MEDICAL PHYSICS TRAINING, EDUCATION AND PROFESSIONAL RECOGNITION IN HUNGARY

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Abstract—**Medical Physics as a science is concerned with the application and development of the principles and techniques of physics to human beings, including the diagnosis, treatment and prevention of human disease. The Hungarian Society of Medical Physics was organized in 2008. The society is the professional community organized voluntarily by medical physicists working in the health care system. The great majority of the members are working in the field of radiation therapy, but medical imaging, diagnostic radiology, nuclear medicine, radiobiology and radiation protection are also represented. As a specialization of the physics MSc, the Department of Nuclear Techniques of the Budapest University of Technology and Economics launched a novel education module being the single medical physics education in Hungary in 2010.**

Keywords— **Medical Physics, Education, Accreditation and Certification, Hungary**

INTRODUCTION: MEDICAL PHYSICS IN HUNGARY

Medical Physics as a science is concerned with the application and development of the principles and techniques of physics to human beings, including the diagnosis, treatment and prevention of human disease. The clinical use of X-ray and Ra-226 isotopes started in Hungary at the beginning of the 20th century. The first Hungarian application of isotope ^{226}Ra was possible in a special department in a hospital of National Health Insurance Institute – now Uzsoki Hospital. The foundation of the Loránd Eötvös Radium and X-Ray Institute in 1935 can be regarded as the birth of medical physics with two famous Hungarian physicists: Dr. Johanna Toperczer (1903-1991), who was the first full time physicist in radiation therapy and Prof. Dr. László Bozóky (1911-1995) who joined in 1937. Later, in 1952 the Ministry of Health reorganized the institute and established the National Institute of Oncology.

The first patient in Hungary was treated with cobalt therapy more than sixty years ago at the National Institute of Oncology, Budapest with a fixed gantry Gravicert type equipment, which had been designed by László Bozóky seven years after the first cobalt unit installation in the world in Canada. At the beginning, the localization was performed with X-ray imaging, while the treatment planning was done manually. In 1965 a Rotacert type cobalt unit was installed at the same institute. This machine was already capable of making irradiation in multiple directions and it worked in rotating mode as well. In Hungary, more cobalt units – first the Gravicert type, then machines manufactured abroad – were gradually installed in other radiotherapy centres. The quality of treatments was significantly improved by the introduction of the computerized treatment planning, and the foundation of the IAEA-supported National Computerized Treatment Planning Network in 1978. Moreover, the planning software donated by Van de Geijn was used on a central computer. The next important development was the commencement of the CT image based treatment planning in 1981.

The first step in July 1974 was the foundation of a Medical Physics Section (headed by Prof. Bozóky) in the Hungarian Biophysical Society (HBS). From 1994 the organization worked as the Hungarian Association of Medical Physicists (HAMP) – still part of the HBS, and became a member of the International Organization for Medical Physics (IOMP) in 1975 and of the European Federation of Organizations for Medical Physics (EFOMP) in 1980.

The first conference of the HAMP was organized in 1994 and the materials of the yearly conferences were published in English or in Hungarian as a Supplement of Radiológiai Közlemények (Radiological Communications, HU-ISSN 0133-2791, periodical of the National Institute for Roentgen and Radiation Physics, ORSI). The Hungarian Association of Medical Physicists as the Hungarian member society of EFOMP became entitled to prepare a Training Scheme, and appointed a Training and Education Committee to administer the Training Scheme in 1996 [1].

1n 2008 we reorganized our society: the medical physics community left the HBS and founded the new independent Hungarian Society of Medical Physics (HSMP). The society is the professional community organized voluntarily by medical physicists working in the health care system. The purposes and activity of the Society are the following:

1. It assists the improvement of the application of medical physics (primarily ionizing radiations) and informs the public on professional issues for the interest of the population.
2. It represents specific aspects and interests of medical physics in the regulation and development of health care.
3. It assists and supports research and the education and training of its members in medical physics.
4. Through the improvement of professional conditions it assists the creative work of its members and urges toward the moral and financial appreciation of its members.
5. It represents the interests and viewpoints of the society as a Hungarian organization in international professional organizations and implements the application of the policy of

the European Federation of Organizations in Medical Physics (EFOMP) in Hungary.

The great majority of the members work in the field of radiation therapy. Today we have 13 radiation therapy centres and several nuclear medicine, X-ray diagnostic radiology and MRI (Magnetic Resonance Imaging) departments in Hungary.

GRADUATE TRAINING

In agreement with the Bologna process, the former university education has been replaced by the two-step Bachelor's and Master's level education. As a specialization of the physics MSc, the Department of Nuclear Techniques of the Budapest University of Technology launched a novel education module being the single medical physics education in Hungary. This MSc specialization offers courses on medical imaging, nuclear medicine, X-ray diagnostics, MRI and radiotherapy. Medical courses such as anatomy and medical physiology are given by lecturers from the Semmelweis University, Budapest.

The Institute of Nuclear Techniques (BME NTI) of the Budapest University of Technology and Economics is part of the Faculty of Natural Sciences. The mission of the institute is the education of physicists, environmental and power engineers in the field of nuclear measurement techniques and power generation. At the end of November in 2009 the Senate of the University approved the curriculum of the Medical Physics module.

The medical physics specialization aims at providing high level interdisciplinary theoretical and practical knowledge and readily applicable skills, which can be put into action both in the clinical and the R&D field. Strong contacts to medical institutions and to medical equipment vendors assure that the courses remain up-to-date and the skills readily applicable.

Applicants entering this profession have an appropriate degree (BSc) in a physical science or an equivalent 3-year training. The duration of the medical physics MSc programme is 4 semesters, 3 of which are intended for theoretical education while the last is for preparing the Master's thesis. The number of contact lectures are 104, resulting in a total of 120 credit points. The Module of Specific Lectures is collected on the basis of IPEM, EFOMP, AAPM and IAEA recommendations.

Module Specific Lectures (lecture/practical/laboratory work/credit): Functional Anatomy (2/0/2/4), Physiology (3/1/0/4), Ethical Aspects of Medical Research (2/0/0/2), Radiobiology (2/1/0/3), Radiation protection (2/0/2/4), Physical basis of Radiotherapy (2/0/2/4), Radiotherapy II. (2/0/0/2), Brachytherapy (2/0/0/2), Quality Assurance and Legislation (2/0/1/3), Medical Imaging (3/1/0/4), Physical basis of X-Ray Diagnostic (2/0/0/3), Nuclear medicine (2/0/1/3), Magnetic Resonance and clinical applications (2/1/0/3), Introduction to Optics (2/2/0/5), Microscopy (2/0/0/2), Physical Basis of Laser Medical Applications (2/0/0/2), Spectroscopy and structure of matter (2/0/0/3), Neutron and gamma transport calculation techniques (2/2/0/5), Monte Carlo Methods (2/0/2/4), Ultrasound (2/0/0/2).

The interest of the students for the programme is high and it has become one of the most popular specialties of physics at the university. Institutes that are involved in the training include: National Institute of Oncology, BME, Institute of Physics, "Frédéric Joliot-Curie" National Research Institute for Radiobiology and Radiation Hygiene, Semmelweis University, Mediso Ltd.

CLINICAL TRAINING

The duration of the clinical training is 48 months (4 years) with a theoretical and practical exam at the end [2,~~2~~]. After a successful exam the physicist is qualified as a Clinical radiation physicist and registered by the Office of Health Authorization and Administrative Procedures.

To enter into the training programme, the applicant shall have an MSc (or equivalent) degree in physics, physics teacher or biomedical engineering, and basic education with a minimum 30-hour course in physiology, functional anatomy and radiobiology. The three main medical physics fields are radiotherapy, nuclear medicine and radiology. The training programme consists of 4 main parts: Practical training I. (17 months), Practical training II. (20 months), Theoretical courses (6 months), Scientific work (5 months).

Practical training I. consists of: radiotherapy (4 months), nuclear medicine (3 months), radiology (4 months), radiation protection (2 months), medical image processing (3 months), health informatics (1 month).

Practical training II consists of: radiotherapy or nuclear medicine or radiology (20 months).

Theoretical courses: 2 months in the field of interest (radiotherapy, nuclear medicine or radiology); 2 months – physical and technical module (comprehensive radiation protection, radiations, atomic and nuclear physics, nuclear measurement methods, methodology of scientific research, health informatics and biomedical statistics); 1.5 months – medical field module (basics of oncology, health organization and management, bioethics, laws in health care, basics of quality management); 0.5 month (comprehensive radiation protection).

Scientific work: The trainee conducts a scientific work in the selected medical physics field which results in a written essay or a paper for publication in a scientific journal.

The aim of life-long learning is well-known; thus, the members of our society are always encouraged to further develop their skills and improve their professional knowledge. To achieve the above-mentioned goals, the society supports its members by financing their participation in international conferences; however, the participant member is required to share the acquired information with the society members in return (in a presentation during the annual conference of the HSMP).

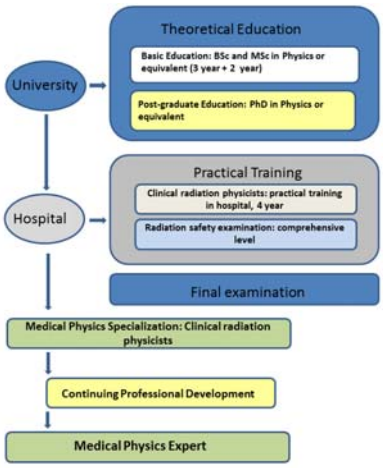

Fig 1 Structure of the present education system of qualified medical physicists in Hungary

Certification is awarded following a written, an oral and a practical examination.

The number of medical physics registrars enrolled in the Basic and Operational Registry of National Healthcare Service Center system is summarized in Table 1.

Table 1 Medical physics specialist registrars enrolled in Hungary in 2021

Specialty	Registrars	Female	Male
Diagnostic radiology	0	0	0
Radiation oncology	20	7 (35%)	13 (65%)
Nuclear medicine	3	0 (0%)	3 (100%)
Total	23	7 (31%)	16 (69%)

Ongoing registration

The successful completion of the clinical training programme enables graduates to be added to the Basic and Operational Registry of National Healthcare Service Center that registers Medical doctors and Clinical radiation physicists.

In order to proceed with the registration, it is required to complete Continuing Professional Development (CPD) activities. This programme is now a web-based system (OFTEX) which extends over 5-year registration periods. Participants are awarded points for the completion of professional development activities, including attendance at scientific meetings, contributions to professional bodies, publications, teaching and supervision, and attending training courses. It is necessary to collect 250 points in total in 5 years. The points for practice are credited by the universities, based on the time spent in employment. 20 points can be collected annually, which means a total of 100 points during one period. In order to finish a period, the collection of at least 60 points is required. The Compulsory training course is worth 50 points. The remaining 100 points can be collected from elective courses, publications and educational activities.

Registered physicists become members of the Hungarian Medical Chamber.

Future opportunities and challenges

Currently, the clinical radiation physicist qualification is only available on a fee-paying basis, and subsidized training is not available. The number of accredited departments is limited. There is no residency system, and no quota as there is for medical doctors. Therefore, tuition fees and course fees have to be paid by the trainees themselves. Furthermore, they are paid by their employer during the 4-year training period and are therefore expected to be at work in their home institution as much as possible. It is unlikely that they can be released for weeks or months to do an internship or a course in another institution. Therefore, many physicists from centres without an accredited training programme cannot afford to take part in the formal training. A solution to this would be to provide centrally funded training for clinical radiation physicists, as is the case with the medical doctor specialist training. With this, the number of physicists participating in the training could be greatly increased.

Conclusions

Training and certification are key activities for professional organizations and HSMP in its more than 20 years of history has been actively involved in many aspects of these tasks. The members of the HSMP have contributed to the delivery of training internationally, through organizations including the International Atomic Energy Agency (IAEA), European Society for Radiotherapy and Oncology (ESTRO) and European Federation of Organisations for Medical Physics (EFOMP).

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