C A M P E P

Commission on Accreditation of Medical Physics Educational Programs, Inc.

Standards for Accreditation of Residency Educational Programs in Medical Physics

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Preamble

Medical Physics is a branch of physics that applies the concepts and principles of physics to the diagnosis and treatment of human diseases. Medical Physics encompasses four fields: Imaging Physics, Nuclear Medicine Physics, Radiation Oncology Physics and Medical Health Physics. This document focuses on the essential educational and experience requirements needed to engage in medical physics research and development, and to enter a residency program in preparation for clinical practice of one of the first three fields.

Terms such as “shall”, “must”, “require”, “should”, “may” and “recommend” are frequently used in these standards. The terms “shall”, “must”, and “require” denote items or activities that CAMPEP believes are mandatory components of an educational program. That is, they are required components. The terms “should”, “may” and “recommend” are considered desirable but not essential components of an educational program.

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1. Program Goal and Objectives

The program objectives shall, at a minimum, include the development in the resident of:

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

1.1. The program shall state its mission and objectives.

2. Program Structure and Governance

2.1. The institution in which the clinical training is conducted must be accredited by the appropriate healthcare accreditation organization.

2.2. The clinical training must be located in an appropriately structured, well-established clinical environment, with a history of stability and with the infrastructure to support resident education and training.

2.3. The Residency program shall be overseen by an appropriate steering committee, which is chaired by the program director or delegate and meets at least twice a year.

2.4. Committee membership shall include the program director and relevant staff involved in residency education including a physician.

2.5. The process for appointment of the members of the steering committee shall be documented.

2.6. Minutes of the steering committee meetings, including a summary of any actions that are proposed or taken, shall be recorded.

2.7. A mechanism for residents to communicate with the steering committee shall be available.

2.8. The steering committee shall establish a process for evaluating the quality of the educational program and annually assess the quality of the educational program based on this process, taking appropriate action to address improvements when needed.

2.9. The steering committee shall assess and monitor the strengths, weaknesses, needs, and long-term goals of the program.

2.10. A procedure shall be in place to appropriately counsel, censure, and, after due process, dismiss residents who fail to achieve acceptable learning metrics or clinical competence. "At will" clauses in employment contracts or offer letters will be considered acceptable provided (1) these clauses do not pertain to resident performance, and (2) they are made known to the residency candidate no later than the time of the resident's interview. In the event that no interview is conducted, this information shall be made known to the resident the earlier of the tendering of an offer to the resident or prior to the date of the Med Phys Match. Employment contracts (if used) shall be consistent with the dismissal procedures and due process described in this Standard.

2.11. All courses and practica should use well-defined and consistently applied metrics for evaluating resident progress and performance.

2.12. A program may consist of a single institution or of a primary site plus one or more affiliated institutions. An affiliated site is a participating site that is physically separated from the primary site such that it would be impractical for the program director at the primary site to directly supervise the resident's training at the affiliated site. Residency programs with multiple physical locations that are reasonable commuting distance, and where the program director can exercise direct supervision of the resident's training at all physical sites, may be considered to be a single site.

For programs with affiliated sites, a formal agreement must be in place between the main site and the affiliate site(s) describing liability, responsibility, accountability and any financial arrangements.

2.13. An accredited program must publicly describe the program and the achievements of its residents, preferably through a publicly-accessible website, readily accessible from the program website home page. This information must be updated no less often than annually and must include the numbers of applicants to the program, of applicants offered admission, of residents entering the program, and of graduates. Information on the subsequent positions of graduates shall also be provided, i.e., numbers in academics, clinical practice, industrial positions, etc. This information should not identify individuals.

2.14. A medical physics residency shall have at least two years of full-time equivalent clinical training (three years for a combined imaging and nuclear medicine physics residency), with progressively increasing responsibilities under the supervision of qualified medical physicists. *Residents' responsibilities shall, under appropriate supervision, rise to the level of actual clinical activities.* The educational experience may take place at one or more affiliated institutions.

Programs that integrate clinical training with research may extend the training period to achieve the required minimum duration of full-time equivalent training. Residents in such programs shall be considered full-time residents during the extended training period.

Residency programs shall have a clearly defined policy stating that the maximum number of "Time Off" days a resident may take without requiring an extension in their residency training period shall not exceed an average of eight weeks (40 workdays) per year over the duration

of the residency. This 40-day limit includes various types of leave including vacation, bereavement leave, parental leave, medical leave (sick time), caregiver leave, military commitments, and other leave as determined by the Program Director.

This information regarding allowed Time Off shall be made known to the residency candidate no later than the time of the resident's interview. In the event that no interview is conducted, this information shall be made known to the resident the earlier of the tendering of an offer to the resident or prior to the ranking deadline of the Med Phys Match.

2.15. A residency program shall clearly identify the program type (therapy, imaging, imaging + nuclear medicine, etc.). If that is not clearly delineated in the program name, then the program must identify the program type on the home page of its website.

3. Admissions

3.1 Residents entering a medical physics residency educational program shall have a strong foundation in basic physics. This shall be demonstrated either by an undergraduate or graduate degree in physics, or by a degree in an engineering discipline or another of the physical sciences and with coursework that is the equivalent of a minor in physics (i.e., one that includes at least three upper-level undergraduate physics courses that would be required for a physics major).

In addition, residents may enter any medical physics residency educational program if they have successfully completed either:

1) a CAMPEP-accredited MS or PhD graduate program, or
2) a CAMPEP-accredited certificate program.

3.2 Residency programs with that have an associated CAMPEP-accredited graduate program or certificate program may conditionally accept residents who possess a PhD in physics or related discipline, but who have not graduated from a CAMPEP-accredited graduate program or completed a CAMPEP-accredited certificate program. The remedial education of such residents shall be well-defined in collaboration with the associated graduate/certificate program director and should be equivalent to the completion of a CAMPEP-accredited certificate program and all courses used for remediation must be within a single associated graduate/certificate program. In addition, the length of the training program for that resident must be at least one year longer than the minimum clinical training period as specified elsewhere in these Standards.

3.3 Admission standards including degrees and graduate transcripts, for incoming residents are clearly stated.

3.4 The method of processing an application, including evaluating the application and informing the applicant of actions taken, shall be clearly stated.

3.5 The program must engage in admissions processes that: (a) create an admissions environment that is free from discrimination, harassment, or coercion of applicants, and (b) support the recruitment of a diverse and inclusive training program.

4. Program Director

4.1 The process for the appointment of the program director shall be documented.

4.2 A sole program director shall be responsible and accountable for ensuring that the residency program satisfies the CAMPEP standards and shall ensure that all residents receive a high-quality education and training at all training sites.

4.3 The program director must be certified to practice medical physics by the American Board of Radiology, the Canadian College of Physicists in Medicine, or another appropriate certifying agency.

4.4 The program director shall have at least five years of full-time post-graduate experience in medical physics in the specialization of the residency training program.

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

4.6 The program director shall be responsible for determining and documenting that each student offered entry into the residency program satisfies the CAMPEP admission standards for residency education in medical physics or completes rigorous remedial education to meet the standards.

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

4.8 The program director shall meet periodically with each resident to assess the resident's progress, and minutes of the meeting shall be maintained. A copy of the minutes shall be provided to the resident.

5. Program Staff

5.1 The process for the appointment of the program staff shall be documented.

5.2 An adequate number of program staff shall be available with sufficient time for clinical mentoring.

5.3 To provide appropriate full-time supervision of the resident at all sites, including remote sites, the number of program staff shall exceed the number of residents in the program plus 1. The level of supervision will be determined by the Program Director based on the competency level of the resident.

5.4 A majority of the program staff shall be licensed to practice medical physics by an appropriate jurisdiction or be certified in a branch of medical physics by an appropriate certifying agency.

5.5 Program staff members shall be engaged in scholarly activities such as participation in scientific societies and meetings, scientific presentations and publications, and continuing education.

6. Institutional Support

6.1 The organization that sponsors the residency program shall provide administrative support, including clinical and educational resources, budget, residents' office or cubicle space and access to computing resources, conference room(s), audiovisual facilities, and office support (e.g. copiers, internet access, email account, and telephones).

6.2 The institution must express its intention to support the program both financially and administratively for the term of the accreditation.

6.3 Any financial support of residents, including benefits, shall be described clearly to prospective applicants prior to their application to the program.

6.4 Entering residents shall be provided with orientation information to ensure their efficient integration into the program.

6.5 The program shall instruct its residents on the potential hazards that they might encounter and on the appropriate measures for them to take to minimize risks to themselves, others, and equipment.

6.6 The program shall instruct its students regarding the professional, ethical, and regulatory issues in the responsible conduct of research and in the protection of the confidentiality of patient information.

6.7 The program must engage in practices that (a) create a training environment that is free from discrimination, harassment, or coercion of residents and program staff, (b) educate residents and program staff regarding unprofessional behavior and the process for reporting, investigating, and addressing such concerns, and (c) support the recruitment and retention of a diverse and inclusive workforce for its training program.

6.8 Restrictive covenants, such as non-compete (NC) clauses and non-disclosure (ND) clauses, although not encouraged by CAMPEP, shall be allowed as part of a resident's terms of employment, provided they are limited in time, geography, and scope, and their terms fully disclosed to prospective residents on the program's public website. A program may not require any resident to sign any restrictive covenant amended after receipt of the resident's application.

All restrictive covenants shall be limited in time to not more than two years following completion of the residency, limited in location to within 50 miles of the resident's primary training location, and limited in scope to working for direct competitors (e.g., other consulting firms or clients), and not existing in-house medical physics positions.

Restrictive covenants shall not restrict residents' retaining the right to take with them any and all educational materials created by or for them during the residency (including lecture notes, educational presentations, study materials, etc,). Restrictive covenants can legitimately prohibit the departing resident from taking with them intellectual property of the practice such as standardized spreadsheets, or business-related property such as pricing, which they may be shown during the residency, as well as other materials that could be considered business and not educational materials.

Restrictive covenants that in any way limit residents' rights or abilities to make open and honest statements to CAMPEP about any matter pertaining to the residency program are expressly prohibited.

Restrictive covenants are explicitly prohibited in jurisdictions in which they may be in violation of the law.

7. Educational Environment

7.1 The program shall have mechanisms that encourage open discussion and communication, and facilitate the exchange of knowledge, experience and ideas.

7.2 Conference, seminar, and journal club activities shall be used for residents to practice their presentation and oral communication skills.

7.3 Residents shall have access to a variety of journals, books, and appropriate resource materials.

7.4 Residents shall have access to clinical and research facilities appropriate for a medical physics residency program.

7.5 Residents shall be provided with a mechanism for regular feedback concerning the quality of their instruction and the diligence of their mentors. The residents shall be protected from unwarranted retribution.

7.6 Feedback on the overall effectiveness of the program and recommendations for improvement should be sought from graduates.

7.7 Issues and concerns that are identified through feedback shall be evaluated by the steering committee and remedial action shall be taken where appropriate.

7.8 All clinical, educational and scholarly activities engaged in by the resident shall be recorded in an activities journal using any appropriate format maintained personally by each resident and examined regularly by the program director.

8. Residency Curriculum

8.1 The self-study document shall include written expectations of resident performance and behavior as well as the training schedule that is given to incoming residents. This training schedule shall include:

1. Duration of each clinical rotation
2. Clinical rotation objectives
3. Didactic educational expectations
4. Optional research opportunities that complement clinical training (The Self-Study should describe how the integrity of clinical training is maintained.)

8.2 The elements of clinical training shall be consistent with the curriculum described below.

8.3 The self-study document shall include a summary of the elements of clinical training of each clinical rotation to include:

1. Documentation of specific training objectives;
2. Documentation of resident progress evaluation with resident name removed;
3. Documentation of any required remedial didactic education;
4. List of clinical conferences, seminars and/or journal reviews including their frequency that the resident is expected to attend.
5. An appropriate reading list.

8.4 The process for creating or modifying training objectives shall be described.

8.5 All facilities used by the residents including their location, availability, and capacity shall be listed.

8.6 Ethics and Professional Curriculum

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

- Professionalism
  - Definition of a profession and professionalism
  - Elements of a profession
  - Definition of a professional
  - Elements of professionalism (altruism, honesty, integrity, excellence, duty, accountability, respect for others)
  - How is professionalism judged?
  - Do's and don't's of professionalism
  - Physician's charter and applicability to physicists
- Leadership
  - Qualities of leaders
  - Rules of leadership
  - Causes of leadership failure
- Ethics
  - Ethics of a profession
  - Ethics of an individual
  - Interactions with colleagues and co-workers
  - Interactions with patients and the public
  - Confidentiality
  - Peer review
  - Negotiation skills
  - Relationships with employers
  - Conflicts of interest (recognition and management)
  - Ethics in research (fabrication, fraudulence, plagiarism)
  - Use of animals in research

- Use of humans in research
- Relationships with vendors
- Publication ethics

8.7 Imaging Physics Residency Curriculum

Minimum requirements are described below for completing a residency in imaging physics. For tests to be conducted, the number of systems to be tested to demonstrate competency is left to the discretion of the program director and the supervising physicist, except for systems where accrediting agencies define the minimum number of systems that must be tested for an individual to be considered a qualified medical physicist. In these cases, the minimum number of systems to be tested shall be at least the number specified by the accrediting agency. For topics that define quantities that may be measured or computed, the resident should perform actual measurements or computations to demonstrate familiarity with the quantities and their uses.

- Conduct system performance evaluations and quality control, safety and compliance tests, including vendor recommendations, under supervision of a qualified physicist
  - Radiography
  - Computed radiography
  - Fluoroscopy
  - Interventional/angiography
  - Mammography
  - Stereotactic breast biopsy
  - Computed tomography (CT)
  - Magnetic resonance
  - Ultrasound
  - Image processors/printers
- Safety evaluations
  - Entrance exposure estimates
  - Organ dose estimates
  - Computed tomography dose index (CTDI) and dose-length product (DLP)
  - Mean glandular dose
  - Effective dose
  - Risk estimates
  - Personnel exposure estimates and reduction
  - Fetal dose
  - Contrast agents
  - Protocol optimization
  - MRI hazards
  - Organ/fetal doses with MIRD system

  - Radiopharmaceutical applications and risks
  - Site considerations and shielding design
  - Personnel shielding/monitoring
  - Calibration and survey instruments
  - Radiation surveys
  - Safety policies/procedures
  - Compliance audits
  - Dose limits
- Informatics
  - Picture archiving and communications systems (PACS) and radiology information systems (RIS) systems and their integration
  - Digital imaging and communication systems (DICOM) standards
  - Health Level 7 (HL7)
  - Information acquisition from PACS/images
  - Informatics variations among modalities
  - Dose reporting features
  - Use of Integrating the Healthcare Enterprise (IHE) radiology profiles
  - Open source software resources
  - Quality/maintenance of imaging workstations
  - Evaluation of viewing conditions
  - Image registration, fusion, segmentation, processing
  - Computer-aided detection (CAD) and computer-aided diagnosis (CADx) systems

8.8 Nuclear Medicine Physics Residency Curriculum

Minimum requirements are described below for completing a residency in nuclear medicine physics. For tests to be conducted, the number of systems to be tested to demonstrate competency is left to the discretion of the program director and the supervising physicist, except for systems where accrediting agencies define the minimum number of systems that must be tested for an individual to be considered a qualified medical physicist. In these cases, the minimum number of systems to be tested shall be at least the number specified by the accrediting agency. For topics that define quantities that may be measured or computed, the resident should perform actual measurements or computations to demonstrate familiarity with the quantities and their uses.

- Conduct system performance evaluations and quality control, safety and compliance tests, including National Electrical Manufacturers Association (NEMA) and vendor specifications, under supervision of a qualified physicist
  - Gamma camera, including intrinsic/extrinsic/SPECT performance
  - PET/CT, including ACR accreditation tests
  - Sufficient tests to achieve ACR qualified medical physicist status
  - Non-imaging equipment (e.g. dose calibrators, uptake probes, well counters)

  - Image processors/printers
  - Computer systems
- Safety evaluations
  - Organ/fetal doses with MIRD system
  - CTDI and DLP
  - Effective dose
  - Risk estimates
  - Personnel exposure estimates and reduction
  - Radiopharmaceutical applications and risks
  - Site considerations and shielding design
  - Personnel shielding/monitoring
  - Unsealed source management (storage, inventory, packaging, transportation, personnel protection)
  - Calibration and survey instruments
  - Radiation and contamination surveys
  - Radiopharmacy considerations
  - Radionuclide therapy/personnel safety/patient release criteria/public safety
  - Safety policies/procedures
  - Compliance audits
  - Occupational and public dose limits
  - National and state regulations
  - Radiation exposure to the public
  - Waste handling and disposal
  - Radioactive spills
  - Radiation signage
  - Medical events (definition and reporting requirements)
- Informatics
  - PACS and RIS systems and their integration
  - HL7
  - DICOM standards
  - Information acquisition from PACS/images
  - Informatics variations among modalities
  - Dose reporting features
  - Use of IHE radiology profiles
  - Open source software resources
  - Quality/maintenance of imaging workstations
  - Evaluation of viewing conditions
  - Image registration, fusion, segmentation, processing
  - Quantitative analysis
  - Kinetic modeling/computer analysis

8.9 Radiation Oncology Physics Residency Curriculum

Minimum requirements are described below for completing a residency in radiation oncology physics. For tests to be conducted, the number of systems to be tested to demonstrate competency is left to the discretion of the program director and the supervising physicist, except for systems where accrediting agencies define the minimum number of systems that must be tested for an individual to be considered a qualified medical physicist. In these cases, the minimum number of systems to be tested shall be at least the number specified by the accrediting agency. For topics that define quantities that may be measured or computed, the resident should perform actual measurements or computations to demonstrate familiarity with the quantities and their uses.

- Conduct system calibrations, performance evaluations and quality control, safety and compliance tests, including vendor specifications, under supervision of a qualified physicist
    - Megavoltage photons
    - Electron beams
    - Small field systems (SRS, SBRT)
    - Gamma knife (if available)
    - ^{60}Co (if available)
    - Brachytherapy implants (temporary/permanent)
    - Brachytherapy applicators, LDR, HDR
    - CT simulators
    - SPECT (if available)
    - PET/CT (if available)
    - MRI/CT (if available)
    - Protons (if available)
    - Dose scanning systems
    - In vivo dosimetry systems (e.g. diodes, thermoluminescence dosimeters (TLD), optically stimulated luminescence dosimeters (OSLD)
    - External beam dose measuring systems
    - 3D external beam treatment planning workstations
    - Immobilization devices
    - Organ motion-correction methods
    - Inhomogeneity correction algorithms
    - Image-guided radiation therapy equipment/techniques [e.g., planar MV and kV imagers, cone beam CT, non-radiographic localization (e.g., ultrasound (US), surface camera, radiofrequency (RF) beacon tracking)]
    - US in therapy
    - MRI
    - Total body photon irradiation (TBI)
    - Total skin electron therapy (TSET)

  - Optional: Conduct evaluations and tests of other therapy items (e.g. fluoro simulation, SPECT, PET/CT, MRI/PET, proton accelerators if in clinical use at the educational institution
- Treatment planning and delivery
  - Treatment simulation techniques (e.g. patient positioning, immobilization)
  - Beam properties (photons, electrons)
  - Beam modifiers [e.g., bolus, compensators, wedges (i.e., physical, dynamic, universal)]
  - Step-and-shoot and sliding window IMRT
  - Treatment planning algorithms
  - Monitor unit calculations/influencing factors
  - Monitor unit calculations/configurations (e.g. SSD setup, SAD setup, extended distance setup, off axis calculations, and rotational beams)
  - Tumor localization and International Commission on Radiation Units and Measurements (ICRU) target definitions [e.g. gross tumor volume (GTV), clinical target volume (CTV), planning target volume (PTV)]
  - Normal tissue anatomical contouring
  - 2D and 3D treatment planning
  - IMRT/VMAT planning/optimization/QA
  - Small field planning/optimization/QA
  - Site specific treatment planning – multiple applications
  - Plan evaluation [e.g., dose volume histogram (DVH), conformity index, homogeneity index, biological evaluators]
  - Treatment records
  - Dose limits to sensitive structures
  - Brachytherapy treatment plans and QA
  - Clinical applications of various radiation treatments
- Safety
  - Failure mode effects analysis (FMEA) principles/applications
  - Root cause analysis (RCA) principles/applications
  - Sealed source storage/safety/protection
  - Sealed source inventory/check in/out procedures
  - Sealed source packaging/transportation (e.g., Title 19 CFR)
  - Calibration of sealed sources
  - Exposure and contamination surveys
  - Radiation signage
  - Definition and reporting requirements for medical events
  - Radiation safety of personnel during radionuclide therapy
  - Patient release criteria following radionuclide therapy and radiation safety for the public

  - Safety policies/procedures
  - Compliance audits
  - Occupational and public dose limits
  - National and state regulations
  - Radiation exposure to the public
  - Site design and shielding (primary and secondary barrier computations)
  - Neutron shielding
  - Facility radiation surveys
  - Personnel dosimetry
- Informatics
  - Beam data acquisition/management
  - Beam modeling
  - Validation of imported images
  - PACS systems and their integration
  - HL7
  - DICOM standards
  - DICOM in radiation therapy (DICOM-RT)
  - Information acquisition from PACS/images
  - Quality/maintenance of imaging workstations
  - Evaluation of viewing conditions
  - Image registration, fusion, segmentation, processing
  - Quantitative analysis
  - Record and verify systems
  - Treatment record design/maintenance
  - IHE – Radiation Oncology (IHE-RO)
  - Network integration/management, and roles of physics and information technology staff
- Therapeutic radiopharmaceutical training should be included in the curriculum of radiation oncology physics residents