



Medical physicist certification and training program accreditation

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Abstract

As a profession, medical physics combines an advanced understanding of physics and math with knowledge of biology, anatomy and physiology. Consequently, rigorous education and training is required to assure that medical physicists have the requisite fundamental knowledge, specialized technical skills, and clinical understanding to contribute to the medical care of patients safely. There is, therefore, an interest in standardizing the educational pathways and in developing mechanisms to assure that competency is achieved and maintained. Throughout the world, several countries, regions, and professional organizations have developed mechanisms for accrediting medical physics educational programs, both for didactic work performed in undergraduate or post-graduate settings, and for clinical training conducted in hospitals and clinics. In addition, several national and international programs exist for certifying individual medical physicists. In some cases, once initial certification is achieved, the diplomate enters a program of maintenance of certification, to ensure that the skills obtained during training are not lost over a career. This article explores the differences and similarities in the training program accreditation and physicist certification mechanisms.

Keywords Certification · Accreditation · Medical physics · Qualified expert · Training · Standards

1 Introduction

Medical physics is an applied branch of physics that combines upper-level physics and math with biology, anatomy and physiology to enable practitioners to contribute to the delivery of healthcare involving radiation of various types. The field is growing rapidly and requires a high degree of knowledge and professional competency due to the rise in complexity of treatment procedures, increasing access to medical technology, and the need for coordination between the disciplines of medicine, physics, and biomedical engineering. The unprecedented surge in medical physics competency in the last two or three decades is due to the implementation of specialized physics-intensive procedures such as particle therapy, image-guided and intra-operative radiotherapy, advanced imaging, and nuclear medicine techniques. Given the advances in imaging and treatment capabilities and the improved access to patients, the quantity of qualified medical physicists needs to be in consonance with the competency needed.

Many medical physicists work in clinical positions where their work can directly influence the quality and safety of patient care. Medical physicists are often employed in

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private clinics, community hospitals, or academic medical centers, and contribute to the quality of medical imaging and radiation treatments. Some medical physics work is applied to specific patients, as indicated above, but much work supports the development and applications of imaging and radiotherapy performed in a clinic. These services therefore can affect the quality of care delivered to many patients, and conversely, if performed incorrectly, can result in harm to large numbers of patients [1–4].

The demand for qualified medical physicists has led to the creation of numerous educational programs around the world. However, the training and educational curriculum needs to be tuned with the requirement to produce sufficient numbers of competent clinically qualified medical physicists (CQMP), not just for the present but also for future needs. Furthermore, the major outcome of an academic program is to provide the students with a thorough grounding in medical physics, critical thinking, scientific rigor, and professional ethics, to facilitate the integration of the graduates in a healthcare profession, where the benefit of the patient is at the center of all activities. Medical physics is facing significant changes, particularly with rapid development of biological sciences, more complex research requiring interdisciplinary teams and an urgent need for translational research. The changes towards personalized medicine are opening new avenues for medical physicists including molecular imaging and advanced adaptive radiation therapy. To prepare medical physicists for the future, education and training should be properly adjusted to include more basic non-physical sciences, particularly biology; more imaging, especially molecular imaging; and more interdisciplinary and translational research components.

In many countries, medical physicists are encouraged to acquire an education consisting of an undergraduate degree in physics or a related science, followed by a graduate degree (often, but not always, an MS or PhD) from a dedicated medical physics program. Before entering a clinical position, it is essential that a medical physicist receive practical training. In some countries, this is handled by close supervision during on-the-job training. Other countries have developed medical physics residency programs that mimic medical residencies and focus on the practical clinical work involved in imaging or radiation therapy.

The public would rightfully question whether medical physicists trained by various universities and other institutions fulfil these expectations, and whether medical physicists leaving our educational programs are sufficiently prepared to discharge the duties of clinical medical physicists without supervision. To enhance and standardize medical physics education and, ultimately, the profession, accreditation of medical physics education programs and certification of individual medical physicists is essential.

This article explores the mechanisms for program accreditation and for the certification of medical physicists in several countries and provides examples of specific accreditation and certification processes. Countries and regions not currently supporting these accreditation and certification mechanisms may use this article as a guide for the development of such mechanisms.

2 Accreditation of medical physics programs

Preparation for a career in medical physics generally includes an undergraduate major in physics followed by a graduate degree (often, but not always, an MS or PhD) in medical physics. The graduate course work is usually followed by a clinical residency or on-the-job training. In many countries, graduate educational programs are not available and medical physics training is conducted as part of an undergraduate degree. PhD programs, on the other hand, incorporate research training and a dissertation allowing recipients to pursue an academic career, although many physicists who follow this track continue to provide clinical medical physics services along with their academic pursuits.

World-wide, many institutes and universities operate medical physics educational programs; however, to meet minimum standards of education and provide credibility the programs need to be accredited. Accreditation helps determine if an institution meets or exceeds minimum standards of quality and helps students determine acceptable institutions for enrollment. In addition, employers often require evidence that applicants have received a degree from an accredited school or program. For the public, accreditation promotes the health, safety, and welfare of society by assuring competency of public health professionals.

Assuring the adequacy and uniformity of training in medical physics graduate programs requires auditing by an independent organization with defined procedures and experienced personnel. The accreditation of medical physics educational programs parallels the mechanisms for accrediting colleges and universities, and those for accrediting medical schools. In the US, colleges and universities are accredited by organizations such as state or regional Higher Education Commissions, while in many other countries accreditation is performed by national groups. However, accreditation of smaller educational programs such as those for medical physics is an expensive process that is unlikely to be sustainable in smaller countries with few programs. Some specific examples follow:

2.1 USA

In the United States, the American Association of Physicists in Medicine (AAPM) recognized in the early 1980s that a

mechanism was needed to evaluate medical physics training. An informal Committee on Accreditation was formed which developed standards for medical physics education and conducted reviews of training programs. Fewer than ten programs were accredited by this method, but it was soon realized that the accreditation process needed to be separated from the AAPM and in 1994 an independent board called the Commission on Accreditation of Medical Physics Educational Programs (CAMPEP) was formed. Funding of CAMPEP is currently provided by the AAPM, The American College of Radiology (ACR), the American Society for Radiation Oncology (ASTRO), the Canadian Organization of Medical Physicists (COMP), and the Radiological Society of North America (RSNA); however, the charter assures that CAMPEP functions independently and cannot be manipulated by the supporting organizations.

CAMPEP has published standards for medical physics graduate programs and residency programs which may be found on its web site at <http://www.campep.org>. The accreditation procedure requires that an institution notify CAMPEP of its intent to apply for accreditation and conduct a comprehensive study of its own educational and training resources (a “self study”). Ordinarily, a site visit is scheduled, and a team of senior medical physicists conducts an in-depth review of the program, speaking to faculty, administrators and students. Recently, due to the pandemic, these visits have largely been virtual. Today, CAMPEP lists 60 accredited graduate educational programs and 121 medical physics residency programs on their website.

2.2 UK

Professional accreditation of medical physics MSc-level university courses was initiated in the UK in the early 1990s. Accreditation was based on the requirements of the UK Institute for Physics and Engineering in Medicine (IPEM). In addition to this professional accreditation, each UK university educational program also passed an internal accreditation process, related to educational standards and systems. The frequency of these accreditations was usually 5 years.

The IPEM accreditation assured the quality of Medical Physics and Medical Engineering MSc education, as the necessary academic element of the practical training (aka residency). The IPEM system was updated regularly, until 2010. It included an Accreditation Board of Specialists with experience in medical physics and medical engineering education. Members of the Board regularly visited MSc programs to check the content of the curricula (compared with an IPEM Guide), the academic level of the MSc theses and the quality of overall teaching and learning activities. Normally, only students from such accredited MSc programs were allowed to enter the coveted Training Scheme of 2 years. This Scheme was also developed by the IPEM and its completion

was assessed by a specific theoretical and practical examination by an IPEM professional panel. Following this the student/trainee could enter the Certification process. Only selected Hospital Departments—Training Centers—could recruit trainees (subject to an additional accreditation of the respective Department). A part of this system, plus the IOMP Model Curriculum and various educational resources (such as the Medical Physics e-Encyclopaedia) were used in the development of the original IAEA TCS 56 – “Postgraduate Medical Physics Academic Programmes” Guide.

In 2010 the UK National Health Service (NHS), in collaboration with IPEM, developed new criteria for education and training. Based on these criteria, selected trainees pass through education (MSc-level) and practical training for 3 years. This leads to Certification as a Clinical Scientist (Medical Physics) or a Clinical Scientist (Clinical Engineering). The initial part of the MSc curricula, associated with this scheme, includes elements which are common for various para-clinical specialties. Only 4 MSc programs in England were selected for this coveted NHS program, associated with a contract between the selected University and the NHS.

In 2014 IPEM developed new Accreditation criteria for Medical Physics and Engineering, available also to academic programs outside the UK. These criteria can be viewed at the following link:

<https://www.ipem.ac.uk/Portals/0/Documents/Accreditation/03-11-11%200264%2007.00%20MLAF%20Handbook.pdf?ver=2020-12-16-134651-383>

2.3 Europe

The European Commission has developed many programs to support accreditation activities. The European Qualifications Framework (EQF) is a learning outcomes-based framework consisting of 8 levels (level 1: basic general knowledge; to level 8: knowledge at the most advanced frontier of a field of work or study and at the interface between fields). Learning outcomes are defined in terms of knowledge, skills and responsibility and autonomy. The ‘European Guidelines on Medical Physics Expert’ (accessible at <https://op.europa.eu/en/publication-detail/-/publication/b82ed768-4c50-4c9a-a789-98a3b0df5391>) lists the learning objectives in accordance with the EQF and provides essential information for organizers of medical physics education and training events as well as for those wishing to achieve the Medical Physics Expert level. The qualification level for the MPE has been set at EQF Level 8.

The European Federation of Organizations for Medical Physics (EFOMP), at its Council meeting organized in Athens, Greece on the 13th of September 2014 decided to establish the ‘European Board for Accreditation in Medical Physics’ (EBAMP). EBAMP is an independent organization,

and its main aim is to accredit medical physics education and training events. EBAMP's Board consists of 4 officers (President, Vice President/Past President, Secretary General, Treasurer) and 5 members. The Board accepts applications from the organizers of events such as congresses, conferences, workshops, seminars and courses. University degree courses are excluded at present. Applications must be submitted online at least 3 months prior to the education/training event. More information about the accreditation procedure, a database of accredited events and the quality manual of EBAMP can be found on its web site at ebamp.eu.

2.4 Asia and Australasia

The Asia Oceania Federation of Organizations of Medical Physics (AFOMP) was founded in 2000 and is one of the largest regional organizations of the International Organization for Medical Physics (IOMP). AFOMP currently has 19 national medical physics member organizations (NMO) as members and two NMOs as affiliate members.

Medical physics education and training, as well as the accreditation of programs and the certification and registration of medical physicists has increased in the last 20 years in the AFOMP region. However, the increasing population and the corresponding increase in the number of patients needing radiological services coupled with rising complexity of techniques has created a demand for certified CQMPs to provide effective and efficient services. Presently, approximately 110 masters in medical physics programs at institutes and universities in AFOMP NMO countries currently have the capacity for over 850 students per year. To bridge the huge gap between supply and demand, additional capacity must be built to educate a sufficient number of certified CQMPs in the AFOMP region.

AFOMP is very heterogenous in terms of socioeconomic and education standards and every country has its own system of education as there is no common binding system as may be found in Europe (See previous section). A few countries in AFOMP have developed accreditation and certification boards such as the Australasian College of Physical Scientists & Engineers in Medicine (ACPSEM), the Japanese Board for Medical Physicist Qualification (JBMP), the South Korean Medical Physics Certification Board (KMPCB), and the College of Medical Physics of India (CMPI). In some countries the medical physics education programs are accredited by IOMP, the Institute for Physics and Engineering in Medicine (IPEM) and CAMPEP. However fewer than 10% of the medical physics education programs in the AFOMP region are accredited as there is no mandatory requirement as is the case in many other countries.

2.5 IOMP accreditation

The IOMP is dedicated to improving medical physics worldwide by disseminating standardized knowledge through education and training of medical physicists, to advance the practice of physics in medicine by fostering the education, training, and professional development of medical physicists. To harmonize medical physics education, the IOMP published Policy Statement No. 2 which defines the basic requirements for education and training of medical physicists. It aims to serve as a reference for medical physics organizations, educational institutions and health care providers, and authorities in planning and development of their national infrastructures for education, training, and certification of medical physicists and for maintenance of standards of practice. To accomplish these goals, the IOMP Accreditation Board has been created to ensure that accredited medical physics programs satisfy the highest standards established by IOMP in collaboration with other international organizations.

The IOMP accreditation board accredits medical physics degree programs, post-graduate programs, medical physics residency programs, medical physics education and training institutions and centers, and education and training events. The application manual with application forms for IOMP accreditation of Medical Physics educational programs was finalized after rigorous review and is now uploaded on the IOMP website: <https://www.iomp.org/accreditation/>

2.5.1 Benefits of IOMP accreditation:

A number of benefits accrue to institutions that complete accreditation through the IOMP:

- Enhanced reputation of accredited programs and courses which will result in more demand for these education and training activities.
- Provision of an international dimension to an education event that will attract participants from other countries.
- Evidence of the highest teaching standards and best preparation of medical physicists for the work environment.
- Publication of accredited programs and courses on the IOMP website.

Accredited programs include the following:

- The Catholic University of Korea – Full Accreditation.
- KAIST University – full accreditation.
- Yonsei University – full accreditation.

- ICTP & Trieste University joint Master of Advanced Studies in Medical Physics – full accreditation.

3 Certification of medical physicists

An assessment of the skills and knowledge of a medical physicist is often referred to as certification, and when conducted by a formal certification board, is known as “board certification”. Medical physicists who have met the standards of a certification board may be referred to as “diplomates” as they typically receive a diploma or certificate attesting to their status.

Candidates for board certification must meet the board’s standards for education and experience, to ensure that they are adequately prepared for the certification procedures. The process generally consists of one or more examinations which may be written or oral. The stated purpose of most certification boards is to assure that the diplomate is sufficiently prepared to perform medical physics services without supervision.

3.1 USA

Certification of medical physicists in the USA is offered by several certification boards. The large majority of medical physicists are certified by the American Board of Radiology (ABR) which also certifies physicians in the disciplines of radiology, interventional radiology, and radiation oncology. The ABR is a member board of the American Board of Medical Specialties (ABMS) which is an umbrella organization that sets standards for the member boards. Twenty-four medical boards are members of the ABMS, including the American Board of Internal Medicine, the American Board of Pediatrics, and others. Membership in the ABMS carries with it the recognition of the American Medical Association and other important medical institutions.

The ABR offers initial certification of medical physicists in the specialties of Diagnostic Medical Physics, Nuclear Medical Physics and Therapeutic Medical Physics. While there have been requests for more granular certification pathways (such as Proton Therapy Physics, or Magnetic Resonance Imaging) the ABR has resisted narrowing the breadth of certification. The rationale for this is that some medical physicists might narrow the focus of their practices as they become more senior, but young medical physicists are more likely to work in circumstances that require them to be proficient across a range of services, or to change jobs to ones in which their responsibilities are different. It is felt that ABR certification in, say, Diagnostic Medical Physics should recognize competence in all specializations including, for example, ultrasound physics and MRI physics.

Certification by the ABR requires that candidates pass several computer-based qualifying exams and an oral certification exam. The qualifying exams are separated into Parts 1 and 2. The Part 1 exams have a general part and a clinical part and may be taken once the candidate has completed the core curriculum specified by CAMPEP and taught in all CAMPEP accredited graduate education programs. For many candidates, this is at the end of the first year of an MS program, or part way through a PhD program. The exam was originally a written exam but was converted to a computer-based exam in the 1990s and for many years was offered at commercial testing centers. In 2020, due to the pandemic, the exam was converted to a remote exam and now is taken by candidates on their home or office computers, in suitably secluded and secure environments.

The Part 2 qualifying exam is offered to candidates who have achieved an appropriate level of clinical experience and is specific to each of the medical physics specialties. Effective in 2014 and following the recommendation of the AAPM, candidates are required to have completed a CAMPEP-accredited residency program. The Part 2 exam also is now taken remotely using the candidate’s home or office computer.

Following successful completion of the Part 2 qualifying exam, the candidate is eligible for the oral certification exam. Until 2019, the exam was offered in person, and each candidate faced five examiners, one at a time. In response to the pandemic, the ABR converted the oral exam into a remote exam and now candidates enter a virtual examination room, in which they are able to see and hear their examiners, and the examiners are able to present questions, which might include text and graphics, while also seeing and hearing the candidates. The five examiners enter the virtual examination room one at a time. Each examination period is nominally 30 min, during which each examiner asks five questions, one from each of five categories. The categories are different for the different medical physics specialties, but include equipment, dosimetry, radiation protection and safety, and clinical procedures. Candidates who successfully complete the oral certifying exam are awarded certificates and may call themselves Diplomates of the ABR.

In 1999 the ABMS mandated that member boards institute Continuing Certification programs. This requirement followed the observation that one’s knowledge and clinical skills tended to deteriorate with time and needed regular refreshing. The programs were originally called Maintenance of Certification but in 2020, the decision was made to transition to the term Continuing Certification (CC), and the ABR is currently making this transition. The ABMS has set standards for CC programs, and member boards are expected to comply with these standards, although adjustments are permitted for specific populations, including medical physicists,

whose practice is somewhat different from the typical clinician. Participants in the ABR's medical physics CC program are expected to maintain standards of professionalism, acquire continuing education, undergo regular assessments of "walking-around knowledge" and conduct personal quality and safety improvement activities. Further details may be found at the ABR web site: <https://www.theabr.org>.

Some medical physicists are certified by the American Board of Medical Physics (ABMP). In 2001 an agreement was reached between the ABR and the ABMP under which the ABMP agreed not to compete with the ABR but would offer certification only in specialties not addressed by the ABR. The ABMP subsequently limited its certificates to medical health physics, magnetic resonance imaging, and hyperthermia. The ABMP is not a member board of the ABMS, but physicists certified in diagnostic, nuclear or therapeutic medical physics by the ABMP prior to 2001 are for most purposes considered to be equally qualified to those certified in the same specialties by the ABR. The ABMP also conducts a program of Maintenance of Certification.

Medical physicists who work in nuclear medicine often seek certification by the American Board of Science in Nuclear Medicine (ABSNM). The ABSNM is not a member board of the ABMS and is not required to meet the ABMS standards. It also does not offer diplomates a program of Maintenance of Certification. The requirements of the ABSNM are perceived by many to be less exacting than those of the ABR and consequently relatively few nuclear medical physicists are certified by the ABR.

3.2 Canada

The Canadian College of Physicists in Medicine (CCPM) certifies Canadian medical physicists, although some pursue certification by the ABR. The certification program requires a graduate medical physics education and a minimum of two years of clinical experience. The initial certification process consists of written and oral exams. Successful candidates are awarded membership in the College.

The CCPM requires its members to become recertified every 5 years to maintain their certification and to demonstrate that they have maintained their clinical skills and professionalism. Re-certification consists of a credential review of evidence of clinical practice and appropriate continuing education.

3.3 UK

Certification of medical physicists in the UK was initiated in mid 1990s through a Voluntary Professional Register of Scientists in Health Care. Initially this Register was open for specialists with significant clinical experience. In parallel the system for certification of early-career medical physicists,

developed by IPEM, was developing young, certified specialists. This system was based on graduation from an IPEM-accredited MSc-level program, plus 2 years of basic training, followed by additional years of supervised work as young professional. The process terminated with a professional exam. Successful completion leads to a Certification Diploma. At the end of 1990s this system was included in the professional register of the Council for Professions Supplementary to Medicine (CPSM). Certification is associated with further status as Chartered Scientist (with Postnominal CSci).

In 2010 the UK National Health System (NHS), in collaboration with the UK Institute for Physics and Engineering in Medicine (IPEM) developed a new system for Certification, based on completion of an NHS and IPEM accredited MSc programs, plus clinical training and an MSc thesis on the subject of the main training subject (e.g. Diagnostic Radiology). This system runs for 3 years and, as usual, is completed with a successfully passed exam, resulting in the Certification Diploma and Chartered status. In specific cases the system allows alternative routes to certification. This system is available for both Medical Physics and Clinical Engineering. In order to support one's certification status, each chartered scientist is required to acquire a specific minimum number of Continuous Professional Development (CPD) activities. These CPD activities are subject to annual assessment by the IPEM. The certification is regulated by the Health & Care Professions Council (HCPC). More information can be seen here:

<https://www.ipem.ac.uk/Training-Workforce/Regulation-and-Registration>

3.4 Europe

Medical physicists in Europe are certified by national competent authorities. EFOMP established the European Examination Board (EEB) in 2017. The EEB awards the 'European Diploma of Medical Physics' and the 'European Attestation Certificate to those Medical Physicists that have reached the Medical Physics Expert level' (EACMPE). EEB examinations are voluntary, and its diplomas do not replace national certificates. EEB diplomas help to standardize training in Medical Physics across Europe by providing a common European qualification for medical physicists.

EFOMP as well as the European Society of Therapeutic Radiation Oncology (ESTRO), the European Society of Radiology (ESR) and the European Association of Nuclear Medicine (EANM) have agreed on the syllabi for the training and education of medical physicists. These documents are essential for the EEB examinations. EFOMP and ESTRO have released very recently the 3rd revised edition of the 'Core Curriculum for medical physics experts in radiotherapy'. Curricula for Medical Physics Experts in Radiology,

Nuclear Medicine and Radiotherapy can be found at <https://www.efomp.org/index.php?r=fc&id=core-curricula>.

3.5 Australasia

In Australia and New Zealand, the Australasian College of Physical Scientists and Engineers in Medicine (ACPSEM) administers a Training, Education and Assessment Program (TEAP) that certifies professionals in Radiation Oncology Medical Physics (ROMP), Diagnostic Imaging Medical Physics (DIMP) and Radiopharmaceutical Science (RPS) (<https://www.acpsem.org.au/Our-Work/TEAP-Certification>). The program which runs for more than 10 years requires a master's degree in medical physics and three years clinical training in an accredited institution. Progressive assessment ensures that candidates make appropriate progress against the Clinical Training Guide. The competency-based program leads to certification which in turn allows registration with ACPSEM.

3.6 International programs

3.6.1 The international atomic energy agency

The IAEA recognized the importance of medical physics in the peaceful use of radiation as early as in 1960. The recent harmonizing efforts including the production of the Training Course Series (TCS) and operating the MMS program in medical physics have had very positive effects on raising the standards of the medical physics profession and even the medical field. In 2013, the IAEA published Human Health Series Report No. 25 on “Roles and Responsibilities, and Education and Training Requirements for Clinically Qualified Medical Physicists” to provide guidance to member states in the development of educational programs.

Following the publication of Report 25, IAEA published in 2021 a Training Course Series (TCS) Report 71 on Guidelines for the Certification of Clinically Qualified Medical Physicists to provide international guidance in the certification of individuals and on the establishment of certification programs. Both publications were endorsed by IOMP and AAPM. The latter was also endorsed by IMPCB.

3.6.2 The international medical physics certification board

IOMP's decades of work including the policy statements of 2010, laid the foundation for IMPCB to build on. Before that, some countries such as USA, Canada, and Australia provided the successful models of education, registration, and certification systems that have proven to work well in the respective countries. Medical physicists in other countries wrote about the need to have an international system to identify similarly qualified individuals. Articles appeared in the

IOMP newsletters in the last forty or more years suggesting reasons for the shortage in medical physicists worldwide and ways to counter it. With the publications of the International Standard Classification of Occupations (ISCO-08) and the IOMP Policy Statements in 2010, the time was right to create a certification and accreditation scheme to address the issue internationally. The IOMP again was the driving force behind it.

The IMPCB was incorporated in 2010 and the IOMP became the Principle Supporting Organization when a Memorandum of Understanding was signed during the World Congress 2016. (Please see: <https://www.impcb.org/policies/>). IOMP agreed to provide a mechanism for supporting the infrastructure of education and scientific meeting accreditation so that the IMPCB could focus on its work. Among the many objectives stated in the bylaws of IMPCB, the tasks of accreditation of national and regional certification boards and direct certification of individual medical physicists are most important. The certification examinations for individual medical physicists are limited to those residing in countries that do not have their own national certification boards. For countries which already have their own board certification programs, the IMPCB offers to provide accreditation of these boards. For those that do not, the IMPCB will provide help in establishing their own national certification boards, providing that the national medical physics communities adopt the basic principles stated in the IMPCB bylaws and the IOMP Policy Statements. National organizations that follow these principles can join IMPCB as Supporting Organizations. Other countries can also join IMPCB starting as Observing Organizations.

It has been challenging under Covid-19 during the past two years. To deal with the restrictions IMPCB has developed a Zoom-based model for oral examinations as an option. The model proved to work well delivering the same features as the in-person model. It does require more staff time to confirm that the candidate has the internet capabilities to assure a stable connection for three hours. For the medical physicists IMPCB aims to serve, this Zoom-based model seems to be a workable alternative. From June 2020 to September 2021 IMPCB has delivered seven oral exam sessions. The dates and numbers of candidates and other details for each session are available for view on the IMPCB website: <https://www.impcb.org/exams/exam-dates/>.

To date, the IMPCB has accredited three national/regional certification boards with another two pending. More than 200 medical physicists have been admitted to the individual certification examination process; 119 of them have passed Part I and 82 passed Part II examinations [5]. As of the end of October 2021, there are 43 who have passed all three parts of the exam and are now fully certified medical physicists who can use the title of DIMPCB (Diplomate of IMPCB). These diplomates reside and work in 20 different countries. Among

them four became certified in Diagnostic and Interventional Radiological Medical Physics while the rest were certified in Radiation Oncology Medical Physics. IMPCB is planning to offer certification in the specialty of Nuclear Medicine Physics in 2022.

4 Summary

Medical physics blends a foundation in academic physics with an upper-level education in advanced physics topics, followed by supervised clinical training. Medical physicists are employed in most countries as an essential element of health care.

Many variations exist, but most countries recognize that the quality of this education is key to assuring the safety of patients receiving diagnostic examinations and treatments involving radiation. Most countries support educational programs to provide didactic and clinical training, and many have developed accreditation mechanisms to standardize the educational processes and verify that the standards are met. International guidelines have been published to assist countries that don't have the resources to develop their own standards.

Similarly, mechanisms exist for evaluating the knowledge and skills of individual medical physicists. Such certification programs are operating in many countries, and an international program supports countries in which managing such a program is not feasible. Some national programs include processes to assure that diplomates maintain the knowledge and technical skills needed to perform their functions safely.

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