AAPM REPORT NO. 197S

The Essential Medical Physics Didactic Elements for Physicists Entering the Profession through an Alternative Pathway: A Recommendation from the AAPM Working Group on the Revision of Reports 44 & 79

Supplement to
Report TG-197 Academic Program Recommendations for Graduate Degrees in Medical Physics

Working Group Members
Richard L. Maughan, Chair
Jay W. Burmeister
Bruce J. Gerbi
Edward F. Jackson
Bhudatt R. Paliwal
Peter B. Dunscombe
William R. Hendee

February 2011

ISBN 978-1-936366-05-7

The Essential Medical Physics Didactic Elements for Physicists Entering the Profession through an Alternative Pathway: A Recommendation from the AAPM Working Group on the Revision of Reports 44 & 79

Introduction

The American Association of Physicists in Medicine (AAPM) Working Group on the Revision of Report 44 (WGRR44) has been charged with the task of recommending the minimum didactic medical physics education requirements for physicists seeking to enter a Medical Physics Residency program accredited by the Commission on the Accreditation of Medical Physics Educational Programs (CAMPEP). It is required that all CAMPEP-approved graduate education programs meet these minimum didactic requirements, so that their graduates are eligible to enter CAMPEP-accredited medical physics residency programs. However, the primary purpose of separately and clearly defining the minimum didactic requirements is to give unambiguous guidance to those wishing to enter a CAMPEP-accredited residency through an alternative pathway, i.e., without completing a graduate degree in medical physics but with a graduate degree in some other appropriate field (e.g., physics, electrical engineering, etc.). Defining academic entrance requirements for CAMPEP-accredited residency programs is an important issue, since beginning in 2014 all medical physicists wishing to take the American Board of Radiology (ABR) certification exam in any of the three sub-specialties of radiologic physics (Therapeutic Radiologic Physics, Diagnostic Radiologic Physics, and Medical Nuclear Physics) will be required to have successfully completed a CAMPEP-accredited medical physics residency program to be eligible for Part 2 of the examination. There are also undergraduate prerequisite physics course requirements defined by the ABR and these are not addressed in this document.

Background

Over the past four decades, Medical Physics has emerged as a well-defined discipline and many academic programs have been created to provide graduate training for those wishing to specialize in this field. In the late 1980s, the AAPM recognized the need for these programs to be accredited and established a committee to undertake this task. Later, in 1995, it was considered that it would be more appropriate for the accreditation body to be independent of the AAPM and that it be sponsored by other interested parties. This led to the creation of CAMPEP under the sponsorship of the AAPM, the American College of Medical Physics (ACMP), the American College of Radiology (ACR), and the Canadian College of Physicists in Medicine (CCPM). Part of the mandate of CAMPEP is the accreditation of programs offering graduate education in

medical physics. As part of the guidelines for the accreditation of graduate programs, the CAMPEP Graduate Education Program Review Committee (GEPRC) adopted AAPM Report No. 2, "Training Programs in Medical Physics" and AAPM Report No. 44 (1993), "Academic Program for Master of Science Degree in Medical Physics," as the basis for the required curriculum in a graduate medical physics program. Report No. 44 was superseded in 2002 by AAPM Report No. 79, "Academic Program Recommendations for Graduate Degrees in Medical Physics," and more recently in 2009 by report AAPM No. 197, under the same title. With respect to AAPM reports on the education and training of medical physicists, CAMPEP states that the curriculum should be consistent with their recommendations but that "curricula will be evaluated with regard to intent, as opposed to strict adherence to these recommendations." In practice, application of this principle by the CAMPEP GEPRC has required that all accredited programs meet the core requirements defined in the latest AAPM Report, No. 197. The CAMPEP-accredited graduate programs in medical physics may vary widely in the details of their curricula, but all share this common core of courses as a minimum requirement. Some programs offer MS degrees only and emphasize practical training (mini residencies) in addition to their curriculum requirements. Many Canadian programs incorporate graduate-level physics courses and thesis work while other programs have a more extensive medical physics didactic component. However, a review of the curricula of all CAMPEP-accredited programs shows that they meet the Report No. 197 core requirements and that a minimum curriculum can be composed of this core curriculum plus a diagnostic radiology course and a radiation therapy physics course.

Report No. 197 has been adopted in this document as the primary resource in defining the essentials of an academic program for the education of medical physicists.

Discussion

AAPM Report No. 197 presents a didactic curriculum for the graduate education of medical physicists, a brief outline of which is summarized below:

1 *Core Topics*
- 1.1 Radiological Physics and Dosimetry
- 1.2 Radiation Protection and Radiation Safety
- 1.3 Fundamentals of Imaging in Medicine
- 1.4 Radiobiology
- 1.5 Anatomy and Physiology
- 1.6 Special Topics
  - 1.6.1 Computational Methods for Radiological Sciences

- 1.6.2 Professional Ethics/Conflict of Interest/Scientific Misconduct
- 1.6.3 Mathematical Methods for Radiological Sciences
- 1.6.4 Safety: Electrical/Chemical/Biological/Elementary Radiation
- 1.6.5 Clinical Research
- 1.6.6 Scientific Communication

2 *Imaging Science*

- 2.1 Mathematical Methods for Imaging in Medicine
- 2.2 Conventional Planar X-Ray Imaging
- 2.3 Digital X-Ray Imaging and Computed Tomography
- 2.4 Ultrasound Imaging
- 2.5 Magnetic Resonance Imaging
- 2.6 Nuclear Medicine

3 *Radiation Therapy*

- 3.1 Radiation Oncology
- 3.2 External Beam Radiation Therapy
- 3.3 Brachytherapy
- 3.4 Treatment Planning
- 3.5 Radiation Therapy Devices
- 3.6 Special Techniques in Radiotherapy
- 3.7 Radiation Therapy with Neutrons, Protons, and Light Ions
- 3.8 Radiation Protection in Radiotherapy

4 *Imaging for Treatment Guidance and Monitoring*

- 4.1 Motion and Motion Management
- 4.2 CT and 4D CT
- 4.3 Portal Imaging
- 4.4 Cone-Beam CT
- 4.5 MV CT
- 4.6 2D and 3D Ultrasound
- 4.7 Fusion, Registration, Deformation
- 4.8 Motion Management through Gating and Coaching

The report states the material in the core section "is designed to teach a graduate in physics (or engineering, with a strong physics and math background) the basics of radiological physics and dosimetry." Core topics 1.1 through 1.5 form the basis of five individual courses equivalent to

3 credits each. The special topics listed in section 1.6 do not require full courses and could be taught in much shorter sessions, some of which could be incorporated into a CAMPEP Medical Physics Residency Program. Some of these topics would have already been covered in the prior training of individuals on an alternative pathway entry into the specialty. In addition to the core courses, there is need for a basic course in Radiation Therapy covering topics 3.1 to 3.8. This course would be taught at a level that could be covered in a 3-credit course. The Imaging Science course described in topics 2.1 to 2.6 is identical in its topical outline with the Fundamentals of Imaging Science course included in the core. The topics outlined in section 4 are of a more practical nature and can be acquired during the residency program, since at the present time most of this information may be taught during clinical practicums/rotations. In the future, with the requirement to complete a residency program, it is anticipated that clinical practicum/rotations will no longer need to be a part of a graduate education program. Hence, the essential elements of a medical physics graduate level didactic curriculum could be covered in six courses at a minimum, although this does not imply that completion of these six courses alone would be sufficient for the granting of a graduate degree in medical physics.

Recommendations

The AAPM Working Group on Revision of Report No. 44 recommends that *The Essential Medical Physics Didactic Elements for Physicists Entering the Profession through an Alternative Pathway* should encompass the following graduate-level core topics:

1. Radiological Physics and Dosimetry
2. Radiation Protection and Radiation Safety
3. Fundamentals of Imaging in Medicine
4. Radiobiology
5. Anatomy and Physiology
6. Radiation Therapy Physics

The course content should follow the guidelines given in AAPM Report No. 197 and will require a total of 18 credit hours of study to provide adequate depth and breadth. Delivery of the required material is likely to be most appropriate using the traditional classroom approach. However, well-planned laboratories and clinical observation could be useful to reinforce and to contextualize the material and would be included in the minimum 18 credits. It should therefore be possible to make up a deficiency in the didactic educational requirements to enter a CAMPEP-accredited residency program with two semesters of study.

This time could be reduced if the residency program offers didactic education, since the CAMPEP guidelines for residency program accreditation allow for the remediation of didactic deficiencies. The amount of didactic coursework that a medical physics resident can make up in a two-year residency program is two 3-credit courses for all residents entering a residency program in 2012. This leaves four courses to be completed before entering the residency program with the potential of completing these courses in one semester. In an extended residency program, no shorter than 2 years and one semester, it would be possible to make up all six required courses during the residency. In this situation no more than two courses may be completed after entering the second year of the residency.