Education and Mentoring of New Medical Physicists
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Outline
- Graduate education
  - AAPM Report 197
  - CAMPEP
  - Graduate education at UF
- Diagnostic and Nuclear Medicine Residency
  - AAPM Report 249
  - CAMPEP
  - Diagnostic and nuclear medicine physics residency at UF
- This talk will focus on curriculum rather than program structure

Graduate Programs in Medical Physics
How to structure a graduate program

- AAPM Report 197: Academic Program Recommendations for Graduate Degrees in Medical Physics
- CAMPEP Standards for Accreditation of Graduate Educational Programs in Medical Physics
- Have strong involvement from clinical physicists who work in and know the field!

AAPM Report 197 contents

- Core curriculum that should be common to all medical physics degrees:
  - Radiological Physics and Dosimetry
  - Radiation Protection and Radiation Safety
  - Fundamentals of Imaging in Medicine
  - Radiobiology
  - Anatomy and Physiology
  - Special Topics (Computational Methods, Mathematical Methods, Professional Ethics, Electrical/Chemical/Biological Radiation Safety, Clinical Research, Scientific Communication)
- More specific guidance for Imaging Physics, Radiation Therapy Physics, and Imaging for Treatment Guidance and Monitoring
- Recommended laboratory training
- Extensive bibliography

AAPM Report 197 for diagnostic physics

- No clinical introduction or clinical applications for diagnostic topics
- Strange organization for some topics
- Missing topics
- Inconsistent treatment of topics related to QA and regulation
- Some of the topics listed are very specific, while others are very vague
- "Role of a clinical medical physicist" and professional organizations found in the therapy section only
- Only 2 of the 10 committee members were diagnostic physicists
- No nuclear medicine physicists?

[[In the Mathematical Methods for Imaging in Medicine section:]]

- Noise Averaging and Filtering
- Principle of noise averaging: The covariance concept
- Transfer function and error propagation concepts ([Note: please fill in the detailed contents here])
- Filtering: The inverse, M0, M0 ważony, and M0-Welsch filters ([Note: please fill in the detailed contents here])
- The propagation of error and the covariance matrix

[[In the Digital X-Ray Imaging and Computed Tomography section:]]

- Dose and Dose Reduction Issues
AAPM Report 197

- Published 10 years ago - is getting dated
  - "Digital imaging" is apart from "conventional planar x-ray imaging" (and lumped in with CT), which does not reflect modern practice, and this section could be expanded
  - Could remove film topics
  - Missing modern technologies such as OSL dosimeters, DBT, CAD, AI
  - Little attention to modern priorities such as dose reduction and accreditation

What does CAMPEP say?

- This document focuses more on program structure, but does have a list of minimum core curriculum requirements
- Not as detailed as AAPM Report 197, but does not suffer from the same problems
- Seems more up-to-date and the diagnostic section is more comprehensive
- Ethics, leadership, and professionalism sections are more comprehensive
- All items must be covered by the graduate program
- You explain how you will cover everything in the self-study document

Excerpt from CAMPEP Standards:

- Excerpt from UF’s self-study:

About UF’s graduate program

- Founded in 1961 in the Department of Radiology as a joint venture with the Department of Nuclear Engineering Sciences
- The program’s home wandered over the years from Nuclear Engineering (in 1972), to Biomedical Engineering (in 2010), and back to Radiology (in 2017)
- Our program has a strong clinical focus!
- Of the medical physics faculty who teach courses or advise students:
  - 12 out of 15 have clinical responsibilities
  - All 15 are board certified by the ABM, ABRM, or ABHP (or in the process of certification)
Mentoring students

- All students meet individually with the Program Director each semester.
- PhD students are evaluated by their advisor each semester, with goals for the following semester explained and agreed upon.
- All students take a 1-credit Survey of Medical Physics course in their first summer (starting 2019), which covers professional development and career planning topics including:
  - Subspecialties of medical physics
  - Work environments in medical physics
  - Rules and regulations that impact physicists
  - QC, QA, medical errors
  - The role of professional societies
  - All about medical physics residency
  - The board certification process
  - Ethics and professionalism

- Students prepare a CV and complete 2 mock residency interviews.
- Each student interviews a working medical physicist about their career and presents to the class.
- Students do an assignment to plan their career path from the present time through board certification.
- Students analyze ethical scenarios in small groups, write up their impressions, and participate in a round-table discussion.

Opportunities for clinical experience

- All students have labs in diagnostic and therapy physics that are part of the courses.
- Students with an interest in clinical diagnostic physics may be hired as Graduate Assistants (GAs) in Radiology (started 1986).
- GAs are responsible for testing mobile radiographic and mobile c-arm fluoroscopic units.
  - There are always 2-3 GAs present during testing.
  - At least one GA in the testing group must have completed a competency assessment with a faculty member.
  - Reports are reviewed by a medical physics resident and then signed by a faculty member.
- GAs may act as assistants for other clinical activities.
- GAs work on their research when not busy with clinical responsibilities.
- We also often have 1-2 undergraduate volunteers who shadow and assist when needed.

Residency Programs in Diagnostic and Nuclear Medicine Physics
How to structure a residency program

- AAPM Report 249: Essentials and Guidelines for Clinical Medical Physics Residency Training Programs
- CAMPEP Standards for Accreditation of Residency Educational Programs in Medical Physics
- Have strong involvement from clinical physicists who work in and know the field!

AAPM Report 249 contents

- Structure of a residency program
- General educational competencies (ethics and professionalism, liability, professional societies, soft skills, administration, accreditation and regulatory agencies)
- Didactic knowledge requirements
- Guidelines for training programs
  - Facilities and resources (equipment, volume and variety of patients)
  - Training requirements (length of program, evaluations, supervision)
  - Expected areas of competence in general and for each modality
  - Specifications, acceptance testing, and QM of imaging equipment
  - How specifications are used in request for proposal
  - Measurement and calculation of radiation exposure and dose
  - Improving and maintaining image quality
  - Training and education of various health professionals in imaging physics and radiation effects
- Published 2013 - there are a few things that are already aging

How to become certified in 2+ specialties

- Complete a 2nd CAMPEP-accredited residency
- Find an ABR-certified physicist (in the specialty desired) who is willing to supervise you
  - Develop a prospective 1-year training plan
  - Get approval by the ABR before training begins
  - When training is completed, the supervisor completes an attestation and the candidate becomes board-eligible in the additional specialty

https://www.theabr.org/medical-physics/initial-certification/certification-requirements/certification-additional-disciplines

- Complete a CAMPEP-accredited combined residency
- Only available for diagnostic and nuclear medicine physics
AAPM Report 249 contents

- Areas of competence for imaging:
  - General radiography
  - Hard-copy and image displays
  - Angiography and fluoroscopy
  - CT
  - Ultrasound
  - Mammography
  - MRI
  - Nuclear Medicine and PET
  - Imaging informatics
  - Safety

- Areas of competence for nuclear medicine:
  - Gamma cameras with/without SPECT
  - PET and PET/CT
  - CT (with SPECT or PET)
  - Non-imaging equipment
  - Radiation safety
  - Patient dosimetry
  - Informatics
  - Radiopharmacy
  - Clinical Studies
  - Radiotracer Therapy

AAPM Report 249: Appendix C

- Appendix C covers advice on combining imaging and nuclear medicine residencies
  - Adding nuclear medicine to an imaging residency "may be accomplished in an additional year (following the completion of an imaging residency)"
  - The "2 + 1" model
  - Requires at least one nuclear medical physicist certified by an appropriate certifying board and a nuclear medical physician certified by the ABR or equivalent
  - The ratio of full-time nuclear medical physicists to residents enrolled in the additional year should be at least 1:1

What does CAMPEP say?

- The document focuses largely on program structure, but does have a list of general and specialty-specific curriculum requirements
  - Ethics, professionalism, leadership
  - For imaging physics and nuclear medicine physics: system performance evaluations and quality control for each modality, safety evaluations, informatics
  - Does not specifically address combined residency programs

- My experience communicating with CAMPEP regarding the development of a combined program:
  - The "2+1 model" is mandatory
  - The nuclear medicine residency must be in the 3rd year, after completion of the 2-year imaging residency: they cannot be intermixed
  - Rationale: so the resident can take ABR Part 2 in Diagnostic Medical Physics after the second year
About UF’s residency program

- The Diagnostic Imaging Medical Physics Residency (DIMPR) program was founded by Libby Brateman
- Accepted its first resident in 2011
- Received CAMPEP accreditation in 2013
- The program has been a 2-year diagnostic-only program until recently, but this year we are applying to expand it to a 3-year combined program

What makes UF’s program unique?

- DIMPR is supported by our medical school’s GME (Graduate Medical Education) office, and is treated just like the radiology residency in terms of pay and benefits.
- Training progresses in a (mostly) logical sequence but the “rotations” do not have fixed schedules. The resident’s competency in a given area is assessed by a faculty member when he or she is ready.
- “Resident as a teacher” is a major philosophy of our program, and the senior resident takes the role of primary teacher to the junior resident. They do almost all equipment testing together.
- Faculty provide direct supervision during all mammography and nuclear medicine testing, and during acceptance and ACR submission testing of other modalities. Indirect supervision provided otherwise.
- The annual year-end evaluation is structured as a mock oral exam

It’s not all work!
Conclusions

- AAPM Reports and CAMPEP provide valuable advice for the structure and content of graduate education and residency programs, but are not 100% comprehensive.
- Making education truly comprehensive and clinically-oriented requires the involvement of clinical physicists with a strong interest in teaching.
- Mentoring should be an essential part of the program structure. Be available for mentoring of former students and residents even after graduation, and build a strong network of supportive colleagues!

Thank you!