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Addressing Medical Physics Resident Knowledge Gaps through a New Collaboratively-Developed Rotation

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INTRODUCTION

As alternative pathways to medical physics residency become more common and increasing numbers of residency entrants have an engineering, computational, or other non-clinical background supplemented by a medical physics certificate, we find that the foundational knowledge expected of incoming residents is increasingly not met.

Out of the 63 CAMPEP-accredited graduate programs listed on CAMPEP's website, approximately half offer CAMPEP-accredited certificate programs. These vary in length from 9 months or 2 semesters to 2 years. All are expected to meet the CAMPEP and AAPM minimum requirements to cover 7 core topics as listed in AAPM Report 365. These topics are as follows:

- Radiological physics and dosimetry
- Radiation protection and radiation safety
- Fundamentals of imaging in medicine
- Fundamentals of radiation therapy physics
- Radiobiology
- Anatomy and physiology
- Ethics and professionalism

CAMPEP-accredited residency programs are expected to cover similar topics, but with more detail and clinical application, necessitating a strong foundational knowledge at the start of residency to achieve clinical competency by the end. When residents present with prior education deficiencies, this must be addressed as quickly as possible. If it is not addressed, the curricular performance in residency may reflect those inadequacies, resulting in substandard performance, inability to grasp advanced concepts, poor clinical competency, or slower progression through rotations, resulting in an extended residency timeline.

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METHODS

Instructor feedback on resident performance identified clinical knowledge gaps in residents with alternative backgrounds. These primarily fell into two categories listed in AAPM Report 365: fundamentals of radiation therapy physics, and anatomy and physiology. Specific topics of concern included:

- Clinical oncology (cancer etiology, staging, treatment modalities, etc)
- Physics and operation of radiation oncology equipment
- Language and specifics of anatomy and identification on imaging

After careful consideration, it was determined that none of these subjects were adequately addressed by existing rotations, as those topics had previously been adequately covered by graduate degrees in medical physics.

To strengthen knowledge in the identified areas, a new introductory rotation was established with the goal of increasing clinical competence and improving board exam performance. A collaborative, interdisciplinary approach was employed, with a radiation oncologist contributing to resource development and direct mentorship. In addition to assigned independent reading, a series of 4 anatomy lectures was presented with a focus on clinical oncology, broken down by anatomic region. Anatomy lectures were tied in with CT-based identification of organs at risk and contouring practice of normal tissues. Residents were also required to shadow the radiation oncologist at consults and observe simulation and treatment of at least 5 different treatment sites, as well as warm-up and daily QA of the CT and linac.

In addition to clinical oncology instruction, residents were also provided with instruction on basic linac operation, as most residents on alternative pathways have not had hands-on experience with a linear accelerator prior to residency, in contrast to residents who have received traditional medical physics education. A lecture on major beamline linac components was developed and paired with a machine workshop carried out by a service engineer, allowing residents to gain an in-depth understanding of the machine while seeing the components in real life.

The new rotation takes the place of the previous first rotation covering CT sim, so the new rotation also covers some CT sim topics: immobilization, quality assurance, and parameters of simulation.

RESULTS

The resulting one-month rotation represents an expedited introduction to clinical radiation oncology, covering a wide breadth of topics. 3 residents have completed the rotation so far, and their feedback has led to further improvements in the rotation design.

Resident and faculty feedback have both been positive. Residents who have experienced the rotation have been especially complimentary of the clinical oncology components, appreciating the consult shadowing experience and in-depth anatomy lectures. Second year residents who completed their first-year cycle prior to the rotation's introduction have since requested an equivalent supplementary experience. Faculty have noted improvement in resident performance on subsequent rotations, as compared to performance before introduction of this rotation.

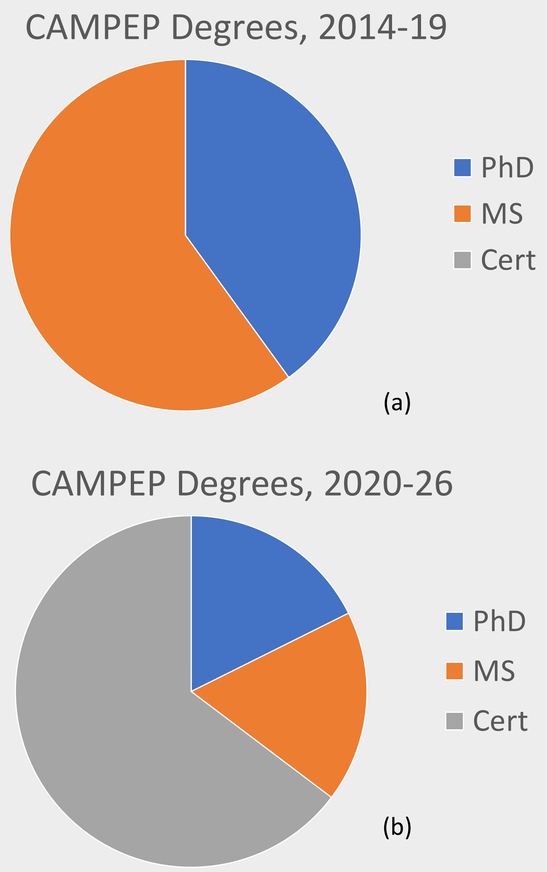

Fig. 1 CAMPEP degrees held by residents at KU from (a) 2014 to 2019 and (b) 2020 to 2026. Number of residents has increased from 1 per year in 2014 to 3-4 per year in 2026.

Table 1 Structure of new introductory rotation

Rotation Components	
Observation/Shadowing	• Consults (1-2) • Simulation (5) • Treatment (5) • Warmup (1-2)
Lectures	• Clinical Oncology (4) • Linac Components (1)
Workshop	• Linac Components
Readings	

DISCUSSION

As more CAMPEP-accredited certificate programs emerge and the differences between education in alternative and traditional pathways become apparent, it is fair to wonder why the differences exist. Certainly the accelerated nature of most certificate programs necessitates less time with the material and perhaps less detail, or glossing over of certain "less important" topics. Additionally, certificate programs are often remote learning, removing the hands-on component that can be extremely valuable for learning clinical medical physics. Regardless of the cause, residency programs must learn to adjust expectations, to serve the residents we have now, not the residents we had in the past. Once clinical knowledge gaps are addressed, residents with alternative backgrounds can certainly flourish in the clinical setting.

When this rotation was originally implemented, all rotations were staggered, so residents experienced this rotation one at a time, and not necessarily as their first rotation. The rotation schedule has since been changed to allow all new residents to take the rotation together as their first rotation. In addition to giving the residents the best possible introduction to their residency journey, this has a secondary benefit, in that it encourages residents to work together to deepen their understanding and find answers.

Several suggestions for improvement have been made, including: instruction on professionalism and how to conduct themselves in the clinic, case study presentations, recording of anatomy lectures for independent study, and splitting the rotation into 2 one-month rotations due to the wide breadth. These have been taken under consideration but have not yet been implemented. It was also suggested that the mentor accompany the residents to simulation and treatment observations to assist them in focusing their observations. While this is not feasible, a question sheet for observations was developed to guide the residents to the important details.

CONCLUSIONS

Collaborative, interdisciplinary rotations can help residents with alternative backgrounds quickly improve their performance in medical physics and understanding of clinical culture and medical parlance. Improved clinical competence and performance in subsequent rotations has been anecdotally reported. As the field adopts medphys 3.0 and the increased potential of clinical physics consults, an integration of physician experience into the medical physics residency helps to prepare our professionals for their future.

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