

Structured intercomparison of Clinical Medical Physicists' Education and Training frameworks in European, North American and Australasian countries

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1. PURPOSE

The clinical medical physicist is an essential link of a multi-professional chain, responsible for the effective and safe implementation of radiation-based medical procedures. To ensure that the physicist can provide an adequate service, sufficient education and training in their fields of practice is indispensable. However, a common education and training framework is not available world-wide. Because of this a uniform level of skills and knowledge does not exist. The aim of this study is to provide a structured collection of information regarding the present status of the clinical medical physicist education and training framework in 25 European, 2 North American and 2 Australasian countries. Evaluation of these data can set the stage for free movement of medical physicists among these countries.

2. MATERIAL & METHODS

For this study, data collection was based on a pre-existing questionnaire prepared by the European Federation of Organizations in Medical Physics (EFOMP) and filled-in either by the corresponding scientific societies-organizations or by the authors. It consisted of three main parts concerning the education and training (Part A), the different professional levels (Part B) and the existence of a national register of clinical medical physicists (Part C).

3. RESULTS

The results of this study are presented in Tables 1-9. Part A of the questionnaire is analyzed in Tables 1-4, Part B in Tables 5-7 and Part C in Tables 8-9.

Table 1. Part A, Question 1: Which degree is required? Is this a university degree? How many years of studies are required?

Geographical region	Current status
Europe	In all member-countries that participated, the basic prerequisite for the entrance into the medical physics profession is to hold a university degree (predominant degrees: BSc in 7 countries-28%, MSc in 9 countries-36%). The duration of the basic university education ranges from 1.5 to 5 years.
USA	ABR: BSc in physics or applied physics and relevant specialties + MSc or PhD from a CAMPEP (Commission on Accreditation of Medical Physics Educational Programs) approved graduate program in medical physics starting in 2012. The candidate must currently work as a medical physicist under the supervision of a certified medical physicist. Also, at least 3 years of clinical experience (full-time) under the supervision of a certified medical physicist are necessary. By 2014, the ABR will require that the clinical experience be gained in a CAMPEP-approved medical physics residency program, not all of which are hospital-based.
USA	ABMP: Similar to the ABR, but without the CAMPEP-related conditions.
USA	ABHP: BSc from a college or university and 6 years experience in health physics (at least 3 years must be in applied health physics).
USA	ABSNM: MSc or PhD, 2 years (PhD) or 3 years (MSc) full-time practical training in physics of nuclear medicine. Alternatively: MSc or PhD, ~5 years of professional experience in health physics. 3 years must be in applied health physics, in order to work on radiation protection.
Canada	CCPM: BSc + MSc or PhD + 2 years of clinical experience.
Australia-New Zealand	ACPSEM: BSc + MSc or PhD in physics + 3 years of clinical experience.

Table 2. Part A, Question 2: Is there a nationally-approved education program?

Geographical region	Current status
Europe	In 16 countries (64%) there is an approval by the Ministry of Health or Education (alternatively by a University or the National Medical Physics Organization).
USA	The American Association of Physicists in Medicine (AAPM) recommends the content of a graduate program in medical physics in its TG79 report. The CAMPEP accredits graduate programs and residency programs in medical physics.
Canada	CCPM: No special approval is mentioned.
Australia-New Zealand	ACPSEM: The MSc-level medical physics courses are accredited by the ACPSEM.

Table 3. Part A, Question 3: Where does the education and training take place: University, hospital or a combination of both? Are these centers accredited? Which official body is responsible for the accreditation?

Geographical region	Current status
Europe	There are 3 different approaches of postgraduate education and training (exclusively university studies: 3 countries-12%, solely practice in a hospital: 3 countries-12%, combination of both: 17 countries-68%).
USA	ABR, ABMP and ABHP: Previously presented educational institutes + accepted hospital from CAMPEP (Commission on Accreditation of Medical Physics Educational Programs). ABSNM: Previously presented educational institutes + (optional) hospital accepted by CAMPEP.
Canada	CCPM: Previously presented educational institutes + hospital.
Australia-New Zealand	ACPSEM: ACPSEM-accredited university MSc courses for education and ACPSEM-accredited hospitals for clinical training.

Table 4. Part A, Question 4: Which is the total duration of the education program and how is the time education-training distributed?

Geographical region	Current status
Europe	Total duration of the education and training program in medical physics ranges from 2.5 to 9 years.
USA	ABR, ABMP: University studies + at least 3 years (full-time) of clinical experience under the supervision of a certified medical physicist.
USA	ABHP: University studies + 6 years of experience in health physics. At least 3 years of experience must be in applied health physics. 1 year of experience can be substituted by an MSc in health physics or a relevant topic (2 years for PhD).
USA	ABSNM: University studies + 2 years (PhD) or 3 years (MSc) of practical training (full time), to work on physics of nuclear medicine. Alternatively: University studies + 5 years of professional experience in health physics including 3 years in applied health physics, to work on radiation protection.
Canada	CCPM: BSc + 2 years (PhD) or 3 years (MSc) of practical training (full time), to work on physics of nuclear medicine or ?5 years of professional experience in health physics including 3 years in applied health physics.
Australia-New Zealand	ACPSEM: University studies for BSc + 2 years (MSc) or 3 years (PhD) of education at ACPSEM-accredited university + at least 3 years (full-time) practical training

Table 5. Part B, Question 1: Is there a license or diploma required to work as medical physicist? Is it officially provided (i.e. government)?

Geographical region	Current status
Europe	In 14 countries (56%) holding a license is compulsory to work as a medical physicist. In 14 countries (56%) the license gives the right to work in all areas of medical physics (radiotherapy, nuclear medicine, radiology, radiation protection) whereas in 4 countries the area of competence depends on the subjects chosen during the education and training program.
USA-Canada	ABR, ABMP, ABHP, ABSNM and CCPM: Apart from 4 states that require a license (New York, Florida, Texas, Hawaii), certification from one of the responsible bodies is sufficient.
Australia-New Zealand	ACPSEM: Licensing is provided by the local regulatory authority (the states and territories in Australia and the New Zealand government in New Zealand). Most states require licensing. Licensing is often just a license to use equipment and not licensing to practice as a medical physicist. National registration is provided by the ACPSEM which is recognised by the national Australian regulatory authority. In New Zealand, a senior physicist who takes direct responsibility for a section/s of the department's work must be licensed.

Table 6. Part B, Question 2: Are there alternative ways for eligibility to work as a medical physicist, except holding the license?

Geographical region	Current status
Europe	In 22 countries (44% of the cases), it is not compulsory to have relevant license to be eligible to work. In these cases the possession of a relevant university degree or working at the specific area for 3-5 years is enough.
USA-Canada	ABR, ABMP, ABHP, ABSNM and CCPM: Apart from the above 4 states of USA (Table 8), in the rest of the states the certification from one of the responsible bodies is sufficient.
Australia-New Zealand	ACPSEM: In states without licensing, sufficient education in physics and mathematics + MSc in medical physics are required.

Table 7. Part B, Question 3: Is the "diploma" or "license" equivalent to Qualified Medical Physicist (QMP) or to Specialized Medical Physicist (SMP)?

Geographical region	Current status
Europe	In 6 countries (24%) the license is equivalent to QMP, in 7 countries (28%) to SMP or and in 13 countries (52%) to Medical Physics Expert (MPE).
USA-Canada	ABR, ABMP, ABHP, ABSNM and CCPM: Equivalent to QMP (level 1 of training).
Australia-New Zealand	ACPSEM: Equivalent to SMP. There are three recognised specialties - radiation oncology medical physicist, nuclear medicine physicist and radiology medical physicist.

Table 8. Part C, Question 1: Is there a "Register of Medical Physicists" in the country? If so, how is someone registered? Is the entrance in the register voluntary or compulsory?

Geographical region	Current status
Europe	17 countries (68%) have an organized "Register of Medical Physicists". Registration is voluntary in 53% of these countries (9 countries in total).
USA-Canada	ABR, ABMP, ABHP, ABSNM and CCPM: There is a register-voluntary registration. The certification from one of these 5 bodies is compulsory for someone to work as a professional.
Australia-New Zealand	ACPSEM: There is a register - voluntary registration. Registration is recognised by national Australian regulatory authority.

4. DISCUSSION - CONCLUSIONS

Analysis of the questionnaire answers demonstrated the significance of two major components: hospital training of medical physicist candidates as an important part of the essential entry standards, and CPD as a means of quality assurance of professional competence.

In conclusion, a common policy on matters concerning education and training as well as the practice of the medical physicist profession is generally followed, notwithstanding the presence of a few differences. Attempts to formulate general guidelines are already in progress based on common features, as well as differences, from country to country.

Table 9. Part C, Question 2: Is there a renewal mechanism in the register? If yes, is it based on a Continuing Professional Development (CPD) system?

Geographical region	Current status
Europe	11 countries have a renewal mechanism in their register. 13 countries (52%) have a legislative CPD system. In 100% of the cases the CPD system is used as the renewal mechanism in the register.
USA	ABR: Maintenance of Certification (MOC). It is a 10-year cycle of education. At least 500 credits are necessary in a 10-year cycle. At least 25 credits (with a maximum of 50 credits) are required per year. Self-education: 20 credits for a 10 year-cycle (2 credits/year with a maximum 4 credits/year). Examinations once in a 10-year cycle. If someone has a certificate in more than one specialty, he or she must take separate examinations for each specialty, to maintain the corresponding right to work.
USA	ABMP: After 10 years from first certification, there is a 5-year cycle of recertification for the maintenance on the "Register of Certified Medical Physicists". An average of 30 credits a year of CPD is required.
USA	ABHP: Recertification every 4 years. It is based on a CPD system. Working currently as a health physicist is compulsory. Credits are received from various activities.
USA	ABSNM: Certification is permanent and no CPD is required.
Canada	CCPM: Recertification every 5 years. 5-year working experience as a medical physicist is compulsory. A recommendation letter from a certified medical physicist of CCPM, ABMP or ABR is necessary (if there is no medical physicist then from a medical doctor with the higher position in the specialty e.g. head of the radiotherapy department etc.). 50 credits from different professional activities are needed.
Australia-New Zealand	ACPSEM: Continued registration requires maintenance of CPD at an average of 50 hours CPD per year, averaged over the previous five years.