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Information Package

Residency in Radiation Oncology Physics

Department of Medical Physics

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General Information

Department of Medical Physics, McGill University Health Centre

Medical Physics Unit, McGill University

Montréal, Québec, Canada

The residency program is of 2-years duration and provides the resident with clinical experience and theoretical knowledge in all aspects of modern radiation oncology physics. An important objective of the program is to prepare the resident for the professional examination and licensure process in the specialty of Radiation Oncology Physics. The residency program consists of four rotations and a possibility of remediation in the form of didactic courses. **Only 2 courses will be able to be taken as part of this program.**

Minimum requirement for admission is M.Sc. degree in Medical Physics; however, the preferred candidate will have a M.Sc. or Ph.D. degree in Medical Physics from a CAMPEP-accredited educational program in Medical Physics.

The four rotations are as follows:

(1) *Basic Treatment Planning and Standard Treatment Techniques*
(2) *Advanced Treatment Planning and Special Treatment Techniques*
(3) *Quality Assurance and Radiation Protection*
(4) *Clinical Physics Practice and Clinical Physics Project*

Each rotation is followed by a comprehensive examination.

The four possible didactic courses are as follows:

(1) *Radiation Physics (MDPH-601)*
(2) *Radiotherapy Physics (MDPH-602)*
(3) *Medical Imaging (MDPH-607)*
(4) *Radiation Biology (MDPH-609)*
(5) *Health Physics (MDPH-613)*
(6) *Anatomy and Physiology for Medical Physics (MDPH-618)*

A resident who already completed a particular course during graduate studies may obtain a course exemption.

Requirements for Successful Program Completion

The residents complete the program after the following requirements are fulfilled:

- All four rotations completed in a minimum time of 24 months.
- All four rotation examinations passed.
- Final examination passed.
- Successful completion of remedial coursework (if required).
- Satisfactory attendance record (better than 80%) at all prescribed seminars organized by the Medical Physics and Radiation Oncology departments.
- The resident has completed the above requirements while behaving in a professional and ethical manner, respecting colleagues, staff members, and patients, demonstrating appropriate industry, competence, responsibility, and learning abilities.

General program regulations

Working conditions

- For the 2-year duration of the training the resident is considered a staff member of the respective hospital department and has the same rights, privileges and obligations as the permanent staff members regardless of the job title employed at each institution.
- **Vacation allowance**: **20 working days/year**.
- **Statutory holidays**: **13 days/year**.
- **Sick days**: up to 0.8 days/month, i.e., **9.6 days/year**.
- **Remuneration**: as per signed contract.
- Office desk and computer: to be assigned upon start of residency.
- Open access to libraries, xerox machine, and fax machine for official use.
- **Grievances** are to be addressed to the program director who is also the Chairman of the Residency Training Committee.
- **Radiation safety** concerns should be addressed to the institutional Radiation Safety Officer (Class II).
- **Normal working hours** are **08:30-16:30**; occasional evening and weekend work will be required to gain experience with QA procedures and equipment commissioning carried out by staff medical physicists.
- Scheduling of rotations, end-of-rotation examinations, research colloquium, and vacation time is arranged with the clinical coordinator.

Formal evaluation of resident performance

The residency program consists of four rotations, each of 6 months duration. To complete a rotation the resident must spend the prescribed amount of time on each rotation and meet the theorical and practical knowledge associated with each sub-section. The resident is guided through the various aspects of each rotation by the site clinical coordinators or their delegates.

The evaluation of the resident comes in four forms:

1) A continual informal assessment by the supervising physicists for each rotation. The assessment by staff during the resident's rotation is particularly important in the evaluation of the resident's attitude, professionalism, and work ethics.
2) Mid-rotation evaluation – the resident submits a mid-rotation self-evaluation of progress to the site coordinator, who in parallel completes a mid-rotation evaluation of the resident. The combined document is submitted by the site coordinator to the program's clinical coordinator.
3) End of rotation evaluation – the site coordinator submits an end of rotation evaluation, signed by the resident, to the program clinical coordinator. This evaluation is a prerequisite to scheduling an end of rotation oral examination.
4) An oral exam specific to each rotation must be successfully completed.

A final examination (oral), covering the material from the entire residency program, will be conducted near the end of the residency once all rotation exams are successfully completed.

The examinations are organized by the clinical coordinator and conducted by an examination committee consisting two to three faculty members appointed by the clinical coordinator. Each element of the rotation (listed in the rotation syllabus) has an oral examination question associated with it. The oral examination questions are selected from a question bank by the clinical coordinator.

The examination questions are marked on a pass/fail basis and an overall grade, is assigned as "PASS", "INCOMPLETE" or "FAIL". Each examiner assigns an individual grade. A grade of "INCOMPLETE" is assigned of the examiner feels the candidate has weakness in a few areas of significance but in less than half of the exam content or shows a weak exam technique. A grade of “FAIL” is assigned if the resident has failed over half of the exam content.

The overall grade for the exam is assigned as follows: a grade of “INCOMPLETE” is assigned if at least two examiners have assigned a grade of incomplete and a grade of “FAIL” is assigned if a least 2 examiners have assigned a grade of “FAIL” or if the resident has had 3 consecutive grades of “INCOMPLETE” in the same rotation exam.

A grade of “PASS” implies the overall rotation objectives have been met. If a passing grade is assigned but that the resident shows a weakness in a given area, some remedial work, such as presenting the material at a residency training session, may be assigned. A resident obtaining a grade of “INCOMPLETE” will be required to complete a remediation program prior to re-examination. A failed rotation has a potential for dismissal from the program, after the particular situation is discussed in a residency training committee meeting and extenuating circumstances (if any) are considered.

The grading sheets that form part of the resident’s file. After every examination, the examination committee debriefs the resident, and areas of improvement in terms of subject knowledge as well as examination techniques are pointed out.

Resident feedback

Residents are asked for feedback continuously through the program. There are several mechanisms for this:

- one-on-one meetings with the clinical coordinator and/or the director
- report of the senior resident to the residency program steering committee
- mid-rotation evaluations

- end of rotation evaluations by the resident
- end of program survey

Self directed readings and reference materials

The resident is expected to use appropriate literature to supplement their learning experience. A list of reference books is available to them, and most of the books are in the medical physics library at the MUHC. Other directed readings are related to the teaching sessions and can include the relevant ICRU, AAPM, and IAEA documents. The list of reference books is given in the clinical rotation summaries. **It is the resident's responsibility to seek out any documentation necessary to successfully acquire any knowledge required within a rotation.**

Residents' issues and concerns

A senior resident, the program director, and the clinical coordinator present resident's issues and concerns at the program steering committee meeting. The issues are discussed and recorded in the minutes of each committee meeting. A plan is formulated and presented to the residents soon after in one of the weekly teaching sessions.

Dismissal from the program

The resident may be dismissed at any time from the program, after due process and at the discretion of the Residency Program Training Committee, if the resident fails to demonstrate the appropriate learning ability, progress, competence or ethical behavior. A grade of "FAIL" in a rotation exam or on the final examination or failing a remediation plan can also result in dismissal. Notwithstanding the above, if the any staff involved with the program feels the resident is at risk, the program director and clinical coordinator are informed, and every effort is made to aid the resident through any difficulties. Additionally, the resident can be dismissed if he/she breaches any of the employer’s conditions for employment or codes of conduct or is released from employment by the institution.

Residency Training Program Committee

Voting members:

Co-Chairs:

William Parker, *M.Sc., FCCPM, Program Director*

Jan Seuntjens, *Ph.D., FCCPM, FAAPM, Graduate Program Director*

Secretary:

Russell Ruo, *M.Sc., FCCPM, DABR*

Clinical Coordinator:

Horacio Patrocinio, *M.Sc., FCCPM, FCOMP, DABR*

Physics Members:

Piotr Pater, *Ph.D., MCCPM*

Gabriela Stroian, *Ph.D., FCCPM*

Krum Aziev, *M.Sc., FCCPM (JGH satellite site coordinator)*

Yannick Hervieux, *M.Sc., MCCPM (HCL satellite site coordinator)*

Sandrine David, *M.Sc., MCCPM (CHUM satellite site coordinator)*

Geneviève Jarry, *Ph.D., FCCPM (HMR satellite site coordinator)*

Lawrence Reinstein, *Ph.D., DABMP (SPH satellite site coordinator)*

Physician Members:

Joanne Alfieri, *M.D., FRCPC Chair of Residency Training in Radiation Oncology at McGill University*

Treatment Planning Dosimetry:

Line Comeau, *R.T. (A.C.), CMD (Dosimetry Coordinator)*

Non-Voting members:

Resident representative:

Senior resident

MPU graduate program secretary:

Margery Knewstubb

The residency-training program is governed by the Residency Training Program Committee (RTPC). The committee is co-chaired by the residency training program director and the graduate program director. The committee consists the co-chairs, a clinical coordinator, a program secretary, several senior medical physicists, a physician member, the chief dosimetrist, as well as a physicist from each of the affiliated hospitals. The senior resident (MUHC) is invited as a resident representative to relevant portions of the committee meetings, and asked to bring any feedback or concerns the residents might have. The role of the committee is to oversee the program operation in its entirety, specifically:

- Set and review the residency program curriculum
- Review resident performance
- Review resident feedback
- Set the timeline and schedules for the residents
- Participate in the examination and evaluation of residents
- Evaluate potential candidates for the residency positions

The committee has a minimum of 2 meetings per year. The minutes of each meeting are maintained. Other ad-hoc meetings can be called at any time to discuss different aspects of the program.

Staff List - MUHC

Academic Staff (McGill University - Medical Physics Unit)

Administrative Assistant
Margery Knewstubb

Medical Physicists
Jan Seuntjens, PhD, FCCPM, FAAPM (Associate Professor, Director MPU)
Sharin Enger, PhD (Associate Professor)
Ives Levesque, PhD, MCCPM (Assistant Professor)
John Kildea, PhD, MCCPM (Assistant Professor)

Clinical Staff (MUHC - Montreal General Hospital)

Administrative Officer
Tatjana Nisic, MA

Medical Physicists
William Parker, MSc, FCCPM (Chief, Department of Medical Physics, MUHC, Assistant Professor)
Michael Evans, MSc, FCCPM (Radiation Safety Officer, Class II, MUHC, Assistant Professor)
Horacio Patrocinio, MSc, FCCPM, DABR (Assistant Professor)
Russell Ruo, MSc, FCCPM, DABR (Faculty Lecturer)
Piotr Pater, PhD, MCCPM (Assistant Professor)
Gabriela Stroian, PhD, FCCPM (Assistant Professor)
Marija Popovic, PhD, MCCPM (Assistant Professor)
Emily Poon, PhD, MCCPM (Assistant Professor)
Tanner Connell, PhD, MCCPM (Faculty Lecturer)
Monica Serban, MSc, MCCPM (Faculty Lecturer)
Peter Watson, PhD (Assistant Professor, Medical Imaging Physicist – Diagnostic Radiology)
Gyorgy Heygi, PhD (Faculty Lecturer, Medical Imaging Physicist – Diagnostic Radiology)

Dosimetrists
Line Comeau, RTT, CMD (Co-Chief Dosimetrist)
Francesco Paolino, RTT, BSc (Co-Chief Dosimetrist)
Cenzetta Procaccini, RTT
Jennifer Brown, RTT
Maria Papageorgiou, RTT
Christine Hudon, RTT
Melodie Siano, RTT
Shi Lei Chan, RTT
Loudmila Dychant, RTT
Luc Edouard Talisma, RTT, CMD

Support Staff
Pierre Leger, BEng (Chief Engineer)
Joe Larkin (Engineer)
Bhavan Siva, BEng (Engineer)
Suzana Darvasi, BSc (Information systems technician)

DESCRIPTION OF CLINICAL ROTATIONS for RADIATION ONCOLOGY PHYSICS RESIDENTS

Clinical Rotation 1

Basic Treatment Planning and Standard Treatment Delivery Techniques

Purpose:

To familiarize the resident with all basic aspects of radiotherapy treatment planning and treatment delivery. The rotation duration is 6 months and is divided into three sub-rotations: (1.1) Simulation (1 month); (1.2) Basic training in treatment planning (2 months), and; (1.3) Clinical treatment planning (3 months).

Objectives:

- The resident will be familiarized with the radiation oncology information system including the electronic charting aspects, treatment planning system, and transfer of information.
- The resident is introduced to basic and intermediate treatment planning concepts (ICRU 50, 62, 83).
- The resident will aid dosimetrists and MDs in contouring of target volumes, normal tissues, organs at risk, and critical structures.
- The resident will learn virtual simulation and simple planning concepts for palliative cases.
- The resident will learn 3D conformal radiation therapy (3D) and basic IMRT treatment planning techniques, plan assessment and evaluation
- The resident will work full time in clinical treatment planning a minimum period of 3 months producing clinically appropriate 3D and IMRT treatment plans.

Elements:

1.1 Simulation

Item	Description	Knowledge objective	Practice objective
1.1.1	Patient positioning and immobilization	Understands standard radiotherapy treatment positioning, immobilization techniques, use of fiducial markers, tattooing, and marking of patients	Expected to have observed a variety of cases
1.1.2	Treatment simulation	Understands principles of treatment simulation and patient data acquisition, differences between conventional and virtual (CT-based) simulation	Expected to have observed a variety of cases
1.1.3	Target and structure delineation	Understands the contouring of target structures and organs at risk following the ICRU 50, 62 and 83 document guidelines for organ and target definition	Can contour basic OARs, recognize the use of relevant ICRU concepts in a variety of sites, and when to use each volume
1.1.4	Field definition	Understands basic treatment techniques and concepts including: SSD direct field setups, SAD isocentric setups, AP/PA beams, lateral opposed fields, mounted blocks, multileaf collimator, field matching techniques	Can define fields in a variety of sites, discuss and recommend field design and relative merits of different beam arrangements including dose estimations
1.1.5	Simulation techniques for curative intent cases	Understands tangential breast irradiation, tangential breast and supra-clavicular lymph node irradiation, head and neck, lung, whole CNS, Hodgkin lymphoma, seminoma	Can recognize standard and non-standard fields in the context of a variety of sites
1.1.6	Simulation techniques for palliative intent and emergency cases	Understands whole brain irradiation, irradiation for various bone metastatic sites, irradiation for superior vena cava (SVC) syndrome, and irradiation for spinal cord compression	Can recognize standard and non-standard fields in the context of a variety of sites
1.1.7	Treatment time and monitor unit calculations	Understands manual and TPS based MU calculations – understands the approach for both SSD and SAD based MU calculations and factors.	Can carry out MU calculations based on simple geometry as well as based on computerized dose distributions

Elements:

1.2 Basic training in treatment planning

Item	Description	Knowledge objective	Practice objective
1.2.1	Data transfer and planning tools including	Understands the basic operation of the treatment planning computer including data transfer, beam placement, block and MLC design, dose calculation, and printing	Can transfer information between systems and recognize and troubleshoot common issue.
1.2.2	Prescription, evaluation, and dose reporting guidelines	Understands the ICRU 50, 62 and 83 concepts and guidelines for treatment plan evaluation and dose reporting	Can identify prescription points and recommend placement, can evaluate a plan.
1.2.3	Basic 2D/3D treatment planning concepts including	Understands basic treatment planning techniques including the use of multiple fields, static wedges, dynamic wedges, field weighting, field-in-field compensation, bolus, basic plan evaluation, and dose volume histograms (DVH)	Can carry out treatment planning for simple beam arrangements and advise on the use of accessories and beam energy
1.2.4	Basic IMRT treatment planning concepts including	Understands optimization techniques, DVH based planning constraints, plan evaluation. Clinical issues for beam geometry selection	Can carry out treatment planning and use the TPS tools
1.2.5	3D and/or IMRT Treatment planning techniques for the following sites	Understands and can rationalize and explain treatment approach for Central nervous system (whole brain, brain tumors, CSI), ENT, GI (esophagus, gastric, rectum, anal canal), lung, GU (prostate, bladder, seminoma), GYN, breast (tangential w/o supra-clav, boost), lymphoma (Hodgkin's and non-Hodgkins), sarcomas (incl. extremities)	Can produce a clinically acceptable treatment plan for any of these sites using 3D and/or IMRT/VMAT and can advise on the suitability of a plan.
1.2.6	Clinical trials treatment planning and electronic submission	Understands the terminology of clinical trials, the steps in implementing or initiating a clinical trial	Expected to have seen patient plans for cases on clinical trial and reviewed facility questionnaires, credentialing results

Elements:

1.3 Clinical treatment planning

Item	Description	Knowledge objective	Practice objective
1.3.1	Clinical aspects of treatment planning	Understands the requirements of the treatment planning process	Can perform treatment planning duties as part of the facility's treatment planning service under the supervision of the treatment planning coordinator or site coordinator
1.3.2	Clinical treatment delivery (treatment room):	Understands the workflow and role of each professional in the delivery of radiation treatments. Understands the actions performed at a treatment until to ensure treatments are correctly carried out.	Expected to spend 5 days on a treatment unit (dual energy linear accelerator with electron beam capability) or a variety of treatment units and observe the treating technologists perform their routine work including chart checks, patient setup, treatment delivery, entering of treatment parameters into the record and verify system production of treatment records, and the
1.3.3	Clinical treatment planning and delivery of electron beams	Understands all aspects of treatment planning, setup, delivery, and dosimetric considerations for electron beam treatments	Can advise on the beam parameters (field size, energy, bolus) for a clinical setup of electrons. Can produce a computerized electron treatment plan.
1.3.4	Clinical treatment planning and delivery of superficial, orthovoltage, and supervoltage beams	Understands all aspects of treatment planning, setup, delivery, and dosimetric considerations for kilovoltage x-ray beam treatments	Expected to have either seen an orthovoltage treatment or discussed the technique with site coordinator or other expert.

Rotation 1 - Relevant literature:

AAPM Report 258: Monitor unit calculations for external photon and electron beams

AAPM Report 176: Dosimetric effects caused by couch tops and immobilization devices

AAPM Report 132: Use of image registration and fusion algorithms and techniques in radiotherapy

AAPM Report 114: Verification of monitor unit calculations for non-IMRT clinical radiotherapy

AAPM Report 113: Guidance for the Physics Aspects of Clinical Trials

AAPM Report 99: Recommendations for clinical electron beam dosimetry: Supplement to the recommendations of Task Group 25

AAPM Report 86: Quality Assurance for Clinical Trials: A Primer for Physicists

AAPM Report 85: Tissue Inhomogeneity Corrections for Megavoltage Photon Beams

AAPM Report 82: Guidance document on delivery, treatment planning, and clinical implementation of IMRT

ICRU Report 83: Prescribing, Recording, and Reporting Photon-Beam Intensity-Modulated Radiation Therapy (IMRT)

ICRU Report 71: Prescribing, Recording, and Reporting Electron Beam Therapy

ICRU Report 62: Prescribing, Recording and Reporting Photon Beam Therapy (Supplement to ICRU Report 50)

ICRU Report 50: Prescribing, Recording and Reporting Photon Beam Therapy

QUANTEC - Quantitative Analyses of Normal Tissue Effects in the Clinic (IJROBP)

Clinical Rotation 2

Advanced Treatment Planning and Treatment Delivery Techniques

Purpose:

To familiarize the resident with advanced treatment planning techniques. The rotation consists of 2 sub-rotations: (2.1) Brachytherapy treatment planning and dose delivery, and (2.2) Advanced external beam treatment planning and dose delivery techniques. The residents are expected to pass through both sub-rotations concurrently as clinical schedules are variable.

Objectives:

- The resident will learn treatment planning and QA procedures for various advanced radiotherapy treatment techniques including: Intensity modulated radiation therapy (IMRT), Stereotactic body radiation therapy (SBRT), and Stereotactic radiosurgery (SRS).
- The resident will learn treatment planning, delivery, and QA techniques for total body irradiation (TBI) and total skin electron irradiation (TSEI).
- The resident will learn radiation safety concepts in brachytherapy treatments.
- The resident will learn how to treatment plan and perform QA for various types of brachytherapy cases.

Elements:

2.1 Brachytherapy treatment planning and dose delivery

Item	Description	Knowledge objective	Practice objective
2.1.1	High dose rate brachytherapy (HDR) basics	Understands all aspects of high dose-rate brachytherapy treatment delivery, radiation safety, and emergency procedures.	Can support a clinical HDR delivery and advise on radiation safety issues.
2.1.2	Treatment time calculations for HDR brachytherapy	Understands the methods for treatment time calculations including TG-43, pre-determined dose rate tables and nomograms.	Can perform independent checks on time calculations in brachytherapy
2.1.3	2D treatment planning for HDR brachytherapy	Understands the concepts of planning using single or orthogonal radiographic films.	Can interpret 2D images and identify anatomy and prescription/reporting points. Can perform manual calculations for simple geometries (ex. single line).
2.1.4	3D treatment planning for HDR brachytherapy	Understands the concepts treatment planning using CT, MR, or CBCT images for sites such as breast, ENT, GYN, lower GI, extremities	Can perform 3D brachytherapy treatment for intracavitary and interstitial temporary HDR
2.1.5	Eye treatments	Understands the concepts of treatment planning and delivery for choroidal melanoma eye-plaque treatments	There is no practical knowledge requirement (technique not currently practiced)
2.1.6	Temporary LDR brachytherapy	Understands the concepts and historical context of planning and delivery for temporary implant LDR brachytherapy	There is no practical knowledge requirement (technique not currently practiced)
2.1.7	Permanent implants	Understands the treatment planning and delivery for permanent implants of prostate cancer with I-125 and Pd-103	Has attended a permanent procedure

Elements:

2.2 Advanced external beam treatment planning and delivery techniques

Item	Description	Knowledge objective	Practice objective
2.2.1	Single fraction stereotactic radiosurgery (SRS)	Understands SRS treatment planning, dose calculations, QA, and treatment delivery. Has knowledge of linac-based localization and delivery techniques (invasive frames, mask systems, collimation, x-ray and CBCT imaging-based delivery) and of dedicated treatment units such as CyberKnife.	Can complete treatment plans for a variety of SRS cases and assess suitability of the technique. Can evaluate SRS treatment plans and advise physician of the relative merits of different plans.
2.2.2	Multi-fraction stereotactic radiotherapy (FSRT)	Understands multi-fraction SRT treatment planning, dose calculations, QA, and treatment delivery.	Can complete treatment plans for a variety of FSRT cases and assess suitability of the technique. Can evaluate FSRT treatment plans and advise physician of the relative merits of different plans.
2.2.3	Stereotactic Body Radiation Therapy (SBRT)	Understands SBRT principles as applied to a variety of treatment sites, including the immobilization, simulation and treatment imaging, volume definition and radiation biology, collimation, and static beam and IMRT/VMAT planning. Gating and other motion management techniques	Can complete treatment plans for a variety of SBRT cases and assess suitability of the technique. Can evaluate SBRT treatment plans and advise physician of the relative merits of different plans.
2.2.4	Respiratory gating and motion management systems	Understands the role of 4DCT and of motion management techniques such as free breathing ITV, gating, abdominal compression, breath hold and tumour tracking.	Can advise on the use 4DCT, imaging and motion management techniques for a variety of treatment sites
2.2.5	Advanced Inverse planned Intensity Modulated Radiation Therapy (IMRT)	Understands the concepts and best practices in advanced linac-based IMRT/VMAT planning (CNS, ENT) and the use of specialized equipment such as helical tomotherapy.	Can produce clinically acceptable treatment plans for complex sites requiring IMRT/VMAT and can prepare QA delivery plans. Can evaluate IMRT/VMAT and advise physicians of the relative merits of different plans.

Elements:

2.2 Advanced external beam treatment planning and delivery techniques (continued)

Item	Description	Knowledge objective	Practice objective
2.2.6	Image Guided Radiation Therapy (IGRT)	Understands basic concepts behind IGRT including the justification, relative merits and use of CBCT, MVCT, EPID, kV x-ray imaging, and ultrasound systems for IGRT	Can recommend and defend an IGRT approach for a given site and identify cases where more or less IGRT would be required.
2.2.7	Total body photon irradiation (TBI)	Understands the rationale for, and the delivery and treatment planning concepts specific to TBI. Understands technical details including commissioning and implementation issues of a TBI technique.	Expected to have either seen a TBI treatment or discussed the technique with site coordinator or other expert
2.2.8	Total skin electron irradiation (TSEI)	Understands the rationale for, and the delivery and treatment planning concepts specific to TSEI. Understands technical details including commissioning and implementation issues of a TSEI technique.	Expected to have either seen a TSEI treatment or discussed the technique with site coordinator or other expert
2.2.9	Linac-based intra-operative radiation therapy (IORT)	Understands IORT principles for conventional linac based or mobile unit IORT (electron applicators, docking, output and dosimetry, and room preparation, radiation safety).	There is no practical knowledge requirement (technique not currently practiced)

Rotation 2 - Relevant literature:

AAPM Report 271: Intracranial stereotactic positioning systems
AAPM Report 229: Dose Calculation for Photon-Emitting Brachytherapy Sources with Average Energy Higher than 50 keV
AAPM Report 221: AAPM recommendations on medical physics practices for ocular plaque brachytherapy
AAPM Report 186: Model-based dose calculation methods in brachytherapy beyond the TG-43 formalism
AAPM Report 180: Image Guidance Doses Delivered During Radiotherapy: Quantification, Management, and Reduction
AAPM Report 137: AAPM recommendations on dose prescription and reporting methods for permanent interstitial brachytherapy for prostate cancer
AAPM Report 129: Dosimetry of 125I and 103Pd COMS eye plaques for intraocular tumors
AAPM Report 104: The Role of In-Room kV X-Ray Imaging for Patient Setup and Target Localization
AAPM Report 101: Stereotactic body radiation therapy
AAPM Report 98: Third-party brachytherapy source calibrations and physicist responsibilities
AAPM Report 95: The management of imaging dose during image-guided radiotherapy
AAPM Report 92: Intraoperative radiation therapy using mobile electron linear accelerators
AAPM Report 91: The Management of Respiratory Motion in Radiation Oncology
AAPM Report 84S: Supplement to the 2004 update of the AAPM Task Group No. 43 Report
AAPM Report 84: A revised AAPM protocol for brachytherapy dose
AAPM Report 75: Clinical use of electronic portal imaging
AAPM Report 68: Permanent prostate seed implant brachytherapy
AAPM Report 61: High dose-rate brachytherapy treatment delivery
AAPM Report 59: Code of practice for brachytherapy physics
AAPM Report 54: Stereotactic Radiosurgery
AAPM Report 51: Dosimetry of interstitial brachytherapy sources (Task Group No. 43)
AAPM Report 23: Total Skin Electron Therapy: Technique and Dosimetry
AAPM Report 17: The Physical Aspects of Total and Half Body Photon Irradiation
AAPM Medical Physics Practice Guidelines 2.a: Commissioning and quality assurance of X-ray-based image-guided radiotherapy systems
AAPM Medical Physics Practice Guidelines 9.a. for SRS-SBRT
ACR–AAPM Technical Standard For The Performance Of Low- Dose-Rate Brachytherapy Physics

ACR–AAPM Technical Standard For The Performance Of High- Dose-Rate Brachytherapy Physics
ICRU Report 91: Prescribing, Recording, and Reporting of Stereotactic Treatments with Small Photon Beams
ICRU Report 89: Prescribing, Recording, and Reporting Brachytherapy for Cancer of the Cervix
ICRU Report 83: Prescribing, Recording, and Reporting Photon-Beam Intensity-Modulated Radiation Therapy (IMRT)
ICRU Report 62: Prescribing, Recording and Reporting Photon Beam Therapy (Supplement to ICRU Report 50)
ICRU Report 58: Dose and Volume Specification for Reporting Interstitial Therapy
ICRU Report 50: Prescribing, Recording and Reporting Photon Beam Therapy
ICRU Report 38: Dose and Volume Specification for Reporting Intracavitary Therapy in Gynecology
NCRP Report 155: Management of Radionuclide Therapy Patient

Clinical Rotation 3

Quality Assurance and Radiation Protection

Purpose:

To familiarize the resident with quality assurance (QA) techniques and radiation protection issues applicable to a radiation therapy facility. The rotation consists of two sub-rotations: (3.1) Quality assurance (5 months) and (3.2) Radiation Safety (1 month).

Objectives:

- The resident will be familiarized with all aspects of quality assurance including: comprehensive QA programs, QA equipment, QA measurement techniques, acceptance and commissioning, QA audits, and reference dosimetry.
- The residents will be familiarized with the following aspects of radiation protection as applied to radiation oncology: radiation safety programs, regulations, licensing, radiation safety issues, and basic radiotherapy facility design.
- The residents will be familiarized with all aspects of ethics and professional issues as applied to the practice of radiation oncology physics.

Elements:

3.1 Quality Assurance

Item	Description	Knowledge objective	Practice objective
3.1.1	QA program	Understands all aspects of the quality assurance program in the medical physics and radiation oncology departments	Can advise on best practices in QA. Should have attended a departmental QA committee meeting.
3.1.2	Guidelines for radiation oncology QA programs	Understands the available sources for QA guidelines (CPQR, AAPM, IAEA) and is familiar with recommended practices for equipment, workflow and patient related QA.	Can implement and carry out QA on the equipment in radiation oncology. Can evaluate QA results and troubleshoot deviations.
3.1.3	QA equipment	Understands the properties, operation and limitations of QA and measurement equipment such as ionization chambers, electrometers, film, OSLD, and 3D water phantoms.	Can operate and troubleshoot QA and measurement equipment and advise on the selection of equipment for a given measurement or QA procedure.
3.1.4	QA measurement	Understands the rationale of QA measurements and the justification for frequency and tolerance of QA procedures.	Can carry-out routine QA procedures (daily, monthly, annual) and has been exposed to some less frequent or sporadic QA processes as well.
3.1.5	Technical specification, acceptance testing, and commissioning of treatment units	Understands the differences and characteristics of acceptance testing and commissioning of linear accelerators and other relevant equipment in radiation oncology	Can carry out vendor specified acceptance tests for a linac.
3.1.6	Technical specification, acceptance testing, and commissioning of treatment planning systems	Understands the process and requirements of acceptance testing and commissioning a treatment planning system used for external beam radiotherapy used for both IMRT/VMAT and non-IMRT/VMAT beams.	The resident will conduct the commissioning and validation of a radiotherapy beam (real or simulated data) in a treatment planning system.
3.1.7	Clinical reference dosimetry	Understands the details and implementation of reference dosimetry protocols for external beam radiotherapy (AAPM TG-51/IAEA TRS-398)	Can perform a reference dosimetry calibration of photon and electron beams.

Elements

3.1 Quality Assurance (continued)

Item	Description	Knowledge objective	Practice objective
3.1.8	External QA audits	Understands the role and operation of external audits (IROQ, protocol requirements).	Should have performed one audit irradiation (linac output or site-specific phantom)
3.1.9	Reference and absolute dosimetry	Understands the differences between reference and relative dosimetry (detectors, calibration, other correction factors)	Can choose and use detectors for relative dosimetry and reference dosimetry. Can cross calibrate detectors.
3.1.10	QA of imaging systems	Understands the basic QA and functional testing of imaging systems used in radiation therapy (CT, MRI, MVCT, CBCT, Simulator).	Can carry out routine QA procedures on imaging equipment (daily, monthly, annual)
3.1.11	IMRT QA dosimetry	Understands the rationale, preparation and analysis of patient specific IMRT QA procedures	Can carry our patient specific IMRT QA procedures and advise on course of action for failing results
3.1.12	SRS small field dosimetry	Understands the issues related to the measurement of sub-centimeter fields (detectors, technique, correction factors)	Can carry out small field measurements and rationalize results
3.1.13	In-vivo dosimetry	Understands issues related to the measurement of dose on/in patients using OSLD, film, MOSFETS and other relevant dosimeters	Can advise physicians on the use and limitations of in-vivo dosimetry and can carry out measurements

Elements

3.2 Radiation Protection

Item	Description	Knowledge objective	Practice objective
3.2.1	Radiation safety program	Understands all aspects of the radiation safety program in the medical physics and radiation oncology departments	Can communicate the elements of the radiation protection program relevant to each professional. Should attend a radiation safety committee meeting.
3.2.2	Regulations	Understands relevant regulations and legislation (local, provincial/state, federal) applicable to the medical physics and radiation oncology department	Can interpret radiation regulations and their implication for the practice at his/her centre
3.2.3	Licensing	Understands the licensing requirements for a radiation facility (CNSC Class II in Canada) and specific radiation devices and sources	Can prepare or interpret an annual compliance report or licensing requirements
3.2.4	Radiation safety issues	Understands radiation safety issues with staff in the radiation oncology department (personnel monitoring, pregnancies, emergencies)	Can advise and communicate with staff regarding radiation safety issues
3.2.5	Facility design	Understands the how facilities are designed for radiation protection and radiation surveying techniques	Can conduct a radiation survey

3.2 Ethics and professional issues

Item	Description	Knowledge objective	Practice objective
3.3.1	Ethics	Understands basic ethical principles and medical physics codes of conduct.	Participates in the ethics training delivered by the McGill Medical Physics Unit.
3.3.2	Professional issues	Understands the role of professional organizations, certification and accreditation bodies, liability and legal issues.	There is no practical knowledge requirement.

Rotation 3 - Relevant literature:

AAPM/IAEA TRS-483: Dosimetry of small static fields used in external photon beam radiotherapy
AAPM Report 283: The report of Task Group 100 of the AAPM: Application of risk analysis methods to radiation therapy quality management
AAPM Report 218: Tolerance Limits and Methodologies for IMRT Measurement-Based Verification QA
AAPM Report 191: Clinical Use of Luminescent Dosimeters: TLDs and OSLDs
AAPM Report 179: Quality assurance for image-guided radiation therapy utilizing CT-based technologies
AAPM Report 160: Radiation Safety Officer Qualifications for Medical Facilities
AAPM Report 159: Recommended ethics curriculum for medical physics graduate and residency programs
AAPM Report 157: Beam modeling and beam model commissioning for Monte Carlo dose calculation-based radiation therapy treatment planning
AAPM Report 148: QA for helical tomotherapy
AAPM Report 142: Quality assurance of medical accelerators
AAPM Report 135: Quality assurance for robotic radiosurgery
AAPM Report 128: Quality assurance tests for prostate brachytherapy ultrasound systems
AAPM Report 120: Dosimetry tools and techniques for IMRT
AAPM Report 119: IMRT commissioning: Multiple institution planning and dosimetry comparisons
AAPM Report 106: Accelerator beam data commissioning equipment and procedures
AAPM Report 105: Issues associated with clinical implementation of Monte Carlo-based photon and electron external beam treatment planning
AAPM Report 99: Recommendations for clinical electron beam dosimetry
AAPM Report 97: In-air output ratio, Sc, for megavoltage photon beams
AAPM Report 87: Diode in Vivo Dosimetry for Patients Receiving External Beam Radiation Therapy
AAPM Report 86: Quality Assurance for Clinical Trials: A Primer for Physicists
AAPM Report 85: Tissue Inhomogeneity Corrections for Megavoltage Photon Beams
AAPM Report 83: Quality assurance for computed-tomography simulators and the computed-tomography-simulation process
AAPM Report 76: AAPM protocol for 40–300 kV x-ray beam dosimetry in radiotherapy and radiobiology
AAPM Report 75: Clinical use of electronic portal imaging
AAPM Report 72: Basic Applications of Multileaf Collimators
AAPM Report 67: AAPM's TG-51 protocol for clinical reference dosimetry of high-energy photon and electron beams
AAPM Report 63: Radiochromic Film Dosimetry

AAPM Report 62: Quality assurance for clinical radiotherapy treatment planning

AAPM Report 48: The Calibration and Use of Plane-Parallel Ionization Chambers for Dosimetry of Electron Beams

AAPM Report 47: AAPM Code of Practice for Radiotherapy Accelerators

AAPM Report 46: Comprehensive QA for Radiation Oncology (TG-40)

AAPM Report 32: Clinical electron-beam dosimetry

AAPM Report 19: Neutron Measurements Around High Energy X-Ray Radiotherapy Machines

AAPM Report 19: Neutron Measurements Around High Energy X-Ray Radiotherapy Machines

AAPM Medical Physics Practice Guidelines 9.a. for SRS-SBRT

AAPM Medical Physics Practice Guidelines 8.a.: Linear accelerator performance tests

AAPM Medical Physics Practice Guidelines 5.a.: Commissioning and QA of Treatment Planning Dose Calculations — Megavoltage Photon and Electron Beams

ICRU Report 35: Radiation Dosimetry : Electron Beams with Energies Between 1 and 50 MeV

IAEA Technical Reports Series No. 430: Commissioning and Quality Assurance of Computerized Planning Systems for Radiation Treatment of Cancer

IAEA Comprehensive Audits of Radiotherapy Practices: A Tool for Quality Improvement (Quatro)

IAEA Setting Up a Radiotherapy Programme: Clinical, Medical Physics, Radiation Protection and Safety Aspects

IAEA Safety Standards for Protecting People and the Environment: Fundamental Safety Principles (Safety Fundamentals No. SF-1)

IAEA Safety Reports Series No. 38: Applying Radiation Safety Standards In Radiotherapy

NCRP Report 151: Structural Shielding Design and Evaluation for Megavoltage X- and Gamma-Ray Radiotherapy Facilities

NCRP Report 147: Structural Shielding Design for Medical X-Ray Imaging Facilities

NCRP Report 160: Ionizing Radiation Exposure of the Population of the United States

NCRP Report 79: Neutron Contamination from Medical Electron Accelerators

ICRP Publication 103: The 2007 Recommendations of the ICRP

ICRP Publication 60: The 1990 Recommendations of the ICRP

NCRP Report 79: Neutron Contamination from Medical Electron Accelerators

CPQR: Quality Assurance Guidelines for Canadian Radiation Treatment Programs (cpqr.ca)

CPQR: Technical Quality Control Guidelines (cpqr.ca) – several documents

CNSC REGDOC-2.2.3: Personnel Certification: Radiation Safety Officers

CNSC REGDOC-1.5.1: Application Guide: Certification of Radiation Devices or Class II Prescribed Equipment

CNSC REGDOC-1.6.1: Licence Application Guide: Nuclear Substances and Radiation Devices

CNSC Class II Nuclear Facilities and Prescribed Equipment Regulations

CNSC General Nuclear Safety and Control Regulations

CNSC Radiation Protection Regulations

CNSC Nuclear Substances and Radiation Devices Regulations

CNSC Packaging and Transport of Nuclear Substances Regulations, 2015

Transport Canada: Transportation of Dangerous Goods Program

Institutional Radiation Safety Manual (as applicable, per site)

Health Canada Safety Code 35: Safety Procedures for the Installation, Use and Control of X-ray Equipment in Large Medical Radiological Facilities

Regulation respecting the application of the Act respecting medical laboratories and organ and tissue conservation (Quebec sites only)

Act respecting medical laboratories and organ and tissue conservation (Quebec sites only)

New York State Department of Health Bureau of Environmental Radiation Protection Radiation Guide 10.1, Rev. 2: Guide For The Preparation Of Applications For Medical Programs (NY state site only)

New York Public Health Law, Section 225, Part 16 - ionizing radiation (NY state site only)

Clinical Rotation 4
Clinical Physics Practice and Clinical Project

Purpose:

The resident will assist in the daily clinical physics tasks required in the radiation oncology and medical physics departments. The resident will also work on a clinical physics project and prepare a report detailing the specifics of the project. The rotation duration is 6 months and it is expected that the resident will work on the project simultaneously with clinical work.

Objectives:

- The resident will work full time as a clinical medical physicist (supervised).
- The resident embarks on a clinical research or quality improvement project.

Elements

4.1 Clinical Practice

Item	Description	Knowledge objective	Practice objective
4.1.1	Routine clinical practice	Understands all aspects of the quality assurance program in the medical physics and radiation oncology departments. Understands and can interpret patient chart information.	Works as a medical physicist in direct support of clinical routine activities (chart checking, phone or in-person support, setup verification, special techniques, QA).
4.1.2	Unusual circumstances, emergencies	Understands how to recognize unusual circumstances (infrequent situations or on-off's, situation requiring unique actions, calculations or measurements) .	Can recognize situations where advise from more senior staff is needed. Can guide personnel through an emergency situation.
4.1.3	Sub-optimal/misuse of technology	Understands the limitations of medical physics equipment and techniques and the conditions surrounding sub-optimal or misuse of the technology.	Can identify situations that imply a sub-optimal or misuse of technology. Can recognize accidents and incidents.

4.2 Clinical project and colloquium

Item	Description	Knowledge objective	Practice objective
4.2.1	Clinical project	Understands the clinical and physics issues, implications and limitations of the research project carried out.	Carries out a clinically relevant research or quality improvement project in collaboration with a physician.
4.2.2	Colloquium	No theoretical knowledge component.	Presents the results of the research project at a residency training session.

Rotation 4 - Relevant literature:

AAPM Report 275 - Strategies for Effective Physics Plan and Chart Review in Radiation Therapy

AAPM Report 203: Management of Radiotherapy Patients with Implanted Cardiac Pacemakers and Defibrillators

AAPM Report 158: Measurement and calculation of doses outside the treated volume from external-beam radiation therapy

AAPM Report 103: Peer review in clinical radiation oncology physics

AAPM Report 81: Dosimetric considerations for patients with HIP prostheses undergoing pelvic irradiation

AAPM Report 80: The Solo Practice of Medical Physics in Radiation Oncology

AAPM Report 50: Fetal Dose from Radiotherapy with Photon Beams

AAPM Medical Physics Practice Guidelines 4.a: Development, implementation, use and maintenance of safety checklists

AAPM Medical Physics Practice Guidelines 10.a.: Scope of practice for clinical medical physics

IAEA Safety Reports Series No. 17: Lessons Learned from Accidental Exposures In Radiotherapy

ICRP Publication 97: Prevention of High-dose-rate Brachytherapy Accidents

ICRP Publication 86: Prevention of Accidents to Patients Undergoing Radiation Therapy

NCRP Report 174: Preconception and Prenatal Radiation Exposure: Health Effects and Protective Guidance

Recommended general literature for Radiation Oncology Physics Residents

1. Bentel, Gunilla: “**Radiation Therapy Planning**”, Second edition, McGraw-Hill, New York, New York (1995).

2. Chao, Clifford KS; Perez, Carlos; Brady, Luther: “**Radiation Oncology Management Decisions**”, Second edition, Lippincott, Williams and Wilkins, Baltimore, Maryland (2002).

3. Johns, Harold E; Cunningham, John R: “**The Physics of Radiology**”, Fourth edition, Thomas, Springfield, Illinois (1984).

4. Khan, F: “**The Physics of Radiation Therapy**”, Third edition, Williams and Wilkins, Baltimore, Maryland (2003).

5. Khan, Faiz M; Potish, Roger A (Editors): “**Treatment Planning in Radiation Oncology**”, Williams and Wilkins, Baltimore, Maryland (1998).

6. Podgorsak, Ervin B (Editor): “**Review of Radiation Oncology Physics: A Handbook for Teachers and Students**”; International Atomic Energy Agency (IAEA), Vienna, Austria (2005). The book is also available at www.medphys.mcgill.ca/iaeabook/

7. Van Dyk, Jake (Editor): “**The Modern Technology of Radiation Oncology: A Compendium for Medical Physicists and Radiation Oncologists**”, Medical Physics Publishing, Madison, Wisconsin (1999).

8. *BRITISH JOURNAL OF RADIOLOGY*, Supplement **25**, “**Central Axis Depth Dose Data for Use in Radiotherapy**”, The British Institute of Radiology, London, U.K. (1996).

9. *INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS*, ICRU Report **50**, “**Prescribing, Recording, and Reporting Photon Beam Therapy**”, ICRU, Bethesda, Maryland (1993).

10. *INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS*, ICRU Report **62**, “**Prescribing, Recording, and Reporting Photon Beam Therapy (Supplement to ICRU Report 50)**”, ICRU, Bethesda, Maryland (1999).

11. *INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS*, ICRU Report **58**,”**Dose and volume specification for reporting interstitial therapy**”, ICRU, Bethesda, Maryland (1997).

12. *INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION* (ICRP), Publication 60, “ **Recommendations of the ICRP on Radiological Protection**”, Annals of the ICRP **21** (1-3), Pergamon Press, Oxford, U.K. (1991).

Sample meetings and conferences for residents

The following is an example of the required attendance at departmental meetings at the MUHC. A similar plan is to be prepared for satellite facilities. The medical physics residency training session is compulsory for all residents regardless of site.

	MON	TUE	WED	THUR	FRIDAY
08:00	Rad. Onc. Rounds (1)	Patient Management Rounds (2)	Site specific Management Rounds (3)		
09:00					Med. Phys. Research Seminar (7)
10:00					
11:00					
12:00					Medical Physics Colloquia (8)
13:00		13:30 Med. Phys. Meeting (4,5)			
14:00					Medical Residents Clinical (9)
15:00	15:30 Physics Residents Clinical (6)				
16:00					

1. Radiation Oncology Rounds (Scientific or clinical presentations, 1 hrs/wk)
2. Curative Patient Management Rounds (chart rounds, 1 hrs/wk)
3. Site specific Management Rounds (chart rounds, 1 hrs/wk) – time slot variable
4. Medical Physics Departmental meeting (Administrative meeting, 0.5 hrs/wk)
5. Medical Physics Clinical meeting (Clinical cases/issues, 0.5 hrs/wk)
6. Medical Physics Residency teaching session (Teaching, 1.0 hrs/wk)
7. Medical Physics Research Seminar (Seminar, 1 hr/wk)
8. Medical Physics Colloquia, Osler Amphitheatre MUHC (Seminar, 1hr/month)
9. Radiation Oncology Residents teaching session (teaching, 2hrs, when relevant)