying for the Medical Physics for Therapeutic Radiology residency program must have the following:

- A university degree in physics, medical physics, engineering, or equivalent physical science
- A minimum of a master's degree in medical physics
- A proven proficiency in written and oral communication English (e.g., an IELTS score of at least 6.5, or equivalent)
- Pass an admission examination and interview
- Comply with any applicable SCFHS credentialing criteria.

Applicants are advised to refer to the executive policy of the SCFHS on admission and registration on the SCFHS website for up-to-date information.

VII. LEARNING AND COMPETENCIES

1. Introduction to Learning Outcomes and Competency-based Education

This training is guided by well-defined "*learning objectives*" that are driven by targeted "*learning outcomes*" of the residency program to serve the needs of the specialty of Medical Physics in Radiation Oncology. Learning outcomes reflect the professional "*competencies*" and tasks that are "*entrusted*" to trainees upon graduation. This ensures that graduates meet the expected demands of the healthcare system and patient care in relation to their specialty. *Competency-based education* (CBE) is an approach to "*adult-learning*" that is based on achieving *pre-defined*, *fine-grained, and well-paced* learning objectives driven from complex professional competencies.

Professional competencies related to healthcare are typically complex and contain a mixture of multiple learning domains (knowledge, skills, and attitude). CBE is expected to change traditional methods of postgraduate education. For instance, the training duration, though a precious resource, should not be considered a proxy for *competence* (e.g., the time of a rotation in certain hospital areas is not the primary marker of competence achievement). Furthermore, CBE emphasizes the critical role of informed judgment in learners' competency progress, based on a staged and formative assessment driven by multiple workplace-based observations. Several CBE models have been developed for postgraduate education in healthcare (e.g., CanMEDS by the Royal College of Physician and Surgeon of Canada (RCPSC), the CBME-Competency model by the Accreditation Council for Graduate Medical Education (ACGME), Tomorrow's Doctors in the UK, and multiple others). The following concepts enhance the implementation of CBE in this curriculum.

- **Competency:** Competency is a cognitive construct that assesses one's potential to perform efficiently in a given situation based on professional standards. Professional roles (e.g., medical experts, health advocates, communicators, leaders, scholars, collaborators, and professionals) are used to define competency roles to make them amendable for learning and assessment.
- **Milestones**: Milestones are the stages of the developmental journey throughout the competency continuum. Throughout their learning journey from junior to senior levels, trainees will be assisted in transforming from (novice/supervised) to (master/unsupervised) practitioners. This should not undermine the role of supervisory/regulatory bodies toward malpractice of independent practitioners. Milestones are expected to enhance the learning process by pacing training/assessment to match the developmental level of trainees (junior vs. senior).
- **Learning Domains:** Learning outcomes are annotated with the corresponding domain (K=Knowledge, S=Skills, and A=Attitude). A given learning outcome may have more than one annotation.
- **Trainees** are expected to progress from novice to master's level in a certain set of professional competencies. The SCFHS has endorsed CanMEDS to articulate professional competencies. This curriculum applies the principles of competency–based medical education. CanMEDS is a globally accepted framework that outlines competency roles, and the CanMEDS 2015 framework is adopted in this program.

2. Program Durations

Medical Physics for Therapeutic Radiology is a three-year residency program divided into two levels: junior level in the first two years (R1 and R2) and senior level in the final year (R3).

3. Program Rotations

The residency rotations throughout the three-year program include clinical rotations structured as follows:

Training Year	Rotation name	Duration (# of blocks)	Setting
R1	• Hospital Orientation	1	Hospital setting
	• Radiation Protection & Safety	2	Radiation Safety Office
	• General Clinical Nuclear Medicine Physics	2	Nuclear Medicine Dep.
	• General Clinical Diagnostic Imaging Physics	2	Diagnostic Imaging Dep.
	• General Clinical Radiation Oncology Physics	5	Radiation Oncology Dep.
	Vacation	1	
R2	• Treatment Equipment and Quality Assurance	4	Radiation Oncology Dep.
	• Treatment Planning I	4	
	• Treatment Planning II	4	
	Vacation	1	
R3	• Special Techniques in Radiotherapy (RT)	2	Radiation Oncology Dep.
	• Brachytherapy	4	
	• Clinical Physics Practice & Research Project	6	
	Vacation	1	

- Each block consists of four weeks.
- Vacations: Following SCFHS regulations, the training hospital's policy, and with the approval of the program director, the resident is granted four weeks of annual leave, in addition to Eid and public holidays.

4. Mapping of learning objectives and competency roles to program rotations

R1 Radiation Oncology Physics Rotations

Rotation1: Hospital Orientation

Introduction:

This rotation will allocate the time needed for residents to complete the required hospital induction program and familiarize themselves with the department, facility, and system.

Learning objectives:

At the end of this rotation, the resident will

Therapy Physics Expert

- Complete all the safety and operation training required by the specific institution and relevant training departments within the required time [K,S]

Collaborator

- Participate in meetings and educational/training sessions [S,A]

Scholar

- Recognize and reflect upon learning and practice issues [S,A]

Professional

- Respect patient confidentially, privacy and autonomy [S,A]
- Demonstrate proper communication and professional appearance [S,A]

- Demonstrate professional work habits, such as being punctual, available, and organized [A]

Duration:

4 weeks

Setting:

Hospital setting and radiation oncology department with designated teaching and training facilities (e.g., conference rooms)

Assessment Tools:

DOPS (1. Basic Fire Safety, 2. Basic Life Support), MCQs, and SOE

Rotation 2: Radiation Protection and Safety

Introduction:

This rotation will provide residents with the necessary knowledge on healthcare radiation protection and safety and a comprehensive understanding of international guidelines and practices for the safe use and application of radiation sources.

Learning objectives:

By the end of this rotation, the resident will be able to

Therapy Physics Expert

- Determine the basics of radiation protection and management (time, distance, shielding, external and internal exposure, radiation dose limits, personnel monitoring, radiation protection regulations, calibration certificate management, radioactive waste types and management, and environmental dispersion) [K]
- Recognize and differentiate local regulations and international guidelines in radiation protection [K]
- Perform shielding calculations of radiation oncology facilities [K,S]
- Safely and properly handle radioactive sources and radiation emitting devices [K,S]

- Determine the functions/uses of and perform measurements using various radiation survey/contamination equipment [K,S]
- Apply statistics in radiation protection guidelines [K,S]

Communicator

- Realize the limits of their expertise and judge when it is appropriate to seek support or escalate to seniors, QMPs, or consultants in a timely manner [S,A]
- Recognize challenging communication issues [K,A]

Collaborator

- Work with others to assess, plan, provide, and integrate care for patients [S,A]
- Participate in departmental and physics meetings [A]

Scholar

- Recognize and reflect upon learning and practice issues [S,A]
- Engage in educational/training sessions [A]

Health Advocate

- Apply ALARA principles in daily practice to justify the application of ionization radiation to patients and staff [K,S,A]

Professional

- Follow team ethics regarding confidentiality, resource allocation, and professionalism [S,A]
- Respect patient confidentially, privacy, and autonomy [S,A]
- Demonstrate proper communication and professional appearance [S,A]
- Demonstrate professional work habits, such as being punctual, available, and organized [A]

Duration:

8 weeks

Setting:

Hospital setting within the radiation safety office/health physics department, with designated teaching and training facilities.

Assessment Tools:

DOPS (1. Radioactive handling and waste management, 2. Radiation Shielding Survey), CbD, Logbook, MCQs, and SOE

Rotation 3: General Clinical Nuclear Medicine Physics

Introduction:

This rotation will provide residents with core concepts and the roles, responsibilities, and safety aspects of nuclear medicine physics.

Learning objectives:

By the end of this rotation, the resident will be able to

Therapy Physics Expert

- Identify the role of a nuclear medical physicist and related health specialists [K]
- Recognize radiation sources (devices and radioisotopes) [K]
- Recognize radiation protection devices and their uses [K]
- Perform basic QA tests using dedicated devices and analyze the test results [K,S]

Communicator

- Realize the limits of their expertise and judge when it is appropriate to seek support or escalate to seniors, QMPs, or consultants in a timely manner [S,A]
- Recognize challenging communication issues [K,A]

Collaborator

- Work with others to assess, plan, provide, and integrate care for patients [S,A]
- Participate in departmental and physics meetings [A]

Scholar

- Recognize and reflect upon learning and practice issues [S,A]
- Engage in educational/training sessions [A]

Health Advocate

- Apply ALARA principles in daily practice to justify the application of ionization radiation to patients and staff [K,S,A]

Professional

- Follow team ethics regarding confidentiality, resource allocation, and professionalism [S,A]
- Respect patient confidentially, privacy, and autonomy [S,A]
- Demonstrate proper communication and professional appearance [S,A]
- Demonstrate professional work habits, such as being punctual, available, and organized [A]

Duration:

8 weeks

Setting:

Hospital setting within the Nuclear Medicine Department with designated teaching and training facilities.

Assessment Tools:

DOPS (1. Daily Quality Assurance Test of a Nuclear Imaging Equipment, 2. Dose Calibrator Quality Testing), CbD, Logbook, MCQs, and SOE

Rotation 4: General Clinical Diagnostic Imaging Physics

Introduction:

This rotation will provide residents with core concepts and the roles, responsibilities, and safety aspects involved in diagnostic imaging physics.

Learning objectives:

By the end of this rotation, the resident will be able to

Therapy Physics Expert

- Identify the role of a diagnostic imaging physicist and related health specialists [K]
- Recognize imaging devices (ionizing and non-ionizing radiation-based) [K]
- Recognize radiation protection devices and their uses [K]
- Perform basic QA tests using dedicated devices and analyze the test results [K,S]

Communicator

- Realize the limits of their expertise and judge when it is appropriate to seek support or escalate to seniors, QMPs, or consultants in a timely manner [S,A]
- Recognize challenging communication issues [K,A]

Collaborator

- Work with others to assess, plan, provide, and integrate care for patients [S,A]
- Participate in departmental and physics meetings [A]

Scholar

- Recognize and reflect upon learning and practice issues [S,A]
- Engage in educational/training sessions [A]

Health Advocate

- Apply ALARA principles in daily practice to justify the application of ionization radiation to patients and staff [K,S,A]

Professional

- Follow team ethics regarding confidentiality, resource allocation, and professionalism [S,A]
- Respect patient confidentially, privacy, and autonomy [S,A]
- Demonstrate proper communication and professional appearance [S,A]

- Demonstrate professional work habits, such as being punctual, available, and organized [A]

Duration:

8 weeks

Setting:

Hospital setting within the Diagnostic Imaging Department. Classrooms with all necessary related facilities and the capacity to present and conduct the required educational sessions.

Assessment Tools:

DOPS (1. Quality Assurance Testing of a Diagnostic Imaging Equipment, 2. Radiation Dose from Imaging Determination), CbD, Logbook, MCQs, and SOE

Rotation 5: General Clinical Radiation Oncology Physics

Introduction:

This rotation will provide residents with a comprehensive overview, functions, and workflow of a typical radiation oncology department. This will include an understanding of the roles and responsibilities of the various professionals involved and the variety of tools and equipment used to image and treat patients in a safe and precise manner.

Learning objectives:

By the end of this rotation, the resident will be able to

Therapy Physics Expert

- Identify the role of a radiation oncology physicist and related health specialists [K]
- Recognize radiotherapy systems (linear accelerators, brachytherapy units, simulators) [K]
- Perform basic QA tests using dedicated devices and analyze the test results [K,S]
- Participate in basic treatment planning [K,S]
- Recognize radiation protection devices and their uses [K]

- Recognize the workflow of radiotherapy (RT) [K]
- Recognize R2 and R3 rotations (treatment planning, QA, special techniques in RT, and brachytherapy) [K]

Communicator

- Realize the limits of their expertise and judge when it is appropriate to seek support or escalate to seniors, QMPs, or consultants in a timely manner [S,A]
- Recognize challenging communication issues [K,A]

Collaborator

- Work with others to assess, plan, provide, and integrate care for patients [S,A]
- Participate in departmental and physics meetings [A]

Scholar

- Recognize and reflect upon learning and practice issues [S,A]
- Engage in educational/training sessions [A]

Health Advocate

- Apply ALARA principles in daily practice to justify the application of ionization radiation to patients and staff [K,S,A]

Professional

- Follow team ethics regarding confidentiality, resource allocation, and professionalism [S,A]
- Respect patient confidentially, privacy, and autonomy [S,A]
- Demonstrate proper communication and professional appearance [S,A]
- Demonstrate professional work habits, such as being punctual, available, and organized [A]

Duration:

20 weeks

Setting:

Hospital setting within a radiation oncology department with designated teaching and training facilities.

Assessment Tools:

DOPS (1. Daily Quality Assurance Testing of a Linear Accelerator, 2. Radiation Treatment Planning of a Palliative Case, 3. Mechanical Test of a Radiotherapy Equipment), CbD, Logbook, MCQs, and SOE

R2 Radiation Oncology Physics Rotations

Rotation 6: Treatment equipment and quality assurance

Introduction:

This rotation will cover the technical aspects and functions of radiation-producing equipment used in a radiation oncology department. Furthermore, it will cover the different initial and periodic measurements and QA tests required to implement and safely use these tools in day-to-day clinical operations.

Learning objectives:

By the end of this rotation, the resident will be able to

Therapy Physics Expert

Equipment Selection:

- Recognize the theory of operation of megavoltage electron and proton accelerators currently used in radiation oncology treatment and their limitations (e.g., linear accelerators (linacs), synchrotrons, and cyclotrons) [K]
- Recognize the major subsystems and uses of cobalt units [K]
- Recognize the major subsystems and components of megavoltage accelerators [K]
- Describe the steps required to select a new linac for use in radiation oncology based on an understanding of performance specifications and feature comparisons [K]

- Explain the mechanical/architectural considerations when installing a new particle accelerator in both new and existing vaults (with discussions addressing heating, ventilation, and air conditioning [HVAC] openings, cabling for communication and dosimetry systems, electrical ports, plumbing, and skyshine) [K]

Acceptance/Commissioning:

- Competently perform the mechanical, safety, and radiation tests required during accelerator acceptance and commissioning [K,S,A]
- Implement the process for defining the treatment beam isocenter of a gantry-based particle accelerator and its relation to the mechanical isocenter of the gantry and any on-board imaging isocenters [K,S]
- Perform tests on treatment unit head radiation leakage and shielding adequacy [K,S]
- Independently set up and perform water tank scans for photon and electron beam measurements that calibrate and characterize these external beams to facilitate computerized treatment planning and manual calculations of the radiation dose to a point [K,S,A]
- Process water tank scans and analyze the results, including the typically accepted tolerances for each test [K,S]
- Recognize acceptance, commissioning, and ongoing annual QA requirements for radiation treatment planning system rotations for external beam treatments [K]

Calibration:

- Discuss the use of instrumentation (e.g., theory of operation and limitations) and protocols that may be employed in calibrating radiation treatment beams with energies in the megavoltage range [K]
- Explain how and why phantoms are used for physical measurements [K]
- Describe the correction factors used for photon and electron calibration measurements [K]

- Competently calibrate the megavoltage external beams of photons and electrons using a recognized national or international protocol [K,S,A]

Quality Assurance:

- Recognize the pertinent recommendations for QA of linacs [K]
- Recognize in-house QA documentation and procedures [K]
- Competently perform routine (daily/weekly/monthly/annual) QA tests of external beam treatment units [K,S,A]
- Competently analyze routine QA tests of external beam treatment units [K,S,A]
- Recognize the basis of accepted tolerances for routine QA tests performed on treatment units and required actions should any of the checks exceed the tolerance [K]
- Recognize external beam treatment unit malfunction management [K]
- Competently perform end-to-end checks of patient treatment plans using phantom images and data [K,S,A]
- Recognize the connectivity requirements of external beam treatment units to treatment simulators, on-board imaging systems, recording and verification systems, and electronic medical record systems [K]

Communicator

- Realize the limits of their expertise and judge when it is appropriate to seek support or escalate to seniors, QMPs, or consultants in a timely manner [S,A]
- Address challenging communication issues effectively [S,A]
- Support and educate others (residents, dosimetrists, radiotherapists, and nurses) regarding the knowledge and practice of clinical physics [S,A]

Collaborator

- Work with others to assess, plan, provide, and integrate care for patients [S,A]
- Participate in committees and meetings effectively [S,A]

Scholar

- Recognize and reflect upon learning and practice issues [S,A]
- Engage in educational/training session [K,S,A]

Health Advocate

- Apply ALARA principles in daily practice to justify the application of ionization radiation to patients and staff [K,S,A]
- Identify opportunities for advocacy regarding patient safety and quality improvement [S,A]
- Identify patient and safety events in radiation oncology, report events in internal/hospital reporting systems, and participate in the analysis of safety events [K,S,A]

Professional

- Follow team ethics regarding confidentiality, resource allocation, and professionalism [S,A]
- Respect patient confidentially, privacy, and autonomy [S,A]
- Demonstrate proper communication and professional appearance [S,A]
- Demonstrate professional work habits, such as being punctual, available, and organized [A]

Duration:

16 weeks

Setting:

Hospital setting within a radiation oncology department with designated teaching and training facilities.

Assessment Tools:

DOPS (1. Annual Quality Assurance Testing of a Linear Accelerator, 2. Output Calibration of Photon/Electron Beams, 3. Dosimetric Characterization of Photon/Electron Beams, 4.

End-to-End Testing of a Radiotherapy Process, 5. Patient-Specific Quality Assurance), CbD, Logbook, SOE, and OSCE

Rotation 7: Treatment Planning I

Introduction:

This rotation will provide residents with an understanding and capability to interpret high-energy photon and electron beam profiles as well as the physics involved in the interaction of these beams with matter, leading to dose deposition. This will also include shaping these beams using various beam modifiers to safely irradiate the intended target. Finally, various planning concepts and techniques will be covered, as well as relevant planning evaluation tools.

Learning objectives:

By the end of this rotation, the resident will be able to

Therapy Physics Expert

Beam Properties:

- Recognize the photon and electron percent depth dose in tissue and other media [K]
- Recognize electron ranges (Rp, R80, R90, and R100) at different energies [K]
- Recognize the proton percent depth dose in tissue and other media and the proton ranges at different energies (e.g., stopping and scattering power and range) [K]
- Recognize the potential uncertainties in dose deposition within proton radiotherapy [K]
- Recognize the flatness and symmetry of photon and electron beams [K]
- Differentiate between source-to-axis distance (SAD) and source-to-skin distance (SSD) treatments [K]
- Recognize the applicability of electron and photon therapy with regard to disease, depth, and critical normal structures [K]
- Recognize the impact of dose and fractionation on normal and tumor tissues [K]

- Recognize the impact of beam quality (e.g., linear energy transfer [LET]) on the relative biological effectiveness (RBE) of different forms of ionizing radiation (e.g., electrons, photons, and protons) [K]
- Recognize the uncertainties related to electron and photon therapy (e.g., in terms of physics, biology, and machine and patient setup accuracy) and how they may be detected and mitigated during the planning and delivery processes [K]

Beam Modifier:

- Recognize the effect of beam modifiers (e.g., wedges and compensators) on the dosimetric characteristics of an incident beam [K]
- Identify wedges (wedge and hinge angles) and the different types of wedges used clinically (physical, universal, and dynamic) [K]
- Illustrate the design of the different commercially available multileaf collimators (MLCs) [K]
- Describe blocking and shielding for therapy beams [K]
- Apply custom bolus in radiotherapy planning [K]
- Illustrate the design and use of tissue compensators [K]

Treatment Simulation Techniques:

- Recognize common patient positioning and immobilization devices [K]
- Identify when and how to use specific treatment devices for specific treatments [K]
- Identify methods to account for beam attenuation from patient positioning and immobilization devices in treatment planning [K,S]

Tumor Localization and Normal Tissue Anatomical Contouring:

- Recognize how the structure is delineated on computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET), PET/CT, single photon emission computed tomography (SPECT), or SPECT/ CT datasets [K]

- Explain target volume determination, including the design of the International Commission on Radiation Unit and Measurements (ICRU) target structures (involving concepts such as gross tumor volume (GTV), clinical target volume (CTV), internal target volume (ITV), planning target volume (PTV), and planning organ at risk volume (PRV) [K]
- Illustrate how 4D data are used for target definition and relevant radiation treatment prescription parameters, such as GTV, PTV, CTV, and ITV [K]
- Identify the role of maximum intensity projection (MIP) images in treatment planning [K]
- Identify the role of digitally reconstructed radiographs (DRRs) in treatment planning [K]
- Perform image registration and fusion of datasets for modalities such as CT/CT, CT/MRI, and CT/PET, deformable registration, and image/dose registration [K,S]

Treatment Techniques:

- Recognize 2D coplanar beam treatment planning [K]
- Describe non-coplanar beams (3D) for external beam treatment planning [K]
- Illustrate image-guided radiation therapy techniques with ionizing and non-ionizing radiation [K]
- Identify the use of objective functions for intensity-modulated radiotherapy (IMRT)/ volumetric modulated arc therapy (VMAT) optimization [K]
- Illustrate the optimization processes involved in inverse planning [K]
- Perform the following site-specific 3D or IMRT: [K,S]
- Breast and chest wall including axilla fields and the single isocenter technique
- Brain, spine, and craniospinal irradiation
- Bladder, prostate, and testis
- Gynecological tumors

- Gastrointestinal tumors, e.g., colorectal tumors and tumors of the esophagus, stomach, and liver
- Head and neck tumors
- Common lymphomas including the mantle field technique
- Skin cancers
- Pediatric cancers, and 3D treatment planning for pediatric craniospinal irradiation
- Sarcoma of the trunk and extremities
- Lungs, mediastinum, and thoracic region

Plan Evaluation Tools:

- Illustrate dose-volume histograms (V(dose), D(volume), mean dose; cumulative and differential) [K]
- Illustrate the conformity index [K]
- Illustrate the homogeneity index [K]
- Recognize biological evaluators (e.g., generalized equivalent uniform dose (gEUD), equivalent uniform dose (EUD), normal tissue complication probability (NTCP), and tumor control probability (TCP)) [K]
- Identify the dose tolerances for various normal tissue structures and relevant volume effects [K]

Monitor Unit (MU) Calculation:

- Perform manual monitor unit (MU) calculations for photon and electron beams [K,S]
- Perform MU calculations using heterogeneity corrections [K,S]

Communicator

- Demonstrate effective and respectful communication with stakeholders (consultants/dosimetrists/radiotherapist/physicists/receptionists/patients) during treatment planning [S,A]

- Realize the limits of their expertise and judge when it is appropriate to seek support or escalate to seniors, QMPs, or consultants in a timely manner [S,A]
- Address challenging communication issues effectively [S,A]
- Support and educate others (residents, dosimetrists, radiotherapists, and nurses) regarding the knowledge and practice of clinical physics [S,A]

Collaborator

- Work with others to assess, plan, provide, and integrate care for patients [S,A]
- Participate in committees and meetings effectively [S,A]

Scholar

- Recognize and reflect upon learning and practice issues [S,A]
- Engage in educational/training session [K,S,A]

Health Advocate

- Apply ALARA principles in daily practice to justify the application of ionization radiation to patients and staff [K,S,A]
- Identify opportunities for advocacy regarding patient safety and quality improvement [S,A]
- Identify patient and safety events in radiation oncology, report events in internal/hospital reporting systems, and participate in the analysis of safety events [K,S,A]

Professional

- Follow team ethics regarding confidentiality, resource allocation, and professionalism [S,A]
- Respect patient confidentially, privacy, and autonomy [S,A]
- Demonstrate proper communication and professional appearance [S,A]
- Demonstrate professional work habits, such as being punctual, available, and organized [A]

Duration:

16 weeks

Setting:

Hospital setting within a radiation oncology department with designated teaching and training facilities.

Assessment Tools:

DOPS (1. Manual Treatment Planning, 2. 3DCRT Treatment Planning for Breast Case, 3. 3DCRT Treatment Planning of Breast/Chest wall + Supraclavicular Case, 4. 3DCRT Treatment Planning for a Whole Brain Case, 5. Treatment Planning for a Palliative Abdomen/Spine Case), Min-CEX, CbD, Logbook, SOE, and OSCE

Rotation 8: Treatment Planning II

Introduction:

This rotation builds on the information from Rotation 7, with a particular focus on more advanced treatment planning techniques, planning verification checks, and related planning and machine QA processes.

Learning objectives:

By the end of this rotation, the resident will be able to

Therapy Physics Expert

IMRT/VMAT Delivery:

- Recognize various IMRT delivery techniques (e.g., compensators, static field IMRT, rotational delivery techniques) and their relative advantages and disadvantages [K]
- Differentiate between dynamic multileaf collimator (DMLC) and segmental multileaf collimator (SMLC) leaf-sequencing algorithms in terms of delivery parameters and dose distributions [K]
- Participate in IMRT or VMAT delivery to patients at a variety of treatment sites and demonstrate an understanding of the techniques and requirements for patient setup, immobilization, and localization [K,S,A]

Treatment Planning and Related Quality Assurance Processes:

- Recognize the patient history review process (such as prior radiotherapy and potential overlap with current treatment), disease, course of treatment, and dose prescription) [K]
- Determine the appropriateness of the treatment plan and dose distribution to achieve the goals of the treatment course [K,S]
- Review the simulation process (e.g., patient positioning and immobilization), planning, imaging, and treatment field parameters [K,S]
- Review the planned MUs or treatment times [K,S]
- Review the processing of images used for patient positioning or monitoring [K,S]
- Recognize the review process for the transfer of plan parameters and images to the record, and verify the system and any other patient monitoring systems [K]

Treatment Planning Systems (TPS):

- Illustrate acceptance testing of TPS [K]
- Illustrate commissioning of TPS [K]
- Perform QA of TPS [K,S]
- Illustrate dose calculation algorithms [K]

3D or IMRT Treatment Planning Techniques (Cont.):

- Independently and competently perform the following site-specific 3D or IMRT/VMAT: [K,S,A]
- Breast and chest wall including axilla fields and the single isocenter technique
- Brain, spine, and craniospinal irradiation
- Bladder, prostate, and testis
- Gynecological tumors

- Gastrointestinal tumors, e.g., colorectal tumors and tumors of the esophagus, stomach, and liver
- Head and neck tumors
- Common lymphomas including the mantle field technique
- Skin cancers
- Pediatric cancers, and 3D treatment planning for pediatric craniospinal irradiation
- Sarcoma of the trunk and extremities
- Lungs, mediastinum, and thoracic region

Monitor Unit (MU) Calculation Software:

- Perform acceptance testing [K,S]
- Perform commissioning [K,S]
- Perform QA [K,S]
- Illustrate dose calculation algorithms [K]

Communicator

- Demonstrate effective and respectful communication with stakeholders (consultants/dosimetrists/radiotherapist/physicists/receptionists/patients) during treatment planning [S,A]
- Realize the limits of their expertise and judge when it is appropriate to seek support or escalate to seniors, QMPs, or consultants in a timely manner [S,A]
- Address challenging communication issues effectively [S,A]
- Support and educate others (residents, dosimetrists, radiotherapists, and nurses) regarding the knowledge and practice of clinical physics [S,A]

Collaborator

- Work with others to assess, plan, provide, and integrate care for patients [S,A]
- Participate in committees and meetings effectively [S,A]

Scholar

- Recognize and reflect upon learning and practice issues [S,A]
- Engage in educational/training session [K,S,A]

Health Advocate

- Apply ALARA principles in daily practice to justify the application of ionization radiation to patients and staff [K,S,A]
- Identify opportunities for advocacy regarding patient safety and quality improvement [S,A]
- Identify patient and safety events in radiation oncology, report events in internal/hospital reporting systems, and participate in the analysis of safety events [K,S,A]

Professional

- Follow team ethics regarding confidentiality, resource allocation, and professionalism [S,A]
- Respect patient confidentially, privacy, and autonomy [S,A]
- Demonstrate proper communication and professional appearance [S,A]
- Demonstrate professional work habits, such as being punctual, available, and organized [A]

Duration:

16 weeks

Setting:

Hospital setting within a radiation oncology department with designated teaching and training facilities.

Assessment Tools:

DOPS (1. Quality Testing of a Treatment Planning System, 2. Treatment Planning for a Pediatric Case, 3. Treatment Planning for a Prostate Case, 4. Treatment Planning for a Head

& Neck Case, 5. Treatment Planning for a Craniospinal Case), Min-CEX, CbD, Logbook, SOE, and OSCE

R3 Radiation Oncology Physics Rotations

Rotation 9: Special Techniques in Radiotherapy*

Introduction:

This rotation focuses on non-standard or specialized radiotherapy delivery techniques. Such techniques usually involve a small, dedicated group of experts within the department and may not be available at most radiotherapy facilities.

Learning objectives:

By the end of this rotation, the resident will be able to

Therapy Physics Expert

Stereotactic Radiosurgery (SRS):

- Explain the rationale behind SRS treatments, examples of malignant and nonmalignant lesions treated with SRS, and typical dose and fractionation schemes for linac-based and Cobalt-60 (Co-60) SRS techniques [K]
- Describe the commissioning components of an SRS system (e.g., accurate localization, mechanical precision, accurate and optimal dose distribution, and patient safety) [K]
- Realize the stereotactic localization of a target (e.g., based on angiography as opposed to CT and MRI) and how the accuracy of this localization is measured [K]
- Describe the alignment of coordinate systems (e.g., target frame of reference with the linac frame of reference) and how the mechanical precision of this alignment is measured [K]
- Identify the issues associated with dosimetry measurements for an SRS system (e.g., choice of dosimeter and phantom geometry) [K]
- Illustrate the components of pretreatment QA for an SRS system, including linac-based and Co-60 SRS techniques [K]

- Participate in all aspects of the SRS treatment (i.e., simulation, planning, plan verification, treatment, treatment verification, and in-vivo measurements) [K,S,A]

Stereotactic Body Radiation Therapy (SBRT):

- Explain the rationale behind SBRT treatments, common treatment sites, and typical dose and fractionation schemes [K]
- Describe immobilization and localization systems for SBRT treatments [K]
- Demonstrate the use of simulation imaging for SBRT target definition, including multi-modality and 4D imaging for cases requiring motion management [K]
- Identify the treatment planning objectives for SBRT treatments, including dose limits, dose heterogeneity, dose gradient and fall-off, and beam geometry [K]
- Participate in treatment verification and delivery for SBRT treatments, as well as the use of in-room imaging [K,S]
- Describe the need for motion management in lung and abdomen SBRT treatments [K]
- Participate in the treatment planning system validation tests, and in this context, tissue inhomogeneity corrections and small-field dosimetry measurements [K,S]
- Participate in all aspects of SBRT treatment (i.e., simulation, planning, plan verification, treatment, treatment verification, and in-vivo measurements) [K,S,A]

Total Body Irradiation (TBI):

- Explain the rationale behind TBI treatments for malignant and benign conditions [K]
- Identify TBI prescription and delivery techniques and issues related to clinical commissioning and maintenance of a TBI program [K]
- Illustrate the significance of beam modifiers commonly used during TBI treatments (e.g., lung/kidney blocks and beam spoilers) [K]
- Participate in all aspects of TBI treatment (i.e., simulation, planning, plan verification, treatment, treatment verification, and in-vivo measurements) [K,S,A]

Total Skin Electron Therapy (TSET):

- Explain the rationale behind TSET treatments for malignant and benign conditions [K]
- Describe TSET delivery techniques and issues related to the clinical commissioning and maintenance of a TSET program [K]
- Demonstrate the significance of the A and B factors [K]
- Illustrate the significance of beam modifiers commonly used during TSET treatments (e.g., shields and beam scatter) [K]
- Participate, if possible, in all aspects of TSET treatment (i.e., simulation, planning, plan verification, treatment, treatment verification, and in-vivo measurements) [K,S,A]

Intra-operative Radiotherapy (IORT):

- Explain the rationale behind IORT treatments [K]
- Describe IORT delivery techniques and issues related to the clinical commissioning and maintenance of an IORT program [K]
- Participate, if possible, in all aspects of IORT treatment (i.e., simulation, planning, plan verification, treatment, treatment verification, and in-vivo measurements) [K,S,A]

Orthovoltage and Superficial RT:

- Explain the rationale behind low-energy X-ray treatments for skin lesions [K]
- Identify clinical commissioning requirement [K]
- Participate, if possible, in all aspects of orthovoltage/superficial RT treatment (i.e., simulation, planning, plan verification, treatment, treatment verification, and in-vivo measurements) [K,S,A]

Electron Arc Therapy:

- Describe the rationale behind electron arc therapy [K]
- Realize the clinical commissioning and requirements for an electron arc program [K]

* Note: It is not expected that all medical physics residents will perform all of the above special procedures in training clinics; however, all residents should have sufficient knowledge of these procedures to prepare them for independent clinical practice.

Communicator

- Demonstrate effective and respectful communication with stakeholders (consultants/dosimetrists/radiotherapist/physicists/receptionists/patients) during treatment planning [S,A]
- Realize the limits of their expertise and judge when it is appropriate to seek support or escalate to seniors, QMPs, or consultants in a timely manner [S,A]
- Address challenging communication issues effectively [S,A]
- Support and educate others (residents, dosimetrists, radiotherapists, and nurses) regarding the knowledge and practice of clinical physics [S,A]

Collaborator

- Work with others to assess, plan, provide, and integrate care for patients [S,A]
- Participate in committees and meetings (M&M and patient reviews) effectively [S,A]

Leader

- Chair in committees and meetings [S,A]
- Coordinate teaching/training sessions [S,A]
- Describe the principles of healthcare financing (budgeting, funding, billing, etc.) [K]
- Supervise junior residents in QA and treatment planning [S,A]

Health Advocate

- Apply ALARA principles in daily practice to justify the application of ionization radiation to patients and staff [K,S,A]
- Identify opportunities for advocacy regarding patient safety and quality improvement [S,A]

- Identify patient and safety events in radiation oncology, report events in internal/hospital reporting systems, and participate in the analysis of safety events [K,S,A]

Scholar

- Demonstrate and reflect upon learning and practice issues [S,A]
- Engage in educational/training session [K,S,A]
- Support and educate others (residents, radiotherapists, and nurses) regarding the knowledge and practice of clinical physics [S,A]

Professional

- Follow team ethics regarding confidentiality, resource allocation, and professionalism [S,A]
- Respect patient confidentially, privacy, and autonomy [S,A]
- Demonstrate proper communication and professional appearance [S,A]
- Demonstrate professional work habits, such as being punctual, available, and organized [A]

Duration:

8 weeks

Setting:

Hospital setting within a radiation oncology department (preferably with SRS, SBRT, TBI, and TSET capability) with designated teaching and training facilities.

Assessment Tools:

DOPS (1. Treatment Planning of TBI, TSET, Orthovoltage or IORT Case, 2. Treatment Planning for an SRS/SRT Case, 3. Treatment Planning for an SBRT Lung Case, 4. Treatment Planning for an SBRT Abdomen Case, 5. Quality Testing for SRS/SBRT), Min-CEX, CbD, Logbook, SOE, and OSCE

Rotation 10: Brachytherapy

Introduction:

This rotation will cover the various available brachytherapy techniques, the clinical applications of brachytherapy, and the various radiation safety requirements involved. It will provide students with an in-depth understanding of the physics behind brachytherapy and go through the complete clinical workflow required for brachytherapy treatment, including all the relevant auxiliary devices used, as well as the essential QA procedures needed for accurate and safe delivery.

Learning objectives:

By the end of this rotation, the resident will be able to

Therapy Physics Expert

Sealed Brachytherapy Sources:

- Recognize how commonly used sources are generated [K]
- State the decay, decay energies (mean energy), and half-lives of commonly used sources [K]
- Describe the form and construction of sealed sources [K]
- Define the different units of source strength used in the past and present [K]
- Perform a decay calculation for the total dose delivered for temporary and permanent implants [K]
- Illustrate personal protection techniques (including time, distance, and shielding) and safe handling of sealed sources [K]
- Apply the appropriate methods for storing radioactive materials (regarding security and accountability) [K]
- Demonstrate routine receipt procedures and both checks into inventory and checks out temporary and permanent sources [K,S]
- Demonstrate a source room survey and quarterly inventory [K,S]

- Perform a leak check on sealed sources (if possible) [S]
- Illustrate radioactive material packaging and transportation requirements (as per local regulatory agency codes of practice) with hands-on experience, if possible [K,S]
- Identify the equipment used to calibrate sealed sources [K]
- Illustrate the process by which sealed sources are calibrated [K]
- Illustrate the process by which measurement equipment (e.g., electrometers and well ionization chambers) is calibrated [K]
- Describe the theory of operation of a well ionization chamber [K]
- Demonstrate how an assay for sealed sources is conducted, and if possible, perform [K]
- Comprehend and follow regulatory requirements and licensing issues (as per local regulatory agency codes of practice) [K,A]
- Recognize the operation and appropriateness of different survey instruments (e.g., Geiger–Müller counters, ionization survey meters, and scintillation counters) [K]

Unsealed Radionuclide Sources:

- Describe how commonly used sources (e.g., I-131, P-32, Sm-153, and Sr-89) are generated [K]
- State the decay, decay energies (mean energy), and half-lives of commonly used sources [K]
- Utilize personal protection techniques (including time, distance, and shielding) and safe handling of unsealed sources [S]
- Perform calibration of unsealed sources [K]
- Use and calibrate measurement equipment (e.g., dose calibrator) and demonstrate an understanding of these processes [S]
- Participate in an assay for unsealed sources, and if possible, perform [S]

- Comprehend and follow regulatory and licensing issue requirements (as per the local regulatory agency code of practice) [K,A]
- Describe the operation and appropriateness of different survey instruments (e.g., Geiger–Müller counters, ionization chambers, and scintillation counters) [K]

Brachytherapy Clinical Application:

- Describe the various brachytherapy sources that have been used clinically in the past and are used today, as well as the rationale for source selection [K]
- Identify the main components of a brachytherapy program [K]
- Participate in the use and operation of the following brachytherapy modalities and their advantages and disadvantages: [K,S]
    - Low dose rate (LDR; optional)
    - High dose rate (HDR)
    - Pulsed dose rate (PDR; optional)
    - Electronic (optional)
- Perform source strength verification (air kerma rate, Sk), as well as a comparison between measured and vendor specifications [K,S]
- Illustrate radiation protection requirements for radiation workers and visitors [K]
- Perform commissioning and acceptance of remote afterloaders [K,S]
- Identify gynecologic (GYN) and genitourinary anatomy [K]
- Participate in the treatment of cervical and endometrial cancers with a HDR (mandatory), LDR, and PDR (optional) [K,S]
- Participate in the treatment of prostate cancer with a HDR or LDR [K,S]

Brachytherapy Treatment Planning:

- Define the source strength of radioactive sources [K]

- Discuss dose rates and dose calculation formalisms for high- and low-energy brachytherapy dosimetry [K]
- Describe the performance of computerized planning of various imaging modalities for LDR and HDR [K]
- Describe the advantages and disadvantages of dose optimization [K]
- Realize secondary calculations as QA checks for computerized planning [K]
- Perform treatment planning commissioning [K,S]
- Perform brachytherapy treatment plans for a cylindrical GYN applicator [K,S]
- Perform brachytherapy treatment plans for cervical applicators (e.g., tandem and ovoids, and tandem and ring) [K,S]
- Differentiate between point- and volume-based treatment planning as per the ICRU 38 and Groupe Européen de Curiethérapie (GEC) European Society for Radiotherapy and Oncology (ESTRO) recommendations [K]
- Develop interstitial brachytherapy treatment plans (e.g., prostate cancer, GYN diseases, and sarcoma) [K,S]
- Develop a brachytherapy treatment plan for eye plaques (optional) [K,S]
- Perform activity/dose calculations for microsphere therapy (optional) [K,S]
- Perform applicator acceptance, commissioning, and periodic QA [K,S]
- Perform periodic spot checks, safety procedures, and source exchange QA, including source calibration [K,S]
- Participate in and realize emergency training requirements for remote afterloaders (as per international codes of practice) [K,S]
- Follow quality management programs as required by local regulations for auditing [K,A]
- Illustrate the criteria for the recording/reporting and subsequent handling of reportable events [K]

Brachytherapy Imaging:

- Describe the mathematics of localization of the target volume and catheter reconstruction by orthogonal films (2D) [K]
- Perform CT-/MRI-/US-/PET-based localization of regions of interest (ROIs) and of catheter reconstruction [K,S]

Brachytherapy QA:

- Perform a comprehensive periodic QA (daily, monthly, and annual) of a remote brachytherapy afterloader [K,S]
- Perform periodic treatment planning QA [K,S]
- Perform implant-specific QA [K,S]

Communicator

- Demonstrate effective and respectful communication with stakeholders (consultants/dosimetrists/radiotherapist/physicists/receptionists/patients) during treatment planning [S,A]
- Realize the limits of their expertise and judge when it is appropriate to seek support or escalate to seniors, QMPs, or consultants in a timely manner [S,A]
- Address challenging communication issues effectively [S,A]
- Support and educate others (residents, dosimetrists, radiotherapists, and nurses) regarding the knowledge and practice of clinical physics [S,A]

Collaborator

- Work with others to assess, plan, provide, and integrate care for patients [S,A]
- Participate in committees and meetings (M&M and patient reviews) effectively [S,A]

Leader

- Organize and lead in committees and meetings [S,A]
- Coordinate teaching/training sessions [S,A]
- Identify the principles of healthcare financing (budgeting, funding, billing, etc.) [K]

- Realize the importance of just allocation of healthcare resources [K,A]
- Engage in the assessment and enhancement of systematic procedure for quality control and patient safety initiatives [S,A]
- Supervise junior residents in QA and treatment planning [S,A]

Health Advocate

- Apply ALARA principles in daily practice to justify the application of ionization radiation to patients and staff [K,S,A]
- Identify opportunities for advocacy regarding patient safety and quality improvement [S,A]
- Identify patient and safety events in radiation oncology, report events in internal/hospital reporting systems, and participate in the analysis of safety events [K,S,A]

Scholar

- Demonstrate and reflect upon learning and practice issues [S,A]
- Engage in educational/training session [K,S,A]
- Support and educate others (residents, radiotherapists, and nurses) regarding the knowledge and practice of clinical physics [S,A]

Professional

- Follow team ethics regarding confidentiality, resource allocation, and professionalism [S,A]
- Respect patient confidentially, privacy, and autonomy [S,A]
- Demonstrate proper communication and professional appearance [S,A]
- Demonstrate professional work habits, such as being punctual, available, and organized [A]

Duration:

16 weeks

Setting:

Hospital setting within a radiation oncology department (including a brachytherapy facility) with designated teaching and training facilities.

Assessment Tools:

DOPS (1. Brachytherapy Treatment Planning for a Cylindrical GYN Applicator, 2. Brachytherapy Treatment Planning for a Cervical Applicator, 3. Brachytherapy Treatment Planning for an Interstitial Applicator, 4. Source Calibration of a Radioactive Source, 5. Quality Testing of a Brachytherapy Afterloader Unit), Min-CEX, CbD, Logbook, SOE, and OSCE

Rotation 11: Clinical Physics Practice & Research Project

Introduction:

During the final rotation, the resident will assist in the daily clinical physics tasks required in the radiation oncology department and in supporting, troubleshooting, and consultations. The resident will also work on a clinical physics research project and prepare a report detailing the specifics of the project under a research mentor.

It is expected that the resident will work on the project alongside clinical work.

Learning objectives:

By the end of this rotation, the resident will be able to

Therapy Physics Expert

- Provide clinical physics support with minimal supervision in the radiation oncology department [K,S,A]
- Perform, analyze, and make decisions regarding QA tests and compliance [K,S,A]
- Serve and assist in treatment planning and 2nd check physics tasks [K,S,A]
- Recognize the ethical requirements of research and demonstrate an understanding of the responsible use of informed consent [K,A]
- Practice appropriate methods for writing and reporting research proposals, manuscripts, data collection, result analysis, and discussions [S]

- Demonstrate awareness of current research topics in radiation oncology/medical physics [K,S]

Communicator

- Demonstrate effective and respectful communication with stakeholders (consultants/dosimetrists/radiotherapist/physicists/receptionists/patients) during the treatment planning process [S,A]
- Realize the limits of their expertise and judge when it is appropriate to seek support or escalate to seniors, QMPs, or consultants in a timely manner [S,A]
- Address challenging communication issues effectively [S,A]
- Support and educate others (residents, dosimetrists, radiotherapists, and nurses) regarding the knowledge and practice of clinical physics [S,A]
- Communicate and collaborate effectively with the research supervisor to conduct the research [S,A]
- Present the clinical project at a medical physics residency training session, departmental seminar, or conference and participate in public discussions [K,S,A]

Collaborator

- Work with others to assess, plan, provide, and integrate care for patients [S,A]
- Participate in committees and meetings (M&M and patient reviews) effectively [S,A]
- Identify, consult, and collaborate with appropriate experts, research institutions, and/or organizational bodies to facilitate research [S,A]

Leader

- Organize and lead in committees and meetings [S,A]
- Assist in training and teaching junior residents, patients, and other health specialists [K,A]
- Supervise junior residents in QA and treatment planning [S,A]

- Identify an area of research interest and a research supervisor to engage in the scholarship of scientific inquiry and dissemination [S,A]
- Utilize available resources and regularly meet with an identified research mentor [S,A]
- Set realistic priorities and use time effectively to optimize professional performance [S,A]

Health Advocate

- Apply ALARA principles in daily practice to justify the application of ionization radiation to patients and staff [K,S,A]
- Identify opportunities for advocacy regarding patient safety and quality improvement [S,A]
- Identify patient and safety events in radiation oncology, report events in internal/hospital reporting systems, and participate in the analysis of safety events [K,S,A]
- Recognize the contributions of scientific research in improving the health of patients and communities [K]

Scholar

- Recognize and reflect upon learning and practice issues [S,A]
- Engage in educational/training session [K,S,A]
- Support and educate others (residents, radiotherapists, and nurses) regarding the knowledge and practice of clinical physics [S,A]
- Undertake and lead a collaborative clinical/physics research project with a medical resident, medical consultant, or QMP [K,S,A]
- Produce a written report upon completion of the clinical project. This manuscript is expected to be submitted for publication in a peer-reviewed journal [K,S,A]
- Identify research limitations and areas for further research [K]

Professional

- Follow team ethics regarding confidentiality, resource allocation, and professionalism [S,A]
- Respect patient confidentially, privacy, and autonomy [S,A]
- Demonstrate proper communication and professional appearance [S,A]
- Demonstrate professional work habits, such as being punctual, available, and organized [A]
- Uphold ethical and professional expectations of research consistent with institutional review board guidelines, including the maintenance of meticulous data and ethical research [A]
- Demonstrate personal responsibility for setting research goals and working with the supervisor to set and achieve research timeline objectives [A]
- Appropriately attribute authorship and contributions when publishing research [A]
- Disclose potential financial conflicts of interest (including speaker fees and consultative relationships) as appropriate when engaging in and disseminating research results [A]

Duration:

24 weeks

Setting:

Hospital setting within a radiation oncology department with designated teaching and training facilities.

DOPS (1. Physics 2nd Check for Treatment Plans, 2. Emergency Treatment (Sim & Treat) Case, 3. In-vivo Radiation Dose Measurement, 4. Receiving and Accepting a Radioactive Source Package, 5. Radiotherapy Shielding Assessment (Radiation Survey)), Min-CEX, CbD, Logbook, SOE, OSCE, and Research

VIII. CONTINUUM OF LEARNING

This includes the learning that should occur at each key stage of progression within the specialty. Trainees are reminded of life-long continuous professional development (CPD). Trainees should keep in mind the necessity of CPD for every healthcare provider to meet the demands of their vital professions. The following table shows how this role is progressively expected to develop throughout the junior, senior, and consultant levels of practice.

Graduate Level	R 1-2 (Junior Level)	R 3 (Senior Level)	Consultant
Non-practicing	Dependent/supervised practice	Dependent/supervised practice	Independent practice/provide supervision
Obtain basic knowledge in medical radiation physics and health sciences and foundational level knowledge in the core discipline	Obtain fundamental knowledge related to the core clinical problems of the specialty	Apply knowledge to provide appropriate clinical care related to the core clinical problems of the specialty	Remain informed about practice changes in the field on the national and international level to critically evaluate existing institutional practice and actively contribute to the continuous improvement of health care quality and patient safety.
Obtain basic skills in scientific research methodology	Learn and practice clinical and technical skills to obtain competences related to the core presenting problems and procedures of the specialty	Learn prioritization of tasks, with a focus on quality and safety in radiotherapy, including radiation protection.	Compare and evaluate challenging, contradictory findings and develop expanded decision-making abilities and a management plan
		Provide support and be able to perform all procedures related to the core specialty and remain informed and responsible for the medical physics issues related to clinical care, education and training, innovation, and scientific research.	

IX. TEACHING METHODS

The teaching process for the Medical Physics for Therapeutic Radiology residency program is based on the principles of adult learning theory. Residents are expected to be aware of the importance of learning and to play active roles in the content and process of their own learning. The training programs implement the adult learning concept in each feature of the activities, in which residents are responsible for their own learning requirements.

Medical physicists will achieve the competencies described in the curriculum using 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 radiation in medicine. Moreover, the training involves practical procedures and interpretation methods taught in a sequential and integrated manner through lectures, tutorials, seminars, and apprenticeships, the latter of which provides hands-on experience.

Formal training time includes the following four teaching activities:

- Program specific learning activities
- Universal topics
- General learning opportunities
- Simulation

1. Program-Specific Learning Activities

Program-specific activities are educational activities specifically designed and intended to teach trainees during their training. Residents are required to attend these activities, and non-compliance can subject them to disciplinary action. It is advisable to link attendance and participation in these activities with formative assessment tools (see the formative assessment section below). Program administration should support these activities by providing protected time for residents to attend and participate.

Program Academic Half-Day:

Every week at least 2–4 h of formal training time (commonly referred to as an academic half-day) should be reserved. Formal teaching time is an activity planned in advance with assigned tutor(s), time slots, and venue. Formal teaching time excludes hands-on clinical teaching. The academic half-day covers fundamental topics that are determined and approved by the specialty's scientific council, aligned with specialty-defined competencies and teaching methods. The core specialty topics will ensure that the important clinical problems of the specialty are taught well. It is recommended that lectures be conducted using an interactive, case-based discussion format. The learning objectives for each core topic must be clearly defined, and it is preferable to use pre-learning materials. Whenever applicable, core specialty topics should include workshops, team-based learning (TBL), and simulations to develop skills for core procedures. Regional supervisory committees, in coordination with academic and training affairs, program directors, and chief residents, should work together to ensure the planning and implementation of academic activities as indicated in the curriculum. There should be active involvement of the trainee in the development and delivery of topics under faculty supervision; this involvement might be in the form of delivery, content development, or research, to name a few. The trainee's supervisor should ensure that the discussion on each topic is stratified into three categories of learning domains: knowledge, skill, and attitude, whenever applicable.

The academic half-day:

- Provide the knowledge, technical skills, and experience necessary for residents to interpret and correlate their clinical findings.
- Promote effective communication and sharing of expertise with peers and colleagues.
- Promote the development of investigative skills to better understand technical skill processes as they apply to both individual patients and the general patient population.
- Advise colleagues from their specialty and other specialties regarding problems related to medical physics.
- Enable residents to recognize the humanistic and ethical aspects of a medical physics career.
- Enable the residents to examine and affirm their personal and professional moral commitments.
- Enable residents to use their knowledge in clinical reasoning and equip them with the interaction skills required to apply this insight, knowledge, and reasoning to human clinical care.

The recommended number of half-days that should be conducted annually is 40 sessions per academic training year, with time reserved for other forms of teaching methods such as journal clubs and clinical/practical teaching. The residency training committee, program directors, and chief residents, in coordination with academic and training affairs and regional supervisory committees, should work together to ensure the planning and implementation of academic activities as indicated in the curriculum. This should be done efficiently by utilizing the available resources with an optimal exchange of expertise. APPENDIX (A) provides an example of an academic half-day.

Educational Component Layout:

Several core courses will be organized for residents to augment their training in various important areas. These courses are typically offered on academic half-days.

R1	General Review	Radiation Therapy Physics	Anatomy & Physiology	Radiobiology	Ethics	Informatics	Research Methodology
	10 w	12 w	4 w	4 w	3 w	3 w	4 w
R2 & R3	Selected topics in Radiation Oncology Physics						
	40 w						

Please refer to APPENDIX (B) for the courses content. APPENDIX (C) provides a list of useful reading.

Practice-Based Learning (PBL):

Training exposure during clinical and other work-related activities, including courses and workshops (e.g., simulations and clinical teaching), offers excellent opportunities for learning. Residents are expected to build their capacity through self-directed learning.

On the other hand, practice-based learning allows educators to supervise residents to become competent in the required practical skills that ensure fulfilling the knowledge, psychomotor, and/or attitude learning domains. Each resident is required to maintain a logbook documenting a record of both supervised and independent clinical training.

The following list constitutes examples of practice-based learning (PBL):

- Journal club
    - Journal articles are preselected, and the activity is prepared and discussed by the residents under supervision to
        - Promote continuing professional development.
        - Stay up to date with the literature.
        - Learn and practice critical appraisal skills.
- Discussion (logbook)
    - Formulate a list of all problems identified in medical physics board examinations.

- Develop a suitable solution for each problem.
- Present a follow-up of the problem.

- Guest speakers on core specialty topics
  - Increase medical physicist staff and resident knowledge and skills and ultimately improve patient care.
  - Understand and apply current practice guidelines in the field of medical physics.
  - Describe the latest advances in the field of medical physics and research.
  - Identify and explain areas of argument in the field of medical physics
- Tutorial
  - Tutorials provide a good quality foundation of knowledge in the skill of radiological interpretation.
  - Discuss and review imaging findings and approaches toward the diagnosis of various radiological conditions.
  - Develop a sense of confidence in handling clinical discussions.
- Courses and Workshops
  - Attend national and international conferences.
  - Form a network with other medical physicists in the community.
  - Exchange ideas.
  - Target courses based on the interests of residents and their involvement in specific departmental projects.
- Self-directed Learning
  - Maintain a personal portfolio (self-assessment, reflective learning, and personal development plan).
  - Achieve personal learning goals beyond the essential and core curriculum.

    - Read, including web-based material.
    - Audit and conduct research projects.

- Clinic-based Learning
    - Discuss differential and management plans with colleagues.
    - Discuss with attending physicists the need for any special procedures.
    - Supervise the resident's notes and orders and interpret and discuss the report results with attending physicists.

Weekly report:

The weekly report is a review session with the resident's primary supervisors. It is common for residency programs to have varying purposes and focuses. The goals of the weekly report are to ensure that the student is achieving the required case-presentation skills, to allow discussion of the management of interesting cases, and to enhance problem-solving and multidisciplinary team skills. APPENDIX (D) and APPENDIX (E) show examples of weekly logs and progress checklists, respectively, that can be utilized during the weekly report.

2. Universal Topics

Universal topics are educational activities developed by the SCFHS and intended for all specialties. Priority will be given to topics that have the following qualities:

- High value
- Interdisciplinary and integrated
- Require expertise that might be beyond the availability of the local clinical training sites

Universal topics have been developed by the SCFHS and are available through e-learning with personalized access for each resident. Each universal topic will have a self-assessment at the end of the module. As indicated in the "executive policies of formative assessment and annual promotion," universal topics are a mandatory component of the criteria for the annual promotion of residents from their current level of training to the subsequent level. Universal topics are distributed throughout the training period.

Table of universal topics distributed over residency years

Training Year	Modules		Topics name	
	Number	Name	Number	Name
R1	Module-1	Medical Fundamentals	Topic-2	Hospital acquired infections
	Module-1	Medical Fundamentals	Topic-4	Sepsis; SIRS; DIVC
	Module-2	Cancer	Topic-6	Colon Cancer
	Module-2	Cancer	Topic-7	Breast Cancer
	Module-2	Cancer	Topic-8	Lung Cancer
	Module-2	Cancer	Topic-9	Prostate Cancer
	Module-3	Diabetes and Metabolic Disorders	Topic-10	Diabetic Emergencies
R2	Module-3	Diabetes and Metabolic Disorders	Topic-12	Obesity
	Module-3	Diabetes and Metabolic Disorders	Topic-13	Cardiovascular Risk
	Module-4	Medical and Surgical Emergencies	Topic-14	Acute chest pain
	Module-4	Medical and Surgical Emergencies	Topic-15	Acute breathlessness
	Module-4	Medical and Surgical Emergencies	Topic-18	Hypertension
	Module-5	Acute Care	Topic-23	Post-Operative Care
	Module-5	Acute Care	Topic-24	Acute and Chronic Pain Management

Training Year	Modules		Topics name	
	Number	Name	Number	Name
R3	Module 7	Ethics and Healthcare	Topic-34	Organ Transplantation
	Module 7	Ethics and Healthcare	Topic-31	Occupational Hazards of Healthcare Workers
	Module 7	Ethics and Healthcare	Topic-32	Evidence-based Approach to Smoking Cessation
	Module 7	Ethics and Healthcare	Topic-33	Patient Advocacy
	Module 7	Ethics and Healthcare	Topic-35	Autonomy and Treatment Refusal
	Module 7	Ethics and Healthcare	Topic-36	Death and Dying

3. General Learning Opportunities

Formal training time should be supplemented by other PBL such as

- Journal Club
- Involvement in quality improvement committees and meetings
- CPD activities relevant to the specialty (conferences and workshops)
- Radiation oncology patient review meetings
- Morbidity and mortality (M&M) meetings

M&M conferences offer trainees the opportunity to discuss patient cases in which adverse effects occur through errors or complications. The goal of this resource is to refocus on the content of M&M and transform it into a platform for teaching patient safety principles and emphasizing error-reduction strategies.

4. Simulation

As the national supervising body, the SCFHS initiated a move toward integrating simulations into residency training programs.

Clinical simulations involve the creation of an artificial clinical scenario from which residents can learn. This process has educational advantages, such as learning and practicing how to deal with rare and/or high-risk clinical scenarios and rare procedures, while practicing in a controlled, standardized environment with immediate effective feedback, which has a significant impact on knowledge, skills, and attitude [8,9, 10,11].

The scenarios for simulations must be as close to real clinical situations as possible, including team members, equipment, and environment, followed by timely and effective feedback. According to McGaghie et al., effective feedback has three key components: planning, pre-briefing, and feedback provision [12].

The use of simulations in postgraduate training programs is currently necessary, especially in competency-based curricula. Current programs aim to graduate skilled, competent, and independent physicians while maintaining a focus on quality and patient safety. Practically, there can be a high level of variability in using simulations to implement competency-based curricula, and the nature of the specialty is likely to play another role in increasing this variability. Establishing standardized needs assessment methods for simulation may pose a challenge to any national organizational body dealing with variable ongoing postgraduate training programs.

Simulation exercises are used at the R2 and R3 levels as the residents gain practical experience, to expose them to infrequent clinical situations. Examples of simulation exercises include simulating freehand setup planning for photon or electron treatment cases that require manual MU calculations, simulating special technique commissioning, such as total-body irradiation or total skin irradiation, and simulating the commissioning of a new linear accelerator beam and configuration of a new treatment planning system model.

X. ASSESSMENT AND EVALUATION

1. Purpose of Assessment

Assessments play a vital role in the success of postgraduate training. Assessment guides trainees and trainers to achieve defined standards, learning outcomes, and competencies. Moreover, assessments provide feedback to learners and faculty regarding curriculum development and implementation, teaching methods, and the quality of the learning environment. A reliable and valid assessment is essential for assessing curriculum alignment with respect to objectives, learning methods, and assessment tools. Finally, assessment assures patients and the public that health professionals can safely and competently practice.

Assessment can serve the following purposes:

a. **Assessment for learning:** Trainers will use information from trainees' performance assessments to help with continuous improvement. This enables educators to use information about trainees' knowledge, understanding, and skills to provide feedback about learning and ways to improve.

b. **Assessment of learning:** This is used to demonstrate the achievement of trainees' learning. This is a graded assessment that usually counts toward the trainees' end-of-training degree.

c. **Feedback and evaluation:** Assessment outcomes will represent quality metrics that can improve the learning experience and help trainers in the future focus on areas that need more attention.

Miller's Pyramid of Assessment provides a framework for assessing the trainees' clinical competencies, acting as a guide to select the assessment methods for targeting different clinical competencies, including "knows," "knows how," "shows how," and "does." However, to understand the process of formative assessment, a list of guidelines is readily available to assist with the proper execution of the necessary steps.

Please refer to the electronic version in www.scfhs.org.sa for the updated edition.

For the sake of organization, assessments will be further classified into two main categories: *Formative* and *Summative*.

2. Formative Assessment

2.1 General Principles

Purpose of formative Assessment:

- Enhance learning by providing formative assessments, enabling residents to receive immediate feedback, measure their performance, and identify areas for development and improvement.
- Drive learning and enhance the training process by clarifying what is required of residents and motivating them to ensure they receive suitable training and experience.
- Provide robust, summative evidence that residents are meeting the curriculum standards during the training program.
- Ensure that residents acquire competencies within the domain of good medical practice.
- Ensure that residents possess the essential underlying knowledge, skills, and attitude required for their specialty.

Trainees, as adult learners, should strive to seek to understand and develop their performance based on feedback throughout their journey of competency from the "novice" to "mastery" levels. Formative assessment (also referred to as continuous assessment) is the component of assessment that is distributed throughout the academic year primarily to provide trainees with effective feedback.

Every two weeks, at least one hour should be assigned for trainees to meet their program director or equivalent to review performance reports (e.g., ITER, logbook, and workplace-based assessment tools). Input from the overall formative assessment tools will be utilized at the end of the year to determine whether individual trainees will be promoted from the current to the subsequent training level. Formative assessment tools will be defined based on scientific (committee) recommendations, which are usually updated and announced for each individual program at the start of the academic year.

According to the executive policy on formative assessment (available online at www.scfhs.org), formative assessment has the following features, which will be used based on targeted competencies:

a. Multisource: minimum of three tools.

b. Comprehensive: covering all learning domains (knowledge, skills, and attitude).

c. Relevant: focusing on workplace-based observations.

d. Milestone-oriented competency reflecting the trainee's expected competencies that match the trainee's developmental level.

2.2 Formative Assessment Tools

Trainees should actively seek feedback during training, and trainers should provide timely and formative assessment. The SCFHS will provide an e-portfolio system to enhance the communication and analysis of data from formative assessment. Trainers and trainees are expected to follow the recommendations of the Scientific Council regarding the updated forms, frequency, distribution, and deadlines related to the implementation of evaluation forms.

To attain the optimum training level outcome, the candidate must complete the compulsory requisition of all selected formative assessment tools.

2.2.1 Workplace-based assessment

Workplace-based assessment (WBA) tools: Compliance must be no less than 75% for each repetitive tool. The compliance shall be calculated using the following equation:

Percentage of compliance in executing a single WBA tool= number of encounters performed by the trainee/total number required for the tool

2.2.2 Educational Activity (Non-WBA assessment)

Educational activities (EAs) are part of the trainee's training program, which involves teaching and learning activities to acquire specialty competencies. Examples of contributions to educational activities can be, but are not limited to, presenting in journal clubs, lectures, M&M rounds, grand rounds, and research and scholarly activities.

All formative assessment tools used for formative assessment purposes MUST abide by the Scoring Categories and Scaling Definitions in the SCFHS policies.

Does not Meet	Borderline	Meets Expectation	Exceeds Expectation
Expectation (<50%)	(50–69.99%)	(>70–89.99%)	(>90%)

The following table summarizes the formative assessment tools that the trainee must complete. Additional details and explanations can be found in the section on mapping of learning objectives and competency roles to the program rotations.

Summary of the required assessment tools for all levels

Program			Medical Physics for Therapeutic Radiology									
Level	Rotation	Duration (weeks)	Knowledge Skills Attitude									
			Workplace-based assessment			Educational activity (Non-WBA assessment)						
			DOPS	mini - CEX	CbD	Academic Activities	Logbook	PT EYPT	SOE	OSCE	Research	ITER
R1	1. Hospital Orientation	4	(x2)			√		√	√			√
	2. Radiation Protection & Safety	8	(x2)		(x2)	√	√	√	√			√
	3. Gen. Clin. Nuclear Medicine Physics	8	(x2)		(x2)	√	√	√	√			√
	4. Gen. Clin. Diagnostic Imaging Physics	8	(x2)		(x2)	√	√	√	√			√
	5. Gen. Clin. Radiation Oncology Physics	20	(x3)		(x2)	√	√	√	√			√
R2	6. Treatment Equipment and Quality Assurance	16	(x5)		(x2)	√	√	√	√	√		√
	7. Treatment Planning I	16	(x5)	(x3)	(x2)	√	√	√	√	√		√
	8. Treatment Planning II	16	(x5)	(x3)	(x2)	√	√	√	√	√		√
R3	9. Special Techniques in Radiotherapy (RT)	8	(x5)	(x3)	(x2)	√	√	√	√	√		√

Program			Medical Physics for Therapeutic Radiology										
Level	Rotation	Duration (weeks)	Knowledge Skills Attitude										
			Workplace-based assessment			Educational activity (Non-WBA assessment)							
			DOPS	mini - CEX	CbD	Academic Activities	Logbook	PT EYPT	SOE	OSCE	Research	ITER
	10. Brachytherapy	16	(x5)	(x3)	(x2)	√	√	√	√	√		√
	11. Clin. Physics Practice & Research Project	24	(x5)	(x3)	(x2)	√	√	√	√	√	√	√

DOPS: Direct observation of procedural skills Mini-CEX: Mini-clinical evaluation exercise CbD: Case-based Discussion MCQs: Multiple-choice question exam PT (EYPT-Local): Progress test SOE: Structured oral examination OSCE: Objective structured clinical examination ITER: In-training evaluation report

Description of Formative Assessment Tools (R1, R2, R3)

Performance Evaluation and Requirements	Formative Assessment Tools	Important details (description & frequency related to the tool/academic year)
Workplace-based Assessment (WBA)	DOPS	- DOPS is used to assess the trainee's procedural, practical, and technical skills while being observed by a trainer/instructor in a workplace setting. - R1 residents are required to perform a minimum of 2–3 DOPS per rotation, i.e., a total of 11 in the academic year. - R2 and R3 residents are required to perform a minimum of five DOPS per rotation, i.e., a total of 15 in the academic year per level. (see program rotation details) - Results are for formative feedback purposes.
	Mini-CEX	- Mini-CEX is used to directly assess resident's clinical skills while being observed by a trainer/instructor in a workplace setting. - R2 (starting from Rotation 7) and R3 residents are required to complete a minimum of three mini-CEX per rotation, i.e., a total of 6–9 mini-CEX per academic year per level. - Results are for formative feedback purposes.
	CbD	- CbD is used to evaluate the resident's clinical decision-making and reasoning skills (higher order thinking and synthesis). - R1 residents are required to complete a minimum of two CbD per rotation (except hospital orientation rotation), i.e., a total of eight CbD per academic year. - R2 and R3 residents are required to complete a minimum of two CbD per rotation, i.e., a total of six CbD per academic year per level. - Results are for formative feedback purposes.

Performance Evaluation and Requirements	Formative Assessment Tools	Important details (description & frequency related to the tool/academic year)
Non-WBA	Logbook & Portfolio	- The logbook is used to document and assess the residents' enrolment and daily activity, while the portfolio is used to provide evidence of teamwork, assessing complex competencies as lifelong learning. - All residents (R1–R3) are required to maintain a logbook to be presented during the supervisor/program director meetings and at the end of rotations. - R1 residents are encouraged to develop a portfolio that records and documents all academic activities (e.g., procedures, lectures, meetings, training courses, workshops, symposia, and presentations) undertaken during each rotation and seek feedback from a mentor. - R2 residents are required to include in the portfolio the background, methodology, results and analysis, and conclusion of quality tests and measurements used in the QA rotation. - R3 residents are required to include in the portfolio the background, methodology, results and analysis, and conclusion of each special technique used in the special techniques rotation. - The logbook and portfolio are to be reviewed during the supervisor meetings for formative feedback purposes and progress checks. See Appendix I for a list of logbook activity requirements.
	Progress Test (PT)	- The progress test assesses the knowledge level that is expected from the trainees' benchmarked against the practitioner's general and fundamental knowledge base. - The PT consists of 50–100 MCQs of general and fundamental medical physics questions (i.e., R1 level).

Performance Evaluation and Requirements	Formative Assessment Tools	Important details (description & frequency related to the tool/academic year)
		- All residents from all levels are required to attend this PT held at the beginning of the academic year. - A progress test is also required for R1 residents, to be held once in the last quarter of the first year. - The exam consists of a minimum 100 MCQs in accordance with the progress test blueprint. - Scores expressed in numbers will be translated to SCFHS categories. - The results are used for formative feedback.
	SOE	- SOE is used to assess the resident's knowledge and as a practice/mock exam for the final exam. - All residents (R1–R3) are required to attend at least two SOE session per level per academic year, held at the middle and end of the academic year. - The minimum number of SOE station(s) is four. - The results are used for formative feedback.
	OSCE	- OSCE is used to assess the resident's clinical/practical performance and application of knowledge skills and as a practice/mock exam for the final exam. - R2 and R3 residents are required to attend at least on OSCE session per level per academic year. - The minimum number of OSCE station(s) is three. - The results are used for formative feedback
	Research Activities	- A clinical research project must be completed during the final residency rotation. - R2 trainees are expected to submit a research proposal with IRB approval or TPC by the end of the academic year

Performance Evaluation and Requirements	Formative Assessment Tools	Important details (description & frequency related to the tool/academic year)
		- R3 residents are required to meet at least one of the following for their research project: submit a publication in a peer-reviewed journal, submit an abstract for an oral or poster presentation in a scientific meeting, or submit research according to SCFHS criteria.
	Educational activity (JC, M&M meeting, oral presentation etc)	- All residents (R1–R3) are required to attend the 40 academic half-day lectures per their level and participate in their activities. - All residents (R1–R3) are required to attend radiation oncology patient review and M&M meetings. - Each resident is required to perform at least one presentation per year and review and present two journal club articles. The resident will be assessed after each EA session by a training supervisor/attending for feedback. (See Appendix F for the form)
	ITER	- The ITER is related to the discipline and rotation's objectives and the stage and level of training. The ITER must be completed after repeated observations and feedback of the trainee's performance within two weeks of the end of each rotation. (Appendix H)

Refer to the SCFHS "Formative Assessment Tools List" for the description and conduction instructions of each Tool at www.scfhs.org.sa

Example of R1 Promotion Exam Blueprint:

Category	Proportions
Radiological Physics & Radioactivity	25%
Principles of Imaging	10%
Radiation Therapy Physics	25%
Anatomy and Physiology	10%
Radiobiology	10%
Ethics	5%
Informatics	5%
Research Methodology	10%

Refer to the commission website, www.scfhs.org.sa, for updated examination details and a blueprint.

2.3 Promotion of the trainee

The trainee must demonstrate compliance by completing the necessary WBA and EA on time and in accordance with curriculum requirements. Furthermore, failure to comply will result in disciplinary consequences for the trainee, which may include repeating the entire academic year or a portion.

The trainee shall be promoted from one level to the next if they comply with the following requirements:

A. Achievement of the minimally required compliance of selected WBA and EA

B. Annual in-training evaluation report (AITER) to be completed by the program director, which incorporates the compliance of the WBAs and EA, as well as the comments and feedback collected by the concerned educators. Ultimately, the recommendations from the program director should be included. Furthermore, the program training committee will vote on the promotion for one of the following options:

1. Unconditional promotion to next level
2. Conditional promotion to next level with remediation program during the promoted year
3. Not endorsing promotion with the recommendation of repeating the current level year, along with a remediation program

3. Summative Assessment

3.1 General Principles

Summative assessment is a component 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 of Training in Postgraduate Programs and General Assessment Bylaws (available online: www.scfhs.org.sa). To be eligible to sit for the final exams, trainees will be granted "Certification of Training Completion" upon successful completion of all training rotations.

3.2 First Part Medical Physics for Therapeutic Radiology Board Examination

The first part of the board is a written multiple-choice question (MCQ) exam open to R2 residents. Passing this exam permits residents to be promoted from junior to senior training levels. The number of examination items, eligibility, and passing scores is established in accordance with the Commission's training and examination rules and regulations.

Example of Part-1 Exam Blueprint:

Section	Proportions
Radiation Safety & Regulations	10%
Ethics & Informatics	10%
Radiation Instrumentation & Dosimetry	15%
Anatomy and Radiation Biology	15%

Clinical Nuclear Medicine Physics	15%
Clinical Diagnostic Imaging Physics	15%
Clinical Radiation Therapy Physics	20%

Refer to the commission website, www.scfhs.org.sa, for updated examination details and a blueprint.

3.3 Final In-training Evaluation Report (FITER)

This report will be the basis for obtaining the Certificate of Training Program Completion, as well as the qualification to sit for the final specialty examinations.

In addition to other requirements for the completion of training and registration for the final board examination by the supervisory training committee, a final in-training evaluation report (FITER) is prepared by program directors for each trainee during the final training year.

Furthermore, a recommendation by the program training committee shall be issued based on the FITER for the last month of the final training year, offering one of the following options:

1. Approved and finished the training requirement
2. Partially approved and completed the training requirements after successful achievement of no more than a three-month remediation program
3. Not approved and incomplete training requirements with the recommendation of a remediation program for an extra training year

3.4 Certification of Training Completion

To be eligible to sit for the final specialty examinations, each resident is required to obtain the "Certification of Training Completion." Based on the General Bylaws of Training in Postgraduate Programs and executive policy (refer to www.scfhs.org), residents will be granted the "Certification of Training-Completion" once the following criteria are fulfilled:

1. Successful completion of all training rotations
2. Completion of the training requirements (e.g., research) outlined in the FITER, as approved by the Scientific Committee
3. Clearance from SCFHS training affairs ensuring compliance with tuition payments and completion of universal topics
4. Passing the first part examination (whenever applicable)

The "Certification of Training Completion" will be issued and approved by the supervisory committee or its equivalent according to the SCFHS policies.

3.5 Final Medical Physics for Therapeutic Radiology Board Examination

The final specialty examination is a summative assessment component that grants residents a specialty certification. It has two elements:

1. Final written exam: To be eligible for the written exam, residents must obtain the "Certification of Training Completion." The written examination assesses the resident's theoretical knowledge base (including recent advances) and problem-solving capabilities regarding radiation oncology physics. The exam is held once a year in a MCQ format.
2. Final clinical/practical exam: To be eligible to sit for the final clinical/practical exam, residents are required to pass the final written exam with a score of at least 70%. The clinical/practical examination assesses the resident's clinical skills, decision-making, and capabilities to perform radiation oncology physics tasks. The exam is held once a year in the objective-structured clinical examination (OSCE) and structured oral examination (OSE) formats.

The number of exam items, exam format, eligibility, and passing scores are in accordance with the SCFHS's training and examination rules and regulations. The updated examination and blueprints details are available on www.scfhs.org.sa.

Example of Final Written Exam Blueprint:

Section	Proportions
Radiation Protection & Regulations	10%
Radiation Equipment and instrumentation	10%
Quality Assurance & Commissioning in Radiotherapy	20%
Radiation Treatment Planning & Radiobiological Models	20%
Brachytherapy	20%
Special & Advanced Technique in Radiotherapy	20%

Example of Final Clinical Exam Blueprint:

Section	Proportions
Radiation Protection & Regulations	20%
Dosimetry & Quality Assurance	30%
Radiation Treatment Planning	30%
Brachytherapy	20%

For further details and updates on the final exams, please refer to the General Bylaws of Training in Postgraduate Programs and General Assessment Bylaws (available online: www.scfhs.org).

Table of Summative Assessment Tools

Learning Domain	Summative Assessment Tools	Passing score
Knowledge	• Part-1 Written Examination • Final Written Examination	• Part-1 Written Examination held once at the end of the two years of training; passing score is 65%. • Final Written Examination held once at the end of the three years of training; passing score is 70%.
Skills	• Objective Structured Clinical Examinations (OSCE) • Structured Oral Examinations (SOE)	• Passing the final written examination is required for OSCE and SOE entrance; a borderline pass as a cumulative for all stations (the number of stations will be determined by the exam committee) is required to pass.
Attitude	• FITER	• Each resident should obtain a clear pass on the FITER from the program director at the end of the training period.

XI. PROGRAM AND COURSE EVALUATION

The SCFHS applies various measures to evaluate the implementation of this curriculum. The training outcomes of this program will follow the QA framework endorsed by the Central Training Committee of the SCFHS. Resident assessment (both formative and summative) results will be analyzed and mapped to the curriculum content. Other indicators that will be incorporated are

- Report of the annual residents' satisfaction survey.
- Reports on residents' evaluation of faculty members.
- Reports on residents' evaluation of rotations.
- Reports from the annual survey of program directors.
- Data available from program accreditations.
- Reports on direct field communications with residents and trainers.

Goal-Based Evaluation: The achievement of intended milestones will be evaluated at the end of each stage to assess the progress of curriculum delivery, and any deficiencies will be addressed in the following stage, utilizing the time devoted to resident-selected topics and professional sessions.

In addition to subject-matter opinions and best practices from benchmarked international programs, the SCFHS will apply a robust method to ensure that this curriculum will utilize all data available during its revision in the future.

XII. POLICIES AND PROCEDURES

This curriculum presents the means and materials and outlines the learning objectives with which trainees and trainers will interact to achieve the identified educational outcomes. The SCFHS has a full set of "General Bylaws of Training in Postgraduate Programs" and "executive policies" (published on the official SCFHS website) that regulate all training-related processes. The general bylaws of training, assessment, and accreditation as well as executive policies on admission, registration, formative assessment and promotion, examination, trainee representation and support, duty hours, and leaves are examples of regulations that must be implemented. Under this curriculum, trainees, trainers, and supervisors must comply with the most up-to-date bylaws and policies, which can be accessed online (via the official SCFHS website).

XIII. APPENDICES

A. Example of an academic half-day Timetable

B. Educational Courses Content

C. Recommended Reading

D. Example of Resident Weekly Logs

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F. Example of Resident Presentation Evaluation by Staff Supervisor

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H. Example of the ITER: In-training Evaluation Report (End of Rotation)

I. Logbook Requirements

J. References

APPENDIX A

Example of an academic half-day timetable

Academic Week	*Section*	*Date*	*Time*	*Sessions*	*Presenters*
1	Radiotherapy Physics Fundamentals	Oct-5	13:00–13:15	Welcome to the program	Radiation Oncology Medical Physicists and/or experts in the related academic session
			13:15–15:00	Interactions of charged particles and photons with matter	
			15:00–16:00	Ion chambers, dosimetry principles, and basic concepts	
2	Measuring Dose	Oct-12	13:00–14:00	Absolute MV photon and MeV electron dosimetry	
			14:00–15:00	Practical session on IAEA TRS-398 for MV photons**	
			15:00–16:00	Cross calibration factor for MeV electron beams	
			16:00–17:00	Small field dosimetry – caveats and pitfalls	
3	Radiobiology	Oct- 19	13:00–14:00	Tumor & normal tissue radiobiology	
			14:00–15:00	Standard fractionation vs. hypo- and hyper-fractionation	
			15:00–16:00	Practical session on various dose regimens for prostate cancer**	
4	Manual Dose Calculation	Oct- 26	13:00–14:00	Journal club*	
			14:00–15:00	CAX manual MV photon dose calculation	

Academic Week	Section	Date	Time	Sessions	Presenters
			15:00–16:00	Practical session on off-axis and wedged MV photon field calculations**	

* Journal club may be attended in the evening or during the half-day

** Practical session may be completed in the evening or during the half-day

APPENDIX B

Educational Courses Content

Several courses/modules will be organized for residents to augment their training in various important areas.

Course: General Review (Radiological Physics, Radioactivity, and Imaging Concepts)

Duration: 10 weeks

Topics:

- ✓ Atomic and nuclear structure
- ✓ Classification of radiation
- ✓ Quantities and units to describe radiation fields
    - Particle fluence and flux
    - Energy fluence and flux
    - Exposure
    - Kinetic energy released per unit mass (Kerma)
    - Absorbed dose
- ✓ Interaction of charged particles with matter
    - Soft collisions
    - Hard collisions
    - Radiative collisions
- ✓ Stopping powers
    - Collision stopping power
    - Radiative stopping power
    - Linear energy transfer
    - Charged particle range
    - Radiation yield

- ✓ Interactions of photons with matter
  - Photoelectric effect
  - Rayleigh scattering
  - Compton scattering
  - Pair production
  - Triplet production
  - Interaction weights and relative predominance
  - Energy transfer
  - Mean radiation fraction
- ✓ Attenuation coefficients
  - Electronic
  - Atomic
  - Mass
  - Linear
  - Energy transfer coefficient
  - Energy absorption coefficient
- ✓ Exponential attenuation
  - Narrow beam
  - Broad Beam
- ✓ Interactions of neutrons with matter
  - Classifications of neutrons
  - Elastic scattering
  - Inelastic scattering
  - Neutron capture
  - Nuclear spallation
  - Nuclear fission
  - Neutron Kerma factor

- ✓ Radioactive decay modes
  - Alpha decay
  - Beta plus decay
  - Beta minus decay
  - Electron capture
  - Gamma decay
  - Internal conversion
  - Spontaneous fission
  - Proton emission
  - Neutron emission
- ✓ Radioactive decay kinematics
  - Parent – Daughter
  - Parent – Daughter – Granddaughter
- ✓ Production of photons
  - Classification of photons
  - Photon production with thin targets
  - Photon production with thick targets
  - Target spectrum
- ✓ Principles of imaging
  - Contrast
  - Noise
  - Resolution
  - Signal-to-noise ratio (SNR)
  - Modulation transfer function (MTF)

Course: Radiation Therapy Physics

Duration: 12 weeks

Topics:

- Clinical linear accelerator design
  - C-arm
  - Helical
  - Robotic arm
- Measuring devices in radiotherapy departments
  - Ionization chambers
  - Diodes
  - Thermoluminescent dosimeter (TLD)
  - Optically stimulated luminescent dosimeter (OSLD)
  - Films
  - Gels
- Dosimetric functions
  - Inverse-square law
  - Tissue-to-air ratio (TAR)
  - Peak scatter factor (PSF)
  - Tissue-to-maximum ratio (TMR)
  - Percentage depth dose (PDD)
  - Off-axis ratio (OAR)
  - Collimator scatter factor (Sc) and phantom scatter factor (Sp)
- MU calculation
  - PDD method
  - TAR method
  - Source-to-surface distance (SSD) treatments
  - Source-to-axial distance (SAD) treatments
  - Extended SSD treatment
- Cavity theory

    - Small cavity
    - Large cavity
    - Intermediate cavity
- Calibration of megavoltage photon beams
- Calibration of megavoltage electron beams
- Calibration of superficial and orthovoltage beams

Course: Anatomy and Physiology

Duration: 4 weeks

Topics:

- ✓ Anatomy nomenclature
- ✓ Pathology nomenclature
- ✓ Skin
- ✓ Skeleton/joints
- ✓ Muscles and ligaments
- ✓ Brain/Central nervous system (CNS)
- ✓ Autonomic nervous system
- ✓ Visual system
- ✓ Thorax
- ✓ Abdomen
- ✓ Pelvis
- ✓ Respiratory system
- ✓ Digestive system
- ✓ Urinary system
- ✓ Reproductive system
- ✓ Circulatory system
- ✓ Lymph system

Course: Radiobiology

Duration: 4 weeks

Topics:

- ✓ History of radiation injuries in humans
- ✓ Radiation interactions in cells/tissues
- ✓ Radiation injury to deoxyribonucleic acid (DNA)
- ✓ Repair of DNA damage
- ✓ Indirect effects of radiation
- ✓ Chromosomal damage and repair
- ✓ Target theory and cell survival curves
- ✓ Free radical formation
- ✓ Apoptosis, reproductive cell death
- ✓ Cell kinetics
- ✓ Cell recovery processes
- ✓ Cell cycle sensitivity
- ✓ Tissue injuries
- ✓ Acute effects of radiation
- ✓ Delayed effects of radiation
- ✓ Radiation carcinogenesis
- ✓ Radiation mutagenesis
- ✓ Radiation teratogenesis
- ✓ Embryo/fetal effects
- ✓ Risk estimates of radiation
- ✓ History of linear no-threshold theory
- ✓ Predictions of cancers in populations
- ✓ Radiation epidemiology
- ✓ Evidence of cancers in populations

- ✓ Concept of radiation hormesis
- ✓ Tumor radiobiology
- ✓ Time, dose, and fractionation
- ✓ Molecular mechanisms

Course: Ethics

Duration: 3 weeks

Topics:

- ✓ Ethics of a profession
- ✓ Ethics of an individual
- ✓ Interactions with colleagues and co-workers
- ✓ Interactions with patients and the public
- ✓ Confidentiality
- ✓ Peer review
- ✓ Negotiation skills
- ✓ Relationships with employers
- ✓ Conflicts of interest (recognition and management)
- ✓ Ethics in research (fabrication, fraudulence, and plagiarism)
- ✓ Use of animals in research
- ✓ Use of humans in research
- ✓ Relationships with vendors
- ✓ Publication ethics

Course: Informatics

Duration: 3 weeks

Topics:

- ✓ Using the Digital Imaging and Communications in Medicine (DICOM) standard to configure modality devices for picture archiving and communication system (PACS) integration, obtaining information for quality control purposes, and diagnosing problems involving the acquisition, storage, communication, and display of medical images.

- ✓ Understanding the aspects of imaging informatics peculiar to each imaging modality (e.g., radiography, fluoroscopy, mammography, computed tomography (CT), ultrasound (US), and magnetic resonance (MR).
- ✓ Understanding the dose reporting features for radiography, fluoroscopy, mammography, and CT.
- ✓ Applying the Integrating the Health Enterprise (IHE) radiology profiles for workflow, content, presentation, and infrastructure to improve department workflow and imaging operations.
- ✓ Using open-source software resources to address clinical medical physics problems.
- ✓ Assessing the display quality of imaging workstations used for primary interpretation and secondary review.
- ✓ Using information technology to retrieve and store patient demographics, examinations, and imaging information.
- ✓ Understanding the functions of radiology information systems (RISs) as they pertain to the ordering, tracking, billing, and reporting of images.
- ✓ Understanding how image processing is used to create radiographic images for display presentation, depict 3D structures in CT and MR, augment interpretation with computer automated diagnosis (CAD), and provide image fusion in SPECT/CT and PET/CT.
- ✓ Using information technology to investigate clinical, technical, and regulatory questions.

Course: Research Methodology

Duration: 4 weeks

Topics:

- ✓ Access
- ✓ Audit
- ✓ Choice of Sample
- ✓ Data Analysis
- ✓ Descriptive and Inferential Statistics
- ✓ Electronic Data Resources
- ✓ Gatekeepers Confidentiality Sensitivity and Ethics
- ✓ Interviews
- ✓ Participant Observation
- ✓ Plagiarism
- ✓ Primary Sources of Data
- ✓ Qualitative Methods
- ✓ Quantitative Methods
- ✓ Quantitative and Qualitative Approaches to Research
- ✓ Questionnaire Design
- ✓ Research Design and Research Focus
- ✓ Sample Size
- ✓ Secondary Sources of Data
- ✓ Task Analysis and Time Management

APPENDIX C

Recommended Reading

1. Khan, F. The Physics of Radiation Therapy, 4th Edition or later.
2. Van Dyk, J. The Modern Technology of Radiation Oncology, volumes I, II, & III.
3. Hall, E., and Giaccia, A. Radiobiology for the Radiologist, 7th Edition or later – or similar text.
4. Bushberg Jr., J, Seibert Jr., J.A., Leidholdt Jr., E.M., and Boone, J.M. The Essential Physics of Medical Imaging, 3rd Edition or later – or similar text.
5. Hoppe, R., Phillips, T.L., and Roach, M., Leibel and Phillips Textbook of Radiation Oncology: Expert Consult - Online and Print, 3rd Edition.
6. Podgorsak, E. Editor, Radiation Oncology Physics Handbook. http://www-naweb.iaea.org/nahu/dmrp/syllabus.shtm.
7. Bentel, G. Radiation Therapy Planning, 2nd Edition.
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APPENDIX D

Example of Resident Weekly Logs

Resident: ______________________________ Week of: ______________to _______________

Linear Accelerators	Hours	Task Supervisor	Rotation Mentor
Daily QA			
Monthly QA			
Annual QA			
Operations and patient treatment			
Data collection/accept./comm.			
Dosimetry	**Hours**	**Task Supervisor**	**Rotation Mentor**
MU calculations			
2D/3D dosimetry			
IMRT dosimetry			
SRS/SRT dosimetry			
Special procedure dosimetry (IGRT, IORT, etc.)			
Diode measurement/calculation			
R&V system			
TPS system configuration/acc/comm.			
Simulation	**Hours**	**Task Supervisor**	**Rotation Mentor**
Patient setup/tx device fabrication			

CT simulation QA			
Conventional simulator QA			
Brachytherapy	**Hours**	**Task Supervisor**	**Rotation Mentor**
LDR planning			
HDR planning			
Eye plaque planning			
LDR/eye plaque case management			
HDR case management			
HDR QA			
HDR machine operation			
Radio a Pharmaceutical therapy			
Radiation safety (specific to brachy)			
Clinical Oncology / Rad Oncology	**Hours**	**Task Supervisor**	**Rotation Mentor**
Clinical instruction			
Patient management			
Other	**Hours**	**Task Supervisor**	**Rotation Mentor**
Weekly chart checks			
General radiation safety			

Shielding			

APPENDIX E

Resident Training Progress Checklists

Checklist for New Residents (0–3 months of Residency Program)

Resident: ____

Date of commencement of residency: ______________________

	Date achieved
Allocation of clinical supervisor	
Resident's application sent to the residency program director	
Letter of acceptance into training program received from the residency program director	
Orientation by the clinical supervisor	
Resident starts a logbook	
Clinical training guide provided to the resident	
Schedule for regular supervisor–resident meetings established (at least monthly)	
Initial six-month training plan agreed	
Training plan for the period of enrolment developed and agreed with clinical supervisor	
The resident begins attendance at clinical meetings and/or tutorials and half days	

Supervisor: ____

Date: ______________________________

Annual Checklist for Residents (3 months to completion)

Resident: ________________________________

Year: 20______

	when satisfactory	Comment
Regular supervisor–resident meetings held (at least monthly)		
Resident logbook up to date		
Competency assessment up to date		
Six monthly supervisor reports completed (and forwarded to residency program director)		
Annual review and report on file		
Annual training plan up to date		
Training plan for the period of enrolment up to date		
Resident regularly attending clinical meetings and/or tutorials/half-days		
Assignments for this year completed		

Supervisor: ________________________________

Date: ________________________________

Completion Checklist for Residents

Resident: ____

Completion of requirements checklist	Date achieved
Required level of competency attained in all sub-modules	
Logbook completed and assessed as satisfactory	
Assignments completed and graded as 3 (out of 5) or better	
Research project, report, and presentation assessed as satisfactory	
ITERs and FITER completed	
Part 1 board written exam conducted and passed	
Final board exam eligible	

Supervisor: ____

Date: ____

Program Director: ____

Date: ____

APPENDIX F

Example of Resident Presentation Evaluation by Staff Supervisor

Resident name: ______________________________

Level: ______________________________

Staff: ______________________________

Supervisor: ______________________________

Date of Presentation: ______________________________

Topic: ______________________________

	Very Weak (1)	Weak (2)	Acceptable (3)	Good (4)	Very Good (5)
Expert					
Demonstrated thorough knowledge of the topic					
Presented at the appropriate level and with adequate details					
Appropriate emergency management					
Comments (optional)					
Communicator					
Provided objectives and an outline					
Presentation was clear and organized					
Used clear, concise, and legible materials					
Used effective methods and presentation style					
Established good rapport with the audience					
Collaborator					

	Very Weak (1)	Weak (2)	Acceptable (3)	Good (4)	Very Good (5)
Invited comments from learners and led discussions					
Worked with staff supervisor effectively in preparing the session					
Comments (optional)					

APPENDIX G

Example of Direct Observation of Procedural Skills (DOPS) Evaluation Form

Resident name: ____

Level: ____

Staff Supervisor: ____

Date of Evaluation: ____

Rotation: ____

Procedure "Radiation Output Measurement of Linac 1"	Below Expectation (1)	Displays Competency (2)	Displays Confidence (3)
Selection and handling of QA test tools and equipment			
Setup of QA test tools			
Acquiring measurement of QA test			
Post-processing, analysis, and interpretation of results			

Reporting and documentation of QA test procedures and results			

Comments:

____

____

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

Resident name: ______________________________ Signature: ________________

Evaluator name: ______________________________ Signature: ________________

Program Director: ____________________________ Signature: ________________

APPENDIX H

Example of ITER Rotation Specific Form

Saudi Commission for Health Specialties	Medical Physics for Therapeutic Radiology Rotation 6: Treatment equipment and quality assurance Stage & Level of training: (Junior) (R1) Evaluated By: Evaluator's name. Evaluating: Person (role) or moment's name (if applicable) Dates: Start date to end date

* Indicates a mandatory response

IN-TRAINING EVALUATION REPORT

ITER Rating scale:

- **NA:** Not Applicable or no opportunity to evaluate during this rotation.
- **Performance that Does not Meet Expectations (<50%):** Trainee consistently struggles to meet basic requirements and requires significant development and intervention in various aspects of training and patient care. Performance consistently lags behind their expected competency level.
- **Borderline Performance (>50–69.99%):** Trainee met some criteria satisfactorily, but there are notable deficiencies in their overall performance that require attention and development. Performance frequently falls below the expected competency level, indicating a need for improvement in some areas.
- **Performance that Meets Expectations (>70–89.99%):** Trainee fulfilled their role competently, met the required criteria effectively, and contributed to their responsibilities. Performance consistently aligns with expected competency level.

- **Performance that Exceeds Expectations (>90%):** Trainee constantly demonstrates exceptional clinical skills, professionalism, and commitment to continuous learning. Performance significantly exceeds expected competency level.

	NA	Does not Meet Expectations (<50%)	Borderline (≥50-69.99%)	Meets Expectations (≥70-89.99%)	Exceeds Expectations (≥90%)
A. Therapy Physics EXPERT					
Understands the technical and clinical science					
Demonstrates expertise in all aspects of the technical, clinical, and management of common medical physics					
Avoids unnecessary or harmful investigations or management					
Demonstrates appropriate knowledge, skills, and attitudes					
B. COMMUNICATOR					
Records appropriate communication notes					
Communicates with medical staff in an appropriate manner					
Maintains professional relationships with other healthcare providers					
Provides clear and complete records, reports, and informed and written informed consent					
C. COLLABORATOR					
Works effectively in a team environment					
Can work with allied healthcare staff					

	NA	Does not Meet Expectations (<50%)	Borderline (≥50-69.99%)	Meets Expectations (≥70-89.99%)	Exceeds Expectations (≥90%)
Can work with senior and junior staff					
D. HEALTH ADVOCATE					
Attentive to preventive measures					
Attentive to issues in public health policy					
Recognizes important social, environmental, and biological determinants of health					
Offers advocacy on behalf of patients at practice and general population levels					
E. SCHOLAR					
Attends and contributes to rounds, seminars, and other learning events					
Discusses present selected topics in an appropriate manner, as requested					
Demonstrates adequate ability to search literature					
Demonstrates efforts to increase knowledge base					
Accepts and acts on constructive feedback					
Contributes to the development of new knowledge					

	NA	Does not Meet Expectations (<50%)	Borderline (≥50-69.99%)	Meets Expectations (≥70-89.99%)	Exceeds Expectations (≥90%)
F. LEADER					
Participates in activities that contribute to the effectiveness of healthcare organizations and systems					
Leaders their practice and career effectively					
Serves in administration and leadership roles as appropriate					
G. PROFESSIONAL					
Recognizes their limitations and seeks advice and consultation when necessary					
Delivers evidence-based care with integrity, honesty, and compassion					
Demonstrates appropriate insight into their strengths and weaknesses					
Shows initiative within the limits of knowledge and training					

Workplace-based Assessment and other Activities	NA	Does not Meet Expectations (<50%)	Borderline (≥50–69.99%)	Meets Expectations (≥70–89.99%)	Exceeds Expectations (≥90%)	Comments
*CBD						
*Mini-CEX						
*DOPs						
Non WBA activities						

*Did you have an opportunity to meet with this trainee to discuss their performance and action plan? (for the evaluator to answer)

○ Yes

○ No

Did you have an opportunity to discuss your performance and action plan with your preceptor/supervisor? (for the trainee to answer)

○ Yes

○ No

* Feedback comments (Verbal and written feedback is a mandatory component of this assessment. Include areas of strengths/areas for improvement.)

....

....

....

*Agreed action plan:

....

....

....

....

APPENDIX I

Logbook Requirements

The objectives of the logbook are as follows:

- Assist the resident in identifying their deficiencies in specific areas.
- Assist the program director/evaluator in documenting the contribution and evaluation of residents.
- Provide the evaluator with guidance regarding appropriate and fair assessment of residents.
- Provide the program director with guidance regarding deficiencies in training.

GUIDELINES FOR RESIDENTS:

- Residents are required to maintain logbooks during the entire training period.
- Logbook entries on recorded activities should be completed on the day the activities occur.
- All entries must be signed by a mentor within one week.
- Residents should discuss their training progress every month, as indicated in the logbook, with mentors and/or program directors.
- Residents should submit their completed logbooks to the program director at the end of the rotation and training for subsequent submission to the regional supervisory committee.
- If the logbook is not signed by the program director, the resident will be ineligible for the end-of-training certification and final examination.
- The following table defines the minimum frequencies required to complete each activity. However, residents are expected to strive for the competency level of an unsupervised satisfactory clinical standard, which may require more procedures than

those listed below. Residents should seek appropriate feedback from healthcare professionals regarding their progress and competency level.

R1:

Activity	Minimum Frequency
Perform imaging QA for diagnostic equipment (CT, MRI, and ultrasound)	3
Perform phantom scans and parameter manipulations in MRI	3
Perform QA for nuclear medicine equipment (Gamma Camera, PET, and SPECT)	3
Perform daily basic QA on linear accelerators	100
Perform monthly QA on linear accelerators	8
Participate in annual QA for linear accelerators	3
Perform machine calibration and dosimetry verification	3
Perform basic treatment planning for simple cases	5 different cases
Participate in imaging and simulation for patient setup	5 different cases
Perform CT simulation QA	3
Participate in brachytherapy QA and source loading	3
Perform routine patient safety checks	50 plans
Perform shielding calculations and evaluations	3
Participate in radiation safety rounds and audits	2

Attend departmental and physics meetings	4

R2:

Activity	Minimum Frequency
Perform advanced QA for linear accelerators (including IMRT QA)	3
Perform advanced dosimetry for IMRT and VMAT	25
Conduct acceptance testing for TPS	3
Perform routine QA for TPS	3
Perform calibration and dosimetry for special procedures (SRS and SBRT)	3
Conduct quality assurance for brachytherapy units	3
Perform patient-specific QA for advanced treatment plans	5 different cases
Participate in commissioning of new equipment (linear accelerators and imaging systems)	3
Perform periodic QA for therapy equipment	6
Attend and present in clinical case review meetings	6
Participate in research projects and quality improvement initiatives	1 project
Conduct radiation safety training for staff	2

R3:

Activity	Minimum Frequency
Perform comprehensive QA for linear accelerators	3
Perform acceptance and commissioning tests for new equipment/techniques	3
Conduct advanced treatment planning and dose verification for complex cases	5 different cases
Perform QA for stereotactic radiosurgery (SRS) and stereotactic body radiotherapy (SBRT)	3
Perform calibration and verification for imaging systems	3
Conduct end-to-end tests for new treatment protocols	3
Attend preventive and corrective maintenance for therapy/diagnostic equipment	3
Participate in multi-disciplinary team meetings and tumor boards	6
Lead a departmental QA audit	1
Mentor junior residents and participate in teaching activities	4 activities

APPENDIX J

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