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Guidelines for the Certification of Clinically Qualified Medical Physicists

Endorsed by the International Medical Physics Certification Board (IMPCB) and the International Organization for Medical Physics (IOMP)

VIENNA, 2021

TRAINING COURSE SERIES 71

GUIDELINES FOR THE CERTIFICATION OF CLINICALLY QUALIFIED MEDICAL PHYSICISTS

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INTERNATIONAL MEDICAL PHYSICS
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FOR MEDICAL PHYSICS (IOMP)

INTERNATIONAL ATOMIC ENERGY AGENCY
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FOREWORD

Clinically qualified medical physicists are physicists working in healthcare who have received adequate academic postgraduate education in medical physics and relevant supervised clinical training. They work as members of multidisciplinary teams that provide services to patients in radiotherapy, nuclear medicine, and diagnostic and interventional radiology. Clinically qualified medical physicists also work in other areas where ionizing or non-ionizing radiation or physics principles are used for diagnosis and treatment of patients. Imaging and therapeutic processes, procedures and interventions are dependent on the safe and effective use of information, science and technologies, and thus require qualified professionals to ensure optimal and appropriate patient care through quality assurance and optimization. The knowledge and competencies of medical physicists are acquired through academic education and clinical training programmes that fulfil internationally defined criteria. International professional organizations recognize the need for continuing education and professional development and promote the certification of medical physicists to ensure a high standard of patient care.

In 2013, the IAEA published Roles and Responsibilities, and Education and Training Requirements for Clinically Qualified Medical Physicists (IAEA Human Health Series No. 25). The publication, endorsed by the International Organization for Medical Physics and the American Association of Physicists in Medicine, highlights the need for certification and registration of medical physicists as well as continuing professional development, and provides specific guidance on the establishment of a certification scheme. Only a limited number of countries currently have national medical physics certification schemes. The International Medical Physics Certification Board was formed in 2010, with the main objective of supporting the practice of medical physics through a certification programme in accordance with the International Organization for Medical Physics guidelines. Consultations with medical physics organizations and certification bodies have revealed a lack of international guidance in this area.

To address this gap, in 2018 the IAEA convened a consultants' meeting to prepare a publication highlighting the need for and benefits of medical physics certification, and providing information on the establishment of national or regional certification schemes. This publication builds on the experience and lessons learned from professional organizations and certification bodies and provides information on certification pathways in different scenarios. It is addressed to medical physics professionals and residents; medical practitioners in radiotherapy, nuclear medicine, and diagnostic and interventional radiology; health authorities and hospital administrators; and radiation protection regulatory agencies.

This publication has been endorsed by the International Medical Physics Certification Board and the International Organization for Medical Physics.

The IAEA officers responsible for this publication were G. Loreti and D. van der Merwe of the Division of Human Health.

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1. INTRODUCTION

Physicists work in many health-related areas, such as: clinical settings, academia (teaching and research), industry (technology development and servicing), national and local government regulatory agencies, accreditation agencies, laboratories (calibration and dosimetry laboratories), and standards' organizations.

Clinically qualified medical physicists (CQMPs) are professionals working in healthcare. Their work includes ensuring quality and effective diagnosis and treatment of patients in areas such as radiotherapy, nuclear medicine, diagnostic and interventional radiology, as well as other clinical areas where ionizing and non-ionizing radiation are used. CQMPs therefore have a direct influence on patient management in the health sector.

Medical physics was included as a health profession according to International Standard Classification of Occupation of the International Labour Organization in 2008 offering a potential benefit for professional recognition [1]. Despite this inclusion, the medical physics profession has yet to be recognized in many countries and this lack of recognition often undermines the impact of the contribution of CQMPs to safe, quality and effective patient care.

As CQMPs contribute to patient's healthcare, their knowledge and competence are of paramount importance. These are acquired through postgraduate medical physics academic education, complemented by a structured and supervised clinical training (also called residency) in one or more specialties of medical physics. The residency is carried out under supervision of experienced CQMPs and aims at acquiring pre-defined competencies to be able to work independently at the highest professional standards. For harmonization of medical physics education, there is a need to have a standardized curriculum in all its components: academic education and clinical training. The IAEA raised this issue in the publication Human Health Series No. 25 [2], co-endorsed by the American Association of Physicists in Medicine (AAPM) and the International Organization for Medical Physics (IOMP). The IAEA Training Course Series No. 56 [3] endorsed by IOMP, specifically addressed postgraduate academic education. Three publications were issued, addressing the clinical training in each of the three specialties of medical physics: radiation oncology, diagnostic radiology and nuclear medicine [4-6]. Medical physics organizations, such as the IOMP, European Federation of Organisations for Medical Physics (EFOMP) [7], the Asia-Oceania Federation of Organizations for Medical Physics (AFOMP) [8], the Federation of African Organisations of Medical Physics (FAMPO) and AAPM [9, 10], have developed or adopted similar guidelines for education and training.

Unfortunately, despite the efforts to define the profession of 'medical physicist' in all the above guidelines and standards, health authorities in many countries do not recognize medical physics as a healthcare profession. As a consequence, there is often no established pathway in place to ensure the professional status of medical physicists based on the consensus knowledge and clinical competence guidelines. Furthermore, this affects the efforts to achieve harmonization of the education and training of medical physicists worldwide. In line with other healthcare professionals and in accordance with international practice, professional certification is an established process to recognize and ensure professional competency. This was, for example, the rationale behind the creation of the American Board of Radiology (ABR) in 1932 to promote the specialist profession

of ‘radiology medicine’ when the discipline started to evolve. The ABR also offered certification to medical physicists since 1949.

2. TERMINOLOGY

2.1. MEDICAL PHYSICS PROFESSIONALS

To emphasize their role as health professionals and be consistent with IAEA terminology, qualified medical physicists with adequate academic education and clinical training working in clinical settings will be called CQMPs in this publication. The roles, responsibilities, and education and clinical training requirements for this specific category of medical physicists are given in the IAEA’s Human Health Series No. 25 [2].

The International Basic Safety Standards (IAEA Safety Standards Series No. GSR Part 3) [11] defines the medical physicist as “A health professional with specialist education and training in the concepts and techniques of applying physics in medicine and competent to practise independently in one or more of the subfields (specialties) of medical physics”, and designates functions and responsibilities in medical exposure accordingly. The IAEA Radiation Protection and Safety in Medical Uses of Ionizing Radiation, Safety Standards Series No. SSG-46 [12], provides guidance on the application of these standards in the medical field and elaborates further on the role of the medical physicist from a safety point of view.

The European Union Directive in their 2014 regional promulgation of the European Commission uses the nomenclature 'Medical Physics Experts'. The IOMP on the other hand, refers to 'Certified Medical Physicists'; whereas the AAPM uses the terminology ‘Qualified Medical Physicists'. Table 1 provides some examples of how national, regional and international organizations have defined CQMPs.

In most definitions reported in Table 1 the recurrent word is ‘competence’ and this implies an indirect reference to certification.

TABLE 1. EXAMPLES OF DEFINITIONS OF CLINICAL MEDICAL PHYSICS PROFESSIONALS

Organization/Society	Name	Document	Definition
AAPM	Qualified Medical Physicist	Definition of a qualified medical physicist on the relevant webpage	For the purpose of providing clinical professional services, a Qualified Medical Physicist (QMP) is an individual who is competent to independently provide clinical professional services in one or more of the subfields of medical physics. A QMP is qualified to practice only in the subfield(s) in which they are certified
European Union and EFOMP	Medical Physics Expert	European Guidelines on Medical Physics Expert, European Commission, Radiation Protection No. 174 (2014) EFOMP policy statement 16 (2018)	A 'medical physics expert' means an individual or, if provided for in national legislation, a group of individuals, having the knowledge, training and experience to act or give advice on matters relating to radiation physics applied to medical exposure, whose competence in this respect is recognised by the competent authority
IAEA	Clinically Qualified Medical Physicist	Roles and Responsibilities, and Education and Training Requirements for Clinically Qualified Medical Physicists IAEA Human Health Series No. 25	A health professional with specialist education and training in the concepts and techniques of applying physics in medicine and competent to practise independently in one or more of the subfields (specialties) of medical physics
IOMP	Certified Medical Physicist	IOMP Policy Statement No. 1 (2010)	A Certified Medical Physicist (CMP) is a medical physicist who has been certified by a national or an international professional certification body to have the competence to practice independently in one or more sub-fields of medical physics
The Department of National Health, South Africa	Medical Physicist	Hazardous Substances Act, 1973 (Act No. 15 Of 1973). Regulations Relating to Group IV Hazardous Substances	A "medical physicist" means a person who is registered as such with the South African Medical and Dental Council and whose certificate of registration as a medical physicist has been endorsed by that Council to the effect that he is competent to practise as a radiation medical physicist

2.2. OTHER RELEVANT TERMINOLOGY

Accreditation: formal process by which an independent recognized body (professional and/or governmental) evaluates and recognizes that a programme or a clinical facility meets pre-determined requirements or criteria [2].

Certification body: the term 'certification body' is used here to identify an organisation that provides certification as a service to professions. Different structures are possible and depend on the maturity, governance and structure of the body. Other common terms interchangeably used are certification board or certification committee. Criteria for certification can be based on certification schemes where the certification process has

been operating successfully, e.g. the International Medical Physics Certification Board (IMPCB) model process and certification requirements [www.impcb.org].

Continuing Professional Development (CPD): from Human Health Series No. 25 [2]: "CPD is one of the essential measures in maintaining professional competency, particularly for certified CQMPs. Its goal is to keep professional knowledge and skills up to date. The concept of CPD varies from country to country, but, in general, includes participation in educational and scientific activities such as conferences, symposia, courses and workshops, and education and training duties of medical physicists and other clinical professionals. Research and development oriented activities also pertain to CPD, including individual contributions to journals or books, publications and refereeing."

Credentialing: certify to practice a highly specialised task, for which very specific education and training are needed.

Licensure: in some settings, additional exam(s) can be requested from certified health professionals including medical physicists, to comply with local regulations and requirements.

Permit to practice: document delivered to the CQMP after the completion of the requirements requested by the authorities that entitle the individual to practice the profession in a specified field.

Registration: records of certified professionals maintained and organized in the form of databases or rosters [2].

3. CERTIFICATION FRAMEWORKS

Certification of physicists working in healthcare is not new. In 1935, in a report appearing in the 'Handbook of the Business Sessions' of the Radiological Society of North America (RSNA), Mr Lauriston Taylor, a physicist who became prominent as a radiation protection specialist, gave a full account of the requirements for certification of standardizing laboratories and of registered X-ray physicists and suggested that an approved list be published after proper certification [13]. The RSNA therefore started certifying and registering physicists in 1936. The responsibility was devolved to the ABR in 1949 and continues to this day. Many other countries have today similar bodies that certify the competence of medical physicists (e.g. American Board of Medical Physics (ABMP), Associação Brasileira de Física Médica (ABFM), Allied Health Professions Council (AHPC) in Ghana, Canadian College of Physicists in Medicine (CCPM), College of Medical Physics of India (CMPI), Health Professions Council of South Africa (HPCSA), Allied Health Practitioners Council of Zimbabwe (AHPCZ), Institute of Physics and Engineering in Medicine (IPEM) in the United Kingdom). In accordance with IAEA guidelines, certification is described as part of the path to becoming and maintaining the status of a CQMP, as shown in Fig. 1.

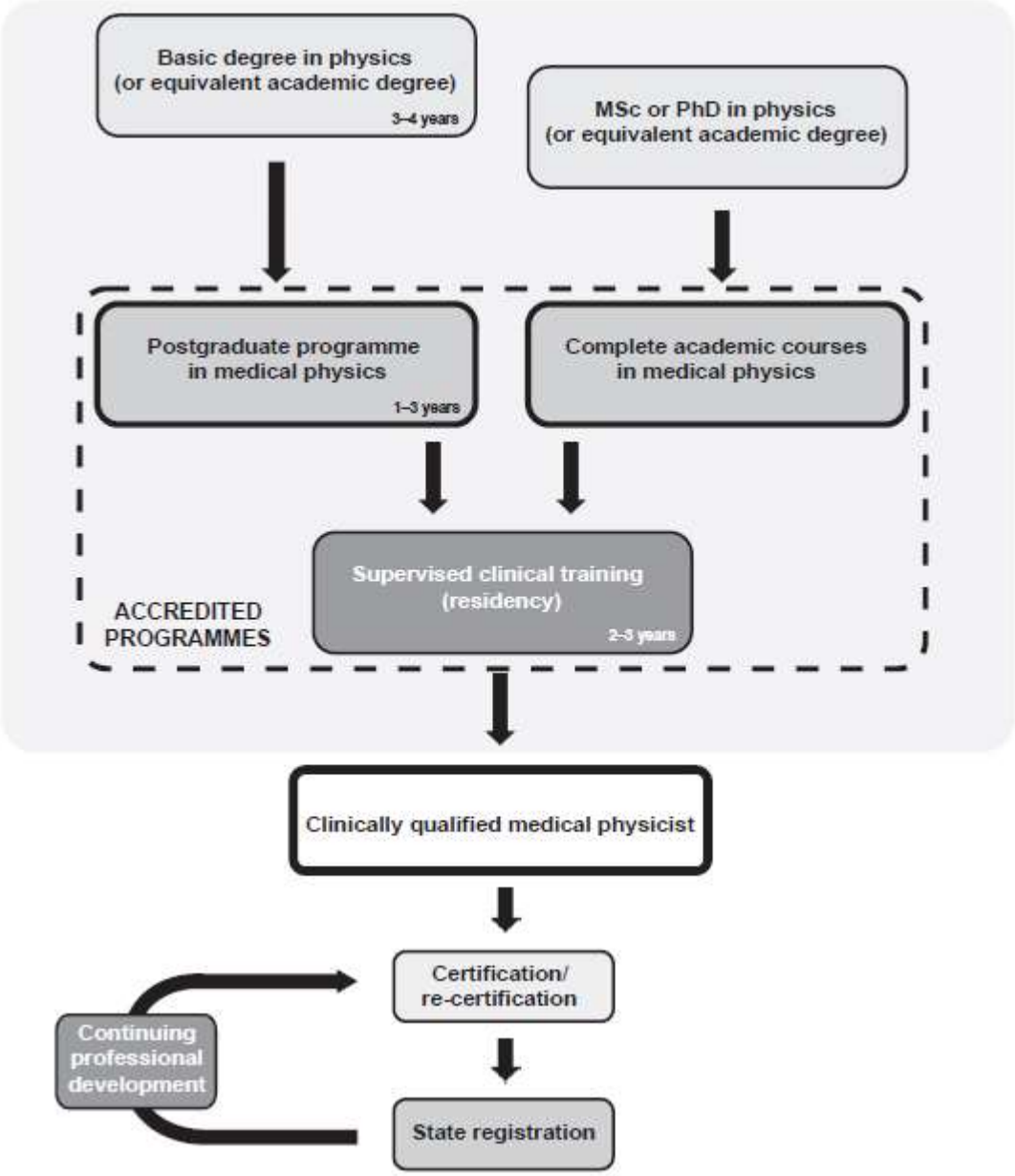

FIG. 1. Diagram extracted from the IAEA Human Health Series No. 25 [2], summarizing the path to becoming a CQMP.

Each health professional category is normally regulated by a national certification body that is recognized or established by the health authorities. The certification body is tasked to set the requirements in relation to national or international guidelines of good practice.

In view of the lack of national medical physics certification bodies in many countries, and in order to support the practice of medical physics through a certification programme in accordance with IOMP guidelines, the IMPCB was established in 2010. The IMPCB primarily aims at accreditation of national certification schemes to ensure their compliance to international standards. The IMPCB seeks to establish the infrastructure, requirements and assessment procedures for the accreditation of medical physics certification programmes in accordance with the requirements of IOMP guidelines, and

defines the knowledge, skills, competencies and examination process for the certification of individual medical physicists. The IMPCB has developed a framework that describes the process of medical physics certification that could be adapted or considered for adoption by countries. Where national/regional certification schemes are not available or under development, the IMPCB has offered a certification process for individuals since 2017.

To facilitate the harmonization of medical physics education and training standards, the EFOMP established an EFOMP Examination Board (EEB), which provides a 'European Diploma of Medical Physics' (EDMP) and a 'European Attestation Certificate' to those medical physicists that have reached the Medical Physics Expert level (EACMPE). Certification from the EEB is voluntary and promotes mobility but does not replace national certification schemes.

In some countries, certification is followed by a registration (or licensure process) that explicitly permits the medical physicist to practice in a clinical setting. In most cases certification to practice is time limited and a re-certification process is required in order to maintain registration. Re-certification is usually granted based on the submission of evidence of participation in a formalised CPD system, also known as continuing education. National medical physics certification bodies are usually responsible for devising the CPD system, whereas medical physics professional organizations are usually providers of CPD activities. The type, topic, field and duration of CPD activities varies depending on the local regulations and can comprise self-learning activities including e-learning, for instance.

3.1. BENEFITS OF THE CERTIFICATION OF CLINICALLY QUALIFIED MEDICAL PHYSICISTS

Certification is one of the essential components for recognition of an individual to practice a profession. “The development of certification schemes for persons, in response to the ever-increasing velocity of technological innovation and growing specialization of personnel, can compensate for variations in education and training and thus facilitate the global job market” [14]. A regulated certification process in medical physics has advantages not only for the individual professional, but also for patients and society, as well as healthcare services. Table 2 summarizes some of the resulting benefits.

The IAEA International Basic Safety Standards [11] directly addresses the need to establish structured mechanisms through which only professionals that have the required competencies are allowed to work independently. The publication also explicitly mentions certification of professionals as an important instrument to perform competency assessments:

“…Competence of persons is normally assessed by the State by having a formal mechanism for registration, accreditation or certification of medical physicists in the various specialties (e.g. diagnostic radiology, radiation therapy, nuclear medicine). States that have yet to develop such a mechanism would need to assess the education, training and competence of any individual proposed by the licensee to act as a medical physicist and to decide, on the basis of either international accreditation standards or standards of a State where such an accreditation system exists, whether such an individual could undertake the functions of a medical physicist, within the required specialty.”

TABLE 2. SUMMARY OF THE BENEFITS TO DIFFERENT STAKEHOLDERS THAT CAN BE ASSOCIATED WITH A CERTIFICATION PROCESS THAT ENSURES STANDARDISATION IN THE COMPETENCY OF A PROFESSIONAL

Area of interest	**For patients and society**	**For the CQMP**	**For the health service**
Reputation	Confidence in the quality and safety of care in the health sector	Confidence in own scientific and technical judgment and abilities	Reputational benefit and reduced risks; assured of appropriate use of resources; improved safety culture.
Technology	Optimized, safe, efficient and appropriate application of technology	Professional satisfaction Accountability Employability	Hospital accreditation and compliance with safety and health technology regulations. Better utilization of equipment and healthcare services, which could lead to a cost benefit.
Best practice	Confidence in the standard of care	Access to a network of peers for continuing professional development and research Assured of adherence to the latest best practices according to international recommendations	Documented Quality Assurance and Improvements Procedures Standards in accordance with international guidelines
Ethics	Professional ethical experience	Recognition and respect	Reduced risk of litigation

The IAEA International Basic Safety Standards [11], underpins and lays the foundations for ensuring health professionals competencies, stating under the requirement 35 that:

"**The regulatory body shall require that health professionals with responsibilities for medical exposure are specialized in the appropriate area and that they fulfil the requirements for education, training and competence in the relevant specialty**." And that such professionals "…Are named in a list maintained up to date by the registrant or licensee."

The certification of CQMPs is a process that can help support the recognition of professionals through maintaining demonstrable adherence to agreed-upon best practices and thus ensuring harmonization and quality standards for the profession. Furthermore, certification can also underpin career development and progression for medical physicists.

3.2 THE SCOPE OF THE MEDICAL PHYSICS PROFESSION

Prior to setting up a certification body and defining procedures for its operation, it is important to define the scope of the profession and in turn, the scope of practice within each specialty of medical physics. The IAEA defines three core specialties [2]:

- Radiation Oncology Medical Physics;
- Diagnostic and Interventional Radiology Medical Physics;
- Nuclear Medicine Medical Physics.

Additional specialties can be defined and can vary between countries and professional organizations, depending on the local circumstances and practices. For example, in the United States of America (USA), medical health physics and magnetic resonance imaging subspecialties also exist. In the Netherlands there is a general clinical physics speciality, which is responsible for the appropriate use of complex non-ionizing medical equipment, and an audiology specialty. In addition, a medical imaging speciality was created, which combines the expertise of radiology and nuclear medicine medical physics owing to the emergence of hybrid imaging. On the other hand, for example in Ghana and South Africa, only one category exists, which requires a basic competence in all three specialities.

Given the rapid development of medical equipment technologies, new categories can be expected to evolve. However, when defining the scope of practice and the relevant organization of specialties within medical physics, a realistic assessment of resources and the infrastructure available to support additional categories, is needed.

3.3. GENERAL REQUIREMENTS FOR MEDICAL PHYSICS CERTIFICATION

The certification body establishes the requirements for eligibility of individuals to apply for certification and documents them in a format that is transparent to potential candidates and that takes into account the relevant scope of practice of the profession. Eligibility criteria will be based on the educational qualification, as well as on the competencies acquired through clinical training. It is important that all of the established requirements conform to regional or national laws, regulations and codes of ethical professional practice that pertain to other health professions.

Minimum requirements for medical physics certification consist of four components:

- A university degree in physics, engineering or equivalent physical science. Adequate mathematics knowledge is essential as is a broad understanding of experimental and theoretical physics;
- Postgraduate medical physics academic education;
- A research component is desirable, but a significant research expertise is not usually a prerequisite for clinical practice;
- Several fulltime equivalent years of clinical training, in a supervised and structured residency programme. Documentation of activities in the form of a portfolio and/or logbook is essential evidence of this training.

Both the postgraduate university degree and the clinical training programme should be accredited by an appropriate body in order to demonstrate adherence to quality standards based on international best practices (for example through internal or external audits). Furthermore, it is important that the scope, content and assessment tools used in the

education and training programme are documented, since these aspects are typically evaluated during the processes of accreditation or audit. Usually national accreditation bodies exist in order to approve tertiary education qualifications and the associated experiential training programmes that are needed to develop the necessary skills or competencies pertaining to the professions.

Currently, accreditation of medical physics programmes is provided by national designated entities (e.g. Commission on Accreditation of Medical Physics Education Programs (CAMPEP) in the USA, ACPSEM for academic education in Australia and New Zealand). Moreover, IOMP has established the 'IOMP Accreditation Board' which operates internationally and accredits medical physics degree programs, medical physics education and training institutions/centres and education and training events.

3.4. DOCUMENTATION REQUIRED FOR CERTIFICATION

Applications for certification are a formal process that follow a defined format. The application identifies the candidate and states the clinical medical physics specialty(ies) (e.g. radiation oncology, nuclear medicine, diagnostic radiology medical physics) in which the candidate seeks certification and includes supporting documentation. A checklist provided by the certification body, can be useful to facilitate the compilation of all needed documents for this purpose. The adequacy and completion of the application submission can be verified by an officer who is familiar with the administrative process, or, depending on the availability of resources, by the secretariat. Ideally, the certification body could have access to a network of CQMPs or other national certification bodies that can clarify education and training programmes in foreign countries, if needed.

Documentation may consist of official degree titles, portfolios and attestation (or reference) letters from clinical departments where the candidate has completed the clinical training programme. It is the duty of the certification body to provide clear guidelines on which documentation is acceptable and whether there is a limit imposed on the time that has elapsed between graduating from an academic programme and embarking on clinical training. There could also be a minimum and maximum time limit on the duration of clinical training programmes. Equivalence of foreign qualifications by a national or regional authority, albeit challenging, can be assessed if the situation arises. Transcripts of university courses and clinical training portfolios provide a good source of information and can also be translated. To facilitate transparency and sustainability, it is suggested that the assessment process is clear and conforms to existing national regulations.

In line with the IAEA Human Health Series No. 25 [2], the process of certification is typically linked to a formal record of registration.

3.5. ASSESSMENT PROCESS OF CANDIDATES BY THE CERTIFICATION BODY

The assessment of a candidate could consist of several sequential steps. An example of an assessment process is as follows:

(a) A paper-based assessment of eligibility based on the application and submitted documentation (which typically would at least include evidence of compliance with the minimum requirements given in Section 3.3);

(b) References and referee reports from the clinical training;
(c) Externally moderated written examinations;
(d) Externally moderated oral examinations;
(e) Observation by external experts in medical physics of performance in clinical practice.

The certification body may choose all or some of them, although typically (a) and (b) are necessary. Written examinations are well suited to assess a broad range of topics, such as general physics and specialist medical physics. Short answer questions are possible and allow the candidate to showcase their depth of knowledge. Multiple choice questions, on the other hand, reduce the subjective component of the marking. An oral or observation exam, which includes case studies, provides a more comprehensive evaluation of clinical practice as a competent observer can probe particular issues and assure the overall competence of the candidate to practice as a CQMP.

It is suggested that existing certification processes in the country for other specialties (in particular medical specialties) are studied, and whenever indicated, reproduced. This has the advantage that there is no need to create precedents, as the already existing certification schemes have been accepted. Usually experts and examiners are certified in the specialties in which they examine.

Whether the examinations are administered at different time periods, and are written or oral, or a combination of both, will also depend on the available resources. Since the final goal of granting certification is affirming that the medical physicist can practice independently, the candidates should be evaluated not only for their competence, but also for their clinical judgment. The latter can better be explored during an oral or observation examination, where the examiner(s) is (are) free to evaluate an individual's problem-solving capability, analytical abilities, creative skills and understanding of the typical challenges related to a clinical environment. Given the interdisciplinary characteristics of clinical settings, another practice best assessed during an observation examination is the conformance by the candidate to a code of professional ethics, see Ref. [15].

An obligatory competence to be assessed in each specialty using ionizing radiation, is the application of radiation protection principles, safety of radiation sources and patient protection, where the candidate is able to demonstrate familiarity with the applicable national radiation control regulations and relevant IAEA Safety Standards [11].

Other competencies that could be considered obligatory for the purposes of a certification examination include:

- equipment specification and characteristics;
- image acquisition, processing and display;
- source calibration;
- quality management;
- patient-related measurements, such as adherence to dosimetry protocols and guidelines.

To improve impartiality, a candidate could be examined by more than one assessor, either jointly or sequentially. Ideally, the examiners will assign the candidate an independent examination score. In addition to giving a score, examiners may also be tasked to justify

their grading and include details of any problem encountered during the examination. This is essential when the candidates cannot obtain certification as a result of a low score, as this will help them address their weaknesses. Supporting documentation is furthermore very important in the case of an appeal, and to demonstrate unbiased procedures and adherence to best practices during the examinations.

3.6. ETHICS AND DATA SECURITY

It is important to ensure that the conduct of all parties involved in the certification process is ethical and transparent. Wherever possible, examiners should not assess individuals whom they supervised during clinical training. In general, the certification body is expected to ensure that examiners declare any conflict of interest [14]. Confidentiality of personal data provided by the candidates, as well as results of their exams and information on their performance during the exam, needs to be maintained and protected [14]. Data provided by the candidates should be stored and handled confidentially, according to the local laws in terms of data protection and security.

A disclosure declaration may be signed to ensure that all certification board examiners are appropriately informed of these procedures.

4. ESTABLISHING A CERTIFICATION PROCESS

When the process of certification is first introduced, existing experienced CQMPs need to be integrated into the certification system. Such a process is sometimes named 'grandfathering clause' or 'voluntary register' and the register is established for a limited amount of time for qualified individuals to be integrated in the new structure. To become part of the temporary voluntary register, the individuals eligible to benefit from this process could volunteer, be referred by the national medical physics organization, hold foreign certification from a country with similar healthcare settings or be proposed by an international medical physics professional organization. Such a process was followed by countries as a starting point to establishing a national certification register, e.g. South Africa, United Kingdom. The CQMPs certified (or partially certified, if they demonstrate a limited number of competencies) can in this way be formally tasked to act as evaluators/examiners and start the national certification assessment process. Recourse to this voluntary register should be established with a specific timeline and then extinguished. After the first certifications have taken place, and assessment method(s) developed and adopted, the certification body can start to create a list of potential assessors among the already fully certified individuals, making sure that all specialties are covered. Examples of application forms for full or partial registration as a radiotherapy medical physicist on a voluntary or established registry, are provided in the Appendix.

4.1. EQUIVALENCE OF CERTIFICATION

When developing criteria for certification, it is important to consider the equivalence or mutual recognition of other medical physics certification schemes. The information on equivalence of schemes and any recommendation based on it, can provide guidance to the authority that issues the permit to practice. Several guiding principles can be taken into consideration in the evaluation, for example:

- Compliance with ISO/IEC 17024 [14];
- The equivalence of eligibility requirements including: the academic degree, the relevant syllabus and the academic qualification, the content and duration of the clinical training;
- The equivalence of the scope of the profession and practice;
- The compliance of the certification body to the relevant requirements, for example with respect to their independence;
- The equivalence of any re-certification procedures including their frequency.

International accreditation of certification bodies, for example as currently offered by IMPCB, can be instrumental in facilitating this process by reviewing the compliance to agreed-upon international standards.

4.2. PATHWAYS TOWARDS THE ESTABLISHMENT OF A CERTIFICATION BODY: AVAILABILITY OF PROFESSIONALS

Certification helps to overcome the lack of recognition of CQMPs and facilitates the maintenance of harmonized standards of education, training and practice of CQMPs. The pathways to create a national certification scheme will depend on how established, harmonized and widespread the medical physics profession is nationally. Examples are provided below, considering different scenarios based on the availability of CQMPs.

If there are sufficient numbers of CQMPs to form a national professional organization, the suggested path is:

(a) To develop and adopt national guidelines for the academic education, clinical training and the scope of practice of CQMPs based on international or regional guidelines, and adapting them to national needs [2];
(b) To develop appropriate guidelines for the certification of CQMPs in all specialties of medical physics as appropriate;
(c) To consider the need for a temporary voluntary register (until all guidelines can be realistically complied with);
(d) To establish a national medical physics certification body (that is functionally independent from the professional society), which is preferably associated with a national authority that certifies other healthcare professionals;
(e) To assess the need for the national certification body to be accredited by other regional or international accreditation bodies, in order to ensure harmonization to international standards;
(f) To establish a CPD scheme which will permit the maintenance of certification;
(g) To seek an affiliation of the national professional organization to the applicable regional chapter of the IOMP and obtain membership to the IOMP.

If there is an insufficient number of CQMPs to form a national professional organization; it is advisable to identify a regional or international certification body, which can assist medical physicists to obtain individual certification and re-certification.
An alternative may be:

(a) To seek cooperation from professionals in neighbouring countries in order to establish a sub-regional professional association that develops appropriate guidelines for the certification of CQMPs in all the specialties represented in the sub-region;
(b) To seek an affiliation of the sub-regional professional association to the applicable regional chapter of the IOMP;
(c) To consider the need for a temporary voluntary register of experienced CQMP in the sub-region;
(d) To establish a sub-regional medical physics certification body (that is functionally independent from the professional association) that is accredited by a regional/international certifying body, which can assist medical physicists to obtain individual certification and re-certification.

The flowchart in Fig. 2 summarizes the above described steps.

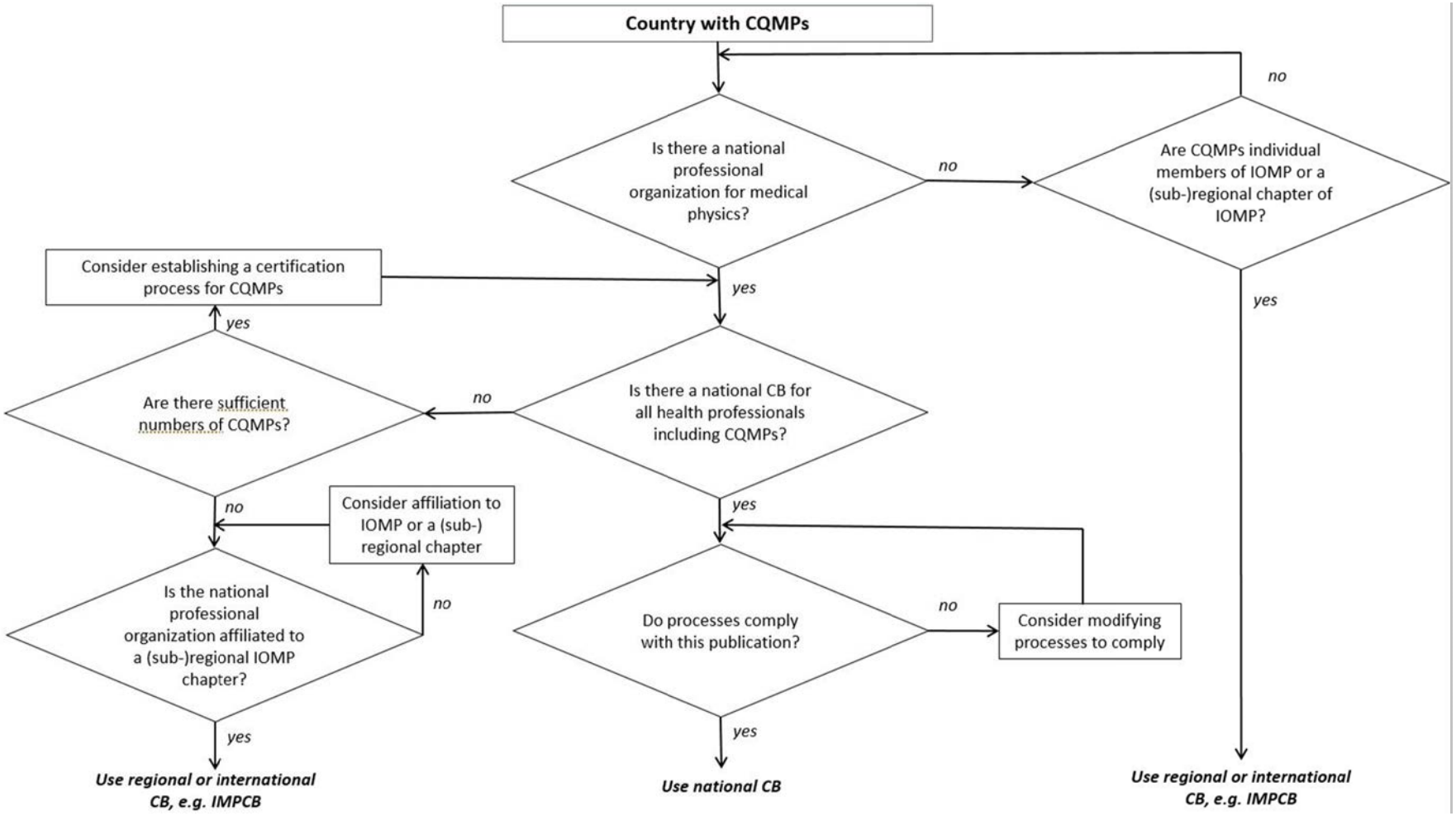

FIG. 2. Flowchart summarizing possible pathways to establishing a certification process. (Key: CB, certification body).

4.3. ESTABLISHING A CERTIFICATION BODY

Depending on the local resources and infrastructure, different paths can be envisaged to establish a national, structured certification process. Different levels of complexity can be considered and adopted sequentially, in order to establish a fully sustainable certification body.

Where resources allow, a certification body could be structured to consist of the following entities:

(a) An executive structure for strategic decision making and communication, financial and administrative management. The medical physics professional organization would provide medical physics-specific advice to this structure as necessary. In principle this structure would oversee all health professions that are certified nationally;
(b) A governance structure to advise or ensure compliance with legislative frameworks including professional ethics;
(c) An operational structure that communicates with professional organizations of each speciality in order to develop the assessment criteria relevant to the different specialties, taking into account the legal and local requirements. This structure could also review the accreditation of education and training programmes and develop the policy guidelines for CPD activities that are used to maintain certification of professionals;
(d) A structure or committee to conduct (or oversee) the assessments, which would ultimately approve or reject the certification of individuals. In some settings, this structure could coordinate the approval or accreditation of training schemes. For all health professions, the committee members should be certified professionals in the relevant discipline;
(e) A structure, which is functionally independent, for handling appeals and complaints from applicants seeking certification.

A graphical representation of this structure is illustrated in Fig. 3.

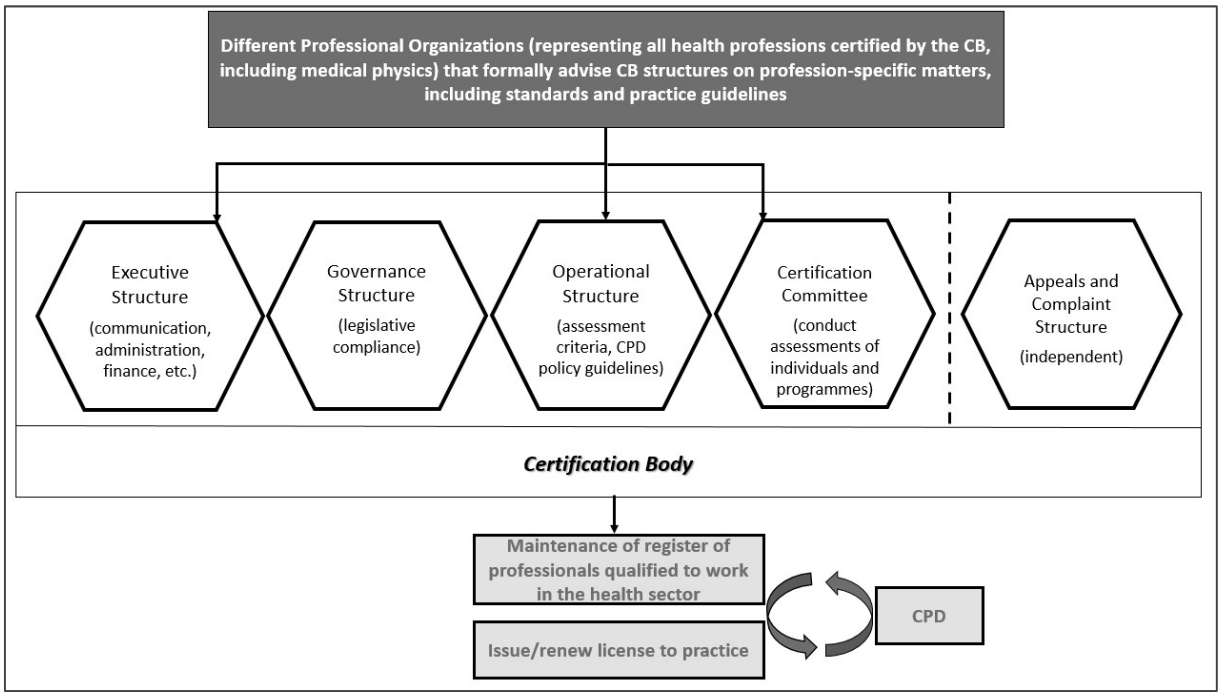

FIG. 3. A diagrammatic representation of the structure of a certification body. (Key: CB, certification body).

To ensure sustainability and facilitate the management of the certification process, the ideal solution would be to integrate the medical physics certification body into an overarching entity that certifies other healthcare professionals, e.g. a Health Professions Council. If this is not possible, the medical physics certification body could also be organized separately, provided the independence of the operational, assessment and appeal structures is guaranteed.

The executive structure of the certification body is typically designated to allow for timely communications and to oversee administration and day to day operations. Financial aspects would typically also be handled in this section. For small, independent bodies this could be a part time role for an individual. The size of the executive structure and its organization will depend on the finances and scope of the certification body. In practice many bodies rely on volunteers.

Given the regulatory nature of certification, including the potential provision of medico-legal advice in the event of unethical conduct or undesirable practice of a certified individual, governance is one of the key elements of a certification body. The governance structure for the medical physics certification body ensures representation from all relevant specialties. Over time, as more certified individuals become available, professionals with national certification will be able to act as governors. The inclusion of other board-certified stakeholders such as radiologists, radiation oncologists, nuclear medicine physicians, or members from regulatory authorities can be beneficial. Also, a medical ethicist and advisor with legal background can add value to the governance structure. Local regulations related to principles of governance apply. In general, it is expected that several officials of the certification body will be nominated by the professional organization that advises the body. It can be helpful to emulate the formal structure of governance of other healthcare professions' boards, where they exist.

Depending on the number of officials available, functions can be combined or further separated. For example, the functions pertaining to assessments could be separated into developing examination questions and administering examinations. Figure 3 also indicates the way professional organizations interact with the certification body. In order to avoid a conflict of interest, executive committee members of national professional organizations should not act as officials in their national certification body.

Countries should have only one national certification body for practicing CQMPs. Consideration could also be given to accreditation of the national certification body through an international organisation such as IMPCB, if desirable. Guidance on certification is also provided by standards such as ISO/IEC 17024 [14], which specifies criteria and requirements for the operation of certification bodies for professionals.

It is important that the rules that govern the board's actions are documented and that nomination, selection and appointment rules for officials, the terms of office and any qualification or training requirements, including ethics principles, are clear.

The certification body should develop procedures for appeals and complaints, which are transparent and avoid any conflict of interest. Procedures need to be documented so that participants can easily access the information required in the event of lodging an appeal. Both appeal and complaints should be dealt with in an impartial, transparent and timely fashion. The result will be a formal notification of the outcome of the appeal or complaint to the individual that has lodged them in the first place. This is required even if the appeal was not successful. Such documents are then kept for a time prescribed by the legal framework in the country.

In summary, a certification body develops written rules and procedures that cover at least the following aspects:

(a) the structure of the certification body;
(b) requirements and modalities on how to apply and undergo a certification process and the duration of the certification;
(c) the way(s) in which the body communicates with all medical physics stakeholders;
(d) how data and personal information will be handled and protected;
(e) which medical physics specialties are represented and can be considered for certification;
(f) the procedure for appointing officials and their term of office;
(g) the operational procedures and the criteria by which decisions are being made by the body;
(h) procedures to submit complaints or appeals;
(i) the tasks, responsibilities and authority of the body;
(j) the qualification and tenure of examiners for each medical physics specialty.

4.4. FACTORS AFFECTING THE SUSTAINABILITY OF A CERTIFICATION BODY

To allow for the establishment of a certification mechanism, while ensuring its sustainability over time, the local situation needs to be assessed with respect to key elements that include: present and future staffing needs in medical physics, status and availability of academic education and clinical training, recognition of the profession.

Examples of challenges that might be encountered when establishing a certification process include, but are not limited to:

(a) Non-availability of formal medical physics education programmes; this needs to be addressed first by taking into consideration the expected number of medical physicists needed in a country. If this number is small, it is more sustainable that the academic education is outsourced, seeking agreements for example with neighbouring countries to enrol local students abroad in established programmes and then recognize their degree locally. If the need for medical physicists is expected to be large or to increase, it might be viable to start local academic education programmes, following international guidelines [3]. In any of these cases, the respective regulatory, health and educational authorities should collaborate to find permanent and sustainable solutions to produce a sufficient number of CQMPs to support the country's healthcare system;

(b) Availability of medical physics academic programmes, but absence of structured residency programmes [3]. Professional organizations, as well as the respective governmental regulatory and health authorities, should take appropriate steps to create access to or establish structured residency programmes as per international guidelines [4-6];

(c) Scarcity or absence of recognition of the profession of CQMP in line with international guidelines such as International Labour Organization [1] and the International Basic Safety Standards [11] and/or lack of understanding of their roles and responsibilities. In order to promote recognition, existing CQMPs in a country may consider forming a national, regional or sub-regional organization for medical physicists and then establish a formal independent certification body affiliated with regional or international medical physics organizations.

(d) Absence of national academic education and clinical training programmes and existing professionals have received clinical training under a variety of programmes in other countries. In this case, the need may arise for partial certification of individuals based on their different competencies. In order to achieve full certification, the competencies of each individual may ultimately need to be complemented, once a formal certification process is adopted. It is advisable to seek cooperation through a sub-regional, regional or international certification mechanism in the interim.

It is advisable that the process of certifying and registering a CQMP be aligned to that of the medical and non-medical (e.g. biologists, engineers, actuaries, psychologists, etc.) specialists. In the absence of a national regulation, the medical physics professional organisation could voluntarily establish an independent national process to issue the certification and, in so doing, set up and maintain a national registry. In such a case, the medical physics organization may then develop the scheme in accordance with other health professions' certification bodies and promote relevant amendments to the national law, in order to formally establish a national certification body for CQMPs, when appropriate.

5. MAINTAINING CERTIFICATION

A certification body endorses that a professional is qualified to practice a particular profession according to agreed-upon professional standards. This results in registration, which implies that an official register (or list) of such professionals is maintained; the certified individual then receives a license to practice. The certification declares the speciality(ies) in which the registered CQMP can practice and reports an expiration date, indicating the timeframe before re-certification.

Registration consists in maintaining a register of certified medical physicists, who uphold the performance and professional ethics standards imposed by the certification body. In some settings (e.g. federal countries with different health regulations), an additional level of local regulation might require an exam to locally certify medical physicists. Credentialing on the other hand, refers to an individual being certified to practice a highly specialised task for which very specific, rare or uncommon education and training are needed, e.g. proton therapy, stereotactic radiosurgery, etc.

The ultimate aim of a certification body is to ensure the highest possible standard of patient care by regulating the training and practice standards of health care professionals. A monitoring system should be established to remove from the registry, certified professionals (or to revoke their license to practice) when their practice is found to be non-compliant or infringe the ethical and professional standards (e.g. as described in Appendix I of the IAEA Human Health Series No. 25 [2]).

5.1. REGISTRY

In accordance with the IAEA Human Health Series No. 25 [2]:

“The process of certification should lead to that of registration, where records of certified professionals are maintained and organized in the form of databases or rosters. The registry should ideally be a legal system which can be operated by a governmental office or by a professional body authorized by the government, but it should be at the national level. A government operated CQMP registry has the advantage that professional requirements can be implemented in a harmonized way across the country, in a similar manner to requirements for regulating other professionals, e.g. architects and medical practitioners. In some countries, registration is a requirement to obtain a professional licence to practise, which is an effective QC mechanism to measure professional competence.”

The registry, which contains personal data of the professionals, is handled confidentially and managed according to the local laws in terms of data protection.

Radiation protection in the medical sector is a field of activity that is pertinent to the scope of practice of a CQMP [16]. National laws/regulations on radiation protection identify competences, responsibilities and registration processes of persons designated to act as Radiation Protection Officers and Qualified Experts. In some cases, the CQMP has to be authorized to assume this role(s) by the appropriate authority. In such cases, a separate or additional registration may be required, and this may also be subject to an ongoing renewal process.

5.2. CONTINUING PROFESSIONAL DEVELOPMENT PROCESS

CQMPs need to continuously update their knowledge and competencies, adapting to the evolution in science and technology. Therefore, CQMPs are expected to not only maintain the standard of practice required, but also actively seek to preserve and update their knowledge and competencies. This can be achieved by undergoing CPD. The type and nature of CPD varies from country to country, but typically such activities include a range of diverse elements such as participation in conferences, classes or e-learning. In general, CPD activities are not part of the daily duties of the professional, but additional opportunities that enhance, supplement or update their practice.

Documentary evidence of CPD is typically collated for the period since the previous certification was granted. Engagement and participation in activities serves the purpose of assuring currency of knowledge and competence. If the individual is registered to practice in more than one specialty of medical physics, the CPD is expected to reflect this. Table 3 gives a list of potential categories and examples of CPD activities.

When grading activities for a system that accumulates points, the system typically defines how the grading is applied and documented. It is also considered good practice to require points from a range of different types of activities, to ensure adequate breadth of professional development. A common method is to award CPD points for activities with one point roughly equivalent to one hour of activity. Confirmation of CPD in professional activities can be self-declared, systematically verified or periodically audited. This requires that certified individuals maintain appropriate evidence or ensure that their CPD has been duly registered in cases where an electronic centralized database system is in place. It is important that an appropriate formal CPD system is implemented in every country where CQMPs operate. A national or regional professional medical physics organisation can play a major role in organizing CPD activities. For countries that do not have a formal and mandatory CPD system in place, a voluntary CPD programme can be established as first step toward a more official pathway.

A formal CPD system is usually governed by the certifying body, therefore clear instructions have to be included in the documents related to re-certification and comprise:

- CPD rules and obligations of professionals;
- how CPD activities are accredited;
- types of activities that can provide CPD credits;
- rules for the grading of CPD activities;
- development and maintenance of the registry of the CPD credits;
- monitoring or auditing of CPD compliance, identifying violations and providing guidance on reissuance of the permit to practice;
- guidance on the recognition of CPD activities obtained from participation in international scientific events.

TABLE 3. A POSSIBLE SYSTEM OF CATEGORIES FOR CPD (ADAPTED FROM CCPM, AAPM AND ACPSEM)

Category	**Examples**	**Comments**
Scientific activity	Attendance at conferences, workshops, symposia or courses	Participation and invited lectures could be assigned a higher grading than attendance.
Clinical activity	Documentation of development of a new technique	This could be supported by publications or conference presentations.
Academic/ research	Publications, grants, editorships, lectureships, research supervision or official appointment as a scientific investigator on a research project.	A distinction may be made between primary authorship and co-authorship
Professional activity	Committee membership, drafting of guidelines	These activities require a high level of expertise in the profession
Self-directed learning	Reading of articles, online continuing education activities	It is important to ensure that online courses include an assessment.
Demonstration of other skills	Presenting case studies, journal review clubs, participating in ethics seminars, organising scientific conferences or training courses for peers	Records of such activities and their time duration are kept

5.3 RE-CERTIFICATION

The re-certification process states the minimum number of CPD points to be acquired for each type of activity over a given period of time. Additional CPD activities may be required of an individual who has not been practicing in the clinical environment for an extended period of time and has not participated in CPD during this period. In exceptional cases, refresher clinical training or a period of supervised practice may be necessary prior to reissuance of a license to practice.

Re-certification should follow uniform, standard and sustainable assessment procedures which are logically administered by the certification body that conferred registration, using the same criteria and scope.

Examples of elements that could be considered prior to the issuance of re-certification (or of a permit to practice, where existing) include:

- Compliance with the established CPD criteria;
- Compliance with professional conduct and ethics as pertaining to all health practitioners;

- Clearance that there are no claims of unethical conduct or undesirable practice against the individual that remain unresolved;
- Ongoing work experience as a CQMP in the declared specialty of medical physics in which the professional has been previously certified.

While maintenance of registration could in principle be conducted through assessments, it is more common to confer re-certification on receipt of documentation providing evidence of having undergone a number and range of CPD activities related to the clinical practice of the certified individual. Nevertheless, periodic random checks and/or audits can be performed to ensure adherence to procedures and best practice.

6. CONCLUSIONS

The positive contribution that well qualified medical physicists can make on the safe and effective delivery of quality health care services is entrenched in regulatory standards however, recognition of the medical physics profession remains a challenge in many countries. Certification bodies for CQMPs provide an independent, regulated attestation of their knowledge, competencies and aptitude to practice. Certification includes the scrutiny of academic education, clinical training and the relevance of continuing education (through CPD evaluation) in order to harmonize and ensure quality of professional CQMP services. Moreover, certification is an effective way to foster recognition of CQMPs as health professionals in accordance with ILO [1]

In general, countries that have certification schemes in place for other health professionals, can seek to incorporate CQMP certification into those. In the absence of a national certification scheme, this publication also provides a description of alternative pathways that can be followed to establish certification for CQMPs.

APPENDIX

EXAMPLES OF CERTIFICATION APPLICATION FORMS

An example of two forms that could be used by a certification body are shown below. The first applies to the development of a voluntary register in order to certify persons who have worked as CQMPs prior to the existence of such a register. The second form provides an example of the information and evidence that could be requested from persons who seek certification in accordance with the requirements of a certifying body.

Emblem of the certification body	**FULL NAME OF CERTIFICATION BODY** **Application for full or partial registration on <u>the Voluntary Register</u>** **as a Clinically Qualified Medical Physicist** **in Radiotherapy Medical Physics**	Form YY REF:.....

A. PERSONAL DETAILS (as it should appear on the certificate)

Name:.....

Postal/courier address for all official correspondence: .....

Email:.....

Unique national identification number: ……

Date of birth (day/Month/year): ..……..

Nationality: .....

Country in which you practice: ……..……..

I certify that all information provided in this form is true and correct:

Signature:…….. Date: …….

DECLARATION:

B. I, (full name, please print): .....

1. Underwent postgraduate academic education in medical physics: .....……. in (year(s)): ……

The education included the following modules (check all that apply):

Medical Physics for Diagnostic Radiology	☐	Medical Physics for Radiation Oncology	☐
Medical Physics for Nuclear Medicine	☐	Radiation Protection and Safety	☐
Radiation Physics for Medical Physicists	☐	Fundamentals of Dosimetry	☐

2. Received formal supervised clinical training in the following competencies in the period(s): .....

……

……..

I confirm that I am competent in the physical, technical, dosimetric and safety aspects of the following modalities and skills pertaining to radiotherapy medical physics practice (check all that apply):

^{60}Co teletherapy	☐	Multi-modality linear accelerator	☐
Kilovoltage therapy	☐	HDR brachytherapy	☐
3-D CT-based treatment planning	☐	Conventional fluoroscopic simulation	☐
Immobilisation and positioning of patients	☐	Radiotherapy mould room and workshop	☐
Absolute and relative dosimetry systems	☐	Radiation Protection and Safety	☐
QMS for Medical Physicists	☐	Professional Ethics for Medical Physicists	☐

3. Have been practicing as a clinically qualified radiotherapy medical physicist for …… years in a fulltime capacity (this should be a minimum of 5 years)

Employer	Years of service

4. Have undergone the following additional training as a clinically qualified radiotherapy medical physicist in the past 3 years (list all fellowships, applications training, attendance in regional training courses or workshops, participation in conferences and symposia, etc.): *

Activity	Dates

*Please note that this does not include academic or research activities

5. Confirm that I am not certified as a clinically qualified medical physicist under another national authority.

6. Declare that I have never been convicted of any criminal offence or been debarred from practice by reason of unprofessional conduct in any country and that, to the best of my knowledge and belief, no proceedings involving or likely to involve a charge of offence or misconduct is pending against me in any country at present

7. I understand and accept that:

(The certifying body) cannot be held liable for my professional performance ☐

Registration by a national authority will replace and supersede any registration endorsed by (The certifying body) ☐

Maintenance of competencies in medical physics requires ongoing clinical experience supplemented by a programme of continued professional development and continuing education in a peer reviewed setting relevant to radiotherapy medical physics clinical practice ☐

C.

REFERENCES

Please provide the contact details of professionals who are willing to confidentially vouch for your competencies, health and professionalism:

Type of professional	Type of reference	Name	Contact email
Radiation Oncologist	Professional		
Clinically qualified medical physicist with at least 10 years' experience	Professional		
General practitioner	Certificate of health		
Medical practitioner, Minister of Religion, Magistrate, etc.	Personal certificate of good character		

Emblem of the certification body	**FULL NAME OF CERTIFICATION BODY** **Application for <u>full or partial registration</u> as a** **Clinically Qualified Medical Physicist** **in Radiotherapy Medical Physics**	Form XX REF:.....

A.

PERSONAL DETAILS (as it should appear on the certificate)

Name:.....

Postal/courier address for all official correspondence: .....

Email:.....

Unique national identification number: ……

Date of birth (day/Month/year): ..……..

Nationality: .....

Country in which you practice: ……..……..

I certify that all information provided in this form is true and correct:

Signature: ……. Date: …….

B.

DECLARATION:

I, (full name, please print): .....

1. Received the following postgraduate academic qualification: .....…….. in (year): ……

The academic qualification included the following modules (check all that apply):

Medical Physics for Diagnostic Radiology	☐	Medical Physics for Radiation Oncology	☐
Medical Physics for Nuclear Medicine	☐	Radiation Protection and Safety	☐
Radiation Physics for Medical Physicists	☐	Fundamentals of Dosimetry	☐

The above can be confirmed by (name and email address): ……..

2. Received supervised clinical training in the following competencies, in accordance with the (state the reference or guidelines that have been adopted by the certifying body), under the supervision of (name and email address):

….....……

in the period (s): .....

……..

My portfolio of competencies in the physical, technical, dosimetric and safety aspects of the following modalities and skills pertaining to medical physics practice includes (check all that apply):

^{60}Co teletherapy	☐	Multi-modality linear accelerator	☐
Kilovoltage therapy	☐	HDR brachytherapy	☐
3-D CT-based treatment planning	☐	Conventional fluoroscopic simulation	☐
Immobilisation and positioning of patients	☐	Radiotherapy mould room and workshop	☐
Absolute and relative dosimetry systems	☐	Radiation Protection and Safety	☐
QMS for Medical Physicists	☐	Professional Ethics for Medical Physicists	☐

A copy of the portfolio of clinical training should be submitted to support this application.

3. Understand and accept that:

(The certifying body) cannot be held liable for my professional performance ☐

Registration by a national authority will replace and supersede any registration endorsed by (the certifying body) ☐

Maintenance of competencies in medical physics requires ongoing clinical experience supplemented by a programme of continued professional development and continuing education in a peer reviewed setting ☐

C.

REFERENCES

Please provide the contact details of professionals who are willing to confidentially vouch for your health and professionalism:

Type of professional	Type of reference	Name	Contact email
General practitioner	Certificate of health		
Medical practitioner, Minister of Religion, Magistrate, etc.	Personal certificate of good character		

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ABBREVIATIONS

AAPM	American Association of Physicists in Medicine
ACPSEM	Australasian College of Physical Scientists and Engineers in Medicine
CCPM	Canadian College of Physicists in Medicine
CPD	Continuing Professional Development
CQMP	Clinically Qualified Medical Physicist
EEB	EFOMP Examination Board
EFOMP	European Federation of Organisations for Medical Physics
IMPCB	International Medical Physics Certification Board
IOMP	International Organization for Medical Physics
QC	Quality Control
RSNA	Radiological Society of North America

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