Self-Study Prepared for CAMPEP Accreditation Application

Residency Program in Medical Physics

(2-year Full-time Clinical Training Program)

University Hospitals Case Medical Center
Cleveland, Ohio

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Note: Candidates with either an MS degree or a PhD degree are encouraged to apply.

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Introduction

Program Evolution and History

In its inception, Radiation Oncology at University Hospitals Case Medical Center was first a Division of the Department of Radiology. This held true for decades until Radiation Oncology became an autonomous department in 1999. The Medical Residency program in Radiation Oncology was first accredited on October 1, 1977 and had one graduate per year (on average). It is currently operating under a 5-year accreditation by the American Council of Graduate Medical Education (See Appendix B). On March 31, 2005, the Department of Radiation Oncology initiated its most recent educational/training program: the Clinical Medical Physics Residency Program in Radiation Oncology.

The University Hospitals Case Medical Center has been designated by the NCI as a Comprehensive Cancer Center in 1998 and nationally ranked 18th best Cancer Center in 2012 by US News & World Report. It is a natural evolution that in the Department of Radiation Oncology we have a high quality training program for medical physicists. The Department of Radiation Oncology has 17 full-time medical physicists on staff and 18 full-time Radiation Oncology clinical faculty. The department currently has 6 physician residents in the Radiation Oncology Residency Program and 3 medical physics (therapeutic) residents.

Our approach to the training of Medical Physicist has been similar to the evolution that has been going on nationally. To fill our demands of clinical practice of medical physics support for IMRT QA, image fusion and routine quality assurance of linear accelerators and special projects (Tomotherapy and Cyberknife), entry-level positions were available in the Department to work and be trained by senior Board-certified medical physicists. This served as an excellent mechanism to bring on talented post-doctoral candidates for the special projects and masters or doctoral level candidates for the on-going supervised QA work. During initial clinical training period (2002-2007), five individuals were trained as a Univ. of Wisconsin style “Rad Lab” based program while performing their clinical duties. No special time allotment from clinical duty was given to them to complete the course of study, but their medical physics training was provided on an individualized basis and opportunity was given to each to acquire the necessary prerequisite/ remedial course work. In the period from 2007 to 2012, we have taken another five residents from the CAMPEP approved graduate program for residency training. These ten individuals were trained as part-time basis and their residencies lasted for three or more years for them to complete their training and prerequisites.

Our physics residency program was accredited by CAMPEP in 2013 and the full-time residency training program started with duration of 2 years. For the full-time residency program we only accept candidates graduating from a CAMPEP approved graduate program and fund three full-time residents whose primary assignment is to participate in the training program. However, to accommodate very talented individuals, who cross our paths in a university setting with an industrial or interdisciplinary training and research background, we keep our option open for a parallel part-time clinical training program. This part-time program would be of 3 years to 5 years long, depending on the status of the candidate during admission into the part-time program as well as available financial supports in the department. For example, a candidate having a Ph.D. degree would be eligible to a 3- or 4-year program and a Ph.D. student may be suitable for 5-year program. A PhD student is expected to take longer time, probably 5 years depending on his/her background and experience. Once, the required course work is completed within first year of admission, he/she will be able to devote more time on research topic and clinical training at a convenient schedule. The research topic is expected to be closely related to applied/clinical medical physics. Out of this 3-/5-years, the candidate must have 2 full years of clinical training by rotating through at least 12 core rotations (as detailed in Section 7). We envision accommodating 2 candidates in part-time program depending on the availability of funds (research, education, or clinical assistance) in the department.

Summary of Program Changes since Last Review

This is an application for renewal of accreditation. Following are the significant changes in the program since the previous self-study submitted in 2012.

- A single room proto therapy center started treating patient since July 2016.
- Increased number of satellite centers from 7 to 9.
- Introduced Cs-131 LDR isotope for permanent H&N implant.
- Dedicated Research (elective) as an elective rotation.
- Introduced advance/new HDR applicators (Split-Ring & Tandem, Multichannel Cylinder, Venezia Applicator)
- Cyberknife is temporarily taken out of clinical service in October 2016.
- Both Tomotherapyunits are taken permanently out of clinical service.
- Some faculties/staffs changes took place.
- Dr. B. Wessels retired and Dr. J. Sohn moved to another institute.
- Program coordinator, Ms. E. Cawley, has been replaced by Ms. O. Boykin.

Proposed New Changes:

- Rearranged some of the rotations and re-sequenced the rotations; combined “Imaging for Simulation, Planning and Treatment Verification” rotation and “IGRT” rotation into one rotation as well as combined “Linac Acceptance, Commissioning and Annual QA” and “TG-51 Calibration and MU Calculations”.
- SRS/SBRT as a core rotation (was elective).
- Proton Therapy as a core rotation (was elective).
- Due to the lack of clinical cases, Cs-137 LDR has been removed.
- FMEA section has been removed.

1. Program Goals and Objectives

The goal of the Clinical Medical Physics Residency Program at the University Hospitals Case Western Reserve University (UH-CWRU) is to prepare individuals to practice independently as a certified medical physicist in Radiation Oncology. Clearly, few individuals can be experts in all areas of Medical Physics, but the graduate should have the experience and knowledge base necessary to implement and maintain routine clinical procedures, and establish novel techniques.

Major objectives of the program include:

- Prepare the graduate for certification in the specialty of Medical Physics (Therapeutic, i.e. Radiation Oncology) by an appropriate certification Board.

- Provide a broad based in-depth training that will permit the graduate to immediately contribute to the quality of medical care received by the radiation oncology patient.

The training program is designed to provide the resident with an understanding of the role of patient safety in the clinical practice of medical physics; the technical knowledge, skills and competency required for the safe application of the technologies used in the practice of medical physics; an appreciation of the clinical purpose and applications of sophisticated technologies; an understanding of the protocols and practices essential to the employment of technologies to detect, diagnose and treat various cancer related illnesses; the ability to use analytical and research methods to solve problems arising in the clinical environment; the ability to deploy new strategies within the clinical environment; the ability to critically evaluate research and scholarly articles in medical physics; the communication and interpersonal skills that are necessary to function in a collaborative, multidisciplinary environment; the professional attributes and the ethical conduct and actions that are required of medical physicists; and a valuing of career-long continuing education to keep professional knowledge and skills current.

Training will take place under the close supervision of experienced radiation oncology physicists. The program emphasizes all areas of training and experience that will be needed by a radiation oncology medical physicist in a “state-of-the-art” treatment facility, as well as exposes them to management of a single accelerator community-based free-standing facility.

2. Program Structure and Governance

Structure within Hospital or Medical Center

The expected process for an internal review of the program would be the same as for all programs at the University Hospitals Cleveland Medical Center (UHCMC). An Organizational Chart of the Radiation Oncology within UH-CWRU has been provided in Table 1. Three divisions of the Department of Radiation Oncology are: (i) Radiation Oncology, (ii) Medical Physics and (iii) Radiation Biology. First two divisions are mainly administered by the hospital (as shown in the chart in Appendix D). Division of Radiation Biology being a non-clinic entity is mainly governed by the CWRU. Faculties from all three divisions have joint appointments or affiliations with both the institutes (UHCMC and CWRU). The Organizational Chart in Table 1 shows the relationship among the three divisions.

Program Structure in Radiation Oncology Department

The Department of Radiation Oncology is an autonomous department within University Hospitals Cleveland Medical Center. All medical physics faculty have appointments at Case Western Reserve University School of Medicine or University Hospital Cleveland Medical Center and medical physics residents are either employees of the University Hospitals Cleveland Medical Center or affiliated employment through Case Western Reserve University. There are currently 18 full-time medical physics faculty members and 2 part-time physicists. Faculty members are board certified by the ABR in Therapeutic Radiology. The medical/physician residency program in Radiation Oncology currently has 6 residents. There are 18 full-time physicians Radiation Oncology faculty. The department also includes the Radiation Biology Program that has 3 outstanding faculty mentors from wide ranging areas of research including Hypoxic Cancer Biology, Radiation Biology, and Radiation Oncology. Apart from the radiation biology course, the medical physics residents have convenient access to the radiation biology faculties as well as the labs. They are encouraged to contact the radiation biology program for continual information and participating in course work and research projects. Extramural funded physics research efforts include several sponsored projects from federal agencies (NIH/NCI, DoD, DoE, etc.) as well as from various foundations, industries, and pharmaceuticals.

The Clinical Medical Physics Residency Program (CMPRP) utilizes two committees within the program: the Education Committee and the Selection Committee. The Education Committee consists of the Core Medical Physics Faculty (Drs. Podder, Geis, Colussi, Pereira, Zheng), Radiation Oncologist (Dr. Machtay, he is also the Dept. Chair.), Radiation Biology (Dr. Oleinick/Junran,), Chief Medical Physics Resident, and Chief/Senior Dosimetrist (D. Dobbins). This committee meets twice a year to review the status of residency program and to review the curriculum content and revise it, if required. The education/steering committee also reviews the physics educational program and takes appropriate action to address improvements when needed. The education/steering committee assesses and monitors the strengths, weaknesses, needs, and long-term goals of the program. Minutes of the education/steering committee meetings and reviews, including summary of action proposed or taken, are recorded. The CMPRP Selection Committee consists of Drs. Podder, Geis, Colussi, Pereira, Zheng, Ellis/, Machtay, Oleinick/Junran, and Chief Medical Physics Resident. This committee meets following each interview cycle. The program Director is selected by the CMPRP Education Committee. The program Director is appointed by the Department Chair and the Division Chief/Director and is confirmed by the Education Committee. If deemed necessary, the director of the program may select an Associate director in consultation with the CMPRP Education Committee. The program is governed by the director of the program with the help from Associate director, as applicable. The role of the Associate Director is to help the Director in managing and smooth of running the residency program, especially in the absence or non-availability of the program director. He/she she will be help in coordinating the bi-weekly meetings, journal clubs, residents presentations, etc. Dr. Zheng has been appointed as Associate Director. The Director reports relevant matters to the Division Director/Chief and the Chair of the department. The program director meets the residents bi-weekly. The chief resident or representative of the residents is a member of the education/steering committee and he/she can conveniently communicate with all members of the committee. Additionally, all the physics residents may also attend the education committee meetings, if deemed necessary.

The departmental facilities are substantial, featuring a wide array of treatment modalities and an adequate number and variety of equipment (details can be found in Section 7). Ten faculty members of the Medical Physics Division are located in the Radiation Oncology department on main campus. Nine additional physicists are full time at 9 off-site facilities (Satellite Centers) which are located in the range of 9 - 65 miles from the main campus in Cleveland (more information are in Table 2). All the full-time physicists at main campus are part of the team teaching physics residents and MD residents. A majority of the teaching team are faculty of the Case Western Reserve University. All physicists are well qualified to assist in the Physics residency training program either through didactic lectures or mentoring for clinical competencies as described in Section C. The residents are trained at the main campus facility at Seidman Cancer Center, Cleveland, Ohio. Residents may also be engaged in assisting Linac commissioning, annual QA and patient-specific IMRT QA at Satellite Centers, if found useful and necessary (e.g. for Linac commissioning, Linac Annual QA)

Currently we have the funding capacity for 3 Medical Physics residents. Incoming residents are provided with written copies of department policy regarding expected performance and training schedule (Section 8 and Appendix C) as well as expected behavior in the clinical and department. Residents are required to complete at least 12 core/mandatory rotation modules during 2 years of clinical training (details are in Section 8). Upon successful completion of the training, a certificate of completion of residency training is issued with the medical physics Director, division Chief/Director and department Chair as signatories.

Table 1: Organizational Chart (UHCMC/CWRU/UHSCC main campus)

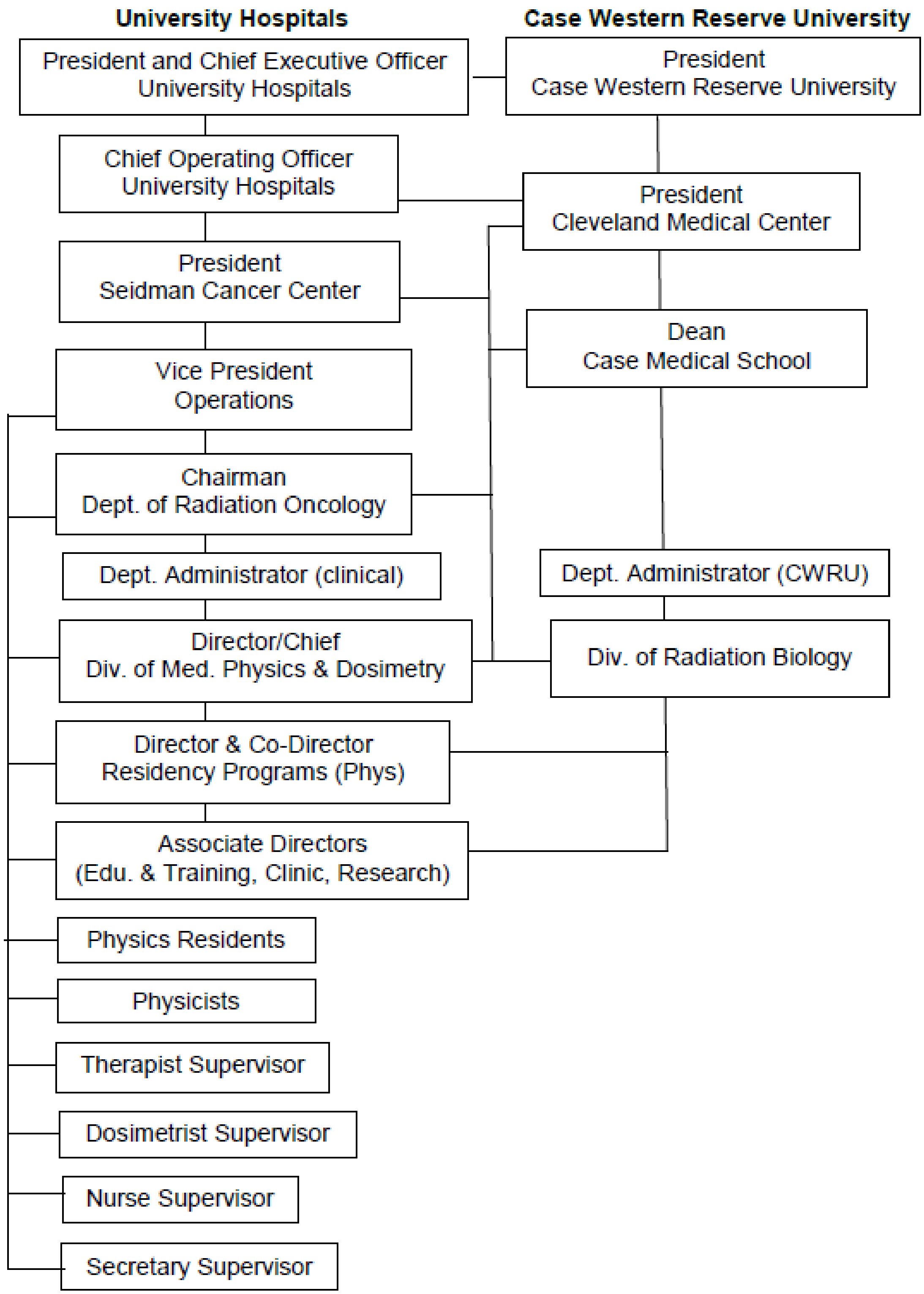

Table 2: A brief statistics of the department.

RT Centers	Distance from Main Campus	No. of Physicians	No. of Physicists	Major Tx equipment	No. of pt. treatment per day (average)
Main Campus (CMC & SCC)	0 miles	7	8	Linac (3), Mobetron (1), GammaKnife (1), HDR (1), LDR Barchy, Proton (1)	100
Chagrin Highlands Health Center SCC	9 miles	1	1	Linac (1)	30
Westlake Health Center	16 miles	1	1	Linac (1)	18
Southwest General Hospital	19 miles	1	1	Linac (1)	20
Lake Health/ Univ. Hospitals SCC	25 miles	2	1	Linac (2), HDR (1)	35
Geauga Med. Center SCC	27 miles	1	1	Linac (1), LDR Brachy	15
Mercy Medical Center	32 miles	1	1	Linac (2), LDR Brachy	30
Firelands Regional Medical Center	65 miles	1	1	Linac (1)	15
Parma Comm. Gen. Hospital	16 miles	1	1	Linac (1)	15
Portage Medical Center	37 miles	1	1	Linac (1)	22
Salem Reg. Med. Center	78 miles	1	1	Linac (1)	(new)
6 MD residents and 3 Physics residents	TOTAL =	18 + 1 part-time	18 + 1 part-time	Linac (15), Mobetron (1), GammaKnife (1), HDR (2), LDR (3), Proton (1)	300 (approx.)

Note: No resident is required to go to Salem or Firelands Regional Medical Center due to the long travel.

Evaluation of Resident's Progress

After each rotation, the resident may require to submit a written report or clinical module rotation evaluation form (see Appendix C). The written report (if any) of the completed module should not be more than ten pages long containing six sections as Introduction, Materials & Methods, Results & Discussion, Conclusion, and References. An oral examination (or presentation) is administered by the mentor at the end of each rotation (evaluation form is in Appendix J). This is evaluated and graded by the mentor and/or associate directors along with an evaluation of the resident's ability to articulate their knowledge developed during the rotation and ability to respond to oral examination. The mentor discusses the conclusions with the resident, and provides the resident and the program director a copy of the mentor's evaluation for the rotation. The evaluation form includes written report grade, oral exam grade, comments, recommendations, overall recommended grade of pass, fail or conditional pass and remediation if conditional pass. The pass/ fail in the written report and/or the oral examination is at the discretion of the mentor and/or associate directors and/or program directors. Any disagreement are discussed and resolved rationally. The program directors review the performance evaluations with the resident during the resident's quarterly review. Any critical issues such as fail or conditionally pass are immediately discussed with the program director.

Residents meet with the program directors and associate directors weekly to discuss their progress. These meetings are useful for providing guidance and praise/criticism. With the resident, the program director reviews the rotations since the last progress meeting, conference participation, recommended readings, remediation, if necessary, and outstanding assignments. Minutes are taken at these meetings. We recognize the amount of time spent by the resident in writing their reports and preparing for their oral exam is substantial. We view this process as an important tool in the resident's successful learning progress, and must be balanced with the clinical responsibilities managed by the resident. Resident discusses the evaluation of their mentors during their quarterly review with the program director. This information is received and consolidated by the program director, and discussed by the director with each mentor annually (or as needed). Examples of evaluation forms are included in Appendix J.

It is to be noted that a resident can continue the clinical rotation even if he/she fails in maximum one rotation. He/she will be given two additional opportunities to clear the failed or conditionally passed rotation. The failed rotation must be cleared before starting a new rotation. However, the resident can start a new rotation if he/she is conditionally passing a rotation. The resident cannot have more than two conditionally pass rotations at any point of time. To make up the lost time, the resident's schedule has four months allocated for electives (Elective I-II) in Appendix C. The program director and associate directors will discuss with the resident and try to understand the resident's cause of failure in the rotation. The resident will be given opportunity to spend more time in the clinic with the mentor and other physicists as well as will be provided with supplemental reading materials and necessary guidelines to succeed.

Guidelines **for Resident Dismissal**

Residents and fellows may be discharged by the Program Director for failing a clinical rotation, failing a required course, unprofessional or unethical conduct, illegal actions, or gross unsatisfactory performance. A decision not to renew a contract made within 4 months of expiration or a decision to cancel a renewed contract before the beginning of the contract period shall be considered a discharge. After explaining the grounds for discharge to the resident, the Program Director shall give written notice of the discharge to resident, including a statement of the grounds for the action.

Individual disciplinary actions (except suspension or discharge) and other departmental actions affecting the individual resident may be reviewed by a committee if an affected resident requests such a review within ten days of his or her becoming aware of the action. The committee will be selected by the Program Director and composed of at least two active clinical staff members and one resident. The only exception in to this review is when the resident has already been afforded an opportunity to present information to such a committee which advised the Program Director before the action and the resident has been informed of the Program Director's action in writing. After its review, the committee will submit its recommendations to the Program Director. If the committee recommends a change in the action, the Program Director will then reconsider the action, giving due consideration to the review committee's recommendation. The resulting decision of the Program Director shall be provided to the resident and the Chair of the Department of Radiation Oncology in writing and shall be final, unless the resident believes that the action could significantly threaten his or her intended career development. Actions will not be postponed while they are being reviewed, unless the Program Director in his or her discretion decides to do so.

If the resident submits a written request to the Chair of the Department of Radiation Oncology within 10 days of receipt of the Program Director's written decision (described in the previous paragraph) and the request includes the reasons for the belief that the action could significantly threaten the house staff member's intended career development, the Chair will review the decision, if he or she finds the alleged threat to be significant. The Chair may seek the advice of an ad hoc committee as part of the review. If the action is non-renewal of a contract prior to completion of the training program, the decision of the Chair shall be given to the resident and Program Director in writing and is final. For all other actions, if the Chair recommends that the Program Director modify the decision, the Program Director will then reconsider the action, in consultation with the Chair. The resulting decision of the Program Director shall be provided to the resident and the Chair in writing.

3. Admissions

Educational Requirements:
A Masters or Doctoral degree from a CAMPEP accredited (or equivalent) program is required for 2-year full-time residency program. Candidate for 3-/5- year part-time program (i.e., Research-Residency program) may be selected for residency from a non-CAMPEP graduate program. Candidate with PhD degree will be eligible for 3-/4-year program and PhD students for 5-year program. These residents in part-time program must complete two-year full residency equivalent training (completing at least 12 core modules listed in Section IV.B.); their research work will not be counted as part of clinical training; they must complete remedial courses (if any) as per CAMPEP guidelines. As mentioned in Section II, these candidates for part-time (Research-Residency) program must have graduate degree from a CAMPEP approved program to be eligible for the American Board of Radiology (ABR) examinations and certification.

Application Requirements
Applicants will submit the following items (or as outlined by the AAPM MP-RAP) for initial evaluation:

1. Official college and graduate transcripts
2. A personal essay describing career goals and interest in medical physics
3. Three letters of recommendation from the applicant's college/graduate instructors, and/or employers.
4. A curriculum vitae, if the applicant has relevant work experience.

After the deadline, all complete applications are divided equally among the faculty physicists to review. The program director (with the help of senior faculty members) reviews and ranks all applicants. They rate each applicant as one of the following and include rationale:

- Do invite to interview
- Don't invite to interview
- Undecided

The faculty physicists and the program Directors (Selection Committee) meet to review application evaluations. If candidates receive (2) Do Invite rankings or (2) don't invite rankings, they are not discussed. If they receive (2) different or undecided ranks, they are discussed. The faculty physicists determine the list of candidates for whom an invitation for interviewing is extended. Approximately 5-7 candidates are invited to interview for each medical physics resident opening. They are invited via email, with the invitation letter and agenda as an attachment. Ranked candidates are listed with the MP-RAP or NMS.
If an applicant is not chosen to invite for an interview, he/she is informed by an email about our decision. Up to 5-7 candidates can be brought over a 1-2 months period. They rotate through interviews with the Selection Committee:

- Radiation Oncology Chair or Vice Chair or Radiation Oncology Medical Residency Program Director(s)
- At least 3 faculty physicists
- Physics Residency program Director
- Dosimetrist, Radiobiologist or lead Therapist
- Chief Physics Resident

Each candidate may be asked to give a seminar (as schedule permits) that is announced in advance in the department and relevant sections of the institute. Each Selection Committee member submits an evaluation form for each interviewee to the program coordinator. The coordinator enters all evaluations into a table that is distributed to the Selection Committee prior to the selection meeting. The evaluation scores are also entered into a spreadsheet so each candidate is ranked by average score across interviewers. In the selection meeting the strengths and weaknesses of each candidate are discussed and each member of the Selection Committee ranks the candidates. The composite ranking is provided to the program director for the selection of candidates.

B. Recruitment Efforts

We recruit via AAPM MP-RAP and national matching. We have a close working relationship with the Case Departments of Biomedical Engineering, Physics, and Computer & Electrical Engineering. Emails were sent to these departments, requesting that they share information about our residency program with their graduate students. The application due date is mention in the advertisement and emails. The admission process takes about 6-8 weeks.

C. Enrollment

Our program capacity is 3 full-time residents (2-year program). These positions are funded by the hospital.

4. Role of Program Director

The Residency Program Director is appointed by the Division Chief/Director and the Department Chair. The current Director, Dr. Podder, is ABR certified medical physicist (therapeutic) having more than 10 years of clinical experience. He is an Associate Professor in Radiation Oncology at Case Western Reserve University. He is actively involved in teaching, research and clinical activities at UHCMC. He directly reports to the physics division director. He coordinates and conducts residency interview process, convening meeting, keeping track of resident's rotation, documents, progress and resolving issues and concerns as required. The program director is responsible and accountable for ensuring that the residency program satisfies the CAMPEP standards. He is responsible for ensuring that all resident statistics, annual reports, and other information that is required by CAMPEP are reported accurately and in a timely fashion. The program director convenes a bi-weekly meeting with the residents and also reviews their progress and status quarterly. All these meeting minutes and review reports are officially documented and saved; a copy of these documents is provided to the residents. Moreover, the residents are allowed to meet or communicate the program director anytime, if necessary.

5. Program Staff

Currently, there are 18 full-time and 2 part-time (10 full-time and 1 part-time physicists are in the main campus; see the list below). A majority of them have PhD degrees. These physics faculty and staff members are involved in teaching and mentoring the physics residents. The mentors of the residency rotation modules are selected based on their clinical experiences and currently involved clinical practices. Any mentor is expected to be an ABR or equivalent board certified clinical physicist with adequate knowledge and experience in the subject matter. Each rotation module should have one primary mentor and multiple secondary mentors. The secondary mentors will help the primary mentor, if required or in case of non-availability of the primary mentor. The selection of the mentors is discussed and approved in the Education/Steering Committee meeting. The residency supporting staff is assigned by the department administration consulting with the division director/chief and the program director. Biographical sketches and clinical interests of the physics faculty and staff members are provided in Appendix G.

6. Institutional Support

The physics residents have access to all personnel, equipment and institutional resources, the same as any member of the physics staff. Each resident is provided with a workspace in close proximity to physics faculty offices within the department. Every resident is provided with a dedicated/separate office space, a desktop computer with necessary software and access to hospital network. All the residents have access to clinical machines/equipment, computers and two conference rooms in the department.

Current Typical Financial Support for Medical Physics Residents Support: Currently (in 2017), the annual salary varies between $50,000 - $60,000. Residents are covered by the Institution's Professional Liability Insurance for malpractices. Residents joining the CAMPEP Program at UHCMC will have a salary of $50,000 (the minimum; may go up depending on education and experience) plus the UHCMC benefit package. Institutional support letters are provided in Appendix A.

Travel and Academic support: Residents are encouraged to present and publish clinical research studies in the form of abstracts and/or manuscripts. Residents having abstracts in the national scientific meetings such as AAPM or ASTRO annual meeting are provided with financial supports to attend the meetings.

Typical living expenses in University Circle, Cleveland, OH
Housing: $850/month average for 1 bedroom
Utilities: $275/month
Health Care: varies (UH provides employee healthcare benefits)

Orientation of New Resident: A new resident starts with a two week long formal rotation in the department and facilities to become familiar with the department and staff as well as to become comfortable in the work environment. A senior medical physicist (normally the Director or Associate Director of the program) is in-charge of this orientation. Example of a new resident orientation schedule is provided below.

Week #1:

Monday (day 1)	
8:30 a.m.	Report to Program Director, Radiation Oncology (Lerner Tower, Seidman Cancer Center, UHCMC, B181/ B161)
1:00 p.m.	Receive Badge – Human Resources Office Take ID card request with you. See Ms. Edie Cawley (B153D)
2:00 p.m.	Health Screening (will need to bring immunization records, green hospital addressograph card (pick this up at registration in main lobby on way to screening) and photo ID badge). Health Screening will be in HR dept.
Tuesday (day 2)	
8:00 a.m. – 5:00 p.m.	New employee orientation, including departmental organization, facilities, staffing, safety (rad and non-rad), basic policies and procedures, and Mosaiq training
Wednesday (day 3)	
8:00 a.m. – 5:00 p.m.	Shadowing in Seidman CC: Patient Treatments on Linear Accelerators (Radiation Therapist)

Thursday (day 4)	
8:00 a.m. – 5:00 p.m.	Shadowing in Seidman CC: Patient Simulation in CT; MRI (Radiation Therapists)
Friday (day 5)	
8:00 a.m. – 10:30 a.m.	Shadowing in Seidman CC: Treatment Planning in Dosimetry (Dosimetrist)
10:30 a.m. – 11:30 a.m.	Benefits Orientation with House Staff
12:30 a.m. – 5:00 p.m.	Shadowing in Seidman CC: Treatment Planning in Dosimetry (Dosimetrist)

Week #2:

Monday (day 6)	
8:00 a.m. – 5:00 p.m.	Shadowing in Seidman CC: Brachytherapy (Physicist)
Tuesday (day 7)	
8:00 a.m. – 5:00 p.m.	Shadowing Physicist for SBRT/ SRS/ Proton Therapy (Physicist)
Wednesday (day 8)	
7:30 a.m. – 11:30 a.m.	UHCMC Benefits Orientation – as applicable
12:30 p.m. – 4:30 p.m.	Shadow a RO physician in Seidman CC
Thursday (day 9)	
8:00 a.m. – 5:00 p.m.	Shadowing in Seidman CC: Physicist of the Day (Physicist)
Friday (day 10)	
8:00 a.m. – 5:00 p.m.	Shadowing in Seidman CC: RO Physician and Nursing Staff

Hazard and Safety Issues

The following safety training and hazard issues are covered during the resident's orientation, which is conducted by the Program Director or Supervisor of Dosimetry or appropriate designated personnel:

- PPE Training
- Mandatory Reporting
- Bloodborne Pathogens
- Safety and Infection Control Test
- HIPAA Training
- Culture Diversity Training
- Patient and Staff Rights and Responsibilities
- Gowns
- Patient Safety
- CPR Certification
- Health Protection Office staff training and test (includes Radiation Safety)
- Hazard Communication Safety Training
- Hazmat Training and Test
- Fire and Tornado Plans and Procedures
- Code Blue Procedures
- Universal Precautions
- Sharps Disposal
- TLD Handling

All residents perform on-line radiation safety training and complete an exam administrated by the Radiation Safety Office during their initial two-week orientation, as outlined above. Additionally, the orientation in-charge discuss about the potential hazards that the residents may encounter during their clinical training. Moreover, the rotation titled "Room Design, Radiation Protection and Radiation

Safety" does include radiation safety training, with the intention of the mentor to assure the residents have successfully comprehended the components of safety instructions and training on each clinical system used (e.g., brachytherapy, linac, and other high-voltage device safety) in each of the rotations throughout their training.

Professional, ethical and regulatory issues:

The residents are required to follow the American Board of Radiology Foundation (ABRF) online modules on ethics and professionalism issues. The modules are accessed through the AAPM website at http://www.aapm.org/education/onlinemodules.asp, which covers the following topics.

a) Historical Evolution and Principles of Medical Professionalism
b) Physician/Patient/Colleague Relationships
c) Personal Behavior, Peer Review, and Contract Negotiations with Employers
d) Conflict of Interest
e) Ethics of Research
f) Human Subjects Research
g) Vertebrate Animal Research
h) Relationships with Vendors
i) Publication Ethics
j) Ethics in Graduate and Resident Education
k) Professionalism in Everyday Practice; The Physician Charter

Residents are also required to read TG 109: Ethics for AAPM. A mandatory rotation on professionalism and ethics provides the residents with the opportunity to learn about legal, professional, and ethical commitments as a medical physicist. In this rotation module, the NRC and the state regulations governing the practice of radiation therapy are reviewed. The resident will also learn about the ethical and professional aspects of medical physics such as patient and colleague relationships, ethical encounters or dilemmas, employer/employee relationships, conflicts of interest, human/ animal research principles, scientific misconduct and publication ethics as well as the role of leadership in the profession. For more details see Appendix C (rotation #7 entitled Professionalism and Ethics).

7. Educational Environment

Radiation Oncology (overall)

The Radiation Oncology Department at UH Cleveland Medical Center (UHCMC) expanded into the new state of the art Seidman Cancer Center (SCC), which is located at an adjacent building, in the May of 2011. The new facility at SCC houses 3 state-of-the-art Elekta linear accelerators (1 VersaHD with FFF, 2 upgraded Versa/Agility) with on-board cone beam kVCT, MVCBCT, respiratory gating capabilities for VMAT and SBRT along with HexaPOD robotic couch. A Siemens 4D-CT is installed and clinically used in the new Radiation Oncology department. The Clinic has access to several Siemens MR scanners at the Department of Radiology (in both UHCMC and SCC) ranging from 1.5T to 3T as well as a Phillips PET/CT scanner. A dedicated special procedures room houses the brachytherapy procedures. A variety of treatment options are available through the Department of Radiation Oncology at Seidman Cancer Center, including: Three-Dimensional Conformal Radiation Therapy (3DCRT), Intensity Modulated Radiation Therapy (IMRT), Volumetric Modulated Arc Therapy (VMAT), Image Guided Radiation Therapy (IGRT), Brachytherapy (HDR and LDR), Permanent Prostate Seed Implant (PSI), Cervical Cancer using Ring-Tandem or Syed Template, Simon-Heyman Capsules, Venezia applicator, Eye Plaque, and Intraoperative Radiation Therapy (IORT). The MOSAIQ record and verification system is integrated with the clinical equipment and planning system to make the department truly paperless and filmless.

A radiosurgery suite is located in an adjacent separate facility (the older one) where a GammaKnife, and a single room Proton Therapy facility. Intracranial radiosurgery is performed with the GammaKnife which was upgraded to the Perfexion in the spring of 2010. The CyberKnife is currently out of clinical service. A single room proton therapy (Mevion), first in Ohio, is treating patients since July 2016.

The physics residents have access to all personnel, equipment and institutional resources, the same as any member of the physics staff. The physics residents have dedicated office, laboratory space and computer facilities. Each resident is provided with a workspace in close proximity to physics faculty offices within the department. The residents having computer with intranet and internet access to electronic journals through the School of Medicine Library on campus. The Department has a library with numerous journals and a number of medical physics text that was acquired by CMPRP. Residents are also encouraged to travel with a faculty physicist to any of the 6 satellites within 35 miles radius (note that one of the satellites is at about 65 miles away and residents are not required to go there). These tools provide the resident learning opportunities in conventional radiation therapy and beyond. Specifically, with regards to the satellite location, they participate in weekly review of patient treatment records, equipment performance records, daily QA records, and perform monthly QA and annual QA on treatment delivery and simulation systems. Some of the physics staffs from satellite facilities are involved in teaching physics resident through special lectures, guiding/supervising when the residents are in their facilities for performing assigned tasks. The physics residents are encouraged to participate in research and clinical studies with physics faculties, radiation oncologists and radiation biologists. Major facilities and patient treatment statistics are summarized in Tables 3a and 3b.

All the radiation therapy facilities under University Hospitals have adequate dosimetry equipment. Some of the major dosimetry equipment at main campus are listed below (numbers of equipment are in the parenthesis).

- WP-300 Manual Water Phantom (2)
- Blue (water) Phantom (2)
- Sun Nuclear 3D water Tank (1)
- Electrometer (5)
- Densitometer (2)
- Film Dosimeter Cassette Holder (2)
- I'MMATRIX (2)
- MAPCHECK (1)
- ArcCheck (1)
- PROFILER (2)
- Ionization (well-type) Chamber (6)
- Ion Chamber (11)
- Survey Meter (4)
- Thermometer (3)
- Barometer (3)
- In-vivo dosimetry systems (2)
- Sr-90 source for ionization chamber calibration (1)

Advanced Technology Programs (Proton Therapy, MR-Simulator, MR-Linac):

The Department of Radiation Oncology, an integral part of University Hospitals Seidman Cancer Center and the Case Western Reserve University School of Medicine, is setting national standards for the delivery of high-quality, cost-effective care and research. The Department provides treatment and consultation for both pediatric and adult cancers and offers the region's most comprehensive array of advanced technologies. Treatment and consultation are provided in ten locations (nine satellites and one main center) throughout Northeast Ohio. The Proton Radiation Therapy Center has started treating patients since July 2016. We are in the process of procuring an MR-Simulator and planning to have an MR-Linac.

Patient Care Treatment Options

A variety of treatment options and equipment are available through the Department of Radiation Oncology at main campus of University Hospitals, which has two centers (i) Seidman Cancer Center (SCC, new one), and (ii) Bolwell Center (or existing UHCMC).

<u>At Seidman Cancer Center (SCC, new one):</u>

- Three-Dimensional Conformal Radiation Therapy (3DCRT)
- Intensity Modulated Radiation Therapy (IMRT)
- Volumetric Modulated Arc Therapy (VMAT)
- Stereotactic body radiation therapy (SBRT)
- 4D-CT simulator, and 4D-CBCT
- 3-D and deformable Image Fusion (MIMvista)
- Intraoperative Radiation Therapy (IORT)
- Total Body Irradiation (TBI)
- Total Skin Electron Irradiation (TSEI)
- Radiolabeled Monoclonal Antibody Therapy
- Brachytherapy (LDR, HDR)
- MOSAIQ record and verification system
- Respiratory gating system
- Active Breathing Control (ABC)
- Megavoltage cone beam imaging
- HexaPOD robotic couch for patient positioning
- Image-Guided Radiation Therapy (IGRT)

<u>At Bolwell Center (existing UHCMC):</u>

- 3DCRT, SRT, SBRT
- CyberKnife (currently out of clinical service)
- GammaKnife
- One clinic-ready linac
- Proton Radiation Therapy – treating patient since July 2016

Table 3a: Departmental statistics (also see Table 2 for additional information).

Major equipment (main and satellites)	LINAC (14), Tomo Therapy (1), Cyberknife (1, temporarily out of clinical service), Gamma Knife (1), HDR (2), CT/CT-Sim (6), 4D-CT (1), CBCT (4), Proton Therapy (1)
Patients treated per day	80-85 at Main Campus with combined average of 270 at the 10 campuses
Treatment types	3D-CRT, IMRT, VMAT, IORT, TSEI, TBI
	Intra- and extracranial radiosurgery
	Brachytherapy (HDR, LDR, PSI)
Staffing	Physicians: 9 in main campus, 9 at satellites

	Physicists: 18 full-time and 2 part-time (10 full-time and 1 part-time in main campus, 8 full-time and 1 part-time in satellites)
	Dosimetrists: 18
	Therapists: 45
	Nurses: 14
	Billing & Scheduling Clerks: 14
Research and Clinical Trials	Funding: NIH/NCI, DoD, Industries/Pharmaceuticals
	Co-operative groups: RTOG/NRG, ACOSOG, COG, GOG, ZCOG, NSABP, NCCTG, ACRIN
	Patient Accruals per year: RTOG (60), other (80)

Table 3b: Brachytherapy, Special Procedures, SRS and SBRT performed at Main Center per year (approx.)

HDR	LDR/ PSI (pt. I-125, Pd-103, Cs-131, Cs-137)	IORT (pt.)	TBI/TSEI (pt.)	IMRT/VMAT (pt.)	SRS (pt. Gamma Knife, pt.)	SBRT (pt. Linac/ Cyberknife,)
200	80	10	20	725	110	475 (fx)

Residents are required to complete all the 12 mandatory rotations. The elective rotations are allowed, if the mandatory rotations are successfully completed. An oral presentation or exam is required to complete a rotation. Some of the topics presented by the residents are listed below.

- Dosimetry Systems – Ion Chambers, Film, TLD and Solid State Instrumentation for Measuring Radiation Dose
- Photon & Electron Interaction; Bragg-Gray, Spencer-Attix
- Floor Physicist of The Day: an overview and critical issues
- Image-guided Volumetric GYN HDR Brachytherapy
- Initial Chart Checks: The Basics and Beyond
- Linear Accelerator Quality Assurance
- AAPM's TG-51 Protocol
- Photon beam data collection and modeling in treatment planning system
- 3D-CRT and Dose Computation Algorithms
- Dosimetric considerations for patients with HIP prostheses undergoing pelvic irradiation
- Brachytherapy Dosimetry - TG43
- Computed-tomography for Radiotherapy simulation
- Motion Management during Image Guided Radiation Therapy
- Electron Beam Radiation Therapy
- Current Trend in Physics Plan Checks
- Use of computed tomography for virtual simulation in radiation therapy
- EUD in Planning and Plan Review
- Issues in successful IGRT
- Linac Commissioning and TG-51
- Photon Dose Calculations with Heterogeneity Corrections
- AAPM Guidance on Prostate Seed Implants

- Dosimeters for Surface Dose Measurements of Radiotherapy Photon Beams
- Patient Immobilization and target Localization for IGRT
- Radiation Protection and Radiation Safety
- Fetal Dose from Radiotherapy with Photon Beams
- Stereotactic Body Radiation Therapy and Task Group 101
- Patient Specific QA for Monte Carlo Lung SBRT on Cyberknife: Is It Necessary?
- Gamma Quality Index – Quantitative Evaluation of Planar Dose Distributions
- New technologies in prostate radiation therapy
- Radiochromic Film Dosimetry and Its Applications
- Photon Beam Commissioning in Treatment Planning System
- Dosimetric comparison of treatment plans based on free breathing, maximum, and average intensity projection CTs for lung cancer SBRT
- ICRU 89: Contouring, Prescribing, Planning and Dose Reporting for GYN-HDR Brachytherapy
- Neutron Contamination of Photon Beams
- Radiation Oncology Patients with Cardiac Implantable Electronic Devices (CIEDs)
- Radiation Safety Basics and the Shielding of a Medical Linear Accelerator Vault
- AAPM TG53: QA for Treatment Planning Systems (TPS)
- TG 109: Code of Ethics for the AAPM

Conference, seminar, and journal club activities:
We document the residents' attendance in conference, seminar, etc. in excel spreadsheet. Please see the attached sample documents. The residents also present their rotation modules using PPT slides in front of physics and department staffs. Additionally, once in each month (2nd Wednesday), the residents jointly present various physics topics with the physics residents from Cleveland Clinic. So far, we did not have regular journal club; we are planning to have at least one journal club per month (on 4th Thursday of the month) from November 2017.

Clinical, educational and scholarly activities record:
We record and update all the clinical, educational and scholarly activities and progress of the residents in bi-weekly meeting using MS-word and excel sheet. Please see the attached sample documents.

Records Available for Review

The following records are kept for access and review as needed.

1. Residency program committee minutes including:
   - Education Committee minutes
   - Selection Committee minutes

2. Resident applications:
   - Application forms
   - Transcripts
   - Candidate interview evaluations

3. Residents:

- Training schedules
- Rotation objectives and expectations
- Rotation evaluations
- Examination (oral/ presentation) results
- Bi-weekly meeting minutes
- Log of recommended readings, clinical, education and scholarly activities
- Quarterly progress reports

Research and Development

The UH Cleveland Medical Center (UHCMC), (note that Seidman Cancer Center is a part of UHCMC) Clinical Trials Unit (CTU) provides a centralized infrastructure to support cancer related research. The CTU's mission is to provide the highest quality nursing, data management, regulatory, financial and quality assurance services for the conduct of clinical trials for the benefit of our patients and investigators. Many of our UHSCC clinical trials are offered at regional sites and affiliates. Faculty members of the Radiation Oncology Department participate in clinical trials of various cooperative groups such as RTOG, ACOSOG, COG, GOG, ZCOG, NSABP, NCCTG, and ACRIN. There are several funded projects (funded by federal, agencies state, industries) in the department in which some of the physics faculties along with the faculties from Radiation Oncology and Radiation Biology are involved as principal investigators (PIs), Co-PIs, and Co-Investigators (Co-Is). The Medical Physics division is actively involved in translational research. There are collaboration opportunities for the residents with basic scientists in Radiation Biology as well as scientists in Bioengineering, Electrical and Computer Engineering, and Radiology. Participation in these research and development activities provides the residents a very good opportunity to extend their knowledge and experience in the field. Moreover, these activities enable the residents to attend scientific conferences and meetings as well as publish in peer-reviewed journals.

8. Residency Curriculum

A. Requirements for Successful Program Completion

The Clinical Medical Physics Residency Program is 2 years in length to include a minimum of 12 rotations, attendance at case conferences, recommended readings, a maximum of 2 didactic courses, written report assignments, and oral examinations. In addition to the experiences from didactic training and clinical rotations, the Medical Physics residents receive clinical training through their participation in monthly and annual quality assurance on the linear accelerators, perform patient-specific IMRT quality assurance measurements with a gantry-mounted diode array and/or with film and ionization chambers as well as perform electron cutout measurements. The resident will become familiar with all aspects of treatment planning (from manual calculation to computer-assisted planning) for both electron and phone clinical cases. As the resident progresses through the clinical rotations, they begin to participate in post-planning and weekly chart review, high dose rate brachytherapy quality assurance, and assist the “physicist of the day” providing first response physics support to all activities within the clinic. Attendance in required courses (if any) and required number conferences (75% attendance) are mandatory. The resident is expected to participate in research studies and publish in scientific conferences/meetings such as AAPM and ASTRO as well as in journals. The resident must follow the department policy and behave as per clinical, departmental and institutional norms. The progression of the resident through these clinical responsibilities is evaluated and discussed with the resident during regular weekly meetings with the program directors. The purpose of these meetings is to discuss with the residents their progression through the program; i.e., successful completion of each rotation, participation in conferences and courses, their evolution in QA participation, and general performance within the department. These meetings also provide the residents an opportunity to voice any concerns they may have about the learning environment.

Minutes of the meetings are taken and stored on the L-drive of a server computer which is accessible to department staffs and residents.

B. Design and Content

Medical physics residents are trained by rotating through a minimum 12 (core) out of 14 possible comprehensive clinical and didactic rotations (details are below in this section and also in Appendix C). Each rotation has an evaluation for the resident's performance at the end of the rotation (Appendix J1). Written acceptance of the Clinic Module and/or graded Radiation Laboratory are administered and reviewed following each clinical rotation. All core rotations (total 12) must be completed for the resident to be eligible for completion of the program requirements. However, the resident is encouraged to complete all 14 rotations.

The evaluation is specified either as a written "Clinical Competency" or graded "Radiation Laboratory" review of the rotation subspecialty. The highlights of the knowledge base acquired and the learning opportunities they experience in each rotation are summarized below in the order experienced by the resident.

1. Dosimetric Systems rotation (core): Two weeks orientation of the new resident is followed by the Dosimetric Systems rotation which is the first in the series of the 15 rotations (see rotation schedule in Appendix C). During this rotation, the medical physics resident develops a basic understanding of the design, characteristics, and clinical limitations of several radiation measurement systems: ionization chambers, radiographic and radiochromic film, diodes, thermoluminescent dosimeters, diode arrays and ion chamber arrays. All radiation measurement systems to be used by the resident throughout the program are to be operated by the resident during this rotation under the supervision of a qualified Medical Physicist. During this process, the resident develops an understanding of the specifications and capabilities of these systems. The resident also develops an understanding of the design and utility of multiple phantom systems, with the most complex system (3D water tank) being operated by the resident during linear accelerator (LINAC) annual QA and calibrations. The resident compiles the signed clinical module and associated documentation regarding the learning opportunities that were experienced during the rotation. The rotation concludes with an oral exam or a presentation organized by the mentor, who is a qualified staff physicist. For more details see Appendix C.

2. Treatment Planning rotation I (core): This rotation is the resident's introduction into treatment planning, which includes observing the Medical Dosimetrists during the treatment planning process of multiple anatomical sites (Brain, Head and Neck, Lung & Esophagus, Breast, Abdomen & Rectum, Pelvis & Bladder, Skin, Sarcoma, whole CNS, and Prostate) and develops treatment plan for each site observed. Additionally, the resident will develop an understanding of the different 3D photon beam dose algorithms, electron beam dose algorithms, non-dosimetric calculations performed by the planning system (e.g., DRRs, contouring tools, etc.), and dose evaluation tools. The resident performs treatment plans cases for wide range of anatomical sites, transfers all data to required information systems, and performs all required quality assurance for those plans. The resident compiles a clinical module detailing the learning opportunities that were experienced during the rotation. The rotation concludes with an oral exam or a presentation organized by the mentor. For more details see Appendix C.

3. Treatment Planning rotation II (core): This rotation is focused on Intensity Modulated Radiation Therapy (IMRT) and Volumetric Modulated Arc Therapy (VMAT). The medical physics resident will be introduced to optimization, critical organ doses, parallel vs. serial organs, typical dose-volume constraints, and dose calculation algorithms specific to IMRT/ VMAT, film as a dose measuring device, small field dosimetry, and the basics of imaging for IMRT/ VMAT. During the rotation, residents will follow a patient from the CT scan process all the way through the initial treatment delivery. This will require shadowing the CT therapists, the dosimetrist, the medical physicist, and the linac therapists. With the first patient, it will be observation. With the second patient, it will be supervised performance of the tasks. With a phantom, it will be an independent performance of the tasks. There are a fair number of IMRT/ VMAT patients (H&N, Lung, GI and GU) in our department, and there will be no lack of opportunities. The resident will work through the Competency Module detailing the learning opportunities that were experienced during each part of the process. The resident compiles a clinical module detailing the learning opportunities that were experienced during the rotation. The rotation concludes with an oral exam or a presentation organized by the mentor. For more details see Appendix C.

4. Linear Accelerator (Linac) Acceptance, Commissioning and Annual QA rotation (core): During this rotation, the medical physics resident performs the tasks necessary to accept and commission a Linac, including the annual QA of the system. The resident will develop an understanding of linear accelerator fundamentals relevant to commissioning, beam optics, flattening, and control parameters, collimation, beam specs and non-beam specs, and more. Residents will also determine the data necessary to commission 1 photon and 1 electron beam in the Pinnacle treatment planning system, collect that data, and format it for commissioning, as well as determine the data necessary to perform MU calculations for 1 photon and 1 electron beam. Finally, an Annual Quality Assurance procedure (including TG-51 calibration) will be performed for one of the systems during this rotation. The resident compiles the signed clinical module and associated documentation regarding the learning opportunities that were experienced during the rotation. The rotation concludes with an oral exam given by the mentor. For more details see Appendix C.

5. TPS Modeling, Acceptance and Commissioning rotation (core): The TPS modeling rotation provides the medical physics resident the opportunity to accept and commission a three-dimensional treatment planning system. During the rotation resident will determine all input data needed to characterize the CT scanner, linear accelerator, photon beam energy, and electron beam energy. The resident will utilize data acquired during the previous rotations to commission the system for photon and electron beam energy and compare the results with measurements. The resident is expected to learn each component of the beam modeling within the planning system, as well as treatment planning dose engines for both photons and electrons. The resident will learn to evaluate their results in the context of published literature including task group reports. The resident compiles clinical module detailing the learning opportunities that were experienced during the rotation. The rotation concludes with an oral exam or a presentation organized by the mentor. For more details see Appendix C.

6. Imaging for Simulation, Planning, Treatment Verification rotation - IGRT (core): During this rotation, the medical physics resident will gain an understanding of the Radiotherapy Simulation process, ranging from CT-based virtual simulation to 4DCT and the utility of multimodality imaging. Also, the resident will follow a patient through the CT (PET/CT) simulation process, with an emphasis being on geometric aspects of the process (setup geometry specification, immobilization, marking, tattoos, CT including x-ray technique, and transfer to planning system). The resident is expected to understand the virtual simulation process and perform a virtual simulation procedure on a phantom – from start to finish with portal film verification. Finally, the resident will observe the use of combined imaging modalities in the simulation process (such as MRI and CT for SRS) and follow a patient through the image-guided setup simulation process. The resident will develop knowledge in basic medical imaging physics and the terms that impact image quality, the design and application of different electronic portal imaging systems, and the necessary processes for commissioning and continuing quality assurance of portal imaging systems. During the rotation, the resident will perform monthly and annual quality assurance on 4DCT and different portal imaging systems. The resident compiles a written report detailing the learning opportunities that were experienced during the rotation. The rotation concludes with an oral exam given by the mentor. The treatment verification part of the rotation is structured to provide the medical physics resident with knowledge of portal imaging systems used either during the simulation/planning process or during treatment verification. In the IGRT part of the rotation, the resident will participate in the clinical implementation of prospective and retrospective CT image acquisition, gated treatment delivery, treatment planning process for IGRT (including multi-modality image registration and fusion), and data export/import into each system. The resident will observe and participate in the IGRT treatment planning and delivery process and understand the functionality of the systems utilized. Quality assurance of every aspect of each IGRT system will be studied, from image acquisition through verification and treatment delivery. The resident compiles the signed clinical module and associated documentation regarding the learning opportunities that were experienced during the rotation. The rotation concludes with an oral exam or a presentation organized by the mentor. For more details see Appendix C.

7. Professionalism and Ethics rotation (core): In this rotation, the resident will learn about his/her legal, professional, and ethical commitments as a medical physicist. The NRC and the state regulations governing the practice of radiation therapy will be reviewed. The resident will participate in hospital inspections conducted by state or other agencies providing oversight of the radiation therapy program. The resident will gain an understanding of the cooperative trials process and entities involved: NRG Oncology, Imaging and Radiation Oncology Core (IROC), and the hospital's Institutional Review Board (IRB). The resident will also learn about the ethical and professional aspects of medical physics such as patient and colleague relationships, ethical encounters or dilemmas, employer/employee relationships, conflicts of interest, human/ animal research principles, scientific misconduct and publication ethics as well as the role of leadership in the profession. The resident is expected to be very familiar with the legal, professional, and ethical issues related to medical physics practice. The rotation concludes with an oral exam or a presentation organized by the mentor. For more details see Appendix C.

8. Brachytherapy rotation (core): The rotation is structured to provide the medical physics resident with knowledge of brachytherapy basics and brachytherapy applications. The resident should develop a knowledge base including radioactive decay, characteristics of radioactive sources, source calibration, calculation of dose distributions, different systems of implant dosimetry and implantation techniques. Basic definitions in dose specification will be covered, along with an overview of remote afterloading systems and various applicators. During the rotation, the resident will observe the medical physicist during brachytherapy procedures, perform source calibration checks, and perform computerized and hand calculated dosimetry to include fundamental calculation techniques. The resident should develop the imaging and treatment planning of brachytherapy, along with patient-specific and system quality assurance. The resident will learn the principles of both interstitial brachytherapy (e.g. prostate seed implantation for LDR) and intracavitary brachytherapy (e.g., cervix, uterus/vagina treatment for HDR). During the rotation, the resident will assist the medical physicist during brachytherapy procedures and reproduce treatment plans and quality assurance tests for multiple procedures. The resident compiles the signed clinical module and associated documentation regarding the learning opportunities that were experienced during the rotation. The rotation concludes with an oral exam or a presentation organized by the mentor. For more details see Appendix C.

9. Stereotactic Radiosurgery (SRS) and Stereotactic Body Radiation Therapy (SBRT) rotation (Core): The SRS-SBRT rotation is designed to give the medical physics resident experience with a intracranial and extracranial hypofractionated radiation therapy with GammaKnife and/or CyberKnife/ Linac. The resident first reviews the key principles of SRS and SBRT, then actively participates in both the treatment process and the quality assurance process. The treatment process for a patient involves image acquisition, treatment planning, and treatment delivery. The resident will participate alongside a staff physicist in clinical SRS and SBRT treatments during this rotation. The resident compiles the signed clinical module and associated documentation regarding the learning opportunities that were experienced during the rotation. The resident is given an oral exam or asked for a presentation at the end of the rotation. For more details see Appendix C.

10. Room Design, Radiation Protection and Radiation Safety rotation (core): The shielding and design rotation is structured to give the medical physics resident experience in designing facilities appropriate for radiation oncology equipment. The resident is asked to design the shielding for different types of rooms typically found in a radiation oncology department, including a high energy linear accelerator vault and an HDR vault. The resident consults with the physics mentor during the rotation to discuss the specifics of the design process. The mentor will propose alternate scenarios that force the resident to re-work the design using different clinical or occupancy criteria. The resident is also expected to perform portions of a radiation survey around existing vaults to gain practical experience in obtaining and analyzing low level radiation data. The resident compiles a written report detailing the learning opportunities that were experienced during the rotation. The rotation concludes with an oral exam or a presentation organized by the mentor. For more details see Appendix C.

11. Physicist of the Day (POD) rotation (core): This rotation will provide the resident with the fundamental knowledge and practical training for proficiency with day-to-day clinical operations as the floor physicist. Resident performs all clinical tasks under the supervision of a senior staff physicist, i.e. the mentor. The resident is expected to learn and become experience with all the details about the clinical tasks that need to be performed in the clinical workflow and the responsibilities of the physicist on clinical duty. The rotation concludes with an oral exam or a presentation organized by the mentor. For more details see Appendix C.

12. Proton Therapy rotation (Core): In this rotation, the resident will be given an overview of the proton therapy physics and treatment techniques. The resident will learn through observation and direct participation in the clinical physics activities. The resident will participate in technical aspects of patient care under the supervision of staff proton physicists. These activities include quality assurance (daily, monthly, annual, and patient-specific), patient treatment simulation, treatment planning, review of patient positioning and immobilization. The resident is expected to gain experience in both technical and clinical aspects of proton therapy. At the end of the rotation the resident's performance will be evaluated by the mentor by taking an oral examination or a presentation on proton therapy. For more details see Appendix C.

13. Special Procedures rotation (elective I): Total Body Irradiation (TBI), Total Skin Electron Irradiation (TSEI), and Intraoperative Irradiation (IORT). This rotation prepares the medical physics resident to develop and commission a total body irradiation program. The resident will develop knowledge of the clinical basis for TBI, equipment, dosimetry issues in TBI, field uniformity, beam energy/penetration, blocking, beam data for TBI, and hand calculations. During the rotation, the resident will observe/attend a TBI simulation, fabricate the blocks under supervision, verify the block attenuation on the machine, attend/observe in-vivo dose measurements for TBI, perform hand calcs and compare to diode results. Additionally, the resident gains an understanding of total skin electron and intraoperative irradiation. The resident will reinforce their basic knowledge of electron beam dosimetry and develop knowledge in the clinical basis and beam data required for TSEI and IORT, equipment, dosimetry issues in TSEI and IORT, field uniformity, beam energy/ penetration, field shaping, collimation and patient alignment, collimation and energy adjustment. During the rotation, the resident will develop an understanding of intraoperative cone effects on electron beam, as well as the effect of different electron applicators (including IORT cones and TSEI beam definer on effective source position). Electron shielding using lead sheets vs. cerrobend blocks will also be measured. The resident compiles a written report detailing the learning opportunities that were experienced during the rotation. The rotation concludes with an oral exam or a presentation organized by the mentor. For more details see Appendix C.

14. Dedicated Research rotation (elective II): Resident may opt for dedicated research time, provided he/she is in a good position to complete the 12 core rotations successfully and on-time. Research topic(s) can be elected based on the resident's interest and availability of a suitable guide/ supervisor. Details of this rotation are provided in Appendix C.

C. Evaluation of the Curriculum

The mentor responsible for a given rotation may propose the creation or modification of the rotation's design and content in consultation with the program director. Any major change needs to be approved by the Education/steering committee. At the end of each rotation, the resident is also given the evaluation form for evaluating the content of the clinical rotation as well as to evaluate the faculty mentor (see Appendix J2). The resident submits the evaluated form and suggestions to the program director. Additionally, at the end of the residency program (at the end of final rotation), the resident is asked to evaluate the whole program and make suggestions for improvement (see Appendix J3). The proposal by the mentor and the comments by the residents are then reviewed by the program director and the education/steering committee for approval and implementation. Suggestions about content, effectiveness, and areas of improvement of the program from each of the mentors of the rotations and the residents are reviewed and compiled by the program director. The compiled review report is then presented to the CMPRP Education Committee for further discussion and implementation. The clinical rotation contents and the residency program curriculum are revised as per any modifications approved by the program director and/or the CMPRP Education Committee. Then the modifications are informed to the residents in writing. Any substantial modifications are implemented in such a way so that they do not affect the current residents adversely.

Ethics and Professionalism Curriculum

These standards shall be fully addressed before completion of the resident educational programs.

Professionalism and Ethics	**How covered**
Professionalism	**ABR/ACR/RSNA/AAPM/ASTRO/ARR/ARS Online Modules on Ethics and Professionalism** - Historical Evolution and Principles of Medical Professionalism.
○ Definition of a profession and professionalism	
○ Elements of a profession	
○ Definition of a professional	
○ Elements of professionalism	
○ How is professionalism judged?	
○ Do's and don'ts of professionalism	
○ Physician's charter and applicability to physicists	
Leadership	Attended departmental QI/leadership meeting.
○ Vision and charisma	
○ Qualities of leaders	
○ Rules of leadership	
○ Causes of leadership failure	

Ethics	
○ Ethics of a profession	The residents are required to follow the American Board of Radiology Foundation (ABRF) online modules on ethics and professionalism issues http://www.aapm.org/education/onlinemodules.asp,
○ Ethics of an individual	
○ Interactions with colleagues and co-workers	Physician-Physician and Physician-Patient Interactions.
○ Interactions with patients and the public	
○ Confidentiality	Review of department and hospital policies;
○ Peer review	Personal Behavior, Peer Review, and Contract Negotiations with the Employers.
○ Negotiation skills	
○ Relationships with employers	
○ Conflicts of interest	Conflict of Interest
○ Ethics in research	Publication Ethics
○ Use of animals in research	Vertebrate Animal Research
○ Use of humans in research	Ethics of Research
○ Relationships with vendors	Relationships with Vendors
○ Publication ethics	Publication Ethics
○ Ethics in graduate and resident education	Ethics in Graduate and Resident Education
○ Selected case studies	Professionalism in Everyday Practice; The Physician Charter

The residents are required to follow the American Board of Radiology Foundation (ABRF) online modules on ethics and professionalism issues. The modules are accessed through the AAPM website at http://www.aapm.org/education/onlinemodules.asp, which covers the following topics.

a) Historical Evolution and Principles of Medical Professionalism
b) Physician/Patient/Colleague Relationships
c) Personal Behavior, Peer Review, and Contract Negotiations with Employers
d) Conflict of Interest
e) Ethics of Research
f) Human Subjects Research
g) Vertebrate Animal Research
h) Relationships with Vendors
i) Publication Ethics
j) Ethics in Graduate and Resident Education
k) Professionalism in Everyday Practice; The Physician Charter

Sample Training Plan

Didactic Training

Clinical conferences, seminars, small discussion groups, journal clubs and one-on-one instruction are integral part of the program. The resident will participate in the following:

- Medical Physics Resident Meeting (bi-weekly)
- Radiation Oncology Chart Rounds conferences (weekly)
- Radiation Oncology Grand Rounds conferences (bi-weekly)
- Physics Division Meetings (monthly)
- Medical Physics Seminars (bi-weekly/ monthly)
- Site-specific Tumor Board conferences (vary)
- Assigned readings with course work or clinical rotation (as required)

Timeline for meetings and courses:

Fridays: 2:30-4:00 pm	Radiation Oncology Chart Rounds conferences
Tuesday, Wednesday, Thursday: 8:00 – 9:00 am	Oncology case conferences and Grand rounds
Wednesday: 3:00 – 4:00 pm	Physics Residents meeting
Every 2nd Monday of the month	Physics Division meetings
Summer, Fall, & Spring Semester: 1.5 hours per week	Medical Physics of Radiation Oncology (optional)
Summer & Fall Semester: 3 hours per week	Radiation Biology (optional)

The following two courses offered by the Radiation Oncology department are now combined for the Medical Physics residents and the Radiation Oncology residents. These courses are optional for the Medical Physics residents, i.e. any Medical resident can attend any lecture if he/she and/or the mentor/director feel that the resident will benefit attending any particular lectures.

Medical Physics of Radiation Oncology (optional): This course is designed to help the student better understand the principles and application of physics in radiation therapy. At the conclusion of the course, the student should understand the following areas: Atomic and Nuclear Structure, The Production of Photons and Electrons, Radiation Interactions, Treatment Machines and Simulators, Photons and X-Rays, Electron Beams, External Beam Quality Assurance, Radiation Protection and Shielding, Imaging for Radiation Oncology, Three-dimensional Conformal Radiation Therapy (3DCRT) including International Commission on Radiation Units (ICRU) Concepts, Intensity Modulated Radiation Therapy (IMRT), and Beam-Related Biology, Assessment of Patient Setup and Verification, Importance of Image-guidance in Radiation Therapy, Importance of Tumor Motion Management, Special Procedures, Brachytherapy, Hyperthermia, and Particle Therapy.
Text Book: The Physics of Radiation Therapy (4th ed), Faiz M. Khan, Lippincott Williams & Wilkins, 2010.
Reference Book: Physics of Radiology (4th ed), HE Johns and JR Cunningham, Charles C Thomas Pub, 1983. Radiation Therapy Physics, (3rd ed), WR Hendee, GS Ibbott, and EG Hendee, John Wiley & Sons, 2005.

Radiation Biology (optional): This course provides a comprehensive introduction to all modern principles necessary for developing a strong working knowledge of Radiation Biology. Areas of focus include radiation chemistry, the physics of interaction of ionizing radiation with biological material, radiation protection, radiation mutagenesis and carcinogenesis, radiation therapy and the effects of

radiation on signal transduction and gene expression. The emphasis is placed on mammalian radiobiology; however, principles derived from lower organisms are also discussed. Students will attend 1 didactic lecture/wk (1.5 hrs) given by experts on each respective topic, as well as making oral and written presentations on student selected cutting edge topics relevant to Radiation Biology in the 21st century. Radiation biology topics to be covered include: Radiation Protection, Human Radiobiology, Metabolic Oxidative Stress and Radiation Effects, Radiation Therapy, Radiation Mutagenesis, Radiation Carcinogenesis, Radiation Teratology, Radiation-induced DNA Damage and Repair, Radiation Effects on the Cell Cycle, Radiation Effects on Signal Transduction and Gene Expression, Bystander Effects, Genomic Instability, Radiation-induced Adaptive Responses, and Modes of Cell Death.
Text: Radiobiology for the Radiologist (7th ed), EJ Hall and AJ Giaccia, Lippincott Williams & Wilkins, 2012.
Reference Book: Molecular Biology of Cancer – Mechanisms, Targets and Therapeutics (3rd ed), L Pecorino, Oxford University Press, 2012.

Clinical Rotations

During each rotation, the residents are expected to acquire all necessary data and information pertinent for the rotation to establish the relevant procedures for their *own* Radiation Oncology department. For example, the MU calculation rotation includes the acquisition of all measurement data, tabulation of data, and creation of independent MU calculation tools to perform this task. They may spend significant time reviewing the literature for the rotation (AAPM Task Group reports, journal publications, textbook, and other reference materials) in their preparation for the written report and oral exam for the rotation. In addition to the rotation, residents are participating clinically in several ways, depending on their demonstrated competency and evolution within the program; routine quality assurance of all machines and equipment, IMRT measurements, electron cut out measurements, treatment planning checks, weekly chart reviews, brachytherapy planning and procedures, and responding to all clinical physics requests following the “Physicist of the Day.” Details of the elements of clinical training of each rotation are provided in Appendix F.

Example Daily Schedule:
Below is a summary of a sample day on any given rotation. This does not reflect individual rotation requirements.

7:30 – 8:30 a.m. Conference/ Grand Rounds/ Seminar

4:00 – 5:30 p.m. Medical Physics of Radiation Oncology (Tuesday) - optional
OR
Radiation Biology (weekly 8:30 am; Monday) - optional

Throughout the day: (a) review literature, (b) collect and analyze data, (c) document findings, (e) meet with mentor, (f) called to machines to observe/perform procedures, (g) work on rotation report and/or work on assignment/task given by the rotation mentor.

5:00/5:30 – 7:00 p.m. IMRT QA, monthly QA, electron cut-out, QA documentation analysis and reporting.

Teaching opportunities for residents: Medical Physics residents have the opportunity to teach Medical Radiation Oncology residents in the basics of Therapeutic Radiological Physics. Teaching any of these lectures will depend upon the medical resident’s suitability and interest. The presentation of a CAMPEP approved seminar has served in the past as an excellent vehicle to demonstrate abilities in a special topic or research area.

Summary

Program strengths, weakness and Goals for the future

The University Hospitals Cleveland Medical Center, i.e. SCC and Bolwell Center is a tertiary care patient care center in Cleveland, a city which is undergoing rapid renovation and upgrading of a 20 mile “high-tech corridor.” Our program is fully integrated within the university, providing us collaboration and teaching/learning opportunities with University physicists, imaging scientists in Bioengineering, Electrical and Computer Engineering, Radiology, and Radiation Biology. We currently participate in teaching in several programs: Clinical Medical Physics Residency Program in Radiation Oncology, Radiation Oncology Medical Residents and graduate level Medical Physics courses in the Radiation Biology Program. Finally, we have several active research projects with faculty members of the three groups mentioned above.

The Department of Radiation Oncology is a part of the NCI-designated “Case Comprehensive Cancer Center”. The Department of Radiation Oncology is designated a “Center of Excellence” at the UHCMC, having recently moved into an expanded, 250,000 sq. ft. state-of-the-art Seidman Cancer Center that includes 4DCT, CT/PET, and a 3-Tesla MRI in Radiation Oncology used for functional imaging and treatment simulation. The department is truly paperless and filmless.

Because we are part of an academic institution, we have a number of different ways to teach our residents. We are continually assessing our curriculum and delivery based on the needs of the individual residents. We anticipate including a greater emphasis on diagnostic imaging physics as applied to radiation oncology, as image guidance in radiation therapy is increasing in importance.

Department of Radiation Oncology is in the process of acquiring an MR-Simulator. Additionally, we are planning to have an MR-Linac. This state-of-the-art equipment will help us in improving the patient care as well as create opportunity for research and development.

Appendix A – Letters of Invitation and Institutional Commitment

University Hospitals
Seidman Cancer Center

Mitchell Machtay, MD
Vincent K. Smith Professor and Chair
Department of Radiation Oncology
11100 Euclid Avenue – LTR B181
Cleveland, OH 44106
216-844-2530 Phone - 216-844-4799 Fax
Mitchell.Machtay@UHHospitals.org

SCHOOL OF MEDICINE
CASE WESTERN RESERVE UNIVERSITY

April 24, 2017

Commission on the Accreditation of Medical Physics Educational Program (CAMPEP)
1631 Prince Street, Alexandria, VA 22314

To Whom It May Concern:

It is my pleasure to provide a letter of support for the continuation of the excellent medical physics clinical training program that was accredited by the CAMPEP in 2013. The Department of Radiation Oncology of University Hospitals Seidman Cancer Center as a part of NCI-designated Comprehensive Cancer Center values the medical physics training program very highly. From my discussions with the senior administrators including Dr. Nathan Levitan (President of University Hospitals Seidman Cancer Center) and Dr. Stanton Gerson (Director of Case Comprehensive Cancer Center) it is obvious that they are highly appreciative and supportive of the CAMPEP accredited medical physics training program.

Our facilities are continuing to be in the forefront with respect to medical procedures and technologies available to our patients as well as our trainees (both medical residents and physics residents). Our patient volume is extremely robust, we treat approximately 265 patients per day within our system. The major modalities of radiation therapy are very well represented, including conventional Linac-based IMRT/VMAT/IGRT, multiple platforms for radiosurgery and stereotactic body radiation therapy (gamma knife, Cyberknife, Elekta Versa), a broad portfolio of brachytherapy (standard HDR and LDR implants, prostate seed implants, H&N seed/mesh implants). Additionally, our new Proton Therapy facility has started treating patients since July 2016. Out clinical team consisting of 18 radiation oncologists and 19 staff physicists is committed to the educational mission and experienced in treating the entire spectrum of adult and pediatric malignancies. At the same time, our clinical research program, which includes RTOG/NRG, COG, GOG, and intra-university/hospital protocols, serves to greatly enrich trainee's clinical experience. We are one of the 36 Full Member Institutes within RTOG and we are very well represented on the various RTOG committees. We also have very active radiobiology division with three faculty members.

Under the guidance of our Medical Physics Residency Director (Dr. Tarun Podder) and with the support from the physics faculty members, there has been strong and steady growth in our physics education and clinical training program over the past several years. The quality of this program and our recent and current trainees is outstanding. This is well documented in the CAMPEP renewal application package that you have received.

In summary, I thoroughly endorse and stand behind the continuation of the CAMPEP accredited medical physics residency training program here at University Hospitals. Please do not hesitate to contact me if I may be of any further assistance and I look forward to the continual success of our educational program.

Sincerely,

Mitchell Machtay, MD
Professor and Chair
Department of Radiation Oncology
Case Western Reserve University School of Medicine
University Hospitals Seidman Cancer Center

University Hospitals
Seidman Cancer Center

Linda M. Mangosh, MBA
Vice President, Seidman Cancer Center
University Hospitals Cleveland Medical Center

11100 Euclid Avenue
Cleveland, OH 44106
216 286 3855 Phone
216 844 1775 Fax

April 26, 2017

Tarun K. Podder, PhD
Associate Professor
Director of the Medical Physics Residency Program
Department of Radiation Oncology
University Hospitals Cleveland Medical Center
Cleveland, OH 44106

Dear Dr. Podder,

I am pleased to offer this letter of support regarding the continuation of our Residency Program in Medical Physics by renewing the CAMPEP accredited program within the AAPM umbrella. Since the accreditation in 2013, the residency program has become very well-structured and the quality of the training program is excellent. It is my pleasure to re-confirm the following administrative commitments to ensure the Residency Program's continued success. We have designated three full-time paid positions funded by the University Hospitals Cleveland Medical Center (UHCMC) for physics residency training. Additionally, we may explore the possibility of a 3-4 year part-time training position having about 50% financial support from UHCMC and another 50% financial support from externally funded grants. In the past, we were successful in maintaining a 4-year part-time training position (2 years equivalent of full-time clinical training) through PRN.

Support of this program is consistent with the mission of the hospital -- to heal, to teach, and to discover. Benefits have been provided at a level equivalent to the physician residents within UHCMC. Appropriate space has been designated to include individual computers and desk, library and conference room space for study and lectures. Travel support to the AAPM meetings or other relevant scientific meetings is provided once during their residency by the Department of Radiation Oncology as a commitment to the residents' professional development. We are delighted that several of our residents in recent years have been awarded travel grants by the local AAPM chapter to attend the AAPM's national meeting. Secretarial support is available for the residents for administrative assistance related to travel, immigration, benefits, scheduling or any other UHCMC process issues. The salary and wages of all the faculty members who instruct the medical physics residents are fully funded through UHCMC/UHHS.

I am confident that under your leadership, our program will experience continued success as a high quality CAMPEP/AAPM accredited medical physics residency training program.

Sincerely,

Linda M. Mangosh

Linda M. Mangosh

Appendix B – Documentation of Institutional Accreditation

Seidman Cancer Center (SCC), University Hospitals, Cleveland, Ohio

American College of Radiology

Certificate of Accreditation

The Radiation Oncology Services of

Seidman Cancer Center
11100 Euclid Avenue, Seidman, LL, S662
Cleveland, OH 44106

were surveyed and accredited by the ACR Committee on Radiation Oncology Practice Accreditation

Period of Accreditation :

July 31, 2017 Through July 31, 2020

Christopher H. Pope, MD
CHAIRMAN
COMMITTEE ON RADIATION ONCOLOGY ACCREDITATION

FML ID : 1110

Appendix C – Clinical Rotation Summary

Radiation Oncology Clinical Medical Physics Resident Rotation - Year 1

Sequence	**Duration** (month)	**Rotation** (rotation #)	**Mentor**
1	0.5	Orientation	**TP** (PG, VC, GP)
2	1.5	Dosimetric Systems (#1)	**VC** (YZZ, GP, JY)
3	1.5	Treatment Planning I (#2)	**GP** (DD, MM, TP)
4	1.5	Treatment Planning II (#3)	**GP (**DD, MM, YZZ)
5 (flexible)	2.0	Linear Accelerator Acceptance, Commissioning, and Annual QA (#4)	**VC** (PG, GP, JY, AB)
6 (flexible)	1.5	Treatment Planning System (TPS) Modeling, Acceptance, Commissioning and Annual QA (#5)	**YZZ** (JY, PG, VC)
7	1.0	Imaging for Simulation, Planning and Treatment Verification (IGRT) (#6)	**YZZ** (GP, AB, VC)
8	1.0	Professionalism and Ethics (#7)	**PG** (TP, RJ, VC)
	1.5	Vacation / Sick Leave / Family Leave / Conferences	TP

Radiation Oncology Clinical Medical Physics Resident Rotation - Year 2

Sequence	Duration (month)	**Rotation** (rotation #)	**Mentor**
9 (flexible)	2.0	Brachytherapy (#8)	**TP** (VC, YZZ, DA)
10	2.0	SRS and SBRT (GK and CK/Linac-based) (#9)	**YZ** (JY, YZZ, , TP)
11	1.5	Room Design, Radiation Protection and Safety (#10)	**PG** (RJ, VC, AB)
12	1.5	Physicist of the Day (POD) (#11)	**TP** (VC, YZZ, GP)
13	2.0	Proton Therapy (#12)	**RJ** (MS, CWC)
14	1.5	Catch-up (#1-12) or Special Procedures (#13) or Dedicated Research (#14)	**TP, VC** (YZZ GP)
	1.5	Vacation / Sick Leave / Family Leave / Conferences	TP

Attendance at the following conferences is required (at least 75%):

Grand Rounds: Tuesdays, 8:00 – 9:00am

Chart Rounds: Monday and Wednesday, 7:30-9:00am

Joint Presentation with CCF: 2nd Wednesdays, 3:00 – 4:00pm

Journal Club: 4th Thursday, 4:00-5:00pm

A total of 12 core rotations out of the 14 rotations must be completed for the resident candidate to be eligible for completion of the program requirements. The mentor of the clinical rotation evaluates the resident's performance at the end of each rotation (see Appendix J). Quarterly review of the resident's progress is performed by the Directors (see Appendix J).

New Resident Orientation

Clinical Medical Residency Program
Department of Radiation Oncology
University Hospitals Cleveland Medical Center

Name of the Resident: ____

Start date: ______________________ Completion date: ________________________

Name of the Mentor: ____

New Resident Orientation schedule and attendance

<u>Week #1:</u>

Monday/ Day1

8:30 a.m.	Report to Program Director, Radiation Oncology (B181/ B153A)
1:00 p.m.	Receive Badge – Human Resources Office Take ID card request with you. See Ms. Octavia Boykin (B153D)
2:00 p.m.	Health Screening (will need to bring immunization records, green hospital addressograph card (pick this up at registration in main lobby on way to screening) and photo ID badge). Health Screening will be in HR dept.

Tuesday/ Day2

8:00 a.m. – 5:00 p.m.	New employee orientation, including departmental organization, facilities, staffing, safety (rad and non-rad), basic policies and procedures, and Mosaiq training

Wednesday/ Day 3

8:00 a.m. – 5:00 p.m.	Shadowing in Seidman CC: Patient Treatments on Linear Accelerators (Radiation Therapist)

Thursday/ Day 4

8:00 a.m. – 5:00 p.m.	Shadowing in Seidman CC: Patient Simulation in CT; MRI (Radiation Therapists)

Friday/ Day 5

8:00 a.m. – 10:30 a.m.	Shadowing in Seidman CC: Treatment Planning in Dosimetry (Dosimetrist)
10:30 a.m. – 11:30 a.m.	Benefits Orientation with House Staff
12:30 a.m. – 5:00 p.m.	Shadowing in Seidman CC: Treatment Planning in Dosimetry (Dosimetrist)

<u>Week #2:</u>

Monday/ Day 6

8:00 a.m. – 5:00 p.m.	Shadowing in Seidman CC: Brachytherapy (Physicist)

Tuesday/ Day 7

8:00 a.m. – 5:00 p.m.	Shadowing Physicist for SBRT/ CK/ GK

Wednesday/ Day 8
7:30 a.m. – 11:30 a.m. UHCMC Benefits Orientation – as applicable
12:30 p.m. – 4:30 p.m. Shadowing Physicist for Proton Therapy
Thursday/ Day 9
8:00 a.m. – 5:00 p.m. Shadowing in Seidman CC: Physicist of the Day (Physicist)

Friday/ Day 10
8:00 a.m. – 5:00 p.m. Shadowing in Seidman CC: RO Physician and Nursing Staff

Safety Training
The following safety training and safety issues are covered in resident safety orientation, which is conducted by the Hospital/ Program Director/ Physics Div. Director/ any qualified personnel:

- Personal Protective Equipment (PPE) Training
- Mandatory Reporting
- Bloodborne Pathogens
- Safety and Infection Control Test
- HIPAA Training
- Culture Diversity Training
- Patient and Staff Rights and Responsibilities
- Gowns, protective equipment
- Patient and Resident Safety
- Health Protection Office staff training and test (includes Radiation Safety)
- Hazard Communication Safety Training
- Hazmat Training and Test
- Fire and Tornado Plans and Procedures
- Code Blue Procedures
- Universal Precautions
- Sharps Disposal
- Handling TLDs, potential risks and safety issues during residency training

Comments: ____

____

____

____

____

-- Signature of the Resident, Date

-- Signature of the Mentor/Supervisor, Date

1. Dosimetric Systems rotation (core, rotation module #1)

Name of the Resident: ______________________________

Start date: ____________________ Completion date: ____________________

Name of the Mentor: ______________________________

A. Skills

a. Linac Operation
   i. F1 “Treat” mode
   ii. F5 “V & R” mode with Mosaiq
b. Use of an Ionization Chamber and Electrometer to read Dose
c. Setting up of water tank
d. Manual Film Densitometry
   i. H&D curve creation
   ii. Running a film processor
   iii. Converting optical density values to dose

B. Knowledge Base

a. Design and Basic Operation of Dose Measurement Devices
   i. Ion Chambers
   ii. Film
   iii. Metal Oxide Semiconductor Field Effect Transistor (MOSFET)
   iv. Diodes
   v. Thermoluminesence Dosimeters (TLD)
   vi. Optically Stimulated Luminescence Dosimetry (OSLD)
b. Design and Basic Operation of Electrometers
c. Phantoms
   i. Solidwater Slabs
   ii. Anthropomorphic
   iii. Water Tanks

C. Clinical Processes

a. Commissioning of Dose Measurement Systems
   i. Ion Chambers / Electrometers
   ii. Film
   iii. Silicon diodes
   iv. TLDs/ OSLDs
b. Commissioning of 3D Water Tank
c. Ion chamber Dosimetry System Effects
   i. Leakage
   ii. Stem Effect
   iii. Signal-to-noise for different chamber volumes
   iv. Variation with bias level and polarity at different dose rates
   v. Variation with changes in water temperature
d. Perform dose profile measurements with each detector and compare results.
e. Manual Film Densitometry
   i. H&D curve creation (10x10 field size, 6MV x-rays)
      1. depths of 1.5 cm and 10 cm in solid water,
      2. EDR2, XV, and Radiochromic film

Learning opportunities

Observe physicist measurements performed with ion chamber and phantom: monthly calibration, electron cutout measurements, IMRT/VMAT QA. Observe dose verification on patient using TLDs.

Reading List

1. The Physics of Radiation Therapy, 3rd ed., Khan, Chs.6 and 8 (focus on pp 144-154).
2. Comprehensive QA for Radiation Oncology (Reprinted from Medical Physics, Vol. 21, Issue 4) (1994) Radiation Therapy Committee Task Group #40; 37 pp, focus on Table IV.
3. Diode in Vivo Dosimetry for Patients Receiving External Beam Radiation Therapy (2005) Radiation Therapy Committee Task Group #62.
4. Acceptance testing of an automated scanning water phantom David E. Mellenberg, Robert A. Dahl, and C. Robert Blackwell Med. Phys. 17, 311 (1990)
5. Radiochromic Film Dosimetry (Reprinted from Medical Physics, Vol. 25, Issue 11) (1998) Radiation Therapy Committee Task Group #55.

Module: Dosimetry Systems

Competency: Dosimetry Systems

Objectives: This module intends to provide fundamental knowledge and sufficient practical training experience for active competency in IVD, Film, TLD Dosimetry and Cutout measurements.

1. Physics Class:

❒ Mentor sign and Date: ____________________

2. Reading Guidelines:

❒ Complete assigned reports and literature

❒ Mentor sign and Date: ____________________

3. Measurements and Data Collection

❒ Participate in actual patient IVD diode measurements

❒ Calibrate/Modify Calibration of IVD style Device

❒ Create an H and D Curve using EDR Film/Linac and RIT Software

❒ Use RIT or similar software to do film analysis using H and D curve created above

❒ Perform e- cutout measurements to determine cutout output factor

❒ Perform TLD Patient Measurements

❒ Use Mapcheck or Matrixx array style device to perform dose measurements and analysis

❒ Perform Special Physics consults for IVD measurements of pace makers in patients.

❒ Learn to pour a simple block or device.

❒ Mentor sign and Date: ____________________

4. Documentation and Reporting

❒ Documentation of Testing and data

❒ Writing Special Physics Consults as appropriate

❒ Mentor sign and Date: ____________________

Assessment (rotation #1):

The resident will take an oral exam or give a presentation. An understanding of the principles behind the processes as well as comprehension of other relevant information from the reading lists must be demonstrated.

Summary of Resident's activities:

____
____
____
____
____

Competency attained _____________yes ___________no

Mentor's Signature _______________________________ Date_______________

2. Treatment Planning I rotation (core, rotation #2)

Name of the Resident: ____

Start date: ____________________ Completion date: _____________________

Name of the Mentor: ____

A. Prepare Knowledge Base

a. Determination of Data Required for TPS Modeling
b. General Operation of Planning System
c. 3D Photon Beam Dose Algorithms
    i. Convolution Method
    ii. Polyenergetic Spectra
    iii. Inhomogeneity Corrections
    iv. Collapsed Cone Convolution
    v. Output Factors
    vi. Monitor Units
d. Electron Beam Dose Algorithms
    i. Pencil Beam model
    ii. Verification Data
e. Non-dosimetric Parameters within Treatment Planning Systems
    i. CT dataset resolution
    ii. CT number to electron density
    iii. Contouring thresholds / expansion / contraction
    iv. Transformations / Projections in Beams-eye-view
    v. Digitally Reconstructed Radiographs
f. Dose Evaluation Tools
    i. Dose grid resolution
    ii. Isodose lines
    iii. Tolerance of Normal Tissues
    iv. Dose-Volume Histograms
    v. TCP/NTCP
g. Treatment Planning Protocols
h. Data transfer
i. DICOM formats / RT Objects
j. Treatment Planning Quality Assurance
k. Record and Verify system data import/ verification/ approval

B. Clinical Processes – Use Clinical Module Work Sheet

a. Observe 3-D Treatment Planning
    i. Brain, Lung & Esophagus, Breast, CNS, Abdomen & Rectum, Pelvis & Bladder, Prostate, Skin, and GYN.
b. Determine the treatment planning protocol for each anatomical site observed.
    i. Prescription summary (total, fractionation, max/min)
    ii. Typical imaging techniques
    iii. fields, beam energy, beam shaping/ blocking
    iv. Regions of interest and their associated doses
c. Create Treatment Plans
    i. Brain, Breast, Lung, Rectum, Prostate, GYN, GI, CNS, Sarcoma, Skin.
d. Perform Quality Assurance on all plans

Learning opportunities

Observe dosimetrists in performing the treatment planning process, and understand the functionality of the planning system. After adequate hands-on time with the planning system and observing 10 different types of cases from 10 different sites (Brain, Breast, Prostate, H&N, whole CNS, GI, GYN, Skin, Sarcoma) perform treatment planning for 13 cases including (i) two cases from each site of Breast, Prostate, and Lung, and (ii) one case from each site of Brain, H&N, whole CNS, GI, GYN, Skin, Sarcoma. Most cases, if not all, should be real patient/clinical cases; as if the resident is working as a dosimetrist. Quality assurance of every aspect of the plan, from plan evaluation through verification within the record and verify system.

Treatment Planning - Operation and Clinical Module

A. Skills

a. TPS system operation
   i. Login
   ii. Access to Patient Database
   iii. Access to Syntegra/Planning
b. Mosaiq Record and Verify system

B. Knowledge Base

a. Determination of Data Required for TPS Modeling
b. 3D Photon/Electron Beam Dose Algorithms
c. Operation of Planning System
d. Treatment Planning Methods/Techniques
e. Dose Evaluation Tools
f. Data transfer
g. DICOM formats / RT Objects
h. Treatment Planning Quality Assurance
i. Record and Verify system data import/approval

Module: Treatment Planning I

I. Objective: Provide the resident with an introduction to dosimetry and treatment planning

II. Didactic Activities:

A. Photon Dosimetry

Task	Mentor Sign/Date
1. Attend 6 hours of lab in dosimetry provided in physics residents' syllabus (if applicable/ available).	________
2. Review Chapters 9 & 10 in Khan (3rd ed.) for basic dosimetry calculations. Submit following problems from Hendee Chapter 7: 1, 3, 5, 7, 9, & 11.	________
3. Review Chapters 11 – 13 in Khan (3rd ed.) for treatment planning. Submit following problems from Hendee Chapter 8: 2, 4, 6, & 8.	________

B. Electron Dosimetry

Task	Mentor Sign/Date
1. Review Chapter 14 and example problems in Khan (3rd ed.) for treatment planning. Submit problem 7 from Chapter 8 of Hendee.	________

III. Clinical Activities:

The resident will work with the therapist/dosimetrist/physicist to observe and perform the steps listed in A and B below for the designated number of patients.

A. Pre-planning process:
- Patient set-up and immobilization
- CT simulation (including isocenter placement)
- Secondary image acquisition and image fusion (if requested by MD)
- Importing images into PHILIPS Pinnacle Treatment Planning System

B. Planning process:
- Plan/patient set-up (couch removal, localization)
- Contour (both normal tissues and target)
- Point placement (isocenter and calc. points, if necessary)
- Beam placement and calculation
- Plan evaluation
- Plan review with physician
- Plan export to Mosaiq and RadCalc
- Plan review with floor physicist

When observing or creating a particular treatment plan, particular attention should be paid to the following items in the planning process:
- Prescription dose summary (total dose, fractionation, min. and max.)
- Imaging techniques utilized
- Fields used, beam energy, blocks
- Potential organs at risk (OAR) and their associated dose limits.

Observed Patient Cases (10):

Type:	**Lung**	**Prostate**	**Breast**	**Brain**	**GI**
Patient Initials:	________	________	________	________	________
Mentor sign:	________	________	________	________	________
Date:	________	________	________	________	________

Type:	**GYN**	**H&N**	**whole CNS**	**Skin**	**Sarcoma**
Patient Initials:	________	________	________	________	________
Mentor sign:	________	________	________	________	________
Date:	________	________	________	________	________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

Planned Patient Cases (13):

Type:	**Lung (2)**	**Prostate (2)**	**Breast (2)**	**Brain**	**GI**
Patient Initials:	__________	__________	__________	__________	__________
Mentor sign:	__________	__________	__________	__________	__________
Date:	__________	__________	__________	__________	__________

Type:	**GYN**	**H&N**	**whole CNS**	**Skin**	**Sarcoma**
Patient Initials:	__________	__________	__________	__________	__________
Mentor sign:	__________	__________	__________	__________	__________
Date:	__________	__________	__________	__________	__________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

Reading List

1. G. C. Bentel, "Radiation Therapy Planning", McGrall-Hill, New York, 2e, 1996.
2. User Manual for Treatment Planning System (e.g. Pinnacle Beam Modeling, planning, etc.)
3. A convolution method of calculating dose for 15-MV x rays, TR Mackie, JW Scrimger, JJ Battista, Medical Physics, Vol 12, Issue 2 (1985).
4. Investigation of the convolution method for polyenergetic spectra, N Papanikolaou, T Rockwell Mackie, C Meger-Wells, M Gehring, P Reckwerdt, Medical Physics, Vol. 20, Issue 5 (1993).
5. Separation of Photon Beam Output Factor into its Phantom and Machine Components using the Convolution/Superposition Method, N. Papanikolaou, T. Rockwell Mackie, B.R. Thomadsen, D.M.D. Frye, B. Paliwal and C.M. Sanders, University of Wisconsin Medical School, Madison WI.
6. Monitor Unit Calculations for Convolution and Monte Carlo Dose Planning Systems, R. Mackie, N. Papanikolaou, B. Thomadsen, P. Reckwerdt, T. Holmes, C. Sanders. 1994 AAPM, Anaheim CA.
7. Tolerance of normal tissue to therapeutic irradiation, B Emami, J Lyman, A Brown, L Cola, M Goitein, JE Munzenrider, B Shank, LJ Solin, M Wesson, Int J Radiation Onc Bio Phys, Vol. 21, Issue 1 (1991).
8. Dose-volume histograms, RE Drzymala, R Mohan, L Brewster, J Chu, M Goitein, W Harms, M Urie, Int J Radiation Onc Bio Phys, Vol. 21, Issue 1 (1991).
9. Collapsed cone convolution of radiant energy for photon dose calculation in heterogeneous media, A Ahnesjo, Medical Physics, Vol. 16, Issue 4 (1989).
10. Electron beam dose calculations, K Hogstrom, M Mills, P Almond, Phys. Med. Biol., Vol. 26, Issue 3 (1981).
11. On methods of inhomogeneity corrections for photon transport, J Wong, J Purdy, Medical Physics, Vol. 17, Issue 5 (1990).
12. Mosaiq User's Manual.
13. Quality Assurance for Clinical Radiotherapy Treatment Planning (Reprinted from Medical Physics, Vol. 25, Issue 10) (1998) Radiation Therapy Committee Task Group #53.
14. Verification data for electron beam dose algorithms, A Shiu, S Tung, K Hogstrom, J Wong, R Gerber, W Harms, J Purdy, R Ten Haken, D McShan, B Fraass, Medical Physics, Vol. 19, Issue 3 (1992).

15. G. Starkschall, R. E. Steadham, R. A. Popple, S. Ahmad, and I. I. Rosen, "*Beam commissioning methodology for a 3-D convolution/superposition photon dose algorithm*," J. Appl. Clin. Med. Phys. **1**, 8–27 (2000).
16. G. Starkschall, R. E. Steadham, N. H. Wells, L O'Neill, L. A. Miller, and I. I. Rosen, "On the need for monitor unit calculations as part of the beam commissioning methodology for a radiation treatment planning system," J. Appl. Clin. Med. Phys. **3**, 86–94 (2000).
17. F. M. Khan, "Treatment Planning in Radiation Oncology", Lippincott Williams & Wilkins, 2009.
18. Verification of monitor unit calculations for non-IMRT clinical radiotherapy: Report of AAPM Task Group 114. Med. Phys. 38(1), 2011.

Assessment (rotation #2):

The resident will present a report giving an overview of all the processes, describing the individual steps conceptually, and results from their assessment of treatment planning methods. Finally, the resident will take an oral exam. An understanding of the principles behind the processes as well as comprehension of other relevant information from the reading lists must be demonstrated

Summary of Resident's activities:
____
____
____
____
____

Competency attained ______________yes ____________no

Mentor's Signature ________________________________ Date ___________________________

3. **Treatment Planning II rotation** (core, rotation #3)

Name of the Resident: ____

Start date: ___________________ Completion date: _____________________

Name of the Mentor: ____

I. Skills

A. Treatment planning
   1. Must complete the Treatment Planning I rotation
   2. Read a Dose Volume Histogram
   3. Transfer a plan to a phantom
   4. Obtain the dose matrices of the plan
   5. Specify Dose-Volume constraints
B. Film Densitometry
   1. H&D curve creation
   2. Running a film processor
   3. Scanning Film
   4. Converting pixel values to dose
C. Use of an Ionization Chamber and Electrometer to read Dose
D. Operate the Record & Verify system
E. Operate the Linac
F. CT scanning a phantom and importing it into the planning system
G. Positioning a phantom – determining shifts from fiducials to isocenter

II. Knowledge Base

A. Optimization – an introduction
B. Critical organ doses, parallel vs serial organs, typical dose-volume constraints
C. Dose calculation algorithms specific to IMRT
D. Film as a dose measuring device
E. Small field dosimetry – measurement and modeling in the planning system
F. Imaging for IMRT – CT basics

III. Clinical Processes

A. IMRT planning
B. VMAT planning
C. IMRT& VMAT chart check (in MOSAIQ)
D. IMRT & VMAT QA
   1. Patient specific
   2. Delivery system specific
E. IMRT boosts
F. IMRT & VMAT delivery
G. Film densitometry QA

Learning opportunities

Take a patient from the CT scan all the way through the initial treatment delivery. This will require shadowing the CT therapists, the dosimetrist, the medical physicist, and the linac therapists. With the first patient, it will be observation. With the second patient, it will be supervised performance of the tasks. With a phantom, it will be an independent performance of the tasks. There are a fair number of IMRT/VMAT patients in our department, and there will be no lack of opportunities. Most cases, if not all, should be real patient/clinical cases; as if the resident is working as a dosimetrist.

Reading List

1. Radiation Therapy Physics, Hendee, Ibbott and Hendee, Ch. 11, focus on pp 270 to 277, Ch. 15, focus on pp. 394-397.
2. The Physics of Radiation Therapy, 3rd ed., Khan, Chs.19 and 20, Ch 8 (focus on pp 151-153) and ch 14 (pp 304-305).
3. Treatment Planning in Radiation Oncology, Khan and Potish, editors, Chs. 8 (focus on pp172-176), 9, 12.
4. Radiation Therapy Planning, Bentel, see the summaries ("Morbidity") at the end of the various anatomical sections in chapters 9 through 13 to get a good idea of dose tolerances for various organs.
5. http://www.sprawls.org/resources/CTIMG/module.htm-This is a nice intro to CT image acquisition. Needed to understand the data acquisition requirements for IMRT.
6. Guidance document on delivery, treatment planning, and clinical implementation of IMRT: Report of the IMRT subcommittee of the AAPM radiation therapy committee. Med. Phys. 30(8), 2003.
7. IMRT commissioning: Multiple institution planning and dosimetry comparisons, a report from AAPM Task Group 119. Med. Phys. 36(11), 2009.
8. Dosimetry tools and techniques for IMRT. Med. Phys. 38(3), 2011.
9. Treatment planning for volumetric modulated arc therapy (VMAT). Med Phys. 36(11): 2009.
10. Evaluation of MatriXX for IMRT and VMAT dose verifications in peripheral dose regions. Med Phys. 37(7), 2010.

Module: Treatment Planning II

I. Objective: This module intends to demonstrate fundamental knowledge and sufficient practical experience for active competency in LINAC-based intensity modulated radiation therapy (IMRT) and quality assurance (QA).

II. Didactic Activities:

Task	Mentor Sign/Date
1. Read Chapter 21 in Khan (3rd ed.).	____________
2. Read AAPM Reports: IMRT Guidance Document [Med. Phys 30(8), 2003), TG 119.	____________

III. Clinical Activities:

The resident will work with the therapist/physicist to observe and perform the steps listed in A – C below for the designated number of patients.

A. Simulation/Treatment Planning activities:

- Observe patient set-up and immobilization in CT-Sim
- Transfer images from CT to PHILIPS PINNACLE
- Set-up patient-planning objectives, avoidance, and DVH
- Utilize DMPO for plan optimization

B. Patient-specific quality assurance:
- Review patient QA protocol
- QA phantom selection/planning
- Run the QA treatment and analyze using RIT and/or Mapcheck
- Perform relative calibration for energy being used
- Create H and D Film and curve
- Use Film and/or array analysis software (i.e. Mapcheck, Matrixx or RIT)

C. Treatment day activities:
- Ensure treatment chart and plan are ready for treatment (review 1st day sheet)
- Ensure applicable IGRT is ready for treatment utilization (i.e., calibration, etc.)
- Treatment console operation/machine operation

Observed Patient Cases (IMRT):

	Case #1	**Case #2**	**Case #3**
Case Type:	________	________	________
Patient Initials:	________	________	________
Mentor sign:	________	________	________
Date:	________	________	________

Planned Patient Cases (IMRT):

	Case #1	**Case #2**	**Case #3**	**Case #4**	**Case #5**
Case Type:	________	________	________	________	________
Patient Initials:	________	________	________	________	________
Mentor sign:	________	________	________	________	________
Date:	________	________	________	________	________

Observed Patient Cases (VMAT):

	Case #1	**Case #2**	**Case #3**
Case Type:	________	________	________
Patient Initials:	________	________	________
Mentor sign:	________	________	________
Date:	________	________	________

Planned Patient Cases (VMAT):

	Case #1	Case #2	Case #3	Case #4	Case #5
Case Type:	__________	__________	__________	__________	__________
Patient Initials:	__________	__________	__________	__________	__________
Mentor sign:	__________	__________	__________	__________	__________
Date:	__________	__________	__________	__________	__________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc).

Assessment (rotation #3):

The resident may prepare a written report summarizing their experiences and present this information to the mentor during an oral exam or module presentation. The resident will develop knowledge of IMRT and VMAT planning and related patient-specific QA. Out of 10 cases (IMRT/VMAT as tabulated above) the resident must select at least three cases from anatomical sites other than Prostate, and Head & Neck.

Summary of Resident's activities:
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____
____

Competency attained ______________yes ____________no

Mentor's Signature ________________________________ Date ___________________________

4. Linear Accelerator Acceptance, Commissioning, and Annual QA rotation (core, rotation #4)

Name of the Resident: ____

Start date: ______________________ Completion date: ________________________

Name of the Mentor: ____

Knowledge Base – From Didactic courses

1. Linear Accelerator Acceptance/Testing
    a. Fundamental concepts of linear accelerators, beam production and control.
    b. Medical linear accelerator safety features.
    c. The acceptance testing process
2. Radiotherapy Beam Data Collection for Commissioning
    a. Data definitions.
    b. Measurement (acquisition) techniques and underlying principles.
3. Medical Radiotherapy Equipment QA
    a. Linac QA
    b. Other treatment machine QA

4. Linear Accelerator Fundamentals Relevant to Commissioning
    a. Basic beam optics
    b. Beam flattening
    c. Significance of beam control parameters
    d. Collimation
        i. Rectangular Jaws
        ii. MLC
        iii. Electron Collimation
    e. Medical Linear Accelerator Specifications
    f. Non-beam specifications
    g. Beam specifications
    h. Acceptance Tests
        i. Safety-related tests (Radiation survey)
        ii. Acceptance vs. Commissioning Data Collection
        iii. Non-beam tests
        iv. Beam modifier and Accessory testing
5. Commissioning Data Acquisition Tasks
    a. Data acquisition using scanning water phantom.
        i. Types and significance of scans
        ii. Scans with different detectors
        iii. Scans with different beam modifiers
        iv. Point data acquisition
        v. Film/planar data acquisition.
    b. Understanding of measurement selection,
6. Analysis of Measurements and Preparation for Commissioning
    a. Preparation for MU Calc data
    b. Preparation for TPS beam commissioning
    c. Conceptual understanding of objectives with respect to commissioning

Reading List:

1. Horton, J.L., "Handbook of Radiation Therapy Physics", Prentice-Hall (1987).

   Chapters 5, 6, 7.
2. Kutcher, G. *et al.*, ''Comprehensive QA for radiation oncology: Report of AAPM Radiation Therapy Committee Task Group 40,'' Med. Phys. 21, 581–618 (1994).
3. Klein, E.E. *et al*., "Task Group 142 report: quality assurance of medical accelerators", Med. Phys. 36(9), 4197-4212 (2009).
4. Starkschall G., Steadham R., et al, "Beam-commissioning methodology for a three-dimensional convolution/superposition photon dose algorithm," Journal of Applied Clinical Medical Physics, 1:1 p 8 – 27, (2000).
5. AAPM TG-53 Report: Quality Assurance for Clinical Radiotherapy Treatment Planning.
6. AAPM TG-35 Report: Medical Accelerator Safety Considerations.
7. AAPM TG-51 Report: Protocol for clinical reference dosimetry of high-energy photon and electron beams.
8. AAPM TG-18 Report: Report on Neutron dosimetry.
9. AAPM TG-26 and TG-22 Report: Physical Aspects of Quality Assurance in Radiation Therapy.
10. AAPM TG-106 Report: Accelerator beam data commissioning equipment and procedures.

Module: Linear Accelerator Annual Calibration

I. Objective: Provide the resident with the fundamental knowledge and practical training for proficiency in the annual calibration a Linear Accelerator in accordance with AAPM Task Group 142.

II. Didactic Activities:

Task	**Mentor Sign/Date**
1. Read AAPM TG-21 Report	________
2. Read AAPM TG-40 Report	________
3. Read AAPM TG 142 Report	________
4. Read AAPM TG-51 Report	________
5. Read AAPM TG-106 Report	________

III. Clinical Activities:

The resident will work with one of the senior physicist and/or staff physicist to observe and perform the steps listed below. At the conclusion of these activities a write-up shall be submitted summarizing the checks performed and findings.

Tasks related to AAPM TG-142	Mentor Sign/Date	
	Observe	Perform
Mechanical, Dosimetry, and Safety Checks (Table III)	________	________
Respiratory Gating Checks (Table III) – if applicable	________	________
Dynamic/Universal/Virtual Wedges (Table IV)	________	________
Multileaf Collimation (Table V)	________	________
Imaging (Table VI)	________	________

Other Tasks related to Annual Calibration	Mentor Sign/Date	
	Observe	Perform
Set-up and alignment of water tank	________	________
Analyze data and perform daily and monthly consistency checks	________	________
Prepare final report and associated documentation	________	________
Preparation/Irradiation of RPC TLDs	________	________
Other checks as outlined in previous years	________	________

Assessment (rotation #4):

The resident may require to provide a written report of principles and process of Linear Accelerator Acceptance Testing, Commissioning Measurements and Annual QA with an overview and detailed descriptions of the relevant underlying principles for each major step. The report should also contain data acquired through measurements or experiment as well as analysis thereof. Finally, an understanding of the principles behind the processes as well as comprehension of other relevant information from the reading lists must be demonstrated in an oral exam (or a presentation) setting.

Summary of Resident's activities:

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____
____
____
____

Competency attained _______________yes _____________no

Mentors Signature ___________________________Date ___________________________

5. Treatment Planning System (TPS) Modeling, Acceptance and Commissioning (core, rotation #5)

Name of the Resident: ____

Start date: ______________________ Completion date: ________________________

Name of the Mentor: ____

Module - Commissioning of Philips Pinnacle or other Planning System

Objectives: This module intends to provide the resident with a basic understanding of the TPS, its functions and capabilities.

1. **Physics Class:** Treatment Planning

❒ Mentor sign and Date: ____________________

2. **Reading Guidelines:**

❒ Read planning system physics guide (e.g. Pinnacle Physics, Instructions for Use, and Pinnacle Physics, Reference Guide).

❒ Mentor sign and Date: ____________________

3. **Equipment:**

❒ Scanning water tank (e.g. Wellhofer) and data acquisition software (e.g. Omni-Pro Accept).

❒ Diode/chamber array (e.g. Sun Nuclear Profiler) to be used for virtual wedge profile acquisition.

❒ Mentor sign and Date: ____________________

4. **Collect and Model Beam Data:**

❒ Create a new machine in the treatment planning software.

❒ Gather and enter physical machine characteristics.

❒ Scan and import required photon beam PDD’s and profiles, open and wedged.

❒ Measure and enter required photon output factors, open and wedged.

❒ Measure and import profiles for virtual wedged beams.

❒ Model all open and wedged photon beams.

❒ Scan and import electron beam PDD’s and profiles for each energy and cone.

❒ Scan in-air electron profiles for virtual source distance and sigma-theta-X calculation.

❒ Measure and enter required electron cone output factors over range of clinical SSD’s.

❒ Model all electron beams.

❒ Mentor sign and Date: ____________________

5. Validate Model and Commission Machine

- ❒ Create and test model validation plan to include measurements, with on-site physicist, of machine orientations, wedges, MLCs, etc.
- ❒ Commission machine in the treatment planning software.
- ❒ Prepare dosimetry book for distribution to physicist and dosimetrists.
- ❒ Mentor sign and Date: ____________________

Recommended Reading List:

1. AAPM Radiation Therapy Committee TG- 53: Quality assurance for clinical radiotherapy treatment planning. Med. Phys. 25(10),1998.
2. Accelerator beam data commissioning equipment and procedures: Report of the AAPM TG-106. Med. Phys. 35(9), 2008.

Assessment (rotation #5):

The resident will present a report that includes photon and electron beam modeling for treatment planning system, verification of modeling accuracy and its clinical implementation. He/she should compare the results obtained with the published data. Finally, the resident will take an oral exam or give a presentation. An understanding of the principles behind the processes as well as comprehension of other relevant information from the reading lists must be demonstrated.

Summary of Resident's activities:

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____
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____
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Competency attained _____________yes ___________no

Mentor's Signature _________________________ Date ________________

6. Imaging for Simulation, Planning and Treatment Verification – IGRT rotation (core, rotation #6)

Name of the Resident: ____

Start date: ____________________ Completion date: _____________________

Name of the Mentor: ____

6A.1. Imaging for Simulation

A. Prerequisite Skills

a. Radiation Safety – X-ray machine operation
b. Human Anatomy – common bony landmarks
c. Fundamental Physics of Radiographic Imaging
    i. Radiation Interactions with Matter
        1. Photoelectric Effect, Compton, Pair Production
        2. Attenuation and Scatter
    ii. Basic Imaging Parameters
        1. Contrast
        2. Detective Quantum Efficiency
        3. Signal to Noise Ratio
        4. MTF
d. Introductory Imaging Technologies
    i. Imaging Detector Concepts
        1. Films
        2. Fluoroscopy
        3. Computed Radiography
        4. Ion Chamber Arrays
        5. Diode Arrays (Asi)
        6. Other planar X-ray imagers
    ii. X-ray CT
    iii. PET
    iv. MRI
    v. Ultrasound

B. Knowledge Base

a. Principle understanding of simulation process.
b. Fundamental Principles of Simulation Equipment
    i. CT/4D-CT
    i. Immobilization and Localization aids.
    ii. Other simulation technologies: PET/CT, MR, US, Photogrammetric.
    iii. Image co-registration ("fusion") and the role of multimodality imagery in simulation.
    iv. PET/CT
    v. Temporally-Registered Imagery (4D).

c. Medical Physicist Role in Simulation and Equipment Management
    i. Conventional Simulation
        1. Process emphasizing physicist role (I.e. historical breast)
        2. QA of Simulator
        3. QA of imaging chain
        4. QA of X-ray generator
    ii. CT Simulation

1. CT numbers, electron density, and relationship to Radiation Oncology treatment planning.
2. Diagnostic CT v. Planning CT (or Simulator)
3. CTSim QA
    a. Mechanicals, lasers, fiducials
    b. Imaging
    c. Heterogeneity correction tables

iii. PET/CT (if applicable)
1. Radiation isotope safety
2. QA
3. Issues in utilizing PET images in simulation.

iv. MRI (if applicable)
1. Application as image set for fusion
2. Potential as primary simulation modality
3. QA for RTMRI

v. Use of “other” modes in RT Simulation (such as photogrammetry, Ultrasound, setup “aids”).

C. Clinical Processes

a. CT Simulation
b. VSIM as an alternative to CT-Sim
c. Sim Aids: Radiocam, Sonosite, etc.

Learning Opportunities:

- Attend a conventional simulation for EBRT. Observe patient setup, use of fluoroscopy and image capture, and annotation of films.
- Follow a patient through the CT (PET/CT) simulation process. Emphasis should be on geometric aspects of the process (setup geometry specification, immobilization, marking, tattoos, CT including x-ray technique, and transfer to planning system).
- Note: Much of this is done for phantom as part of monthly CT simulator QA.
- Follow a patient and then take a phantom through the VSIM process.
- Observe the use of combined imaging modalities in the simulation process (such as MRI and CT for SRS).
- Follow a patient through the Optical Image guided setup simulation process, attend CT, bite block registration, and initial treatment.
- Perform Radiocam and Sonosite QA.
- Perform CT (PET/CT) QA to include using the ACR phantom.

Reading List:

1. “Quality assurance for computed-tomography simulators and the computed-tomography simulation process: Report of the AAPM Radiation Therapy Committee Task Group No. 66,” Med Phys 30 (10), 2003.
2. Christensen’s Physics of Diagnostic Radiology (In order) Chapters 14, 15, 19, 12, 24.
3. Perry Sprawl’ On-line lectures:
    a. http://www.sprawls.org/ppmi2/IMGCHAR/
    b. http://www.sprawls.org/resources/CTIMG/module.htm
4. Johns & Cunningham, “The Physics of Radiology,” Chapter 16.
5. “The phantom portion of the American College of Radiology (ACR) Computed Tomography (CT) accreditation program: Practical tips, artifact examples, and pitfalls to avoid”, Med Phys 31(9), 2004.
6. AAPM Report #14, “Performance specifications and acceptance testing for x-ray generators and automatic exposure devices”, 1985.

6A. **Observed Patient CT-Sim Setup Cases** (1 H&N, 1 Lung, 1 Cyber/SBRT):

	Case #1	**Case #2**	**Case #3**
Case Type:	__________	__________	__________
Patient Initials:	__________	__________	__________
Mentor sign:	__________	__________	__________
Date:	__________	__________	__________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

6A. **Perform (with RTTs) Patient CT-Sim Setup Cases** (1 H&N, 1 Lung, 1 Breast, 1 Cyber/SBRT, 1 GYN/Prostate):**:**

	Case #1	**Case #2**	**Case #3**	**Case #4**	**Case #5**
Case Type:	__________	__________	__________	__________	__________
Patient Initials:	__________	__________	__________	__________	__________
Mentor/RTT Sign:	__________	__________	__________	__________	__________
Date:	__________	__________	__________	__________	__________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

6A.2. Imaging for Planning and Treatment Verification

A. Skills

1. Fundamental Understanding of Basic Radiotherapy Process
    a. Simulation imaging
    b. Treatment planning
    c. Treatment delivery/verification
2. Basic Understanding of Radiological Imaging Modalities
    a. X-ray film/fluoroscopy
    b. X-ray CT
    c. MRI
    d. PET (PET/CT)
3. Basic Imaging Science
    a. Contrast Resolution
    b. Signal to Noise
    c. Image Quality
        i. Point/Line spread function
        ii. Modulation transfer function
    d. Digital imaging
        i. Quantum mottle
        ii. Noise frequency/spectrum
        iii. Detective Quantum Efficiency

B. Knowledge Base

1. Radiotherapy Simulation
    a. CT simulation/virtual simulation

b. DRR generation
   i. Set-up verification
   ii. Portal image verification
c. X-ray simulator
   i. Set-up verification
   ii. Portal image verification

2. Verification Imaging in Radiotherapy
   a. Kilovoltage x-ray images
      i. Simulator set-up images
      ii. Simulator portal images
      iii. Beams eye view DRR from CT
      iv. Set-up/Portal verification
   b. Megavoltage x-ray images
      i. X-ray film/cassette
      ii. Comparison to hardcopy DRR
      iii. Electronic portal images
   c. Ultrasound localization
      i. Set-up verification
      ii. SonArray system
   d. Megavoltage conebeam CT
      i. 3-D localization
      ii. Adaptive targeting
3. Electronic Portal Imaging Devices
   a. Fluoroscopic screen/camera based systems
      i. Principles of operation
      ii. Disadvantages/Limitations
   ii. Clinical prevalence

   Liquid Ion Chamber based systems
      i. Principles of operation
      ii. Disadvantages/Limitations
      iii. Clinical prevalence
   c. Active Matrix Flat Panel (aSi) based systems
      i. Principles of operation
      ii. Advantages/Limitations
      iii. Clinical prevalence

A. Clinical Processes

a. CT simulation
   i. Patient set-up
   ii. Iscocenter localization
b. Digital Reconstructed Radiograph
   i. Generation
   ii. Clinical use
c. Electronic Portal Imaging Devices
   i. Principles of operation
   ii. Daily/monthly quality assurance testing
   iii. Set-up/portal image verification
   iv. Megavoltage conebeam computed tomography

Learning Opportunities:

1. Clinical Use of Images
2. Portal Imaging Detector Systems
3. Image Quality
4. Commissioning and QA

Reading List:

1. Radiation Therapy Physics 3rd Ed, Hendee, Ibbott and Hendee, Chapter 9.
2. The Physics of Radiation Therapy, 3rd Ed, Khan, Chapter 12 (focus on pp 228 – 244), Section 12.7 (Patient Positioning) pp 264 – 268.
3. The Physics of Radiation Therapy, 3rd Ed, Khan, Chapter19 pp 467 – 474.
4. Marks JE, et al. "Localization error in the radiotherapy of Hodgkin's disease and malignant lymphoma with extended mantle fields," Cancer (NY) **34**, 83-90 (9174).
5. Rabinowitz J, et al. "Accuracy of radiation field alignment in clinical practice," Int. J. Radiat Oncol., Biol., Phys. **11**, 1857-67 (1985).
6. Nixon E. "Hydrogenated Amorphous Silicon Active Matrix Flat Panel Imagers (a-Si:H AMFPI) Electronic Portal Imaging Devices. Graduate Research Paper. University of Iowa. 2005.
7. Pang G and Rowlands J A Electronic portal imaging with an avalanche-multiplication-based video camera *Med.Phys.* **27** 676–84 (2000).
8. Rajapakshe R, Luchka, and Shalev S, "A quality control test for electronic portal imaging devices," Med. Phys. 23, 137-1244 (1996).
9. Gilhuijs KG, et al. "Optimization of automatic portal image analysis." Med. Phys. 22, 1089-1099 (1995).
10. Fristch DS, et al. "Core based portal image registration for automatic radiotherapy treatment verification." Int. J. Radiat. Oncol., Biol., Phys. 33, 1287-300 (1995).
11. Herman MG, "Clinical use of on-line portal imaging for daily patient treatment verification," Int. J. Radiat. Oncol., Biol., Phys. 28 (4) 1017-1023 (1994).
12. Herman MG, et al. "Effects of respiration on target and critical structure positions during treatment assessed with movie-loop electronic portal imaging," Int. J. Radiat. Oncol., Biol., Phys. 39, 163 (1997).
13. Mubata CD, et al., "Portal imaging protocol for radical dose-escalation radiotherapy treatment of prostate cancer," Int. J. Radiat. Oncol., Biol., Phys. 40, 221-231 (1998).
14. Lebesques JV, et al., "Clinical evaluation of setup verification and correction protocols: Results of multicenter Studies fo the Dutch cooperative EPID Group," The Fifth International EPID Workshop, Phoenix AZ, 1998.
15. Kirby MC, et al. "The use of an electronic portal imaging device for exit dosimetry and quality control measurements." Int. J. Radiat. Oncol., Biol., Phys 31, 593-603 (1995).
16. Hansen VN, "The application of transit dosimetry to precision radiotherapy," Med Phys. 23, 713-721 (1996).

6B. Image Guided Radiation Therapy (IGRT)

A. Skills

a. TPS system operation
b. Linear Accelerator operation
c. KV Cone Beam CT (and 4D CBCT, if applicable)
d. Megavoltage cone-beam operation – (if available)
e. MR and PET/CT operation

B. Knowledge Base

a. Prospective and Retrospective CT principles
b. Gated treatment delivery principles
c. Treatment planning process for IGRT
d. Data export/import into each system

C. Clinical Processes

a. Perform Quality Assurance on each of the IGRT components
   i. 4D image acquisition
   ii. gated delivery
   iii. megavoltage conebeam (if applicable)
b. Export IGRT Treatment Plans for
   i. Brain, Head and Neck, Lung, GI/GYN, and Prostate.
c. Perform image registration and fusion for multimodality imaging utilized in treatment planning
   i. CBCT with CT
   ii. PET with CT
   iii. MRI with CT
   iv. Prepare dose composite with EQD2 computation

Learning opportunities

Observe and participate in the IGRT treatment planning and delivery process and understand the functionality of the systems utilized. Quality assurance of every aspect of each IGRT system studied, from image acquisition through verification and treatment delivery.

Reading List

1. Quality Assurance for Clinical Radiotherapy Treatment Planning, Med. Phys., 25(10), 1998.
2. Radiation Therapy Committee Task Group #53.
3. Sanford L. Meeks, Wolfgang A. Tomé, Lionel G. Bouchet, et al. Patient Positioning Using Optical and Ultrasound Techniques. AAPM Summer School 2003.
4. Jean Pouliot, Ph.D., Ali Bani-Hashemi, Ph.D., Josephine Chen, Ph.D., et al. Low-Dose Megavoltage Cone-Beam CT For Radiation Therapy. Int. J. Radiation Oncology Biol. Phys., 61(2), 2005.
5. Nicole M Wink, Michael F McNitt-Gray and Timothy D Solberg. Optimization of multi-slice helical respiration-correlated CT: the effects of table speed and rotation time. Phys. Med. Biol. **50** (2005).
6. Allen Li, C. Stepaniak, and E. Gore, Technical and dosimetric aspects of respiratory gating using a pressure-sensor motion monitoring system, Med. Phys. 33 (1) 2006.
7. Gregoire, et al., Comparison of CT- and FDG-PET-defined GT. Int. J. Radiation Oncology Biol. Phys.,Int J Radiat Oncol Biol Phys, 63(1) 2005.

8. Arnold C. Paulino and Mary Koshy, In Response to Dr. Gregoire et al., International Journal of Radiation Oncology Biology Physics, 63(1), 2005.
9. Ling, J. Humm, et al. Towards multidimensional radiotherapy (MD-CRT): biological imaging and biological conformality. Int. J. Radiation Oncology Biol. Phys., 47(3), 2000.
10. J-P Bissonnette et al. Quality assurance for image-guided radiation therapy utilizing CT-based technologies: A report of the AAPM TG-179, MedPhys 2012.
11. P.J. Keall, et al. The Management of Respiratory Motion in Radiation Oncology: Reprot of AAPM TG 76, MedPhys 2006.
12. D.A. Low, et al. Dosimetry tools and techniques for IMRT: Report of TG 120. MedPhys 2011.
13. F-F. Yin, et al. The Role of In-Room kV X-Ray Imaging for Patient Setup and Target Localization: Report of AAPM TG-104 (2009).
14. MR Subcommittee Task Group I. AAPM Report #100, 2010 (see AAPM website: http://aapm.org/pubs/reports/RPT_100.pdf).
15. Evaluation of MatriXX for IMRT and VMAT dose verifications in peripheral dose regions. Med Phys. 37(7), 2010.

Module: IGRT

<u>I. Objective</u>: This module intends to demonstrate fundamental knowledge and sufficient practical experience for active competency in IGRT.

<u>II. Didactic Activities</u>:

Task	Mentor Sign/Date
1. Read AAPM TG-104 report and TG-179	____________
2. Read AAPM TG-76 report	____________
3. Read Chapter 21 in Khan (3rd ed.) and AAPM TG-101 report	____________
4. Read AAPM Reports: IMRT Guidance Document [Med. Phys 30(8), 2003]	____________

<u>III. Clinical Activities:</u>

The resident will work with the therapist/physicist to observe and perform the steps listed in A – C below for the designated number of patients.

A. Simulation/Treatment Planning activities:
- Observe patient set-up and immobilization in CT-Sim
- Observe and/or assist with the 4D-CT image acquisition and motion management
- Transfer images from CT to Philips Pinnacle (or relevant Tx planning system)
- Set-up patient-planning objectives, avoidance,
- Calculate and optimize treatment plan (through Full dose and Final dose steps)

B. Patient-specific quality assurance:
- Review patient QA protocol
- IMRT/VMAT/SBRT phantom selection/planning

- Run the IMRT/VMAT/SBRT treatment and analyze

C. Treatment day activities:
- Ensure QA and First Day Checklist are filled-in, reviewed and is approved for treatment
- Ensure treatment chart, Mosaiq, and treatment plan are ready for treatment
- Treatment console operation/machine operation

6B. **Observed Patient Cases (Brian, Lung, GI/GYN, prostate, H&N):**

	Case #1	Case #2	Case #3	Case #4	Case #5
Case Type:	________	________	________	________	________
Patient Initials:	________	________	________	________	________
Mentor sign:	________	________	________	________	________
Date:	________	________	________	________	________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

6B. **Planned Patient Cases (Brain, Lung, GI/GYN, prostate, H&N):**

	Case #1	Case #2	Case #3	Case #4	Case #5
Case Type:	________	________	________	________	________
Patient Initials:	________	________	________	________	________
Mentor sign:	________	________	________	________	________
Date:	________	________	________	________	________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc).

IV. Machine-related Quality Assurance/Calibration/Safety

The resident will work with the therapist/physicist to perform the daily QA. The resident will work with the physicist to actively participate in all other tasks listed below.

Tasks:	Case #1	Case #2	Case #3	Case #4
Daily QA	________	________	________	________
Monthly QA	________	________	________	________
Patient Archive/Retrieval	________	________	N/A	N/A
Cluster Server Operation	________	________	N/A	N/A
Data Server Operation	________	________	N/A	N/A
Post-service checks after Linac/Target change	________	________	N/A	N/A
Follow FSE for PMI	________	________	N/A	N/A
Annual QA Review:	________	N/A	N/A	N/A

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

Assessment (rotation #6):

The resident may require to present a report that describes the simulation process and equipment in Radiation Therapy as well as prepare a summary of his/her experiences for IGRT. This information is to be submitted to the physics faculty during an oral exam or presentation. The resident will develop knowledge of portal imaging systems used during the simulation/planning process and during treatment verification. The application of different patient immobilization techniques, and different electronic portal imaging systems will be studied by comparison of systems from Varian and Siemens. The resident will perform the necessary processes for commissioning the EPID systems, as well as identify and perform continuing quality assurance. During the rotation, the resident will perform monthly and annual quality assurance of CT-simulator, CBCT and different portal imaging systems.

Summary of Resident's activities:
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____
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Competency attained ______________yes ____________no

Mentor's Signature ________________________________ Date ___________________________

7. Professionalism and Ethics (core, rotation #7)

Name of the Resident: ____

Start date: _______________________ Completion date: ________________________

Name of the Mentor: ____

A. Skills

a. Ability to interact with medical colleagues and patients in a professional manner
b. Technical, personal, and professional skills required to represent a radiation oncology program during an inspection/audit by IROC, The Joint Commission, or a state or federal regulatory agency.

B. Knowledge Base

a. NRC, state regulations and rules governing radiation oncology
b. Institutional technical requirements for participation in multi-institutional clinical trials governed by NRG Oncology, IROC, and other cooperative trials organizations
c. Compliance requirements common to U.S. healthcare providers, The Joint Commission, and other accrediting organizations
d. Knowledge of HIPAA requirements relevant to the medical physicist
e. Understand the ethical issues of human and animal research
f. Understand professional issues related to vendors, coworkers, and medical peers
g. Understand legal and ethical issues involved in medical error evaluation and reporting

C. Learning opportunities

a. The resident will demonstrate to the mentor that he/she has developed a solid understanding of the professional, legal, and ethical issues related to radiation therapy.
b. The resident will review medical error case studies, and gain an understanding of the failure modes common to many previous technical medical accidents in the field of radiation therapy.

Clinical Activity

The resident will participate in an Ohio Department of Health Bureau of Radiation Protection inspection. Participation includes being present for and possibly assisting the staff physicists during the inspection process. The inspection may be at any campus, covering either radioactive materials or radiation generating equipment. This requirement may be satisfied any time during the residency, but is a requirement for rotation completion unless waived by the rotation mentor or program director.

Online Training

Residents are required to complete the following online training modules. Certification of completion should be submitted to the rotation mentor.

1. Collaborative Institutional Training Initiative (CITI) modules, accessed through UH's Clinical Trial Unit.

2. American Board of Radiology Foundation (ABRF) online modules on ethics and professionalism issues. The modules are accessed through the AAPM website at http://www.aapm.org/education/onlinemodules.asp:

    a. Historical Evolution and Principles of Medical Professionalism
    b. Physician/Patient/Colleague Relationships
    c. Personal Behavior, Peer Review, and Contract Negotiations with Employers
    d. Conflict of Interest
    e. Ethics of Research
    f. Human Subjects Research
    g. Vertebrate Animal Research
    h. Relationships with Vendors
    i. Publication Ethics
    j. Ethics in Graduate and Resident Education
    k. Professionalism in Everyday Practice; The Physician Charter

Reading list

1. NRG Oncology and NCI
    a. https://www.nrgoncology.org
    Includes links explaining the mission of NRG Oncology, and links to oncology protocols.
    b. http://www.cancer.gov/research/areas/clinical-trials/nctn
    An overview of the National Clinical Trial Network with links to additional information.

1. The Joint Commission
https://www.jointcommission.org/assets/1/6/Accreditation_Guide_Hospitals_2011.pdf
The Joint Commission Accreditation Guide for Hospitals, pages 1-14

2. HIPAA: The Health Insurance Portability and Accountability Act
https://www.healthit.gov/sites/default/files/pdf/privacy/privacy-and-security-guide.pdf
Guide to Privacy and Security of Electronic Health Information, Chapters 1-4

As an agreement state, sections a. and b. of the Ohio Administrative Code listed below mirror the NRC regulations for radioactive materials.

3. Ohio Department of Health. http://www.odh.ohio.gov/
    a. Chapter 3701:1-38-10 through 1-38-15: General Radiation Protection Standards for Sources of Radiation.
    b. Chapter 3701:1-58-12 through 1-58-101: Medical Use of Radioactive Materials. Review sections relevant to high dose rate brachytherapy and prostate seed implant brachytherapy only.

c. Chapter 3701:1-66 Radiation Generating Equipment Requirements and Quality Assurance Standards
d. Chapter 3701:1-67 Therapy Radiation Generating Equipment

Assessment (rotation #7):

The resident will take an oral exam at the conclusion of the rotation. The resident should be able to demonstrate knowledge of these processes and other relevant information obtained from the reading lists.

The resident will also submit paperwork certifying satisfactory completion of:

1. The Collaborative Institutional Training Initiative (CITI) modules, or equivalent, and
2. The AAPM (ABRF) Online Modules on Ethics and Professionalism.

Summary of Resident's activities:

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Competency attained ______________yes ____________no

Mentor's Signature _______________________ Date___________________________

8. Brachytherapy rotation (core, rotation #8)

Name of the Resident: ____

Start date: ____________________ Completion date: _____________________

Name of the Mentor: ____

8A. Brachytherapy – (Basics and LDR)

B. Skills

1. Radiation Safety
   a. Safe source handling
   b. Time/distance/shielding
2. Radiation Dosimetry
   a. Electrometer
   b. Re-entrant well chamber
3. Treatment Planning
   a. Dose prescription – Written directive
   b. Dose objectives – DVH parameters

C. Knowledge Base

1. Radioactive Decay
   a. Alpha
   b. Beta
      i. Electron capture
      ii. Internal conversion
   c. Gamma
2. Radioactive Sources Commonly Used in Radiotherapy
   a. Radium
      i. Decay
      ii. Source construction
      iii. Source specification
      iv. Exposure rate constant
      v. Applications
      vi. Physical characteristics
   b. Cesium-137
   c. Cobalt-60
   d. Iridium-192
   e. Gold-198
   f. Iodine-125
   g. Palladium-103
   h. Cesium-131
3. Calibration of Brachytherapy Sources
   a. Specification of source strength
      i. Activity
      ii. Exposure rate at distance
      iii. Equivalent mass of radium
      iv. Apparent activity
      v. Air Kerma strength
   b. Exposure rate calibration
      i. Open-air measurements

            ii. Well-type ion chambers
4. Calculation of dose distributions
    a. Exposure rate
        i. Sievert Integral
        ii. Effects of inverse square law
    b. Absorbed dose in tissue
    c. Modular dose calculation model: TG-43
    d. Isodose curves
5. Systems of Implant Dosimetry
    a. Paterson-Parker
        i. Planar implants
        ii. Volume implants
        iii. Paterson-Parker tables
        iv. Determination of implant area or volume
    b. Quimby
    c. Memorial
    d. Paris
    e. Computer
6. Computer Dosimetry
    a. Localization of sources
        i. Orthogonal imaging method
        ii. Stereo-shift method
    b. Dose computation
7. Implantation Techniques
    a. Surface molds
    b. Interstitial therapy
    c. Intracavitary therapy
        i. Uterine cervix
        ii. Uterine corpus
8. Dose Specification: Cancer of the Cervix
    a. Milligram-hours
    b. The Manchester System
        i. Bladder dose
        ii. Rectum dose
    c. The International Commission on Radiation Units and Measurements System
        i. Absorbed dose at reference points
9. Remote Afterloading Units
    a. Advantages
    b. Disadvantages
    c. High-dose rate versus low-dose rate

D. Clinical Processes

1. Source Calibration check
    a. HDR
    b. LDR seed
2. Low Dose Rate Cesium Implant (if possible)
    a. Dosimetry planning
    b. Hand calculation (time)
3. Implant Dosimetry Hand Calculation
    a. Paterson-Parker tables
    b. Quimby System
    c. Memorial System
    d. Paris System

4. Eye Plaques (if available)
    a. COMS (Collaborative Ocular Melanoma Study) protocol
    b. Treatment planning/prescription
    c. Seed ordering
        i. Single Source Strength Assay
        ii. Plaque construction
    d. Plaque placement/recovery source disposal
5. Prostate Seed Implants
    a. Volume Study
        i. Ultrasound/ CT/MR imaging
        ii. Volume estimate
        iii. Contouring – volume for planning
    b. Treatment planning
        i. Dose-volume constrained
        ii. Nomogram based (if any)
    c. Seed ordering
    d. Source strength assay
    e. Implant QA checklist
    f. Implant Procedure
        i. Seed sterilization
        ii. Needle placement
        iii. Seed placement
        iv. Cystoscopy (seed recovery from bladder)
        v. Recovery/disposal of waste seeds
    g. Post Implant Dosimetry
        vi. CT-based planning/assessment
        vii. Dose-volume parameters

Learning Opportunities:

The resident is expected to perform extensive reading of background materials.

1. Observe HDR source exchange. Participate in HDR source calibration check.
2. Observe and participate in LDR source calibration check measurements.
3. Write up solutions to the following exercises:
    a. Hendee (reference 1) pg. 294: 12-4, 12-5 and 12-6.
    b. Hendee pp 329-330: 13-1, 13-4, 13-5, 13-6, 13-8, 13-9, 13-12, 13-13, 13-14, 13-15. The resident is encouraged to write solutions to as many more of these problems in Chapter 13 as they desire.
    c. Johns and Cunningham (reference 3) pg. 497: 8, 9, 10, 11, 14, 15, 16, 17.

Reading List:

1. Radiation Therapy Physics 3rd Ed, Hendee, Ibbott and Hendee, Chapter 1 (focus pp 8-19), Chapters 12 & 13, Chapter 15 (pp 399-408).
2. The Physics of Radiation Therapy, 3rd Ed, Khan, Chapters 1 & 2 (focus pp 20-23), Chapter 15, Chapter 17 (pp 444-447).
3. The Physics of Radiology (4th Ed.), Johns and Cunningham, Chapter 13.
4. Brachytherapy Physics, 2nd Ed (2005 AAPM Summer School Proceedings), Thomadsen, Rivard, Butler (Eds), Chapters 1, 2, 3, 4, 5 (Overview & Fundamentals), Chapters 12, 13 (Localization), Chapters 14, 15, 16 (Dosimetry).
5. Code of Practice for Brachytherapy Physics (Reprinted from Medical Physics, Vol. 24, Issue 10) (1997) Radiation Therapy Committee Task Group #56.
6. ICRU. Dose and volume specification for reporting intracavitary therapy in gynecology. ICRU Report No. 38 and No. 89.

Module: LDR Brachytherapy – Prostate Seed Implant (PSI)

I. Objective: This module intends to provide fundamental knowledge and sufficient practical experience for active competency in prostate seed implant

II. Didactic Activities:

Task	Mentor Sign/Date
1. Attend 5 hours of class for Brachytherapy provided in the physics residents' syllabus (if necessary).	___________
2. Read Chapter 23 in Khan (3rd ed.) for PSI overview. Submit following problems from Hence Chapter 13: 14, 15.	___________
3. Read following AAPM Reports: TG-43, TG-64, TG-128, TG-137, TG-138	___________
4. Review prostate seed device/applicator with physicist/therapists.	___________

III. Clinical Activities:

The resident will work with the therapist/physicist to observe and perform the steps listed in A and B below for the designated number of patients.

A. Pre-treatment process:
- Volume study via ultrasound
- Target and normal tissue delineation
- Pre-treatment plan for seed determination
- Seed ordering with therapists
- Seed assay and enter data into spreadsheet

B. Treatment day planning process in operating room (OR):
- Input seed data/patient information into treatment planning system
- Plan/assist radiation oncologist with treatment plan
- Ensure/verify seed inventory
- Perform patient and room survey after procedure is complete

C. Post-treatment activities:
- Perform CT-based assessment
- Perform final dose assessment

8A. **Observed PSI Patient Cases:**

	Case #1	**Case #2**	**Case #3**	**Case #4**	**Case #5**
Patient Initials:	_________	_________	_________	_________	_________
Mentor sign:	_________	_________	_________	_________	_________
Date:	_________	_________	_________	_________	_________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

8A. **PSI Planned & OR Patient Cases:**

	Case #1	Case #2	Case #3	Case #4	Case #5
Patient Initials:	_________	_________	_________	_________	_________
Mentor sign:	_________	_________	_________	_________	_________
Date:	_________	_________	_________	_________	_________

	Case #6	Case #7
Patient Initials:	_________	_________
Mentor sign:	_________	_________
Date:	_________	_________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

Reading List:

1. Collaborative Ocular Melanoma Study Group, "Collaborative Ocular Melanoma Study (COMS) randomized trial of I-125 Brach therapy for choroid melanoma", multiple COMS Reports. See Ed Pennington for copies.
2. Radiation Therapy Physics 3rd Ed, Hence, Abbott and Hence, Chapter 13 (focus pp 322-329).
3. The Physics of Radiation Therapy, 3rd Ed, Khan, Chapter 22 (HDR), Chapter 23 (Prostate Implants) and Chapter 24 (Intravascular Brachytherapy).
4. Brachytherapy Physics, 2nd Ed (2005 AAPM Summer School Proceedings), Thomason, River, Butler (Eds.), Chapter 6 (HDR), Chapter 7 (HDR QA), Chapters 28-33 (Prostate Brachytherapy) Chapter 34 (Eye plaques).
5. Code of Practice for Brachytherapy Physics (Reprinted from Medical Physics, Vol. 24, Issue 10) (1997) Radiation Therapy Committee Task Group #56.
6. Dosimeter of Interstitial Brachytherapy Sources (Reprinted from Medical Physics, Vol. 22, Issue 2) (1995) Radiation Therapy Committee Task Group #43.
7. Update of AAPM Task Group No. 43 Report: A revised AAPM protocol for Brach therapy dose calculations. Medical Physics, Vol. 31, Issue 3 (2004); Radiation Therapy Committee Task Group #43.
8. High Dose-Rate Brachytherapy Treatment Delivery (Reprinted from Medical Physics, Vol. 25, Issue 4) (1998) Radiation Therapy Committee Task Group #59.
9. Permanent Prostate Seed Implant Brachytherapy (Reprinted from Medical Physics, Vol. 26, Issue 10) (1999) Radiation Therapy Committee Task Group #64.
10. Dose Prescription and Reporting Methods for Permanent Interstitial Brachytherapy for Prostate Cancer (AAPM TG #137).
11. Report of the Task Group 186 on model-based dose calculation methods in brachytherapy beyond the TG-43 formalism: Current status and recommendations for clinical implementation (TG-186)

Assessment (rotation #8A):

The resident may require to prepare a written report summarizing their experiences and present this information to the physics faculty during an oral exam or a presentation. This report will include any treatment planning results performed by the resident and overall understanding of the clinical procedure.

Summary of Resident's activities:

____
____
____
____

Competency attained ______________yes ____________no

Mentor's Signature ________________________________ Date ___________________________

8B. Brachytherapy (HDR)

A. Skills

1. Brachytherapy Safety
    a. Safe source handling
    b. Time/distance/shielding
2. Brachytherapy Dosimetry
    a. Exposure Rate Constant Formalism
    b. Air Kerma Strength Formalism
3. Brachytherapy Treatment Planning
    a. Dose prescription – Written directive
    b. Dose objectives – DVH parameters

B. Knowledge Base

1. Source Exchange/Calibration check
2. Daily (day of treatment) QA
3. Applicator/catheter placement
4. Imaging for treatment planning
    a. Orthogonal images
    b. Reconstruction geometry
    c. CT-based planning
5. Dose prescription/fractionation/rational
6. Treatment planning
    a. Written Directive
    b. Dose planning objectives
    c. Critical structure doses
    d. Treatment planning procedures
    e. Treatment plan QA
7. Treatment delivery
    a. Pre-treatment survey
    b. Attach catheters/applicator
    c. Authorized User/Medical Physicist requirements
    d. Treatment progress assessment
    e. Post-treatment survey
    f. Recovery/remove catheters/applicator
8. Emergency procedures
    a. Annual HDR safety training
    b. Manual source retract
    c. Stuck source
    d. Patient safety

C. Clinical Processes

1. High Dose Rate Procedures
    a. Vaginal (single and multichannel) Cylinder
    b. Ring and Tandem; Venezia Applicator
        i. Split-Ring & Tandem, Venezia Applicator
        ii. MR-guided CT based volumetric planning
        iii. Dose-volume constraint evaluation
        iv. Bladder rectal dose points
        v. Prescription dose (Point A)
        vi. Dose optimization points
        vii. Treatment plan assessment

viii. Treatment plan QA
ix. Treatment Delivery
x. Patient recovery

c. Interstitial Implant
   i. CT-based planning
   ii. Dose-Volume assessment
   iii. Manual plan/dose manipulation
d. Endobronchial
   i. Pre-planned treatment template
   ii. Endoscopic-guided catheter placement
   iii. Pre-treatment verification imaging
e. MammoSite (partial breast irradiation, if available)
   i. Prescription dose/fractionation/rational
   ii. CT-based planning/assessment
   iii. Point dose prescription/dwell time calculation
   iv. Pre-treatment verification imaging

Learning Opportunities:

This rotation requires reading an extensive amount of background material.

Accompany the medical physicist during brachytherapy procedures at least one time for each of the following: eye plaque planning/seed ordering, eye plaque construction, eye plaque placement and removal procedure, prostate implant planning volume study, prostate implant treatment planning session, prostate implant procedure, prostate implant post implant dosimetry assessment, HDR vaginal cylinder (VC) placement procedure, HDR tandem and ovoid/ring (T&O/R) placement procedure, HDR VC simulation and planning session, HDR T&O/R simulation and planning session, HDR VC treatment delivery, HDR T&O/R treatment delivery. Observe as many less frequently performed clinical cases as possible (endobronchial, MammoSite, interstitial implants).

Participate in the brachytherapy treatment planning with the qualified medical physicist for each of the following clinical cases: eye plaque, prostate implant, high dose rate tandem and ovoid/ring, and high dose rate vaginal cylinder.

Perform the monthly HDR QA and single source activity assays for prostate and eye plaque implants. Perform one set of hand calculation (following TG-43) for clinical sources and attend in HDR source exchange activities.

Module: Brachytherapy – High Dose Rate (HDR)

I. Objective: This module intends to provide fundamental knowledge and sufficient practical experience for active competency in high dose rate brachytherapy,

II. Didactic Activities:

Task	***Mentor Sign/Date***
1. Attend 6 hours of class for brachytherapy provided in the physics residents' syllabus (if necessary).	____________
2. Read/review Chapter 15 in Khan (3rd ed.) for brachytherapy overview, Section 18-5 in Modern Tech. of Radiation Oncology (Van Dyke, 1999).	_____________
3. Read following AAPM Reports: TG-41, TG-56 and TG-59.	_____________
4. Read ICRU 089	_____________
5. Submit following problems from Hendee – Chapter 12: 4, 5, and 6.	_____________
6. Review types of high dose rate applicators with physicist/therapists.	____________

III. Clinical Activities:

The resident will work with the therapist/physicist to observe and perform the steps listed in A and/or B below for the designated number of patients.

A. Intracavitary HDR (Vaginal Cylinder, Split-ring & Tandem, Ring& Tandem, Simon-Hyman Capsules, Mammosite, etc.):

Pre-treatment activities
- Observe CT scan
- Import CT scan into Oncentra treatment planning system
- Perform/assist in critical structure contouring
- Generate linear plan
- Generate optimized plan

Treatment day(s) activities
- Verify linear and optimized plans
- Verify treatment parameters including time and activity (after 1st fraction)

B. Interstitial HDR (Syed, Venezia, etc):

Pre-treatment activities
- Observe CT scan
- Import CT scan into Oncentra treatment planning system
- Perform/assist in critical structure contouring
- Generate treatment plan
- Check the plan using TG-43 formulation

Treatment day(s) activities
- Verify treatment parameters including time and activity (after 1st fraction)

C. Other types of HDR brachytherapy cases, which occur less frequently, can be observed as well. These cases can be substituted for one of the observed cases.

8B. **Observed HDR Patient Cases:**

	Case #1	**Case #2**	**Case #3**	**Case #4**	**Case #5**
Case Type:	__________	__________	__________	__________	__________
Patient Initials:	__________	__________	__________	__________	__________
Mentor sign:	__________	__________	__________	__________	__________
Date:	__________	__________	__________	__________	__________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

8B. **Planned HDR Patient Cases** (expected to have at least one multichannel cylinder, two Ring & tandem, one Syed or Simon-Heyman capsule, and one Venezia cases)**:**

	Case #1	**Case #2**	**Case #3**	**Case #4**	**Case #5**
Case Type:	__________	__________	__________	__________	__________
Patient Initials:	__________	__________	__________	__________	__________
Mentor sign:	__________	__________	__________	__________	__________
Date:	__________	__________	__________	__________	__________

	Case #6	**Case #7**	**Case #8**	**Case #9**	**Case #10**
Case Type:	__________	__________	__________	__________	__________
Patient Initials:	__________	__________	__________	__________	__________
Mentor sign:	__________	__________	__________	__________	__________
Date:	__________	__________	__________	__________	__________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

IV. Quality Assurance/Calibration/Safety for HDR

The resident will work with the special procedures therapist/physicist to perform the daily QA. The resident will work with the physicist to actively participate in tasks associated with the monthly QA, the source exchanges, and other related activities. The resident will also attend at least one of the scheduled HDR safety training sessions proctored by the Nucletron/Elekta field service engineer.

Tasks:	Case #1	Case #2	Case #3	Case #4
Daily QA	__________	__________	__________	__________
Monthly QA	__________	__________	__________	N/A
Source Exchange:	__________	__________	N/A	N/A
Console Update:	__________	__________	N/A	N/A
Oncentra Update:	__________	__________	N/A	N/A
RadCalc Update:	__________	__________	N/A	N/A
Emergency/ Safety Training:	__________	__________	N/A	N/A

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

Assessment (rotation #8B):

The resident may require to prepare a written report summarizing their experiences and present this information to the physics faculty during an oral exam or a presentation. This report will include any treatment planning results performed by the resident and overall understanding of the clinical procedure.

Summary of Resident's activities:

____
____
____
____
____

Competency attained ______________yes ____________no

Mentor's Signature ________________________________ Date ___________________________

9. SRS and SBRT rotation (core, rotation #9)

Name of the Resident: ____

Start date: ____________________ Completion date: _____________________

Name of the Mentor: ____

A. Prerequisite Skills

a. SRS Principles
b. Operation of Gamma/ CyberKnife and Elekta Versa in SRS/SBRT mode
c. MU calculation (TPR, PSF, CF, ISF) for conventional treatments
d. Use of ion chamber/electrometer/diodes/MOSFETs
e. Film dosimetry (if applicable)
f. Treatment planning basics for each modality

B. Knowledge Base

a. Small field dosimetry
b. Film measurements for small fields
c. SRS Beam modeling
d. Patient immobilization
    i. Frame
    ii. Frameless
e. Treatment Planning
    i. Reference frame coordinate system
    ii. Image fusion
    iii. Target localization
    iv. Isocenter selection
    v. Dose verification
f. Delivery
    i. Gantry/collimator/couch alignment
    ii. Floor stand isocenter location
g. Verification (QA) of delivery process

C. Clinical Process

a. Geometrical Alignment
    i. Patient Position
    ii. Verify alignment using Diode and film
    iii. Verify target simulator
    iv. Verify target localization accuracy using absolute phantom
    v. Patient Immobilization
        1. Frame placement
        2. Frameless
b. Beam data acquisition
    i. Measure small field TPR
    ii. Measure small field output factors
    iii. Create data table of TPR/OPF/Calibration data
c. Planning system commissioning
    i. Enter beam data into planning system
    ii. Verify planning system beam data
    iii. Verify localization for frame treatments
    iv. Verify localization for frameless treatments

d. Treatment planning
    i. Perform image fusion
    ii. Create single isocenter plan
        1. Identify arc/couch limitations
        2. Establish arc/couch angle presets
    iii. Create multiple isocenter plan
        1. Explain isodose line normalization
        2. Explain isodose line prescription
e. Plan Transfer to R&V/Linac
    i. Transfer data to Mosaiq
    ii. Transfer isocenter coordinates or plan to Gamma or CyberKnife
    iii. Perform independent MU calculations
f. Delivery
    i. Identify patient safety precautions
    ii. Perform pre-treatment QA
    iii. Participate/observe frameless delivery
    iv. Participate/observe frame delivery
    v. Operate linac, gamma or CyberKnife in QA mode (simulated treatment)
g. Workflow
    i. Generate SRS workflow diagram
    ii. Perform Failure Mode Analysis

Learning opportunities

- Perform QA on radiosurgery system using absolute phantom.
- Obtain small field TPR and OPF for two collimator sizes.
- Verify physics data in planning system.
- Establish mechanism for independent MU calculations.
- Create and execute a single isocenter plan on a phantom. Measure the dose delivered to the phantom and compare it to the planned dose.
- Follow a frame patient through all steps of process (frame placement, imaging, planning and delivery.) See item C. above.
- Follow a frameless patient through all steps of process (bite plate generation, imaging, planning and delivery.) See item C. above.
- Using workflow diagram, identify critical failure points and make recommendations on how to minimize or eliminate critical failures.

Reading list

1. AAPM report 54, Stereotactic Radiosurgery
2. Radiosurgery Vol 4, Kondizielka ed., Karger 2002, pages 251-261
3. Stereotactic Radiosurgery Treatment Planning Software Manual.
4. The Physics of Radiation Therapy, 3rd ed., Khan, Ch.21

Assessment:

The resident will acquire TPR/OPF/Calibration data for 2 small collimator fields. Upon successful demonstration of the acquired data, the staff physicist will give the resident data for all other collimator sizes. The resident will assemble a data book of the SRS planning data. He/she will format the data (TPR/ OPF/ OAF/ CAL) appropriate to enter into the planning system and to use for independent calculations. The resident will perform QA on the mechanical system, from localization to delivery giving quantitative analysis of the geometrical errors at each step of the process. The resident will be expected to observe as many actual SRS treatments as possible during their rotation.

The resident will take an oral exam or presentation (complete Module in CyberKnife/Linac SBRT or Gamma Knife) at the conclusion of the rotation. The resident should be able to demonstrate knowledge of these processes and other relevant information obtained from the reading lists.

Module: Radiosurgery – GammaKnife

I. Objective: This module intends to demonstrate fundamental knowledge and sufficient practical experience for active competency in GammaKnife Stereotactic Radiosurgery Procedures

II. Didactic Activities:

Task	Mentor Sign/Date
1. Attend 1.5 hours of class for GammaKnife provided in the physics residents' syllabus.	____________
2. Read Chapter 21 in Khan (3rd ed.).	____________
3. Read AAPM Reports: TG-42, TG-101	____________
4. Read "Licensing Guidance Gamma Knife Perfexion" (L:\physics\GammaPerfexion\Licensing Guide _NRC)	____________
5. Review entire GammaKnife system with physicist/therapists.	____________

III. Clinical Activities:
The resident will work with the physicist to observe and perform the steps listed in A – C below for the designated number of patients.

A. Pre-planning activities:
- Observe frame placement
- Observe MRI scans
- Open a new patient in Leksell Treatment Planning System (TPS)
- Input skull coordinates into TPS
- Import DICOM data in TPS
- Multi-view (Image fusion and co-registration, if necessary)

B. Treatment planning activities:
- Contouring (all to be reviewed by senior physicist/attending physician)
- Place the target (formerly "Matrix") according to physician-confirmed lesions
- Place treatment shots as needed to achieve physician's prescription
    - Utilize the dynamic-shaping tool when necessary
- Review plan upon completion
    - Check for clearance, zero-dose shots

C. Treatment day activities:
- Assist with treatment patient set-up in room
- Assist therapists with collision checks (if necessary)
- Prepare special medical physics consult for physicist review and signature
- Verify source strength on plan with values found in GammaKnife daily QA book.
- Observe the initial portion of the treatment (approximately 25%)
- Perform final physics check on chart

For each set of cases (Observed and Planned), a single metastasis, a multiple, and AVM cases must be included in the five documented cases. One case should include a fusion/co-registration.

Observed Patient Cases:

	Case #1	Case #2	Case #3	Case #4	Case #5
Case Type:	________	________	________	________	________
Patient Initials:	________	________	________	________	________
Mentor sign:	________	________	________	________	________
Date:	________	________	________	________	________

Planned Patient Cases:

	Case #1	Case #2	Case #3	Case #4	Case #5
Case Type:	________	________	________	________	________
Patient Initials:	________	________	________	________	________
Mentor sign:	________	________	________	________	________
Date:	________	________	________	________	________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc).

IV. Quality Assurance/Calibration/Safety

The resident will work with the therapist/physicist to perform the daily QA. The resident will work with the physicist to actively participate in tasks associated with the monthly and annual QA.

Tasks:	Case #1	Case #2	Case #3	Case #4
Daily QA	________	________	________	________
Monthly QA	________	________	N/A	N/A
Review output factor measurements:	________	N/A	N/A	N/A
Review annual calibration films:	________	N/A	N/A	N/A
Receive emergency training:	________	N/A	N/A	N/A

Note: Collect documentation (electronic or paper) for the

Summary of Resident's activities:

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Competency attained ______________yes ____________no

Mentor's Signature ________________________________ Date ___________________________

Module: Stereotactic Body Radiation Therapy (SBRT) with Linac and/or – CyberKnife (as applicable)

I. Objective: This module intends to demonstrate fundamental knowledge and sufficient practical experience for active competency in SBRT Procedure.

II. Didactic Activities:

Task	Mentor Sign/Date
1. Attend 1.5 hours of class for SBRT/CyberKnife provided in the physics residents' syllabus.	____________
2. Read Chapter 21 in Khan (3rd ed.).	____________
3. Read AAPM Reports: TG-42, TG-101, TG-135	____________
4. Review entire SBRT/CyberKnife system with physicist/therapists.	____________

III. Clinical Activities:

The resident will work with the therapist/physicist to observe and perform the steps listed in A – C below for the designated number of patients.

A. Simulation/Treatment Planning activities:
- Observe initial set-up in treatment room
- Observe treatment planning simulation/image acquisition (CT, MR, PET, etc.)
- Import all acquired images into treatment planning system
- Perform necessary image fusion using either seed points or manual manipulation
- Contour normal tissue structures
- Determine the proper immobilization/ tracking method
- Create treatment plan per physician's objectives

B. Post-treatment planning activities (as applicable):
- Perform second check of plan monitor units (MU Check).
- Authorize the plan at the Admin. workstation
- Create the digitally reconstructed radiographs (DRRs) at the CDMS workstation
- Prepare the physics BED or SMPC
- Input necessary information into MOSAIQ for treatment

C. Treatment day activities:
- Assist with treatment patient set-up in room
- Align the patient for treatment (with assistance of RTT for image acquisition)
- Create a Synchrony model for treatment (if applicable).
- Observe the treatment and provide necessary assistance to therapists
- Perform final physics check on chart (upon completion of patient's final fraction).

Observed Patient Cases:

	Case #1	Case #2	Case #3	Case #4	Case #5
Case Type:	________	________	________	________	________
Patient Initials:	________	________	________	________	________
Mentor sign:	________	________	________	________	________
Date:	________	________	________	________	________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

Planned and Delivered Patient Cases:

	Case #1	Case #2	Case #3	Case #4	Case #5
Case Type:	________	________	________	________	________
Patient Initials:	________	________	________	________	________
Mentor sign:	________	________	________	________	________
Date:	________	________	________	________	________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc).

Summary of Resident's activities:

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Competency attained ______________yes ____________no

Mentor's Signature _______________________ Date___________________________

10. Room Design, Radiation Protection and Radiation Safety rotation
(core, rotation #10)

Name of the Resident: ____

Start date: ______________________ Completion date: ________________________

Name of the Mentor: ____

A. **Skills**
   a. Interpretation of architectural drawings
   b. Survey meter operation
   c. Use of spreadsheet for data analysis
   d. Linac/HDR operation

B. **Knowledge Base**
   a. Understand radiation safety principles
   b. Understand dose limits/regulatory requirements
   c. Understand barrier material composition and preferences
   d. Understand process of neutron production
   e. Barrier HVL/TVL values
   f. Methodology of barrier thickness computation
   g. Understand differences between head leakage, scatter and primary radiation

C. **Clinical Process**
   a. Apply radiation safety principles to situations found in a radiation oncology clinic
      i. Time-Distance-Shielding
      ii. Brachytherapy safety and source accountability
      iii. Operational safety practices for linac, CT, PET, HDR, and MR
      iv. Patient safety
   b. Identify allowable radiation limits for occupationally exposed individuals
   c. Identify allowable radiation limits for members of the general public
   d. Identify/define controlled areas vs. non controlled areas
   e. Identify sources of radiation exposure found in typical radiation therapy facility
   f. Compute workloads
      i. Accelerator
      ii. HDR
      iii. LDR
      iv. Conventional simulator
      v. CT scanner
   g. Determine use factors for various radiation sources
   h. Determine occupancy factors for regions adjacent to sources of radiation
   i. Calculate barrier thickness
   j. Measure actual exposure outside treatment vault/HDR unit.

D. **Learning opportunities**
   a. The resident will demonstrate to the mentor that he/she has developed a solid grasp of radiation safety practices that need to be implemented in a typical radiation oncology facility.
   b. Compute barrier thicknesses for a typical linear accelerator room layout.
   c. Compute barrier thicknesses for a typical HDR suite

d. Measure exposure at door and in rooms adjacent to linear accelerator
e. HDR room survey
f. Neutron survey
g. Film Badge area monitoring
h. Optional: Patient specific shielding design (i.e., fetal dose reduction)

Reading list

1. NCRP Report 49
2. NCRP Report 151 (S:\OncShare\PHYSICS\NCRP_Reports)
3. The Physics of Radiation Therapy, 3rd ed., Khan, Ch. 16
4. Ohio Dept of Health Regulations (http://www.odh.ohio.gov/rules/final/finalRules.aspx)
5. Shielding Techniques, 2nd ed McGinley
6. AAPM task group 32 – Fetal Dose
7. AAPM online refresher courses
8. M.T. Masden, et al. AAPM Task Group 108: PET and PET/CT Shielding Requirements. Medical Physics, 33,(1): 2006.

Assessment (rotation #10):

The resident will compile a report describing the individual steps that were taken to perform the shielding design and analysis for the linear accelerator vault and/or HDR suite assigned in the learning opportunities. This report should be written as if the intended recipient was the architect in charge of designing the facility.
While the bulk of this rotation involves a shielding design project, the resident's overall understanding of radiation safety will be evaluated during this rotation. Radiation safety training is a continuous process throughout the 2-year rotation. Specific safety topics should have been addressed in previous rotations. The mentor will use this rotation to evaluate the resident on their understanding of safety issues by asking pertinent questions that the resident should be able to answer. Should the resident fail to answer any questions to the mentor's satisfaction he/she will be asked write a report covering the specific safety issues that need further study.
The resident will take an oral exam at the conclusion of the rotation. The resident should be able to demonstrate knowledge of these processes and other relevant information obtained from the reading lists.

Summary of Resident's activities:

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Competency attained ______________yes ____________no

Mentor's Signature ________________________ Date____________________________

11. Physicist of the Day rotation (core, rotation #11)

Name of the Resident: ____

Start date: ______________________ Completion date: _______________________

Name of the Mentor: ____

I. Objective: Provide the resident with the fundamental knowledge and practical training for proficiency with day-to-day clinical operations as the floor physicist. Resident will perform all tasks under the supervision of a senior physicist.

II. Didactic Activities:

Task	Mentor Sign/Date
1. Review Floor Physicist of the Day document.	__________
2. Review functionality of clinical software programs: Mosaiq, Lifeline Software's RadCalc, and Sun Nuclear's Daily QA3	__________

III. Clinical Activities:

The resident will work with the designated floor physicist of the day on the activities listed below:

A. Under the supervision of the senior physicist, assist with clinical issues that arise during the treatment day, prepare and review PHY SMPC, as needed.

B. Daily Quality Assurance: Review morning machine quality assurance data for all treatment units and identify any parameters outside of specification.

C. Complete 25 initial treatment plan/chart checks
- Check patient prescription in Mosaiq compared to the physician approved treatment plan
- Check second MU calculations (generated in RadCalc)
- Provide treatment day physics assistance
- Perform final physics chart checks

D. Complete 50 weekly treatment plan/chart checks
- Overall check of chart for completeness & signatures
- Check fractions treated & dose site summary
- Check the tolerance table values in Mosaiq compared those found in the treatment chart.
- For applicable plans, review diode measurements to ensure readings are within the expected range and transcribed into Mosaiq.

E. Complete 25 final treatment plan/chart checks
- Work through Final Physics Checks spreadsheet
- Become familiar with process of billing (senior physicist is responsible for billing)

Note: It is the responsibility of the resident to track (by spreadsheet) work associated with the items above. For a given chart check, annotate the type of chart check, date, patient initials, MRN, and senior physicist reviewing the work

Assessment (rotation #11):

The resident's performance will be evaluated based on his/her understanding and confidence of handling clinical situations, behavior and relationship with other clinical staff and patient. An oral examination will be taken by the mentor and/or other staff physicist worked with the resident in this rotation.

Summary of Resident's activities:

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Competency attained _____________yes ___________no______________

Mentor's Signature ______________________ Date__________________________

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12. Proton Therapy (core, rotation #12)

Name of the Resident: ____

Start date: ____________________ Completion date: ______________________

Name of the Mentor: ____

I. Objective: This module intends to provide fundamental knowledge and sufficient practical experience for active competency in Proton Therapy Procedures.

A. Prerequisite Skills

a. Experienced in QAs with linear accelerator
b. EBRT with photons and electron beams
c. MU calculation (TPR, PSF, CF, ISF) for EBRT treatments
d. Use of ion chamber/electrometer/diodes/MOSFETs/Planar array detector/scanning water phantom
e. Film dosimetry
f. Knowledge of TG142
g. Treatment planning for photon and electron beams

B. Knowledge Base

a. Physics in proton therapy
b. Dosimetry protocol for proton therapy (TRS-398)
c. Uncertainties in proton therapy with emphasis on passive scattering technique
d. Small field dosimetry
e. Compensator design and manipulation of compensator in plan optimization
f. Patient immobilization
g. Treatment Planning
   i. Image fusion
   ii. Delineation of anatomical structures
   iii. Beam setup and compensator design
   iv. Dose computation
   v. Dose verification and analysis
h. Delivery techniques

C. Clinical Process

a. Beam data acquisition
   i. Pinnacle data acquisition requirements for the Mevion S250 system
b. Planning system commissioning
   i. Enter beam data into planning system *
   ii. Beam modeling
   iii. Verify planning system beam data
c. Treatment planning
   i. Perform image fusion
   ii. Create single isocenter plan
      1. Identify gantry angle/couch limitations
   iii. Create multiple isocenter plan (composite or CSI)
      1. Explain isodose line normalization
      2. Explain isodose line prescription
d. Plan Export to R&V

i. Transfer RT ion plan, RT structures, Dose prescription, DICOM CT and orthogonal DRRs to Mosaiq
ii. Ordering hardware (apertures and compensators)
iii. Perform patient specific QA
(a) QA of apertures and compensators
a. Output factor measurements and MU second check
b. Verification of planar dose

e. Geometrical Alignment
i. Patient Position
ii. Patient Immobilization

f. iii. Verify alignment using laser, orthogonal x rays with VerityDelivery (observe or assist RTT)
i. Identify patient safety precautions
ii. Observe patient setup and treatment procedures
iii. Review or verify treatment completion & documentation

II. Didactic Activities:

Task	Mentor Sign/Date
1. Attend 3.0 hours of class for Proton Therapy provided in the physics residents' syllabus.	___________
2. Read Chapter 26 in Khan (4th ed.).	___________
3. Read AAPM Reports: TG 20	___________
4. Read book "Proton and Charged Particle Radiotherapy", by DeLaney and Kooy	___________
5. Read "Symposium on the promise and perils of proton radiotherapy" (L:\physics\RedidentTeaching\Proton\Symposium2008)	___________

III. Clinical Activities:

The resident will work with a proton physicist to perform the steps listed in A – B below for the designated number of patients.

A. Treatment planning activities:
- Contouring (all to be reviewed by senior physicist/attending physician)
- Setup beams
- Compute dose as per prescription
- Handling of uncertainties
- Perform patient-specific plan QA
- Perform initial plan check (to be reviewed and approved by senior staff physicist)

B. Treatment day activities:
- Assist with treatment patient set-up in room for the VSIM
- Assist therapists with collision checks (if necessary)
- Prepare SMPC for physicist review and signature (if applicable)
- Observe the treatment (1st fraction)
- Perform final physics check on chart

For each set of cases (Observed and Planned), at least three different anatomical sites must be included in the five documented cases.

Observed Patient Cases:

	Case #1	Case #2	Case #3	Case #4	Case #5
Case Type:	__________	__________	__________	__________	__________
Patient Initials:	__________	__________	__________	__________	__________
Mentor sign:	__________	__________	__________	__________	__________
Date:	__________	__________	__________	__________	__________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

Planned and Delivered Patient Cases:

	Case #1	Case #2	Case #3	Case #4	Case #5
Case Type:	__________	__________	__________	__________	__________
Patient Initials:	__________	__________	__________	__________	__________
Mentor sign:	__________	__________	__________	__________	__________
Date:	__________	__________	__________	__________	__________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc).

IV. Quality Assurance/Calibration/Safety

The resident will work with the therapist/physicist to perform the daily QA. The resident will work with the physicist to actively participate in tasks associated with the monthly QA and annual QA.

Tasks:	Case #1	Case #2	Case #3	Case #4
Daily QA	__________	__________	__________	__________
Monthly QA	__________	__________	__________	N/A
Review output factor measurements:	__________	N/A	N/A	N/A
Review annual calibration/ QA:	__________	N/A	N/A	N/A
Receive safety training:	__________	N/A	N/A	N/A

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.).

Assessment (module #12):

The resident will provide a written report of learning experience about Proton Therapy. The report should also contain data acquired through measurements or experiment as well as analysis thereof.

Finally, the resident will give a presentation (or an oral exam) at the end of the rotation. An understanding of the principles behind the processes as well as comprehension of other relevant information from the reading lists must be demonstrated.

Summary of Resident's activities:

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____

Competency attained ______________yes ____________no

Mentors Signature _____________________________ Date ______________

13. Special Procedures rotation (elective, rotation #13)

Name of the Resident: ____

Start date: ______________________ Completion date: ________________________

Name of the Mentor: ____

A. Prerequisite Skills
   a. Radiation Safety – X-ray machine operation
   b. Human Anatomy – common bony landmarks
   c. Introductory MV Imaging
   d. Introduction to custom shielding used in Radiation Therapy.

B. Knowledge Base
   a. Clinical Basis for TBI
   b. Equipment
   c. Dosimetry issues in TBI
      i. Field uniformity
      ii. Beam energy/penetration
      iii. Blocking
   d. Beam Data for TBI –hand calculations

C. Clinical Processes
   a. Simulation and Custom Block management
   b. MU calculations
   c. In-vivo dose measurement
   d. Custom compensation

D. Commissioning of a TBI Program

Learning Opportunities

1. Observe/attend a TBI simulation, Fabricate the blocks under supervision; verify the block attenuation on the machine.
2. Collect sufficient TBI beam data to perform hand calculations.
3. Perform measurements to determine efficacy of the current TBI flattening filter.
4. Attend/observe in-vivo dose measurement for TBI. Perform hand calcs and compare to MOSFET results.

Assessment

The resident will provide a written report of principles and process of Total Body Irradiation with an overview and detailed descriptions of the relevant underlying principles for each major step. Some emphasis should also be placed on practical issues in establishing a TBI program. The report should also contain data acquired through measurements or experiment as well as analysis thereof. Finally, an understanding of the principles behind the processes as well as comprehension of other relevant information from the reading lists must be demonstrated in an oral exam.

Clinical Competency: Total Body Irradiation (TBI)

I. Objective: Provide the resident with the fundamental knowledge and practical training for proficiency in the Total Body Irradiation (TBI).

II. Didactic Activities:

Task	Mentor Sign/Date
1. Review/read Chapter 18 in Kahn (3rd ed.), AAPM Report 17 (TG-29), Chapter 17A in Modern Technology of Radiation Oncology (Van Dyke, 1999).	___________
2. Attend 1.5 hours of class provided in physics residents' syllabus.	___________

III. Clinical Activities:

The resident will work with one of the physicists and/or dosimetrists to observe the steps below for one TBI case and perform the same steps listed below for three additional cases.

A. Pre-treatment
- Review physician prescription
- Obtain measurements for patient
- Observe CT scan for applicable treatments
- Perform dosimetry calculations
- Fabricate special custom lung block using cerrobend
- Create custom compensators
- Perform chart check (Mosaiq, treatment chart)

B. Treatment
- Assist with in-vivo dosimetry set-up
- Provide treatment day physics assistance
- Perform final physics chart check

Reading List:

1. Van Dyk et al, AAPM Report 17 /TG-29 "Physical Aspects of Total and Half Body Irradiation"
2. Johns & Cunningham, "The Physics of Radiology," Chapter 11.
3. Perez CA, "Principles and Practice of Radiation Oncology" Chapter 11.
4. Zierhut, Dietmar et al, "Cataract incidence after total-body irradiation", IJBORP 45(1) p. 131, 2000.
5. Thomas, Oliver et al, "Long-term complications of total body irradiation in adults", IJBORP 49 (1) p.125, 2001.
6. Faraci, Maura, et al, "Very late nonfatal consequences of fractionated TBI in children undergoing bone marrow transplant", IJORBP 63(5) p. 1568, 2005.

7. A literature review is strongly suggested for this topic.

Patient Cases

	Observed Case	Case #1	Case #2	Case #3
Patient Initials:	_________	_________	_________	_________
Mentor sign:	_________	_________	_________	_________
Date:	_________	_________	_________	_________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

Summary of Resident's activities:

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Competency attained ______________yes ____________no

Mentor's Signature _______________________ Date___________________________

Total Skin Electron Irradiation (TSEI) and Intraoperative Radiotherapy (IORT)

A. **Prerequisite Skills**
   a. Radiation Safety –Treatment machine operation
   b. Human Anatomy –common bony landmarks
   c. Introduction to custom shielding used in Radiation Therapy.
   d. Introduction to electron beam dosimetry.

B. **Knowledge Base**
   a. Dosimetry of electron beams
   b. Clinical Basis for TSEI- and IORT
   c. Equipment
   d. Dosimetry issues in TSEI- and IORT
      i. Field uniformity
      ii. Beam energy/penetration
      iii. Field Shaping
         1. Collimation and patient alignment (IORT).
         2. Collimation and energy adjustment (TSEI).
   e. Beam Data for TSEI- and IORT –hand calculation

C. **Clinical Processes**
   a. Clinical indications and conditions treated
   b. Simulation and Field shaping
   c. MU calculations
   d. In-vivo dose measurement
   e. Custom compensation

D. **Commissioning of a TSEI Program**
   a. General electron beam commissioning
   b. Specifics related to TSEI- commissioning.

Learning Opportunities:

Perform measurements of:

- Effect of SSD change on electron beam characteristics.
- Electron beam collimation and effects of surface shielding.
- Obliquity effects.

Assessment:

The resident will provide a written report of principles and process of Total Skin Electron Irradiation and Intraoperative Irradiation with an overview and detailed descriptions of the relevant underlying principles for each major step. Some emphasis should also be placed on practical issues in establishing TBI and IORT programs. The report should also contain data acquired through measurements or experiment as well as analysis thereof. Finally, the resident will take an oral exam. An understanding of the principles behind the processes as well as comprehension of other relevant information from the reading lists must be demonstrated.

Summary of Resident's activities:

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Competency attained _______________yes   _____________no

Mentor's Signature _________________________   Date_____________________________

Module: Intraoperative Radiation Therapy (IORT)

I. Objective: Provide the resident with the fundamental knowledge and practical training for proficiency in intraoperative radiation therapy (IORT).

II. Didactic Activities:

Task	Mentor Sign/Date
1. Review/read Chapter 14 in Kahn (3rd ed.),	___________
2. Read AAPM report (TG-72)	___________
3. Attend 1.5 hours of class provided in physics residents' syllabus.	___________

III. Clinical Activities:

The resident will work with one of the physicists and/or therapists on the steps listed below for five cases.

A. Pre-treatment
- Observe location of all treatment applicators
- Verify the warm-up and/or monthly quality assurance calculations
- Review IORT dosimetry book in operating room
- Prepare required documents for treatment

B. Treatment
- Observe/assist with docking of unit
- Perform MU calculation based on physician's directive (verified by physicist)
- Monitor treatment delivery
- Complete all necessary documentation

Patient Cases

Type:	**Case #1**	**Case #2**	**Case #3**	**Case #4**	**Case #5**
Patient Initials:	_________	_________	_________	_________	_________
Mentor sign:	_________	_________	_________	_________	_________
Date:	_________	_________	_________	_________	_________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

IV. Machine-related Quality Assurance/Calibration/Safety

The resident will work with the therapist/physicist to perform the daily QA. The resident will work with the physicist to actively participate in tasks associated with the monthly QA.

Tasks:	Case #1	Case #2	Case #3
Perform daily QA	_________	_________	_________
Perform monthly QA	_________	_________	_________
Assist in annual QA:	_________	N/A	N/A

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

Mentor Assessment:

Summary of Resident's activities:
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____
____
____
____

Competency attained _______________yes _____________no

Mentor's Signature _________________________ Date______________________________

Module: Total Skin Electron Irradiation (TSEI)

(This module may be truncated if adequate number cases are not available due to change in clinical practice at UHCMC. Residents will participate in available cases).

I. Objective: Provide the resident with the fundamental knowledge and practical training for proficiency in the Total Skin Electron Irradiation (TSEI).

II. Didactic Activities:

Task	Mentor Sign/Date
1. Review/read Chapter 14, section 8 in Kahn (3rd ed.), AAPM Report 23 (TG-30), Chapter 17B in Modern Technology of Radiation Oncology (Van Dyke, 1999).	___________
2. Attend 1.5 hours of class provided in physics residents' syllabus.	___________

III. Clinical Activities:

The resident will work with one of the physicists and/or dosimetrists to observe the steps below for one TSEI case and perform the same steps listed below for three additional cases.

A. Pre-treatment
- Review physician prescription
- Perform dosimetry calculations with special attention to energy selection and determination
- Perform chart check (Mosaiq, treatment chart)

B. Treatment
- Assist with in-vivo dosimetry set-up
- Provide treatment day physics assistance
- Perform final physics chart check

Reading List:

1. Perez & Brady, "Principles and Practice of Radiation Oncology", Lippincott, 2nd ed, 1992, Chapters 10 and 22.
2. Khan, F.M., "The Physics of Radiation Therapy", Williams & Wilkins (1984)
3. Chapter 14, particularly section 14.8.
4. Clinical Electron-Beam Dosimetry, Reprinted from Medical Physics (Vol. 18, Issue 1) (1991) Radiation Therapy Committee Task Group #25.
5. Intraoperative radiation therapy using mobile electron linear accelerators: Report of AAPM Radiation Therapy Committee Task Group No. 72. (2006).
6. Commissioning of a mobile electron accelerator for intraoperative radiotherapy; M. D. Mills, et al. J. Appl. Clin. Med. Phys. **2**, 121 (2001).
7. Use of routine quality assurance procedures to detect the loss of a linear accelerator primary scattering foil; M. G. Davis, C. E. Nyerick, J. L. Horton, and K. R. Hogstrom; Med. Phys. **23**, 521 (1996)A study of the effect of cone shielding in intraoperative radiotherapy; Nikos Papanikolaou and Bhudatt Paliwal, Med. Phys. **22**, 571 (1995).

8. The dosimetric properties of an intraoperative radiation therapy applicator system for a Mevatron-80; Charles E. Nelson, Richard Cook, and Susan Rakfal; Med. Phys. **16**, (1989).
   The dosimetric properties of an applicator system for intraoperative electron-beam therapy utilizing a Clinac–18 accelerator; Edwin C. McCullough and Joseph A. Anderson Med. Phys. **9**, (1982).
9. Total Skin Electron Therapy: Technique and Dosimetry(1987)
10. Multiple scattering theory for total skin electron beam design; John A. Antolak and Kenneth R. Hogstrom; Med. Phys. **25**, (1998).
11. Spatial distribution of bremsstrahlung in a dual electron beam used in total skin electron treatments: Errors due to ionization chamber cable irradiation; Indra J. Das, John F. Copeland, and Harry S. Bushe; Med. Phys. **21**, (1994).
12. Dosimetric study of total skin irradiation with a scanning beam electron accelerator; Subhash C. Sharma and David L. Wilson; Med. Phys. **14**, (1987).
13. Physical aspects of a rotational total skin electron irradiation; E. B. Podgorsak, C. Pla, M. Pla, P. Y. Lefebvre, and R. Heese; Med. Phys. **10**, (1983).
14. A literature review is strongly suggested for this topic.

Patient Cases

	Observed Case	Case #1	Case #2	Case #3
Patient Initials:	__________	__________	__________	__________
Mentor sign:	__________	__________	__________	__________
Date:	__________	__________	__________	__________

Note: Collect documentation (electronic or paper) for the various steps (i.e., printouts, etc.)

Mentor Assessment:

Summary of Resident's activities:

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____

Competency attained _______________yes _____________no

Mentor's Signature ______________________________ Date _______________________________

14. Dedicated Research (elective, rotation #14)

Name of the Resident: ____

Start date: _______________________ Completion date: _________________________

Name of the Mentor: ____

I. Objective: This module intends to prepare the resident for identifying clinical oriented problems and develop the skills necessary for solving those problems. The resident will work under the direct supervision of the research guide/mentor on well identified problem(s)/topic(s) and highly expected to publish meaningful scientific articles.

Assessment:

The resident will provide a written report of the research topic and research performance. The report should contain the purpose of the research, methodology, data collection, results and discussions, conclusions, and future directions. An understanding of the research topic(s) as well as comprehension of other relevant information from the research must be demonstrated. Finally, the resident will take an oral exam.

Mentor's and/or Director's Assessment:

List of Publications:

Summary of Resident's activities:

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Oral Exam. ______________passed ____________failed

Mentor's Signature ___________________________________ Date ____________________

Director's Signature ___________________________________ Date ___________________

Appendix G – Faculty & Staff and their Primary Clinical Interests

Alphabetical List of Faculty/Staff

Name (abbreviation)	*Degree*	*Designation*	*Certification*	*Primary Clinical Interest*
David Albani (DA)	M.S.	Staff Physicist	ABR	EBRT, PSI/LDR
Ande Bao (AB)	Ph.D.	Staff Physicist	ABR	EBRT, IGRT
Chee-Wai Cheng (CWC)	Ph.D.	Professor	ABR	Proton Therapy, EBRT
Valdir Colussi (VC)	Ph.D.	Associate Professor	ABR	EBRT, SBRT, Brachytherapy
Paul Geis (PG)	Ph.D.	Assistant Professor	ABR	EBRT, Radiation Safety, Professionalism & Ethics
Albin Gonzalez (AG)	Ph.D.	Staff Physicist	ABR	EBRT, PSI/LDR
Frederick Jesseph (FJ)	M.S.	Staff Physicist	ABR	Proton Therapy, Radiation Safety
Chunhui Luo (CL)	Ph.D.	Assistant Professor	ABR	EBRT, HDR
Marcel Marcu (SMM)	M.S.	Assistant Professor	ABR	EBRT, Tomotherapy
Gisele Pereira (GP)	Ph.D.	Assistant Professor	ABR	EBRT, TPS, SBRT
Tarun Podder (TP)	Ph.D.	Associate Professor	ABR	Brachytherapy, Cyberknife , SBRT
Carl Shields (CS)	Ph.D.	Staff Physicist	ABR part-II	EBRT
Mark Smith (MS))	M.S.	Staff Physicist	ABR	EBRT, Proton Therapy
Randall Smith(RS)	M.S.	Staff Physicist	ABR	EBRT
Charles Wissuchek (CW)	MS	PRN	ABR	EBRT
Jiankui Yuan (JY)	Ph.D.	Assistant Professor	ABR	Tomotherapy, Proton Therapy, LDR, EBRT, Gamma Knife
Yuxia Zhang (YZ)	M.S.	Instructor	ABR	SBRT, HDR, Cyberknife, Gamma Knife
Yiran Zheng (YZZ)	Ph.D.	Assistant Professor	ABR	IGRT, TPS, HDR, SBRT, Gamma Knife

Appendix J1 – Resident's Rotation Evaluation Form

Clinical Medical Physics Residency

University Hospitals Cleveland Medical Center

Department of Radiation Oncology

Resident's Rotation Evaluation (by Mentor)

Resident____ Date:____________________

Rotation Topic ____

Reviewer/ mentor____

Written Report Grade (if applicable) ______________

Unsatisfactory				Satisfactory				Superior		
1	2	3		4	5	6		7	8	9

Comments____

____

____

Exam (Oral/presentation) Grade___________

Unsatisfactory				Satisfactory				Superior		
1	2	3		4	5	6		7	8	9

Comments____

____

____

Recommendations____

____

Overall recommended grade (Pass, Fail, or Conditional Pass)

Remediation (if Conditional Pass)____

____

____

Signature____ Date: ________________________

Appendix J2 – Clinical Rotation Evaluation Form

Clinical Medical Residency Program
Department of Radiation Oncology
University Hospitals Cleveland Medical Center

Clinical Rotation Evaluation (by Resident)

Name of the Clinical Rotation: ______________________________________

Name of the Mentor: ____

1 – lowest, 5 - highest

Contents	*(Circle one)*					
Design of rotation	N/A	1	2	3	4	5
Relevance	N/A	1	2	3	4	5
Adequacy	N/A	1	2	3	4	5
Equipment	N/A	1	2	3	4	5
Software/ computer	N/A	1	2	3	4	5
Facility/ environment	N/A	1	2	3	4	5
Opportunity to learn	N/A	1	2	3	4	5
Mentor's knowledge	N/A	1	2	3	4	5
Mentor's availability	N/A	1	2	3	4	5
Clarity of instruction	N/A	1	2	3	4	5
Mentor's help	N/A	1	2	3	4	5

Additional Comments and Suggestions:

Design and content of the rotation: ________________________________

____

____

Equipment/ software/ facilities/ mentor: ____________________________

____

____

UH Ireland Cancer Center is now University Hospitals Seidman Cancer Center

CASE — CASE WESTERN RESERVE UNIVERSITY

Appendix J3 – Residency Program Evaluation Form

Clinical Medical Residency Program
Department of Radiation Oncology
University Hospitals Cleveland Medical Center

Residency Program Evaluation (by Resident at the end of residency training)

Start date: ______________________ Completion date: ___________________

1 – lowest, 5 - highest

Contents	*(Circle one)*					
Design of clinical rotations	N/A	1	2	3	4	5
Relevance	N/A	1	2	3	4	5
Adequacy	N/A	1	2	3	4	5
Equipment	N/A	1	2	3	4	5
Software/ computer	N/A	1	2	3	4	5
Facility/ environment	N/A	1	2	3	4	5
Opportunity to learn	N/A	1	2	3	4	5
Evaluation methods	N/A	1	2	3	4	5
Clarity of instruction	N/A	1	2	3	4	5
Mentor's help	N/A	1	2	3	4	5
Associate director's role	N/A	1	2	3	4	5
Director's role	N/A	1	2	3	4	5
Help in critical issues	N/A	1	2	3	4	5
Overall standard of the program	N/A	1	2	3	4	5

Additional Comments and Suggestions:

Design and content of the rotation: ____

____

____

Equipment/ software/ facilities/ mentor/ directors: ______________________________

____

____

Appendix J4 – Quarterly Review of the Resident

Clinical Medical Residency Program
Department of Radiation Oncology
University Hospitals Cleveland Medical Center

Quarterly Progress Report (by Director & Resident)

Resident's Name:

Start Date:

Evaluation Period:

Conference Participation:

Didactic Course (if applicable):

Progress of Recommended Readings:

Clinical Participation:

Program Director Comments:

____

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____________________ ____________________

Program Director's signature & date Resident's signature & date