Residency Program in Medical Physics

Vassar Brothers Medical Center

Self-Study

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Program Director

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Contents

Introduction

Program evolution and history

When a new chief of medical physics was hired in July 2007, it became a program goal to establish a medical physics residency. The first step was to sponsor a summer intern in medical physics in 2008. This allowed the staff to better determine the resources needed to sustain a residency program.

At that point it was determined that another staff physicist would be needed to adequately run the program. So in June of 2009 three new positions were approved by VBMC: two residency positions, the first to start in July 2009 and the second in July 2010, and the position of senior medical physicist and medical physics residency program director. The recruitment of the program director was completed in February of 2010.

The first resident was interviewed and hired in August of 2009. His degree was not from a CAMPEP program and, after consultation with Bruce Gerbi, it was decided to extend his residency for three months and to have him take a course at Columbia in anatomy and physiology to make up that deficit in his didactic training. Starting from the second resident only graduates of the accredited program were accepted.

When the medical physics residency program director resigned and as per the recommendations that followed the CAMPEP site visit, two associate director positions were created. These positions will be filled by two existing staff physicists with adequate experience and desire to participate. In 2014 one of them accepted position of director of residency program.

The program's first graduation of a resident took place in June of 2012. Since then, as of February 2016, residents were graduated annually, all of them finding jobs, currently having jobs as clinical medical physicists and all of them successfully progress towards board certification.

Summary of Program Changes since Last Review

- Program moved to VBMC from UROC
- Training Schedule was established
- Exam procedures were formalized and exam question were prepared in the form of presentations
- Candidate selection procedure was formalized
- Residents feedback is distributed to the faculty

New technologies were introduced:

- Elekta Infinify linac (replaced old Varian linac on the main site)
- Seed implant program (resumed)
- Ra-223 therapeutic injections

- Raystation treatment planning system
- OnCentra Elekta afterloader (replaced Varian's GammaMed Plus)

1. Program Objective and Goals

The goal of the medical physics residency program in therapeutic radiological physics at Vassar Brothers Medical Center is to prepare new medical physics graduates to independently perform the diverse duties of a radiation oncology physicist in a typical practice. We believe, that the individuals who choose clinical medical physics as their profession must have

- Developed professional ethics and leadership skills
- Strong basic skills
- Sound clinical judgment, including the ability to recognize the edges of their own competencies
- Diverse expertise in various procedures
- Developed responsibility and independence to serve as a source of expertise in a health care organization
- Soft skills

Therefore, the program's objectives include:

1.1. Teaching the technical knowledge and skills related to the sophisticated technologies used in the practice of medical physics

Training of technical knowledge and skills is the main component of our residency. This entails:

- Teaching apprehension of harm to patient arising through error or omission, and the critical role of the medical physicist in assuring patient safety
- Teaching knowledge and skills required to accept, commission and monitor performance of the major equipment used in radiation oncology
- Teaching how to select and use the correct instrumentation to make clinically significant radiation measurements

Specific technical skills and level, which is required to be achieved in our residency, are outlined below in Subsection 2.11.1 (page 14), Table 13 (page 13) and Subsection 8.1.1 (page 24).

1.2. Cultivating a critical awareness and evaluation of research and scholarship in the field

Our institution implemented two monthly open journal clubs. One of them, General journal club, is clinically oriented and designed for participation of MDs and other non-technical staff, the other, Physics journal club, is more technical. Both journal clubs are focused on papers on current progress in clinical or technical practices.

Residents are required to attend these journal clubs; also, they are asked to present 4-6 times during two-year period. This teaches resident to regularly follow the literature and communication skills.

Additionally, annually residents are attending AAPM conferences and encouraged to attend scientific presentations. All these help developing and reinforcing habits of monitoring progress in the field, critical thinking, problem recognition, problem solving and attention to details.

1.3. Instilling an understanding of the protocols and practices essential to the deployment of technologies to detect, diagnose and treat various illnesses and injuries

Similarly to objectives described in Subsection 1.1, teaching current practices is the essential part of our curriculum. It is discussed in more details in Subsection 2.11.1 (page 14) and Subsection 8.1.1 (page 24).

1.4. Training the ability to use analytical and research methods to solve problems arising in the clinical environment:

During their study, residents are required to perform two clinically oriented projects, 'phantom design' and 'experiment design' as a part of Instrumentation and dosimetry protocol competency. Additionally residents participate in most out of ordinary measurements and tests, such as small field dosimetry, electron cutout measurements, any acceptance and comisisoning of new equipment, etc.

1.5. Teaching the professional attributes and the ethical conduct and actions that are required of medical physicists:

We believe that proper professional training should include the following:

- Teaching the role of radiation oncology in health care
- Teaching the role of the professional medical physicist in radiation oncology
- Developing professionalism, ethics and leadership

While the whole program teaches the role of radiation oncology in cancer care and role of medical physicist in radiation oncology, the most critical for this training parts are shadowing physicians (Clinical patient management rotation) and shadowing therapists (External beam delivery rotation).

Farther development of residents is done as part of Administrative and professional competency as described below in Subsection 2.11.2 (page 16).

1.6. Training the communication and interpersonal skills that are necessary to function in a collaborative environment:

Complex dynamics of the clinics is, obviously, a good teacher for social and communication skills. Additionally, residents are:

- regularly presenting at journal clubs and AAPM meetings
- participate and, as necessary, present in planning rounds (performed bimonthly) and chart rounds
- often involved in interaction with the patients

- are specifically taught soft skills, by example in complex situation, by senior physics and dosimetry staff
- taking mandatory institutional online classes devoted healthy workforce environment
- writing competencies' reports
- taking oral exams as a part of their competencies and preparation for part II ABR exam

1.7. Developing an awareness of the complexity of knowledge in the field and receptiveness to other interpretations, new knowledge, and different approaches to solving problems:

Teaching the complexity of knowledge in the field and receptiveness is integral part of our training and is achieved via developing and reinforcing habits of monitoring progress in the field, critical thinking, problem recognition, problem solving and attention to details as described in Subsections 1.2, 1.4, 1.6 and others.

1.8. Cultivating an awareness of the need for confidentiality of patient information and familiarity with relevant regulations:

HIPPA training is part of institutional on-line training and mandatory for the residents.

1.9. Teaching an appreciation of the clinical purpose and applications of sophisticated technologies:

Appreciation of the clinical purpose and application of radiation therapy technologies is integral part of the training similarly to training described in subsections 1.1 and 1.3.

1.10. Cultivating the acknowledgement of the role of medical physicists in a clinical environment in which physicians, nurses, technologists and others work in cooperation:

As described in Subsection 1.5 understanding role of medical physicist is essential part of professionalism. Additionally residents understand their (medical physicist) role via observing administrative tasks performed by senior physicists, and via day to day interaction, while performing clinical duties, with therapists, dosimetrists, doctors, etc.

1.11. Training the sensitivity to potential hazards that residents may encounter and appropriate measures to take to prevent risks to themselves and equipment:

Teaching the principles of the safe use of radiation in medicine is integral part of our training, particularly, Radiation safety rotation. Initially, basic radiation safety is provided by the institution and mandatory for the residents.

While first familiarized, before they start working independently with the equipment, residents are taught how to safely operate it.

Residents never work independently, but only under staff physicist supervision, with any radioactive material.

Response to fire is taught at the institutional level (at orientation) and is mandatory for the residents.

.Biomedical department provides training on work in high voltage environment.

1.12. Training the recognition and correction of suboptimal application or unsafe use of technologies:

Key component of residents training is performance of 2nd checks for linacs and e-brachy, peer reviews of external beam treatment plans, weekly chart checks, IMRT/VMAT/Tomo QA. As a part of these procedures, residents learn to recognize and, as needed, correct errors or suboptimal use of linac, e-brachy or other equipment. Under the supervision of staff physicists residents also perform physics consults.

1.13. Cultivating the commitment to continued education so that practice knowledge and skills remain current:

As is pointed out in Subsection 1.2 residents follow current literature and progress in the field via participation in journal clubs and conference visits. All physicists and physicians participating in training are involved in CME as required by the corresponding ABR specialty.

2. Program Structure and Governance

2.1. Accreditation

VBMC and the other three sites, where training takes place, are accredited by the America College of Radiology (ACR). Accreditation documentation is available in Appendix B on page 38.

2.2. The clinical training environment

Health Quest has four clinical radiation oncology centers in the mid-Hudson Valley region of New York State. The main hospital-based department is Vassar Brothers Medical Center (VBMC) located in Poughkeepsie, NY. The affiliated centers are located south in Carmel (Putnam Radiation Oncology Center, PROC) and Fishkill (FROC), and north in Kingston (Ulster Radiation Oncology Center, UROC). Carmel and Kingston, the two most widely separated centers, are approximately 55 miles apart. Specific equipment and patient load are given in Subsection 8.5 (page 37).

The staffing of the four centers is managed centrally and assignments of personnel to clinics remain relatively static. This strategy affords stability and continuity in the practice of each center combined with the significant advantages of built-in peer review and cross-coverage as well as centralized administrative control.

The physics division of the group comprises five full-time licensed medical physicists, including one chief of physics, plus two medical physics residents. All four centers are served by a single physician group that currently comprises five ABR-certified radiation oncologists; all of them are credentialed at all sites. The dosimetry section, which also reports to the chief of medical physics, comprises four Certified Medical Dosimetrists (CMD) including one chief dosimetrist.

The therapists group consisting of 17 radiation therapy technologists (RTT) report to the manager of technical services.

The Health Quest radiation oncology has an ongoing program of quality management and peer review to maintain consistent practices across the four centers. Both clinical and administrative meetings are routinely attended by staff from all centers using teleconferencing. The enterprise shares a single treatment planning database server for external beam treatment planning system use and a single MOSAIQ database so that all records are viewable from all sites at any time. The entire clinical practice is fully electronic within MOSAIQ EMR. Physics documents and other machine-related records have migrated to shared electronic storage.

Due to the community hospital setting of our clinic, there are some procedures that we do not offer to our patients, and therefore our residents are not able to observe at Health Quest. To remediate this, we commit to preserving collaborations with other clinics that offer TBI and TSET. We will maintain contact with the teams at those centers and coordinate visits of our residents so that they can have hands on experience with the treatments.

2.3. Admission

The residency only accepts applicants who completed CAMPEP-accredited graduate program. This included accredited master's level programs as well as accredited certificate programs for PhD holders. Per discretion of the selection committee candidates with the certificate from ABR or CAMPEP showing that their education meets CAMPEP standard may be considered.

Medical Physics residents are regular employees of Health Quest on a two-year fixed-term contract. Program's Selection Committee strictly controls the decision as to the ranking order of candidates; some of the administrative aspects of the hiring process are handled by the Human Resources (HR) department in accordance with their standard policies and procedures.

Our Medical Physics Resident positions are advertised through the AAPM Placement Service (MP_RAP). We participate in National Matching program, https://natmatch.com/medphys/ and out match ID is 14911.

Program recruitment and hiring follow timeline of The Medical Physics Matching Program with deadline for the application in mid or late December. Mid-January top 15-20 candidates are asked to write an assay explaining their choice of Health Quest residency program. Top 12-15 candidates are offered phone interviews, which are conducted late January – early February. On-site interviews are offered to the best 4-8 individuals late February or early March. Typically we cover candidates' travel expenses.

Candidates meet one-on-one with selected members of physics group, with the radiation oncologist and with the current medical physics residents. They also may meet with other physician(s), and with senior members of the technical and dosimetry groups. A formal scoring system is used to receive input from the personnel who meet with the candidates. Scoring form is shown in Appendix H on page 43. Finalists are ranked by the Selection Committee based on feedback from the interviews and a ranked list of acceptable candidates is submitted to match program. Offer letter, which is shown in Appendix I on page 43, is sent by HR to the candidate selected by National Match.

New Residents report for work on or about June 23rd of their incoming year.

2.4. Exception for applicants with deficiencies in their academic background

As pointed out in Subsection 2.3, no exceptions are granted. Since Vassar Brothers Medical Center is a community practice, we are not able to and do not intend to offer remedial coursework in adjunct to the residency.

2.5. Committees and Meetings

There are three standing committees with responsibility for the direction and operation of the Residency Program. They are as follows:

The **Steering Committee** takes overall responsibility for administrative matters having to do with the structure, staffing and funding of the Program. The Steering Committee comprises the senior vice president for oncology, the director of the program, chief medical physicist, associate director(s), and a radiation oncologist. The steering committee meets as needed, but at least twice per year: prior to commencement of the year's recruitment effort and after the recruitment of new resident, but before the graduation of senior resident.

The **Selection Committee** takes responsibility for the recruitment and selection of each year's incoming resident. The selection committee comprises the director of residency program, chief physicist, the residency Program Associate Director(s), a radiation oncologist, a manager of technical services and both medical physics residents. The selection committee meets as needed during the recruitment season.

The **Operations Committee** takes responsibility for routine operations of the Residency Program, including management of resident work assignments, assessment of Resident progress, coordination of mastery examinations, and allocation of any necessary support resources. The operations committee comprises the director of residency, chief physicist, radiation oncologist, and the residency program associate director(s). The operations committee meets twice a month, once with the radiation oncologist and one without, to review residents' progress, and, in addition, as needed to address emerging management issues.

The selection committee and the operations committee report to the steering committee. Meeting minutes will be formally documented by director or one of the associate directors in Typhon.

Residents can communicate their questions or concerns via any member of any committee.

There is no formal appointment procedure to the committees per se; participation in committee is determined by Health-Quest administrative structure. E.g., should a new vice president for oncology be hired by Health-Quest, he will assume position of steering committee member. As radiation oncologists are not formal Health Quest employees, physician member(s) of the committees is chosen per discretion of the physician group.

2.6. Program review and improvement

The curriculum is expected to change and improve periodically. The separation of clinical rotations from competencies in our model provides a great deal of flexibility in adapting the

resident's course through the program to the resident's own strengths. We have developed and entered into the Typhon tracking system a nominal number of exposures and experiences for each competency, but those numbers will be under constant revision as experience grows and, more importantly, for any given Resident the numbers should be considered to be advisory rather than mandatory. Our focus is on mastery, not on specific numbers of cases.

Major decisions on program change are performed by steering committee, which, at least annually, reviews the overall program and changes implemented.

2.7. A procedure to appropriately counsel, censure and, after due process, dismiss residents who fail to demonstrate appropriate learning ability, competence, or ethical behavior

Our dismissal process follows Health Quest practice. If a Resident's progress is judged by the Operations committee to be inadequate to achieve the graduation criteria within the two-year span of the program, the Operations committee will endeavor to develop a three-month remediation plan in collaboration with the resident. Should such remediation plan prove unsuccessful then the Operations committee will recommend to the Steering committee that the resident be terminated. The resident will either be terminated or may be permitted to complete the two years of employment without the possibility of a graduation certificate (in essence dismissed from the program but retained as a junior staff member). The decision as to which failure mode will be employed is made by the Steering committee in consultation with the resident and with the Health Quest Human Resources department.

2.8. Evaluating student progress and performance

Evaluation of residents' performance is based on the following components:

- Timely completion of necessary credentialing
- Timely completion of necessary competencies, by completion meaning achieving necessary level, conversant or mastery
- Attendance of required meetings, such as chart rounds, journal clubs, planning rounds, etc.
- Monthly/rotation evaluations
- Handling of routine clinical duties, such as weekly and 2nd checks, assigned to residents

Certainly, failure to meet a single deadline for credentialing or competency is by no means a ground for dismissal; moreover, schedule may be adapted for each individual resident and to clinically dictated circumstances. However, regular failure to adhere to the established schedule may indicate inadequate performance and lead to inability to complete all required competencies in two-year time.

A supplemental mid-course assessment is conducted by the operations committee of the resident's progress at the halfway point of the Program, in July of the second year.

We subscribe to the Typhon Group's student tracking system that includes the competencies

Competency area	Exam type	Mastery Required
Clinical Patient Management	O	
External beam delivery	O	
External beam treatment planning	P+O	yes
Brachytherapy Commissioning and QM	P+O	yes
Brachytherapy Treatment Planning	P	yes
Brachytherapy Delivery	P	yes
Instrumentation and Dosimetry Protocols	P+O	yes
Patient-specific Physics Services	P+O	yes
Information Systems / EMR	O	
Administrative and Professional	O	
Clinical Program Development	P	
Special Procedures Treatment Planning	O	
Special Procedures Delivery	P	
Radiation Safety and Regulatory	P+O	yes
External beam Commissioning and QM	P+O	yes
Special Procedures Commissioning and QM	P+O	

Table 1. 16 competencies which residents learn during their training.

configuration and the number of expected encounters in each skill and also allows evaluation. More description is available in Subsection 8.1.1 on page 24 and in Appendix C on page 39 and J on page 43.

More details on evaluation of each competency are given in Subsections 2.11.1 on page 14 and 2.11.4 on page 16.

2.8.1. Progress monitoring and documentation

Detailed tracking of residents' work is accomplished using the Typhon Group's on-line student tracking service. All patient encounters are logged as are all "encounters" related to equipment, and a log is maintained of attendance at clinical conferences. Tracking of the work accomplished is particularly critical in our environment, where most competencies do not have designated rotations. The operations committee has the ability to monitor progress on-line at any time.

Each resident meets once a month privately with the operations committee to discuss progress on current rotations and on target competencies, to clarify specific work assignments for the coming month, and to discuss any longer-term projects. Specific remedies or additional work may be assigned by the operations committee at that time if deficiencies have been noted. The resident is also given an opportunity to self-assess progress, to accentuate successes, and to raise any issues that are of concern to the resident.

2.9. Residents training and work at the other sites

While majority of residents' training is performed at VBMC, about 20-25% of their time residents spend at the other three facilities, approximately half of this time at PROC. This is necessary to expose residents to larger diversity of technologies and clinical procedures. Primary site of program director is VBMC and primary site of one of the associate directors is PROC.

All sites share the same governance and budget under the umbrella of Health Quest. The Health Quest radiation oncology has an ongoing program of quality management and peer review to maintain consistent practices across the four centers. This is also achieved via use of the same policies and procedures.

Both clinical and administrative meetings are routinely attended by staff from all centers using teleconferencing. The enterprise shares a single treatment planning database server for external beam treatment planning system use and a single MOSAIQ database so that all records are viewable from all sites at any time. The entire clinical practice is fully electronic within MOSAIQ EMR. Physics documents and other machine-related records have migrated to shared electronic storage.

This allows direct supervision for the residents for the program director or one of two associated directors at any of four sites. Hence, residents' progress, while at another site can be monitored by director or associate directors.

2.10. Program statistics

Program graduates and statistics are shown on departmental web page: goo.gl/Y06iOs Appendixes D, E and F reference the same webpage.

2.11. Program structure

2.11.1. Content of the program

We have identified sixteen core competencies which residents develop during their training. These 16 core competencies are shown in Table 1. More details are given in section 8.3.

As described below, we have three grades, mastery, conversant and fail to evaluate the performance of our resdients.

It is a requirement for graduation to achieve the grade of "Mastery" in eight specific competencies, as we believe they are the foundation for a practicing clinical medical physicist. It is also a requirement for graduation for the resident to achieve the grade of "Mastery" in four more competencies; in addition to those where grade "Mastery" is mandatory. Therefore to successfully graduate, the resident must have a total of 12 competencies where they achieved the grade "Mastery". It is a requirement for graduation for the residents to achieve at least the grade of "conversant" in the remaining four out of sixteen competencies.

Mastery is defined as the ability to independently perform the work completely and accurately in a timely fashion.

A resident is found to be conversant if he/she can communicate clearly the important concepts and cite the relevant source of authority for an area of competence, but has not yet demonstrated the ability to perform the work independently. Typically, lack of 'hands-on' experience, particularly due to absence of some special procedures (TBI, TSE) in our institution, may lead to competency grade to be 'conversant.'

Ethics	**How covered**
o Ethics of a profession	Residents will be required to review AAPM code of ethics
o Ethics of an individual	Residents will be required to review AAPM code of ethics
o Interactions with colleagues and co-workers	Residents will be required to review AAPM code of ethics; also, residents are required to take Health Quest Code of Ethics course
o Interactions with patients and the public	Residents will be required to review AAPM code of ethics; also, residents are required to take Health Quest Code of Ethics course
o Confidentiality	Residents will be required to review AAPM code of ethics; also, residents are required to take Health Quest Code of Ethics course
o Peer review	Residents will be required to review AAPM code of ethics
o Relationships with employers	Residents will be required to review AAPM code of ethics; also, residents are required to take Health Quest Code of Ethics course
o Conflicts of interest	Residents will be required to review AAPM code of ethics
o Ethics in research	Residents will be required to review AAPM code of ethics
o Use of animals in research	Residents will be required to review AAPM code of ethics
o Use of humans in research	Residents will be required to review AAPM code of ethics; residents will be familiarized with MSKCC material on the course on Conduct in Research; also, residents will familiarized themselves with Nurnberg code (available online)
o Relationships with vendors	As part of their practice resident will regularly participate in interactions with vendors; also, conflict of interest is covered by AAPM code of ethics
o Publication ethics	Residents will be required to review AAPM code of ethics
o Selected case studies	Cases from MSKCC course will be reviewed

Table 2. Residents training on non-technical aspects.

Mastery in any competency is judged by a combination of (1) performance evaluations (P) by clinical supervisors during rotation, meaning direct observation of each task as it is being performed, (2) written report created by the resident and (3) performance of a skill and/or in an oral exam (O). Oral Exam is structured similarly to ABR, with a debrief of the examiners and feedback to the resident. Questions are predefined in confidential excel documents. Additional questions asked by examiner are to be saved as a part of documentation.

A complete list of the specific skills and experiences encompassed in each major competency area is provided in Subsection 8.1.1 at page 24 in the list of Typhon skills. More details on competencies requiring oral exam are given in and in preparedness checklists in the same subsection. Designated reading list is given in Subsection 8.3 (page 26).

While these are categorized and sorted differently from the competencies suggested in AAPM Report 90 and by CAMPEP, it is our assertion and our intent that the content fulfills the recommendations of the report and CAMPEP. For several skills we also perform credentialing of residents. Such a credentialing allows them to perform work independently prior to achieving mastery in the whole competency.

2.11.2. Professionalism, Ethics and Soft Skills

In addition to more technical side of the training, our program includes training of the professionalism, ethics and soft skills. These qualities are integral part of overall training. E.g. residents are acquiring communication skills during their day to day clinical interactions; residency directors and other faculty and staff involved are correcting residents' actions as needed.

However, some essential didactic training is given to residents as a part of Administrative and professional and other competencies:

Introduction into medical physics profession, role of radiation oncology in health care and role of medical physicist is conducted by one of the directors in the form of presentations. These presentations will include profession and professionalism and discuss physician charter.

Designated reading on leadership and negotiation is provided to residents as shown in Subsection 8.3.10 on page 33.

Summary on how some non-technical aspects for medical physics professions are taught is shown in Table 2.

2.11.3. Residency duration

As recommended by AAPM Report 90 residency is two-year position. The program supports two residents at a time, one at year 1 and the other at year 2. Exceptions as to the timing may be granted for cause on a case by case basis at the sole discretion of the Operations Committee, but in no case shall a Resident graduate with less than twenty-four months full-time equivalent attendance.

2.11.4. Design of the program

Overall, our program is an apprenticeship where residents are directly involved in clinical support of our clinics.

For most competencies, the Vassar Brothers Medical Center residency program is structured as a sequence of experiences necessary to achieve mastery. Only two competencies have dedicated rotations followed by the exam, and one competency combines both strategies: rotation and accumulation of experience (Table 3 on page 22). This approach places the responsibility on both the operations committee and the resident to monitor progress throughout the training period.

We are very clear and consistent, beginning at recruitment, in our message that residents must take a great deal of responsibility for their own success in our program. The resident's professional career begins on day 1 of residency, not on day 730. Our model is not of a specific course of study to be completed, but rather of a structured and supportive environment in which the professional can incrementally develop and hone skills that will sustain him/her through a career as a professional medical specialist. The demands on them in their future professional practice will be relentlessly unreasonable. Part of the work that they will have to do to maintain their own health and happiness in a career as a clinical medical physicist is to monitor their own commitments, plan for the resources they need to achieve those commitments, and negotiate for adjustments before the commitments become unrealistic. It is our expectation that residents will begin to learn-by-doing these career-management skills while in our program. Their participation as co-creators of their own program is expected. Clearly, the mastery of the required competencies is not negotiable, but optimizing the resident's personal course through the encounters leading to mastery is in part the resident's responsibility.

Each rotation or competency has a designated clinical supervisor who is expected to maintain constant supervision of the Resident's progress in the rotation. The clinical supervisor produces a written evaluation of the Resident's work effort and mastery monthly and at the end of the rotation. The clinical supervisor also communicates directly with the director or associate program directors, if there are concerns requiring more immediate attention.

Competencies are evaluated by a combination of performance, report and, for some competencies, oral examination within the larger practice group. Exam to a reasonable degree imitates ABR oral examination environment. Mastery is assessed by consensus of the Operations Committee and the Clinical Supervisors as described in Subsection 2.11.1 on page 14. Completed exams and competencies are documented in Typhon.

Similarly, when the resident is prepared to defend a performance-examined competency, the Resident is given a written description of a relevant task to be performed, the expected work products and the expected time required for completion. The Resident is given an opportunity to request in writing adjustments of the exam, and such adjustments may be granted at the sole discretion of the Operations Committee. At a mutually agreed time the Resident performs the work under scrutiny of the Operations Committee and other members of the physics staff. Performance is scored as to appropriateness, responsiveness to the prompt, correctness and timeliness. The Resident is given the opportunity to orally defend any perceived inadequacies. Mastery is assessed by consensus of the Operations Committee and the Supervisors of the relevant rotations.

Credentialing and case accumulation on some procedures and skills are a prerequisite for some of the competencies. Such procedures and skills are shown in Table 4 on page 24. This credentialing allows the resident to perform independent work in a specific area in accordance with the department's policies and procedures for that task. A resident is eligible for credentialing according to department policy.

A schedule is established for the completion of the following: rotations, accumulation of the sufficient number of cases in Typhon for competencies, and some specific procedures and

skills, credentialing and competencies exams. For selected competencies or skills half-way deadlines for the accumulation of the number of cases are established as well. Schedule is shown in Subsection 8.1.3 on page 25 (Fig. 1 on page 29).

Residents are also attending clinical and educational meetings as described in subsection 6.2 on page 23 and attending AAPM conferences annually.

The time commitment for the resident to routine clinical support activities is expected to approach 100% as the resident is integrated into the clinical workflow of the physics section. Resident training is concluded by and independent work as shown in Table 3 on page 22 and on Fig. 1 on page 29. In any apprenticeship the learning comes from the doing.

2.11.5. Residency and Health Quest

The Medical Physics Residents are regular employees of Health Quest. This entails:

- there is no program enrollment per se
- residents are entitled to the full protections and due process defined for all employees under Health Quest's normal Human Resources policies; current salary is $50,000 a year
- residents are subject to annual review which is performed by chief medical physicist, this is in addition to mid-course review in Subsection 2.8.

Also, as described in subsection 2.5 on page 11 administrative structure of Health Quest determines management structure for the residency.

3. Program Director and Associate Directors

3.1. Responsibilities

The program director takes overall responsibility for the residents in the program and, in particular, responsibility for ensuring that all training requirements are met. He or she takes primary responsibility for developing curriculum and timelines, coordinating work assignments of residents, laying out and monitoring supervisor responsibilities, overseeing progress through the program, and serving as a point of contact for administrative issues of all sorts. Particularly program director is accountable for ensuring that the residency program satisfies CAMPEP standards at all sites and for all residents.

The program director and associate directors supervise the medical physics residents. They also

- Coordinate the activities of the residents with other physics staff
- Monitor progress of residents during their 2 year program to ensure satisfactory progress
- Are in charge of resident application and selection process
- Are in charge of developing resident training processes

3.2. Certification

The program director and associate directors must be certified by the American Board of Radiology, the Canadian College of Physicists in Medicine, or other appropriate certifying agency in the field of therapeutic medical physics.

3.3. Experience

The program director and associate directors shall have at least five years of full-time experience beyond clinical certification.

3.4. Recruiting

The program director shall be responsible for coordinating the faculty, recruiting residents into the program, advising the residents, and evaluating and promoting the program.

3.5. Verification of CAMPEP prerequisites for new residents

Program director will ensure that educational requirement described in subsection 2.3 (page 10) is satisfied.

3.6. Annual reports to CAMPEP

The program director shall ensure that all student statistics, annual reports, and other information required by CAMPEP are reported accurately and in a timely fashion.

3.7. Appointment of new program director and associate program directors

Chief medical physicist appoints program director and associate program director. Chief physicist assumes the role of the other associate program director.

3.8. Meetings with the residents

As a member of operations committee program director shall meet periodically with each resident to assess the resident's progress, as described in subsection 2.5 (page 11). Additionally program director and associate directors meet monthly with the residents. Minutes of these meetings shall be documented.

3.9. Documentation of previous education

Only residents satisfying requirements described in section 2.3 (page 10) are accepted. No farther documentation of residents' education is necessary.

4. Program Staff

4.1. Qualification and time

Most, perhaps about 3/4, of the training is performed by the director or associate directors. Exceptions are Clinical patient management, External beam delivery and External beam treatment planning.

Director and associate directors are ABR certified with more than 5 years of post-certification experience. Their clinical interests and biosketches are shown in Appendix G (page 39). Director and one of the associate directors have about 10% of their time allocated to residency program.

Clinical patient management and External beam delivery competencies are structured as 2-3 weeks rotations in the very beginning of the training and require shadowing ABR certified radiation oncologist and NYS licensed therapists. All radiation oncologists and therapists in our clinics are certified and involved in maintenance of certification.

External beam treatment planning training is performed by certified medical dosimetrists involved in maintenance of certification as required by their board.

Additionally other staff physicists, who are all ABR certified, may participate in exams and, as needed, other training.

4.2. Appointment

Appointment of program director and associate directors is described in Subsection 3.7 on page 19. The program staff is appointed based on their role in the organization. The program staff shall include the Chief Medical Physicist, the Residency Program Director, the Associate Program Director, and the Medical Director of the physician group or designee. All medical physicist, dosimetrists, and therapists are expected to contribute to the training of the residents to some degree, so specific appointments are not made for those staff. Clear objectives are provided to the staff for each training activity as list of Typhon goals and preparedness checklist as shown in Subsection 8.1.1 on page 24.

4.3. Scientific and educational activities

Our residency takes place in clinical, rather than academic environment. However, Residency director holds PhD title and, together with associate directors and other staff physicists, is involved in clinical research. Our physics group is annually presenting at AAPM conference and regularly at ASTRO.

All physics group is enrolled in ABR maintenance of certification which involves continuing education.

Physics and dosimetry groups are participating in physics and general journal clubs; each takes place monthly.

4.4. Physicists to residents ratio

Three board certified physicists are strongly engaged in the program; hence, physicist to resident ratio is 3:2.

5. Institutional Support

5.1. Administrative support and resources

Residents are regular Health Quest employees and to this degree are entitle to all the resources available for the employees. This includes orientation, annual on-line training, library access, IT support, email, internet, etc.

Health Quest does not provide direct support to program administration except for the help in hiring process.

The majority of the Residents' time spent at the Murphy Center for Radiation Oncology (VBMC) in Poughkeepsie. An office space has been allocated for residents' use. At all locations Residents have access to networked computers and desk space adequate to accomplish assigned tasks, and have access to all typical office supplies and equipment. Particularly at VBMC they have designated office space and office PCs. Each of the facilities has a dedicated conference room with a video projector and speaker phone that are used routinely for teleconferencing.

Residents receive user accounts on all necessary software; usually, they receive accounts with the same rights as staff physicists.

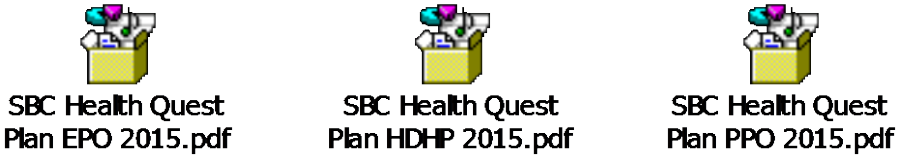
There are no teaching or research laboratories *per se* in the treatment facilities. There is no captured machine shop or electronics shop on either site, but those resources are available on demand through outside providers. Physics equipment maintenance and repairs are almost exclusively purchased from third party service providers.

5.2. Institutional commitment

Letter of support is shown in Appendix A (page 38).

5.3. Financial support and benefits

Residents' positions in Health Quest are fully funded by the department as full time employment for a limited term of two years + ~ 10 days. As such, residents have the same benefits and privileges as standard full time Health Quest employees.



Residents' salary is given in subsection 2.11.5. (page 18). Brief description of current health benefits is enclosed (clickable icons should open PDF files). More details are given to prospective residents during on-site interview by HR.

Additionally, Health Quest covers other necessary expenses, such as residents conference and educational travel, candidates travel to Health Quest at initial interview, residents AAPM membership, Typhon membership, MP_RAP and Match expenses.

5.4. Orientation

As regular employees of Health Quest, new residents are required to attend a full-day orientation session within their first month of employment. The orientation is managed by the Human Resources department and covers all aspects of employment, including but not limited to payroll issues, benefits, safety in the workplace, appropriate dress and behavior, drug screening policy, regulatory compliance, harassment and discrimination policy.

Residency director and/or associated director give resident a copy of self-study and discuss with the residents all aspects of training, particularly resident's schedule. Also, the resident is provided orientation to policy and procedure that are specific to the distributed radiation oncology practice, and a site-specific orientation for each of the facilities where the resident is assigned.

Activity	Supervisor	Objective
Orientation	Staff	Familiarization with the facility, expectations, safety practices and basic policies and procedures
Therapist shadowing	Supervisor of therapists	Part of the external beam delivery competency
Physician shadowing	Dr. Torres, Dr. Smith	Part of the clinical patient management competency
Dosimetry	Chief Dosimetrist	Dedicated part of the external beam treatment planning competency.
Physics introduction	Director or associate director	Introducing into basic physics procedure and clinical workflow
Independent work	Director or associate director	Independent coverage in the very end of the training

Table 3. Rotations and some other activities of the residents.

5.5. Safety

Details of safety training are given in subsection 1.11 (page 8)

6. Educational Environment

6.1. Open communication

Health Quest and Radiation Oncology department support culture of safety, which, among other, entails open communication among all staff including resident. Residents, along with the other staff members, are encouraged to communicate their question and concerns, particularly during chart rounds, planning rounds, journal clubs, etc.

Student radiation therapy interns are having rotations in out center. Their learning objectives are, however, different from that for residents. As Health Quest is clinical organization, there is no other educational activity takes place except medical physics residency.

Skill	Comment	Credentialing?

6.2. Educational activities

There are regularly scheduled clinical conferences in the department at which Resident attendance is mandatory. The conferences are the weekly chart rounds, the weekly treatment planning rounds, the twice-monthly institutional tumor board and the monthly physics and general journal clubs. If the Resident fails to attend at least 75% of the occurrences of each conference the Resident will not be allowed to use the corresponding competency as one of the required twelve mastery competencies.

Resident attendance is mandatory at the monthly physics and dosimetry operations meeting and at the monthly resident status review meeting.

Since VBMC is not an academic institution, the opportunities for the resident to directly participate in the teaching of other personnel are limited. The resident is required to develop model radiation safety education presentations for a number of target audiences (see Typhon goal in Radiation safety competency in Subsection 8.1.1 on page 24) and will be expected to defend one of those as part of the examination for the radiation safety competency oral exam.

6.3. Books and journal access

The departments do not have dedicated libraries within the clinical department space. Many books are available in the Physics work area at VBMC. VBMC does have a library for the larger institution with a staff reference librarian. Access to textbooks and archival literature for all staff is either through private collections, on-line access or orders through the VBMC librarian. Funds are available for any necessary reference materials that the Residents cannot obtain otherwise.

6.4. Access to clinical facilities

Training is performed in clinical environment as described in subsection 2.2 (page 9).

6.5. Feedback from residents

Residents are required to provide monthly feedback via Typhon system via the form shown in Appendix C on page 39. The feedback is circulated among residency directors and radiation oncologist(s).

Starting with the current resident, HR performs exit interview.

Monthly		yes
Annual		no
Weekly chart check	Including finals	yes
Modulated field QA	Includes linac and tomo	yes
Second check	All external beam categories	yes
Treatment planning	Credentialing is done simultaneously with External beam treatment planning competency exam	yes
Peer review	All external beam categories	yes

Table 4. Selected subcategories of the competencies with the separate deadlines and credentialing exam.

In addition the entire organization is committed to a fair and just culture. All staff, including residents, receives training in corporate compliance which includes a discussion of zero tolerance for any retaliatory behavior.

6.6. Feedback and committees

Significant questions will be brought to operations and steering committees. Residents can provide their feedback directly to any member of steering committee.

7. Scholarly Activities

7.1. Research projects

As discussed in Subsection 1.4 (page 7) residents are required to participate in clinical research projects. They also, depending upon the project, may be encouraged to present their findings at AAPM conferences.

7.2. Equipment commissioning

Residents are required to actively participate in equipment commissioning, whenever we get new up upgrade existing. Whenever such an upgrade do not take place, residents are still taught the procedure and may be required to perform a fake commissioning, e.g. TPS for a single energy or HDR planning.

7.3. Documentation

All activities, including such scholarly activities are documented in Typhon.

8. Residency Curriculum

8.1. Competencies

8.1.1. What residents need to learn

Residents are required to complete 16 competencies as shown in subsection 2.11.1 (page 14). Details of the skills required for

competencies are stored in Typhon as shown in enclosed printout. Only assisted and performed procedures are counted towards minimum # of cases goal stated in Typhon.

Note, that Typhon does not allow changing skill names, so that some of the skills still say 'Eclipse.' While Eclipse is available for the residents to use and learn, these skills are required to be learned in Raystation.

Competencies include not only skill but also specific knowledge, which does not fit into Typhon format and is learned via designated reading. To monitor and direct residents and catch delinquencies before the exams or report completion a preparedness checklist is created (enclosed).

8.1.2. How residents learn

As pointed out in section 2.11.4 (page 16) residents progress through the program via accumulation of cases. Only two of the competencies are structured as conventional rotations, Clinical Patient Management – shadowing physicians, and External Beam Delivery – shadowing therapists. Each of these rotations is usually 14 business days. Additionally, External Beam Treatment Planning includes 15 business day rotation – dosimetry shadowing.

There are three other continuous activities, initial orientation which is 3-5 business days and includes Health Quest orientation, 3-5 business day introduction into clinical physics and 15 business day independent work in the very end of the training. Summary of these activities are shown in Table 3.

8.1.3. Schedule

Time table for the competencies and activities is shown in Fig. 1 on page 29. While most competencies do not have dedicated rotations, our schedule establishes deadlines for case accumulation and report submission, and, where applicable, deadlines for the oral exams.

Schedule also contains deadlines for case accumulation and, as applicable, credentialing for six subcategories of the competencies. These subcategories, as being the most fundamental for residents training, are presented in a separate Table 4.

8.1.4. Didactic training

While we cannot provide didactic training to compensate for the basics technical knowledge, as determined by CAMPEP, director or associate director gives a lecture, which provides an introduction into medical physics profession, role of medical physics in the department and introduction in to medical physics ethics. Director or associate director may also give, as needed, introduction into the dose calculation algorithms. We provide designated reading on technical subjects as well as on ethical subjects, management, and negotiation.

8.1.5. Research

Part of instrumentation and dosimetry protocol competency are experimental design and phantom design. These two mandatory skills in the competency represent small clinically related project. Residents are encouraged to present their findings at the departmental meetings

or at AAPM. Outstanding residents who manage to be ahead of the schedule may be able to participate in more and more substantial research projects.

8.2. Our program and CAMPEP requirement on subjects to be learned

While our program skill and competencies lists, as shown in Tables 1 on page 13 and 2 on page 15 and in Typhon printout and preparedness checklist in Subsection 8.1.1 on page 24, do not match letter to letter CAMPEP requirement, our program fully covers all required CAMPEP topics for the Radiation Oncology Physics Residency.

The following CAMPEP optional items are not being taught in our program: system calibration, performance evaluations and quality control, safety and compliance tests, including vendor specifications, under supervision of a qualified physicist for ^{60}Co, PET/CT, MRI/CT, Protons, US therapy.

Certain items in the list we do not perform clinically; hence, residents training is done through designated reading, 1-to-1 conversations and examination. These modalities are total body and total skin radiation.

8.3. Clinical competencies details and designated reading

In addition to requirements given in Tables 1 and 2 and in Typhon printout in subsection 8.1.1, we also provide designated reading list for each competency. Designated reading is located in 'Q:\Medical Physics Residency\2. Designated Reading' in electronic form, unless otherwise stated, or is on the shelf in residence room.

This section also contains further elaboration of competencies shown in Table 1.

8.3.1. Clinical Patient Management

Residents shadow one or more radiation oncologists and participate in all physician activities: consultations, weekly visits, follow ups, treatment planning, simulations etc. This is the competency with the most exposure to patients, so learning to conduct oneself in the presence of patients is emphasized. The residents are expected to learn about staging, side effects and side effect management from real life examples.

Online:

- Joint commission 2-page document on lung staging

No designated reading

8.3.2. External beam delivery

The residents shadow the radiation therapists and interact with patients and learn how to operate machines we have. The therapists are exposed to the simulation and treatment techniques from a therapists' perspective, and learn how to properly operate, initialize and shut down equipment. This is chronologically the first competency. We have purposely structured it so, as the correct and accurate treatment of the patients is the most important part of the job. As the residents go through the future competencies, we frequently refer back to things they saw during this competency and may not have appreciated.

No designated reading

8.3.3. External beam treatment planning

The residents spend some dedicated time with dosimetry on this competency. Learning the inner workings of the treatment planning system, but also creating plans, from simple 3D to more complicated IMRT. Creating the plan but also documenting why certain things are done in a certain way, perhaps, if different, is emphasized. Residents are expected to practice varying complexity plans and develop clinical judgment on which one is the best for the patient. This ties back to the external beam delivery competency, and residents understand certain steps in planning, for example, placement of origin of coordinates.

Designated reading:

Online:

- Klein EE *et al*, A volumetric study of measurements and calculations of lung density corrections for 6 and 18 MV photons, IJROBP **37**, 1163 (1997)
- Smith BD *et al*, Fractionation for whole breast irradiation: an American society for radiation oncology (ASTRO) evidence based guideline, IJROBP **81**, 59 (2011)
- PDF (from powerpoint presentation) of the lecture on IMRT process, IMRT optimization, fluence optimization, MLC characteristics
- PDF Summary of QUANTEC
- PDF summary of IMAMI
- TG-63
- TG-65
- Pirzkall A et al, The effect of beam energy and number of fields on photon-based imrt for deep-seated targets, IJROBP **53**, 434 (2002)

Paper:

- A practical guide to intensity-modulated radiation therapy, Medical Physics Publishing, Madison WI (2003); chapters 2, 6, 15
- Steel GG ed, Basic clinical radiobiology

8.3.4. Brachytherapy Commissioning and QM

At the beginning of this competency we pose this question: “Assume you are working at a facility that has no current brachytherapy program, and the director tells that the hospital now approved x-y-z. What do you need to do to get this going?”. This is the easiest way for the residents to visualize developing a program and be inclusive of equipment requirements and quality assurance programs that needs to developed.

Designated reading:

Online:

- Wang X-H and Potters L, A theoretical derivation of the nomograms for permanent prostate brachytherapy, Med Phys **28**, 683 (2001)
- Cohen GN *et al*, The Anderson nomograms for permanent interstitial prostate implants: a briefing for practitioners, IJROBP **53**, 504 (2002)
- NYS code 10 part 16 (ionizing radiation)
- Rivard MJ, The TG-43 brachytherapy dose calculation formalism, chapter 16 of unknown book
- NYS renewed license for new afterloader installed
- Perez-Catalayud J *et al*, Dosimetry characteristics of the Plus and 12i Gammamed PDR ^{192}Ir sources, Med Phys **28**, 2576 (2001)
- Ballester F *et al*, Technical note: Monte-Carlo dosimetry of the HDR 12i and Plus ^{192}Ir sources, Med Phys **28**, 2586 (2001)
- NUREG-1556, volume 9, main focus on appendix U
- Radcalc acceptance (HDR/LDR part)
- AAPM report 69
- AAPM report 89
- TG-137
- Podgorsak MB *et al*, Thermal and scatter effects on the radiation sensitivity of well chambers used for high dose rate It-192 calibrators, Med Phys **19**, 1311 (1992)
- TG-40
- TG-43 and all the supplements
- TG-56
- TG-59
- TG-64
- TG-128
- Perez-Calatayud J *et al*, Dose calculation for photon-emitting brachytherapy sources with average energy higher than 50 keV: Report of the AAPM and ESTRO, Med Phys **39**, 2904 (2012)

Paper: none

8.3.5. Brachytherapy Treatment Planning

The residents practice test cases and, eventually, once comfortable enough, they do real clinical cases, under supervision. Emphasis is given on hands-on practice with procedures that may not occur often, such as breast balloons. The residents maintain their planning skills throughout the entire residency. If clinical cases are not available, residents practice on past cases.

Designated reading:

Online:

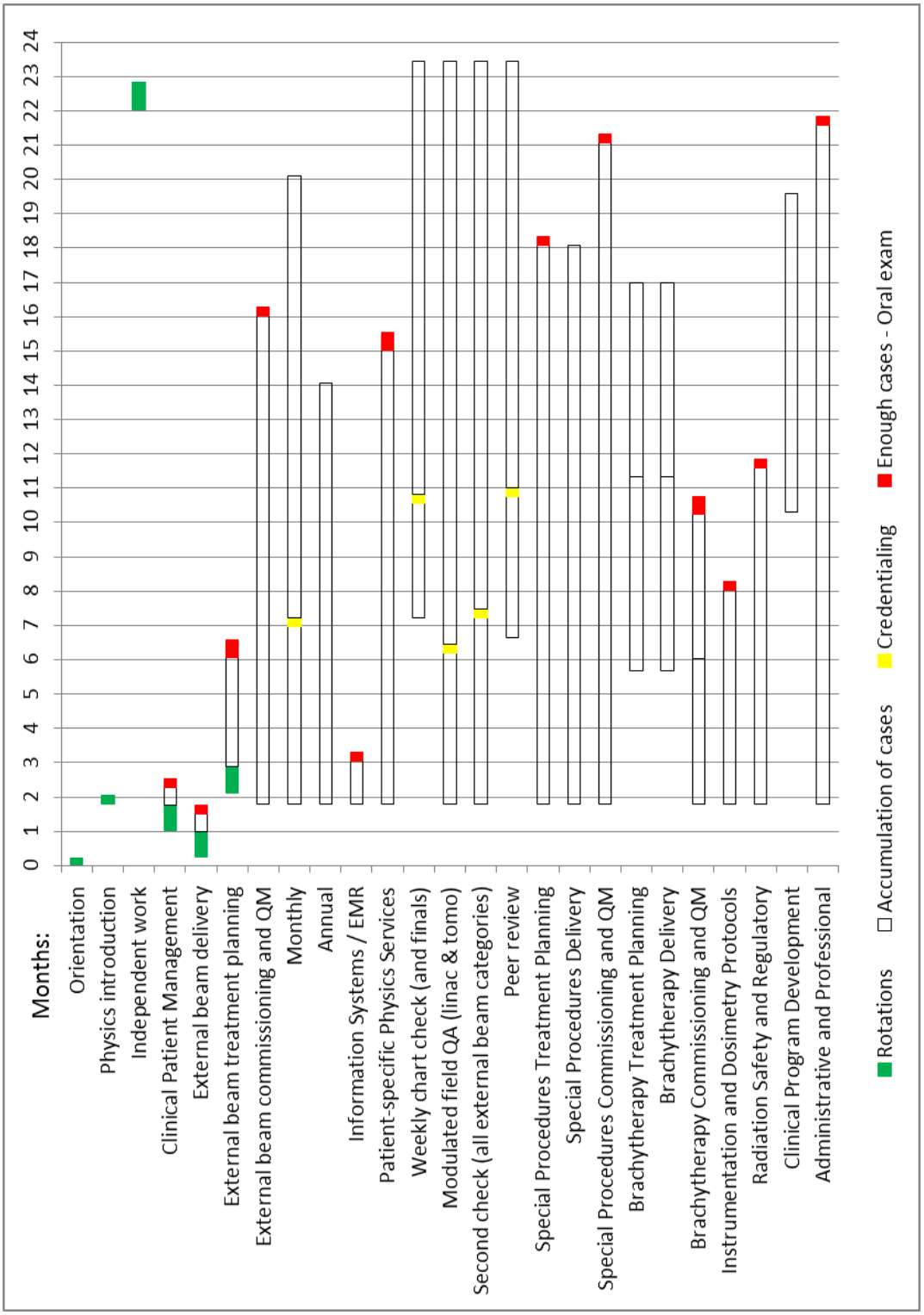


Fig. 1. Time table for the residency program.

- Johnson M *et al*, Dosimetric and technical aspects of intraoperative I-125 brachytherapy for stage I non-small cell lung cancer, PMB **52**, 1237 (2007)
- Fleischman EH *et al*, Iodine^{125} interstitial brachytherapy in the treatment of carcinoma of the lung, J Surg Oncol **49**, 25 (1992)

- Trombetta MG *et al*, Tolerance of the aorta using intraoperative iodine-125 interstitial brachytherapy in cancer of the lung, Brachytherapy **7**, 50 (2008)
- Voynov G *et al*, Intraoperative ^{125}I Vicryl mesh brachytherapy after sublobar resection for high-risk stage I nonsmall cell lung cancer, Brachytherapy **4**, 278 (2005)
- Chen A *et al*, Intraoperative ^{125}I brachytherapy for high-risk stage I
- non-small cell lung carcinoma, IJROBP **44**, 1057 (1999)
- RTOG 1021
- Batler WM and Butler EG, Partial breast irradiation using the MammoSite®
- radiation therapy system, chapter 40 of unknown book
- Thomadsen BR, Physics of uterine corpus brachytherapy, chapter 47, same unknown book
- Rownd J, Changing from low dose rate to high dose rateintracavitary gynecological brachytherapy, chapter 48, same unknown book
- Sharma AK, Gynecological interstitial implants, chapter 49, same unknown book
- Thomadsen B, PDF of presentation on ICRU cervical intracavitary dose reporting Recommendations
- Nag S *et al*, The American brachytherapy society recommendations for high-dose-rate brachytherapy for carcinoma of the endometrium, IJROBP **48**, 779 (2000)
- Nag S *et al*, The American brachytherapy society recommendations for high-dose-rate brachytherapy for carcinoma of the cervix, IJROBP **48**, 201 (2000)
- Nag S *et al*, The American brachytherapy society recommendations for permanent prostate brachytherapy postimplant dosimetric analysis, IJROBP **46**, 221 (2000)

Paper: none

8.3.6. Brachytherapy Delivery

The residents go through the technical details with staff physicists about what to check according to the procedure and situation. Once confident, residents perform HDR, seed implant and IORT treatments (with the immediate presence of a licensed physicist).

One of the most fun times of the year is when we hide a seed in the physics lab and we ask them to find it. They pick out the equipment and do a survey.

Designated reading:

Online:

- Layer A and Horton J, PDF of the presentation on Interstitial prostate seed implants
- TG-59
- Butler WM *et al*, Third-party brachytherapy source calibration and physicist responsibilities: report of the AAPM low energy brachytherapy source calibration working group, Med Phys **35**, 3860 (2008)
- TG-128
- TG-137

Paper: none

8.3.7. Instrumentation and Dosimetry Protocols

This competency is all about what is the appropriate instrument to perform certain dosimetry protocols. We spend a lot of time reviewing the details of TG51, and have hands-on experience with the equipment described on the list. For the experiment design, we usually attempt to coordinate with a clinical project, and have the resident come up with the proposal on how to execute the experiment. When appropriate, we let them fail the experiment and try again.

Designated reading:

Online:

- Nahum AE, PDF of presentation on Cavity theory, stopping-power ratios, correction factors
- ACR accreditation report
- ADCL reports for ion chambers, electrometers and survey meters
- Burns DT *et al*, R_{50} as a beam quality specifier for selecting stopping-power ratios and reference depths for electron dosimetry, Med Phys **23**, 383 (1996)
- Followill DS, Clinical implementation of the TG-51 calibration protocol, chapter 8 of unknown book
- Rogers DWO, The Physics of the AAPM's TG-51 Protocol, chapter 9 of the same unknown book
- PTW brochure, Detector for small field dosimetry
- PTW brochure on Dosimetry diode E T60017 from serial number 300, dosimetry diode P T60016, dosimetry diode SRS T60018
- Sun Nuclear brochure on edge detector
- Standard Imaging brochure on Exradin A1SL ion chamber
- Landauer brochure on Luxtel
- Ludlum brochure on digital area monitor
- PTW report on seven29
- PTW user manual on Semiflex ionization chambers type 31010, 31011, 31012, type 31013 from serial number 1000
- Sun Nuclear brochure on Daily QA3
- Sun Nuclear brochure on IVD
- TG-39
- TG-51
- Almond PR *et al*, The calibration and use of plane-parallel ionization chambers for dosimetry of electron beams: An extension of the 1983 AAPM protocol report of AAPM Radiation Therapy Committee Task Group No. 39, Med Phys **21**, (1994)
- Followill D, PDF of presentation on Clinical Implementation of the TG-51 protocol
- Tailor RC *et al*, TG-51: Experience from 150 institutions, common errors, and helpful hints, JACMP **4**, 102 (2003)
- Lowenstein JR *et al*, Implementation of TG-51: practical considerations, MD Anderson report
- TG-66

- Vendor report on Victoreen model 451B

Paper: none

8.3.8. Patient-specific Physics Services

By the completion of this competency, we are comfortable that residents will be able to perform routine medical physics duties in clinical settings. The patient-specific physics services described in Typhon goals are the daily clinical duties of our staff physicists, and the resident is expected to be able to perform them equally as well. The resident has to pass the same credentialing exam (Table 4) as the staff physicists have in order to perform these clinically and independently. After completion, the residents are expected to help with clinical coverage as needed in order to maintain their skills.

Designated reading:

Online:

- Saw CB, Clinical dose calculation, chapter 7 of unknown book
- PDF of presentation on Photon dosimetry concepts and calculations
- PDF of presentation on Dose distribution and scatter analysis
- Court L, PDF of presentation on Electron therapy
- PDF of presentation on VMAT
- PDF printout on TAR-TMR-BSF comparison
- Li H *et al*, Toward a better understanding of the gamma index: Investigation of parameters with a surface-based distance method, Med Phys **38**, 6730 (2011)
- Low DA *et al*, Dosimetry tools and techniques for IMRT, Med Phys **38**, 1313 (2011)
- TG-34
- TG-40
- TG-64
- TG-114
- TG-71

8.3.9. Information Systems / EMR

The basics of DICOM and networking are explained in this competency. DICOM editors are installed and we experiment with the tags and see what they do. We also go into details of the development of a record and verify, and how we have progressed to an EMR. We go through the basics of MOSAIQ and explain security settings and hard stops.

Designated reading:

Online:

- PS 3.6-2011. Digital Imaging and Communications in Medicine (DICOM). Part 6: Data dictionary, published by NEMA
- Germond JF, PDF of presentation on The clinical physics aspects behind DICOM DICOM—RT

- Reilly AJ, PDF of presentation on DICOM Radiotherapy
- Matthews JW, PDF of presentation on RT Plan
- https://kb.iu.edu/d/aerg
- http://www.computerhope.com/jargon/h/http.htm
- Neumann M, PDF of presentation on The DICOM extensions for radiotherapy
- IMPAC document on RTPConnect

Paper: none

8.3.10. Administrative and Professional

For this competency, the residents spend dedicated time with the chief physicist, reviewing the budget and equipment selection rationales. The ethics modules and other items described elsewhere, particularly in Table 2, are also part of this competency.

Designated reading:

Online:

- The essentials, Harvard business review press, Boston, MA
- Clayton MC, How will you measure your life? Unknown journal or book
- Hallowell EM, Overloaded circuits, unknown journal or book
- Review capital funds requests
- Review Vendor's comparison excels (two comparisons + decision matrix)
- Review business plan for FROC VisionRT
- Review FROC OBI capital request
- Review initial equipment request for PROC
- Dirksen B and White J, PDF of presentation on Medical physics economics update
- Review document on review of vendors' claims
- https://en.wikipedia.org/wiki/Nuremberg_Code
- http://www.aapm.org/medical_physicist/ethics.asp

Paper:

- Malhotra D and Bazerman M, Negotiation Genius: How to Overcome Obstacles and Achieve Brilliant Results at the Bargaining Table and Beyond, Bantam (2008)
- Papers from MSKCC course on ethics

8.3.11. Clinical Program Development

Whenever possible, the residents participate in actual hazard analysis projects we do in the department. In addition, they go through the basics of major equipment QA programs and how to develop them. At the completion of the competency, the residents are expected to be able to demonstrate sufficient knowledge on how to develop any one of the programs listed from scratch.

Designated reading:

Online:

- Review nuclear medicine safety manual
- Prisciandaro JI, PDF of presentation on from licensing to QA, how to implement HDR brachytherapy into your clinic
- TG-40
- TG-50
- TG-53
- TG-56
- TG-59
- TG-64
- TG-66
- TG-128
- TG-142
- TG-148
- TG-179

Paper: none

8.3.12. Special Procedures Treatment Planning

For this competency, the residents do practice cases first until we assess that they are competent enough for live cases. We discuss the details of how and why certain plans should be done on certain machines, etc.

Designated reading:

Online:

- Yin F-F, PDF of presentation on Treatment Quality Assurance for Linac Based SRS/SBRT

Paper: none

8.3.13. Special Procedures Delivery

For this competency, the residents participate in the actual treatment plan delivery, and appreciate the technical aspects of treating a real patient, and, making some of these special treatments, not only accurate and appropriate, but also short in time. For TBI and TSI, arrangements are made at other centers as described elsewhere.

Designated reading:

Online:

- Hooper S, PDF of presentation on Ra-223 calibration

Paper: none

8.3.14. Radiation Safety and Regulatory

In this competency, we review radiation safety from a practical point of view. The residents are required to review licensing requirements for New York state and develop a training plan for all types of coworkers and edit it according to the target audience.

Designated reading:

Online:

- NCRP 147
- NCRP 151
- 10CFR35
- 10CFR20
- PROC shielding report
- NUREG 1556, volume 9, Appendix U
- PDF from Astarita training on DOT Hazmat shipping
- http://www.astaritaassociates.com/DOTHazmatTraining.html
- http://www.astaritaassociates.com/doseinfo.html
- Tavel JS, PDF of presentation on DOT hazmat training for the nuclear medicine technologist
- Ritter *et al*, Audit tool for external beam radiation therapy departments, Practical Radiation Oncology **2**, e39 (2012); comparison table for that article
- PROC license + updates
- PROC license application
- CRCDP's H-40, Inspection protocol for medical linear accelerator
- TG-36
- License update for Tomotherapy installation

Paper:

- A practical guide to intensity-modulated radiation therapy, Medical Physics Publishing, Madison WI (2003); chapter 19

8.3.15. External beam Commissioning and QM

For this competency the residents review all the commissioning documents for major equipment and develop quality management plans according to the equipment. For the treatment planning system, they develop a photon and an electron model on their own. Raystation actually has great modeling tools and they are used for teaching purposes; for example, effects on primary source size on penumbra, energy spectrum etc. This is done one-on-one with one of the associate directors and the resulting models have to be equivalent to the ones used clinically.

As a part of this rotation, residents shadow consulting group performing QA on CT, MRI and PET scanner.

Designated reading:

Online:

- Jacques R *et al*, Towards real-time radiation therapy: GPU accelerated superposition/convolution, unknown journal
- Garcia-Vicente F *et al*, Clinical impact of the detector size effect in 3D-CRT, Radiother Oncol **74**, 315 (2005)
- Eclipse algorithms reference guide
- Arnfield MR *et al*, The use of film dosimetry of the penumbra region to improve the accuracy of intensity modulated radiotherapy, Med Phys **32**, 12 (2005)
- TG-65
- TG-105
- DesRosiers C, PDF of presentation on Calculation algorithms in radiation therapy treatment planning systems
- Mobius3D report on Dose calculation algorithm
- Chapter 8.4 of Modern technology of radiation oncology
- Karzmark CJ *et al*, Medical electron accelerators
- Sample QA reports
- TG-51
- Jeraj R *et al*, Dose calibration of nonconventional treatment systems applied to helical tomotherapy, Med Phys **32**, 570 (2005)
- Thomas SD *et al*, A Monte Carlo derived TG-51 equivalent calibration for helical tomotherapy, Med Phys **32**, 1346 (2005)
- McNutt T, brochure on The ADAC Pinnacle3 Collapsed Cone Convolution Superposition Dose Model
- TRS 430
- Cygler JE, PDF of presentation on Commissioning and clinical implementation of Monte Carlo treatment planning system for electron beams
- ESTRO, quality assurance of treatment planning systems practical examples for non-imrt photon beams
- Popple RA *et al*, Comprehensive evaluation of a commercial macro Monte Carlo electron dose calculation implementation using a standard verification data set, Med Phys **33**, 1540 (2006)
- PDF of presentation on modeling MLC
- Carolan MG, Pencil Beam Dose Calculation Algorithm
- Gifford KA, PDF of presentation on Photon Beam Dose Calculation Algorithms
- TG-23
- TG-53
- Merrill R and Miller M, PDF of presentation on Treatment planning system quality assurance

Paper:

- A practical guide to intensity-modulated radiation therapy, Medical Physics Publishing, Madison WI (2003); chapters 3-5, 7, 8

8.3.16. Special Procedures Commissioning and QM

This competency is specific to any additional commissioning and quality assurance tests that need to be performed and developed for the special procedures listed. This is logical continuation of patient specific physics services.

Designated reading:

Online:

- Shepard D, PDF of presentation on Gamma Knife and CyberKnife: physics and quality assurance
- Poodgorsak EB, PDF of presentation on Special Procedures and Techniques in Radiotherapy
- TG-25 + errata + supplement
- TG-29
- TG-30
- TG-42
- TG-48
- TG-72
- TG-76
- TG-101
- TG-135
- TG-142
- TG-148
- TG-152

Paper: none

8.4. Program modifications

As discussed in subsection 2.6, program can be adjusted for individual resident or changes can be made for the overall program.

8.5. Equipment and clinical load

Our clinical centers are briefly described at subsection 2.2. The main facility at VBMC has a Tomotherapy unit that was installed in 2008 and a Elekta Infinity with Agility MLC that was installed in 2014. A wide bore, multi-slice CT is used for simulation. There is an active and diverse brachytherapy program (HDR, intraoperative breast treatment, prostate seed implants, Ra223, etc.). Specialized equipment and/or features include the IMRT/VMAT delivery, 4D imaging/treatment planning/ delivery, frameless linac stereotactic radiosurgery/radiotherapy, image guidance provided by multiple technologies, and intra-operative radiation therapy.

There are three satellite centers affiliated with VBMC. Each has a single linear accelerator. The Ulster Radiation Oncology Center (UROC) has a Varian iX with 120MLC, OBI, and CBCT. In addition the site has a Philips CT sim, and HDR unit.

The Putnam Hospital site has a Varian Trilogy accelerator, a four-slice CT sim with gating capability, and an HDR unit.

The Fishkill Radiation Oncology Center (FROC) has a Varian EX accelerator with an 120 leaf MLC. The site has a single-slice CT.

At all four centers we are treating about 100 external beam treatment patients per day, roughly about half being IMRT, VMAT or Tomotherapy cases, several HDRs per month and several IORT, seeds implants and Ra-223 injections per year. About 2/5 of external beam patients and 1/3 of HDRs are treated at VBMC; seed implants, Ra-223 and IORT are only performed at VBMC.


ACR FROC certificate 2014.pdf


ACR PROC certificate 2014.pdf


ACR UROC certificate 2014.pdf


ACR VBMC certificate 2014.pdf

8.6. Ethics and professionalism curriculum

In addition to technical aspects of training we also educated residents on ethical and professional aspects as described in subsection 2.11.2 on page 16.

9. Admission

Details of admission are given in section 2.3.

10. Future plans

10.1. Summary of Strengths and Needs

The program's greatest strength is that it is a practical, community-based program designed to provide excellent training to individuals who have chosen to pursue Medical Physics clinical practice as a career. Support for the Program among the physicians is enthusiastic, and all other staff have embraced the opportunity to be part of the resident training.


letter of support.pdf

10.2. Further Developments and Improvement

Our focus in further development and improvement has to be on firming up the infrastructure, to make expectations clearer, to make policy and procedure more transparent, and to make our audit trail more robust.

Appendix A – Letter of invitation and institutional commitment

Letter of the institutional support of the program is enclosed.

Appendix B – Documentation of institutional accreditation

Certificates of ACR accreditation for all four centers are enclosed.

Appendix C – Clinical rotation summaries and evaluation forms

Complete list of competencies, structure, supervisor and methods of resident's evaluation at these competencies are shown in subsection 2.11.1 (page 14) including Table 1 (page 13) and in subsection 8.1 (page 24) including Table 3 (page 22). Residents are using Typhon system to count accumulation of cases for every skill required for competency.

Residents are being evaluated monthly with a minimum of one time per rotation by the clinical supervisor. Additionally, an evaluation form is provided for the Resident to evaluate their experience in a rotation, again once per month with a minimum of one per rotation.

Finally, resident is evaluated in the beginning of his/her second year, i.e. early July. Evaluation form is enclosed. This evaluation is different, though not necessarily independent from Health Quest evaluation performed by chief medical physicist. This evaluation of the resident is performed by program director in coordination with other members of operation committee.


annual evaluaiton form - to be done in J


rotation evaluation by supervisor.pdf


rotation evaluation by residents.pdf

Appendix D – List of residents admitted

List of current residents is available online on Health Quest medical physics residency page at goo.gl/Y06iOs in section Program statistics.

Appendix E – List of current residents

List of residents admitted is available online on Health Quest medical physics residency page at goo.gl/Y06iOs in section Current residents and alumni.

Appendix F – Program graduates

List of alumni is available online on Health Quest medical physics residency page at goo.gl/Y06iOs in section Program statistics.

Appendix G – Faculty and staff biographical sketches and primary clinical interests

The list of staff directly involved in training for most of the masteries is shown in Table 5.

Name	Primary Clinical Interest
Serguei Kriminski	SBRT
Dan Pavord	Phantom design QA trending Intraoperative radiotherapy Quality and Safety
Patricia Sansourekidou	Electron Monte Carlo accuracy and Photon Monte Carlo development Deformable image registration quality assurance Process robustness and error incidence Toxicity and adverse reactions

Table 5. Alphabetical List of Faculty/Staff

Biographical Sketch – Kriminski, Serguei

Clinical Appointment(s):	Medical Physicist at Health Quest, 2009-present Poughkeepsie, NY
Education:	MS, Engineer-Physicist, 1997, Moscow Institute of Physics and Technology PhD, Physics, 2004, Cornell University
Post Graduate Training:	Postdoctoral fellow at UCLA (2004-2005) and MSKCC (2005-2009)
Continuing Education:	Participates in ABR continuing education
Certification(s):	ABR in Therapeutic radiological physics, 2010
Role(s) in Residency Program:	Residency program director
Academic Supervision:	None
Clinical Responsibilities:	Overall clinical support of VBMC program
Research Interests:	SBRT; data integrity
Research Summary	a) Peer-reviewed papers: in refereed journals: 16 (total) / 2 (last five years) b) Book chapters: 1 (total) / 0 (last five year) c) Published abstracts: 14 (total) / 4 (last five years)
Research Funding Support:	None

Biographical Sketch – Pavord, Daniel

Clinical Appointment(s):	Medical Physicist at Montefiore Hospital 1989-1990 Pittsburgh, PA Medical Physicist at Western Pennsylvania Hospital, 1990-1995 Pittsburgh, PA Chief Physicist at Triangle Radiation Oncology, Mercy Hospital 1995-1999 Pittsburgh, PA Senior Physicist at University of Pittsburgh, Shadyside Hospital 1999-2001 Pittsburgh, PA Director of Radiation Oncology at Western Pennsylvania Hospital 2001-2007 Pittsburgh, PA Chief Medical Physicist at Health-Quest 2007-present Poughkeepsie, NY
Education:	BS, Physics, 1987, Carnegie Mellon University Med Phys Fellowship, St. Francis Medical Ctr,Pittsburgh,PA(1987-1989) MS, Radiation Health, 1989, University of Pittsburgh
Post Graduate Training:	none
Continuing Education:	Participates in ABR continuing education
Certification(s):	ABR in Therapeutic radiological physics, 1993 ABR in Diagnostic and nuclear medicine physics, 1998
Role(s) in Residency Program:	Residency program associate director
Academic Supervision:	None
Clinical Responsibilities:	Overall clinical support of Health Quest program, coverage of special procedure
Research Interests:	Phantom design
Research Summary	a) Peer-reviewed papers: in refereed journals: 4 (total) / 2 (last five years) b) Book chapters: 26 (total) / 26 (last five year) c) Published abstracts: 29 (total) / 14 (last five years) d) Presentations at national/international conferences: 6 (total) / 2 (last five years)
Research Funding Support:	Automated Patient Contour Measurement, Pittsburgh Life Sciences Greenhouse, $90,000, Awarded 2002. Subcontractor for Benchmark Beam Data: Improved Accuracy in Radiotherapy, NCI funded SBIR, 10% salary support for 2.5 years, Awarded August 15, 2005.

Biographical Sketch – Patricia, Sansourekidou

Clinical Appointment(s):	Medical Physicist (starting 2015 chief of clinical physics) at Health Quest 2008-present Poughkeepsie, NY
Education:	BS, Particle Physics, 2003, Aristotle Univ, Thessaloniki, Greece MS, Medical Physics, 2004, Columbia University
Post Graduate Training:	none
Continuing Education:	Participates in ABR continuing education
Certification(s):	ABR in Therapeutic radiological physics, 2008
Role(s) in Residency Program:	Residency program associate director
Academic Supervision:	None
Clinical Responsibilities:	Clinical coverage of PROC, coverage of other sites, work coordination
Research Interests:	Workflow development
Research Summary	Published abstracts: 12 (total) / 10 (last five years)
Research Funding Support:	None

Appendix H – Sample Interview Evaluation Form

Sample interview evaluation form is enclosed.

Appendix I – Sample Offer Letter

Sample offer letter is enclosed.

Appendix J – Examples of Resident's Evaluation

Typhon software is used to monitor and evaluate residents' performance.

"Quick evaluation of encounter" is intended for at-will use by the Clinical Supervisor to document significant successes or significant failures as they occur. The sample is enclosed.

The second is the longer, more formal Rotation evaluation form, to be used by each Clinical Supervisor once per month with a minimum of one per rotation to report on the progress of the Resident in the rotation. Sample Rotation evaluation form is shown in Appendix C. Appendix C also contains mid residency evaluation form, which is used to perform resident evaluation in the beginning of the second year.