

Medical Physics History, Professional and Educational Development in Pakistan

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Abstract— Aim of this article is to discuss the historical background, current status and available and possible available resources for education and professional development of Medical Physicists (MPs) in Pakistan. Medical physics is a unique profession and acknowledged one of the vital part of healthcare that needs an immediate intension to improve professional skills of MPs in developing countries. In Pakistan, first radiotherapy centre was established in 1958 at Mayo Hospital Lahore. Pakistan Nuclear Regulatory Authority (PNRA) was formed in 1956 to regulate the clinical institutes and handle nuclear safety issues. There was no formal training or education facility available for MPs in Pakistan till 1980. According to regulation on Radiation Protection (PAK/904) published (2004) by PNRA, only six months on job training is sufficient to work legally as an independent clinical MP. On job training program in Pakistan varies from institute to institute. In Pakistan, very limited annual professional's development courses are organised by PNRA for MPs. Pakistan Institute of Engineering and Applied Sciences (PIEAS) was the first chartered university by the government of Pakistan which offered a two years MS Medical Physics degree Program in 2001. Most of the clinical MPs rely on international funding scheme for professional development. Presently, MPs develop and enhance their professional expertise through attending national and international conferences, workshops, fellowships programs and educational scholarship in medical physics. Currently, PNRA and Pakistan Organisation of Medical Physics (POMP) are working with federal government of Pakistan to set up a certification program for MPs under International Atomic Energy Agency (IAEA) RAS6077 Regional Cooperation Agreement program. There are also few options to achieve certification as a qualified MPs form international certification bodies. A brief survey was conducted to study the professional and educational development needs in Pakistan.

Keywords—Medical Physicist, education, professional development, accreditation

I. INTRODUCTION

In last five decades, revolutionary development took place in the field of diagnostic imaging (DI) and radiation therapy (RT), where medical physics had played an extremely important role to optimize and regulate the ionisation radiation used in medicine. Now a day, radiation therapy and diagnostic examinations are routinely performed in medical clinics under the supervision of qualified medical physicists (MPs) [1, 2]. In radiotherapy, MPs play a vital role in clinical decisions and considered to be the back bone of radiotherapy department. Scope of medical physicist is not limited to the radiotherapy but also have a great contribution in DI and nuclear medicine (NM). The clinical MPs are responsible to design and implement quality control and quality assurance programs, radiation shielding requirements, radiation protection, implementation of clinical protocols, personal and radiation equipment dosimetry and treatment planning. Along with these expertise, MPs also actively participate in research, establishing training programs for MPs, radiation therapist (RTs), doctors and nurses which further include the practical implementation for their professional growth.

There is no cancer registry program in Pakistan. Every year, 1.48 million new cancer cases were reported [3]. With respect to population, cancer incidence, cancer deaths and cancer prevalence rate (in millions) are 17.6, 1.48, 0.1016 and 0.00274 respectively [4]. According to IAEA Directory of Radiotherapy Centers (DIRAC) only 30 cancer centers are operational in Pakistan [5]. Pakistan has 60 Radiation Oncology Medical Physicists (ROMP) [6].

History

In Pakistan, development of medical physics profession was started in 1958 when first radiotherapy centre was established at Mayo hospital Lahore, Pakistan. Pakistan Atomic Energy Commission (PAEC) established first cancer centre (Nuclear Medicine Centre for Cancer Treatment) in 1960 at The Jinnah Medical College Karachi [7]. Now more than 18 cancer centres are working under the umbrella of PAEC till 2018 [8]. These cancer centres are spread geographically throughout the country and provide diagnostic as well as therapeutic services to cancer patients at very nominal charges. First private cancer facility was

established at Shifa International hospital, Islamabad, Pakistan in 1995. In Pakistan, there are 30 radiotherapy centers running privately and under provincial and federal government. Pakistan has 27 linear accelerators, 31 cobalt-60 Teletherapy units, 3 Computed Tomography (CT) simulators, 10 conventional simulators, 9 treatment planning system (TPS) and 11 brachytherapy units [9]. Currently, more than 120 clinical MPs are working in private and government cancer centers [10]. The concept of nuclear regulatory and infrastructure existed since 1965 in Pakistan. In 1984, the Nuclear Regulatory Authority was upgraded to Directorate of Nuclear Safety and Radiation Protection (DNSRP). After signing the Convention on Nuclear Safety in 1994, PAEC has established Nuclear Regulatory Board (PNRB) within PAEC. DNSRP was dissolved in 2001 and created Nuclear Regulatory Authority (PNRA) in Pakistan to look after radiation protection and nuclear safety issues [7].

Education

There was no formal education facility available for clinical MPs in Pakistan till 1980, only requirement was MSc. Physics (16 Years of education) to work as clinical MP. Centre for Nuclear Medical Studies (CNS) under the umbrella of PAEC conducted first medical physics course (6 months) in 1967. Currently, CNS is known as Pakistan Institute of Engineering and Applied Sciences (PIEAS). PIEAS was the first chartered university by the government of Pakistan who started offering two years MS Medical Physics degree Program since 2001. PIEAS has produced 174 graduated in medical physics so far but most of them are working in the nuclear power plant, research and development at Pakistan Institute of Nuclear and Technology (PINSTECH) and PNRA. Other than PIEAS, there is no university or institute offers MS degree program in medical physics in Pakistan. Secondly, there was no formal training or education facility available for MPs in Pakistan till 1994. Shifa International hospital started one year on job training program for MPs in 1995. Higher Education Commission (HEC) of Pakistan also started Overseas Scholarship Program (OSP) since 2003. More than 5000 Ph.D. scholarship are awarded for study in technology and 3000 indigenous Ph.D. scholarship are awarded 2002 to 2008. HEC also has designed a Faculty Development Program (FDP) for capacity enhancement and teaching skills for the non-Ph.D. faculty members. In 2010, International Islamic University Islamabad has started MS Radiation Physics degree program. In last few years few more universities has started MS and PhD programs in medical physics.

Professional Development

Whereas, according to regulation on Radiation Protection (PAK/904) published (2004) by PNRA, only six months on job training is sufficient to work legally as an independent clinical MP. Mostly, trained MPs work under the supervision of a qualified MP [11]. On job training program

in Pakistan varies from institute to institute and strongly depend upon the institution formwork, resources and needs. Currently, government of Pakistan is working with International Atomic Energy Agency (IAEA) to implement formal training program in all specialties of medical physics under the project RAS6077 [12].

In Pakistan, limited professional's development activities are organised by PNRA for MPs to update their skills and knowledge and equipped themselves with new techniques technologies. Most of clinical MPs rely on international funding schemes (Union for International Cancer Control (UICC) fellowship program, International Atomic Energy Agency (IAEA), IAEA-International Centre for Theoretical Physics (ICTP), Australian Endeavour Executive Fellowship Award (AEEFA), ELEKTA Travel award etc.) for professional development [13-17].

Pakistan Organisation of Medical Physics (POMP) was established in 2012 to improve the quality, efficiency and professional development of MPs in Pakistan [18]. POMP has engaged Pakistani MPs in developed countries and planning to organise professional development activities (workshop, short courses, Symposiums etc.) for medical physics community on regular bases.

Australian College of Physical Sciences and Engineering in Medicine (ACPSEM) has established the Asia Pacific Special Interest Group (APSIG) in Australia. The purpose of this group is to encourage and assist ACPSEM members to work with similar overseas organisations and institutions in the advancement of medical physics and radiation engineering, in developing countries of the Asia-Pacific region. POMP is also planning to collaborate with APSIG and set up special training program for clinical MPs.

Certification/Accreditation Program

There are a few options available for Pakistani MPs to achieve accreditation or certification as a qualified MPs e.g. experienced ROMP path way through Australian College of Physical Sciences and Engineering in Medicine (ACPSEM), International Medical Physics Certification Board (IMPCB), Regional Cooperative Agreement (RCA) certification and Accreditation program (under process), Health and Care Professionals Council (HCPC) registration United Kingdom (UK) and European Attestation Certificate for Medical Physics Expert (ESCMPE).

A. ACPSEM Registration/Certification

ACPSEM has introduced new policy called ACPSEM Register of Qualified Medical Physics Specialists and Radiopharmaceutical Scientists [19]. In this policy a complete process is explained to achieve ACPSEM certification as a qualified MP. According to this policy, each application is process individually depending upon the individual applicant application. Most of the Pakistani MPs do not have any international certification (IPEM, COMP, ABR or HPC), due to this reason, the certification process

will be longwinded (sign off level 3 competencies of all core modules or equivalent, written examination plus oral and practical examination) and difficult. This certification process is very costly and also having difficulty to arrange oral and practical examination in Australia which has similar equipment as you have at your home institution. Otherwise, if you are interested to arrange oral and practical examination in your own centre than you have to bear the travel and accommodation cost of two examiners. One of the main requirements for the international applicants is the ability to communicate effectively in English and should pass the International English Language Testing System (IELTS) as per ACPSEM criteria. A structural diagram is summarising the certification process adopted by ACPSEM (figure 1).

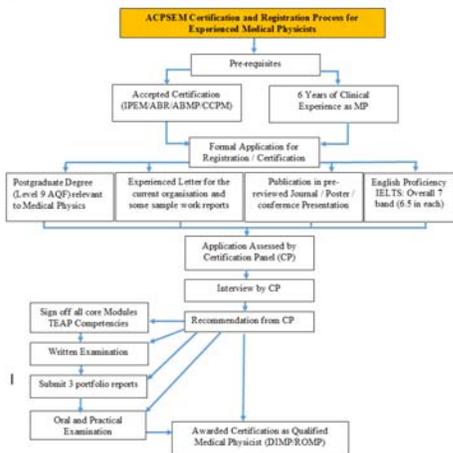


Fig. 1 ACPSEM certification process for overseas experienced applicants.

B- International Medical Physics Certification Board (IMPCB)

IMPCB was formed on May 23rd 2010 by eleven charter member organisations in medical physics.

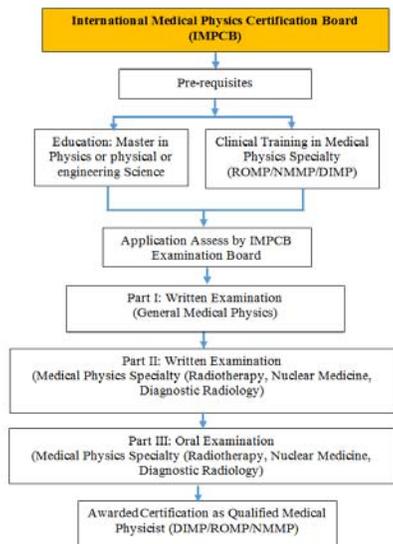


Fig. 2 IMPCB certification process for all applicants.

The main objective was to support the practice of medical physics through certification program in accordance with International Organisation of Medical Physic (IOMP) guidelines and establish a continuing education and professional development who achieve the certification in medical physics. The model is simple and cost effective. IMPCB arrange an examination every year during the conferences or ICTP medical physic summer school. This certification process consists of two written examinations (Part-I and part-II). Part-I is about general medical physics and Part-II is about the specialized medical physic (Radiology, Nuclear Medicine and Radiation Oncology). After successfully completing the Part-I and II, candidate will be eligible to sit in Oral examination. Examination fee is very nominal (\$550 USA for Part-I, II and Oral). But in addition to that, there is travelling cost involve to sit in these examinations. A structural diagram is summarising the certification process adopted by IMPCB (figure 2).

C- Health and Care Professionals Council (HCPC) registration United Kingdom

Health and care professions council (HCPC) in United Kingdom (UK) regulates the qualified members of different professions including medical physicists. This council maintains high standards of education and trainings outside the UK for international applicants. After registering with HCPC, MP is eligible to work in clinical applications.

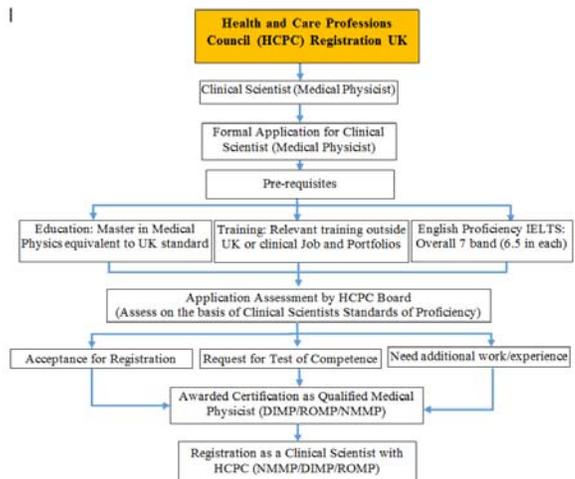


Fig. 3 HCPC certification process for overseas experienced applicants.

For international applicants HCPC has its own specific criteria for assessment that includes the proficiency of different elements. Applicants are further assessed through their education, relevant trainings and experience in specific area of profession. One of the main requirements for the international applicants is the ability to communicate effectively in English and should pass the International English Language Testing System (IELTS) as per HCPC criteria. HCPC registration is revised after every two years while maintain the quality standards of the council.

D- Regional Cooperative Agreement (RCA) certification and Accreditation program

IAEA has initiated a project RAS6077 under Regional Cooperation Agreement on “Strengthening the Effectiveness and Extant of Medical Physics Education and Training” [10]. The outcome of this project was to agree on a set of minimum standard and recommendations to be utilised to train medical physics in each subspecialty. IAEA held number of meeting to established recommendations on accreditation and certification for MPs. This document guides the professionals and administrators to develop, implement and manage education and training program in the Asia Pacific Region for MPs.

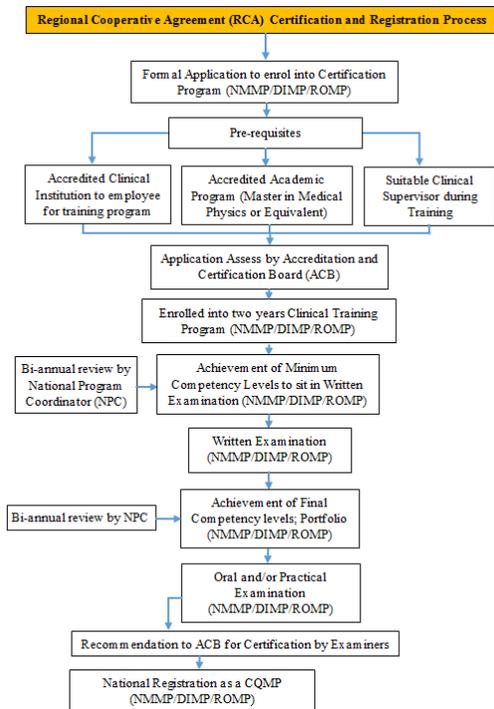


Fig. 4 RCA Accreditation and certification program for newcomer Medical Physicists.

According to this document, each country should have its own National Responsible Authority (NRA) who looks after accreditation and certification process for MPs. NRA will be responsible to develop the formwork for accreditation of a training institutes, academic programs and supervisors. NRA also will be responsible to designed guidelines for experience MPs to achieve certification and also designed a clinical training program for the new registrars. Those registrars who registered in RCA can also have access of Advanced Medical Physics Learning Environment (AMPLE) e-learning platform. Each registrar should achieve level 2 competencies in all core modules before sitting in written examination. For oral and practical (Practical examination is depending upon the accreditation and certification board (ACB)) examination, registrar

should have level three competencies including the portfolio reports. Currently, NRA is not established in Pakistan but extensive efforts has put together to established it. An AMPLE training program is followed similar process as ACPSEM has adopted for MPs registrars in Australia.

E- European Attestation Certificate for Medical Physics Expert (ESCMPE)

European Attestation Certificate for Medical Physics Expert (ESCMPE) program was designed to facilitate the harmonisation of education and training of MPs to medical physics expert (MPE) level among the member states aiming at an improvement in cross border mobility [20].

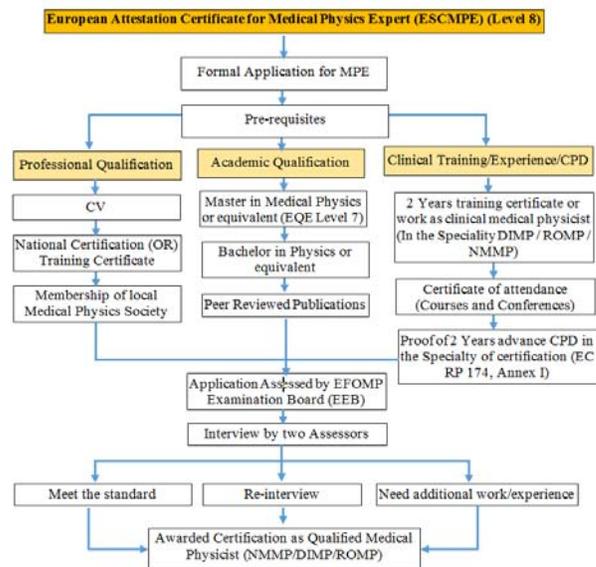


Fig. 5 ESCMPE certification process for overseas experienced applicants.

According to ESCMPE program any MP can apply for this certification. According to European Federation of Organization for Medical Physics (EFOMP) examination Board (EEB) guidelines, application is assessed on the basis of professional Qualification (CV, national certification or training certificate in the field of specific field of medical physics (NMMP/DIMP/ROMP) and membership of professional body), Academic Qualification (Mater in Medical Physics or equivalent according to European standard) and clinical training or experience (2 years clinical training certificate or worked as clinical MP in any field of medical physics (NMMP/DIMP/ROMP)). In addition to that applicant should have proven record of continuous professional development (CPD).

F- Proposed Certification Program for Pakistani Medical Physicists

MP training and certification program is a key to established world class services for the cancer patients. In this article, few key recommendations are given to the authorities who

will guide them to establish a sustainable certification program for MP community in Pakistan.

i- Regulatory Body

POMP was established in 2012 but it has no legal authority to regulate medical physics profession because it is not recognized by government of Pakistan like other organisation or societies e.g. Engineering Council, College of Physicians and Surgeons Pakistan etc. First of all, POMP writes a constitution with the collaboration of medical physics community which includes the framework to establish a certification program for MP and accreditation program for universities and clinical institutes. This constitution structure under the guidelines set by Pakistan government (Act of the parliament 1976) to establish as a body corporate. After completion of the constitution submit a documentation to get the approval from the government to establish a regulatory body for medical physics profession. It is very hard and long process to establish a regulatory body. It is suggested to establish a self-regulatory profession like ACPSEM in Pakistan for the time being to set a solid ground toward the regulatory body. POMP will responsible to self-regulate medical physics profession but at the same time POMP establish a committee who will be responsible to keep working and negotiating with the government to establish a regulatory authority for MPs like engineering council of Pakistan for engineers.

ii- Education

All over the world, for Medical Physicists, an accredited medical physics degree program is compulsory prior to enrol in the certification program. This education program not only reduces the training duration but it also helps to provide the fundamental base to construct a clinical certification program. Currently, PIEAS is offering a Master in Science (MS) in Medical Physics degree program which is accredited by International Organisation of Medical Physics (IOMP). Similarly, two years post graduate accredited degree program should introduce in government and private universities. According to the load of the patients, Pakistan government should established master program in the existing four universities which are geographically distributed among the provinces. The curriculum should be designed as per IOMP guidelines so it will be easy to get the accreditation for this master program form IOMP or in-house in future when a proper certification program is established in Pakistan.

iii- Residency Program

Internship or residency program help to groom clinical significance to the fresh medical physics graduate. Clinical environment in hospital setting is quite different form academic. Regularity body (or self-regulatory) is responsible to design a training program for each speciality, its duration, routine assessment procedure and pass and fail criteria. These graduate who complete their education form the accredited universities are eligible to enroll in this

internship or residency program. Currently, PIEAS and PNRA are working with IAEA to set up Medical Physics Training program under RAS6077 Regional Cooperation Agreement program. POMP is also supporting PIEAS and PNRA to establish national training program. It is an excellent initiative to develop a well organised training program under the governance of PNRA.

iv- Proposed Certification program Structure

Medical physics certification program is regulated by National Responsible Authority (NRA) which regulates the medical physics profession in Pakistan. It is responsible to establish a certification board (CB) for each modality of medical physics (ROMP, DRMP and NMMP). CB will be responsible to conduct the routine assessment of registrars, held examinations and designed pass and fail criteria. At the same time, NRA will also responsible to regulate the academic and clinical training institutes. Any graduate who finish his Master degree from the accredited institute will be eligible to enroll his/her clinical training at a NRA accredited clinical institute. During the training, CB will appoint a clinical supervisor who will be responsible to look after the registrar during the training and make sure registrar achieve the required competencies on time. To monitor the training progress, national and program coordinators (NPC) or regional program coordinator (RPC) are available to mentor and help the registrars during their training program. In addition to that, independent progress review (IPR) should be conducted by RPC or NPC semi-annual or annual to assess the registrar progress independently. NPC or RPC will responsible to submit a report after the assessment to CP. After achieving the required competencies and successful IPR, registrar will be eligible to sit in the examination. After successful completion of training, CB will provide recommendations to NRA for certification. After achieving the certification, NRA will offer registrar a qualified MP registration. All qualified MP are responsible to keep their continuous professional development (CPD) activities up to date to comply with the NRA registration policy. A schematic diagram is shown in the figure 6.

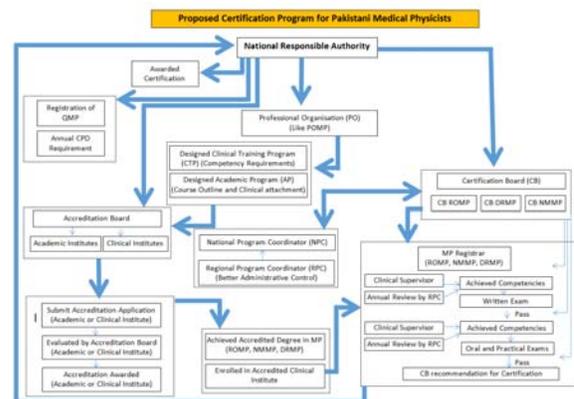


Figure 6: Proposed certification program for medical physicist in Pakistan.

II. CONCLUSIONS

A certification program is vital to maintain the standard of medical physics services throughout the country. PIEAS makes very strong contributions for the medical physics education in Pakistan. The demands of the medical physics services are increasing rapidly due to the increasing number of patients and growing population in Pakistan. The country needs specialized education in Medical Physics to produce high quality medical physicists. More universities need to introduce a medical physics degree program which is directly attached to a clinical institute to complete the research component of the degree. PNRA and POMP can play a vigorous role in developing more infrastructures and facilitating cooperation within the medical physics community. The introduction of a certification program can bring more development in this field; Pakistan can attain more recognition in the field of medical physics. A structure of a certification program is proposed and discussed in this paper which could provide a ground for establishing it in Pakistan. The author's direct experience working within the Pakistani medical physics community has informed this proposal.

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