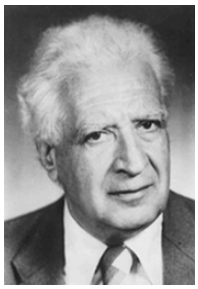
Highlights of Medical Physics in Bulgaria

Early Years of Medical Physics in Bulgaria

The Medical Radiation Physics was the first developed area of Medical Physics in Bulgaria. The work of the Bulgarian Professor in Physiotherapy and Radiology, Andrea Sakhatchiev (1883-1947) in radiation measurements, in 1921, practically started medical radiation physics in Bulgaria.



Prof. Victor Vransky (1916-1990)

The first medical physicist (MP) was Prof. Victor Vransky (1916-1990) who worked in radiation dosimetry and biophysics. He was also the first lecturer in the postgraduate courses for medical doctors on radiation dosimetry and radiotherapy as well as the author of the first textbook in this field (Fundamentals of Radiation Dosimetry, 1953). Prof. Vransky worked in a period when an intensive development of radiology, radiotherapy and nuclear medicine emerged. His active assistant was Mrs. Stefanova – the first woman-MP in the country.

The sizable growth of the reputation of MPs in radiology is credited to the prominent physicist Ivan Uzunov (1927-1996), who was a long-term professor in radiation dosimetry and radiation protection for physicists and medical doctors. He established in 1952 the first laboratory of clinical dosimetry and radiation protection at the former Institute of Postgraduate Medicine, presently the University Hospital "Queen Giovanna" in Sofia. Significant contribution to the laboratory development left also medical physicists Vladimir Penchev, Michael Gantchew, Robert Popitz, Borislav Konstantinov, Zdravko Buchakliev, Katia Ivanova. The second strong center of clinical dosimetry and radiation protection was established at the National Research Centre of Oncology in Sofia (1963-1968), presently Specialised Hospital of Active Treatment in Oncology. Prof. Andrei Sakhatchiev, head of the radiotherapy department, employed the first MP in this center Michael Gantchew, Ventseslav Todorov, Hans Iordanov and Tsvetana Naumova. Both laboratories stayed through the years very powerful centres for development and modification of therapeutic methods, for training medical doctors and MP and for a methodological support to the radiotherapy network in the country. To support the need of accuracy in radiotherapy, the Ministry of Health founded in the70's a Quality Control Laboratory for Radiology and Radiotherapy authorized to supervise all hospitals. This facility, at the University Hospital, was transformed in 1975 to a National Secondary Standard Laboratory of Ionizing Radiation Dosimetry. Since 1978 it has been included in the IAEA network of Secondary Standard Dosimetry Laboratories.

In 1969, an accelerator "Betatron 42 MeV" was installed in the National Oncological Institute in Sofia that was the second radiotheraphy accelerator in Eastern Europe, operating until 1999 and then replaced by a new Linac.

The Establishment of the Bulgarian Society of Biomedical Physics and Engineering (BSBPE)

In the 70's, physicists working in medicine were members of the Bulgarian Society of Radiology while the biomedical engineers - members of the Section of Medical Electronics in the Bulgarian Physiological Society. On 19th of February 1971 these two groups merged to form the new Bulgarian Society of Biomedical Physics and Engineering. Thus, one of the oldest biomedical scientific societies in the world came to life. Among the founders of the

Society were the medical physicists Victor Vransky, Nikolai Karabashev, Robert Popitz, Vladimir Pentchev, Michael Gantchew, Ivan Uzunov and the medical engineers Dimitar Karadimov, Ilion Stamboliev, Ivan Daskalov and Ivan Dotsinsky. The founder and head of the Department of Physics and Biophysics at the Medical Faculty in Sofia Prof. Nikolai Karabashev was elected the first chairman of the new society. In 1983 BSBPE became a member of the European Federation of the Organizations of Medical Physicists (EFOMP) and few years later – of the International Organization of Medical Physicists (IOMP) and of the International Federation for Medical and Biological Engineering (IFMBE).

Nowadays BSBPE is a collective member of the Union of Scientists in Bulgaria and the Union of the Bulgarian Medical Societies. BSBPE is a collective member of IOMP, EFOMP, IFMBE and the European Association of Medical Engineering and Sciences (EAMBES). Good collaborations are kept with all of them. They provide the BSBPE with information and support for participation in international schools and conferences. IOMP donated to BSBPE many medical physics books and journal series. Two IOMP sponsored Medical Physics Libraries – in Sofia and in Shumen are accessible to all Bulgarian specialists. The BSBPE is maintaining good contacts with the identical organizations in many other countries. Thanks to Dr. D. White since 1992 the BSBPE has collaborated actively with the Clinical Science Foundation – London. The latter subsidized three seminars on Radiation Physics with invited lecturers from abroad, and financially supported members of the BSBPE to participate in the 8th Congress of the Bulgarian Association of Radiology in Varna, October 1995. Later Dr. Slavik Tabakov from Kings College Hospital in London, who is a regular member of the BSBPE, and Prof. V. C. Roberts (Kings College, London) initiated a project TEMPUS S-JEP09826 for establishment of a postgraduate training center on Medical Radiation Physics and Engineering, financed by the European Commission.

The activities of the Society include organization of national conferences, distribution of information on scientific research and development from the country and abroad as well as practical implementations, expertise, revision of new books, approbation of dissertations or publications, celebration of anniversaries of important scientific events, participation in the education and postgraduate training of medical physicists and engineers from Bulgaria and abroad, consultations to governmental and non-governmental institutions (advising the Ministry of Health and other government agencies) on major problems of MP and engineering such as acquisition of special instrumentation and distribution of clinical physics and engineering services, etc. Through the years the activities varied and have been carried out with different intensity. The political changes in the country had some negative impact on the activities of the society and on the membership, with a period of stagnation during the last years of 20th century and early years of the new century, but positive tendencies occurred during the past years, with increase in the number of members and the activities of the society. Nowadays the BSBPE has 164 members – clinical physicists, biomedical engineers and biophysicists, working in hospitals, research institutions, universities and private companies. In 2011 the society was registered as a legal entity according to the Bulgarian legislation.

National Conferences on Biomedical Physics and Engineering

One of the activities that have never been interrupted during the years was the national conferences on Biomedical Physics and Engineering, organized every 4 years, starting in the early 70thies. The First National conference on Biomedical Physics and Engineering was held in 12-14 April 1972 in Sofia. 56 scientific papers were presented and proceedings were published of 230 pages. The Second National conference held in 1976 was for the first time

with international participation, and with impressive number of participants (220), 184 of them from Bulgaria and 36 from abroad (German Democratic Republic, Hungary, Poland, Czechoslovakia, UK, and Belgium). Since 1972, the Society holds its regular scientific National Conferences every 4 years. Scientists from all Central and Eastern European countries, France, Germany, England, Finland, India, USA, Canada, Australia actively participated in the ten conferences. In the scope of the conferences WHO-seminars, IOMP- and EFOMP-supported meetings and IAEA-workshops have been organized in order to follow actual problems and trends in special fields The next 11th National Conference on Biomedical Physics and Engineering with international participation will be held in October 2012 in Sofia, Bulgaria.

Annual Colloquium "Physics in Protection of Man and Environment"

Another important activity run by the society is an annual colloquium titled "Physics in Protection of Man and Environment". It was organized for the first time in 1978, together with the Sofia Branch of the Union of Physicists in Bulgaria. Since then, it is organized every June in the beautiful area Gjulechica in Rila Mountain at 1400 m above sea-level. Every year a different ecological "hot topic" is tackled, attracting many physicists, engineers, doctors, chemists, biologists, etc. The topic of the latest colloquium in June 2010 was "Lessons for the future from Chernobyl and Fukushima".

Lecture Course "Physics in Biology and Medicine"

For about 15 years the BSBPE has been organizing annually a two-day lecture course for the Physics teachers from the Sofia region, on different topics in the field of MP and biomedical engineering. Initiated by the former president of the BSBPE Ventseslav Todorov, who is still the main organizer, this course is highly rated and attended by the Physics teachers, and is one of the ways to disseminate the information about the new developments in the field and to make MP profession known to teachers and their students.

Participants of the colloquium "Physics in Protection of Man and Environment" in 2010

Present Status of Medical Physics in Bulgaria

Presently the largest group of MPs works in the field of medical application of ionizing radiation. Their number increased in past 5 years mostly stimulated by the national regulation enforced in 2005, which harmonised the Council Directive 97/43 EURATOM. This important ordinance of the Ministry of Health requires medical physics expert (MPE) to be involved in radiotherapy, nuclear medicine and diagnostic radiology. It also prescribes the minimum

staffing level of MP and MPEs, adopted from the EFOMP Policy statements, and recommendations of IPEM, ESTRO, and AAPM.

Radiotherapy. Much to regret, in opposite to the situation in the 60thies – 70thies, when the radiotherapy in the county was on a very high world level, nowadays it is behind the times. There are 14 radiotherapy centers in the country, but with only 5 linear accelerators, 9 Cobalt machines, 13 orthovoltage X-ray equipment and only two HDR brachytherapy systems. Fortunately, the national plan for development of radiotherapy foresees in 2012-2013 new radiotherapy equipment to be supplied, including 13-14 new linacs, imaging equipment, TPS, simulators. About 35 MPs are presently employed in radiotherapy departments, but in next 1-2 years at least 15 more MPs should be employed to meet the new needs of modernizing radiotherapy.

Nuclear medicine. There are 21 nuclear medicine (NM) departments in the country but in only few of them full time MP is employed. In some NM departments, mostly situated in oncological hospitals, a radiotherapy physicist is sharing responsibility, but there are still some departments working without involvement of MPs. At least 12-14 MPs are needed for NM according to the staffing levels in the regulation.

Diagnostic radiology. A newly developed area for MPs in the country is diagnostic radiology. Despite the legislative requirements, only few big imaging departments employed medical physicist, and in some others a part-time medical physicist is contracted. At the same time, diagnostic radiology contributes to about 24 % of the average total radiation exposure for the Bulgarian population. X-ray equipment in the country amounts to above 1430 conventional units, about 194 CT scanners, 183 dedicated mammography units and 43 angiography and interventional systems. The reason for the small number of MPs is insufficient understanding of the role of quality control and optimisation, and as a consequence – of MP in this field. Quality control is performed mostly by external medical physics services that were established after the enforcement of the regulation. Definitely more MPs are needed in the medical imaging field, but also more knowledge and practical training to increase the capacity of already involved colleagues.

Radiation protection. A group of about 15 specialists with medical physics education are employed in the National Centre of Radiobiology and Radiation Protection (NCRRP) and the radiation protection inspectorates in Burgas, Varna, Vratca, Plovdiv and Ruse. The department of Radiation Protection at Medical Exposure at NCRRP has gained a leading role in the country in the field of patient and staff protection in medicine, by performing national patient dose surveys, radiation protection training, research and providing methodological support in patient dosimetry and quality control in diagnostic radiology, nuclear medicine and radiotherapy. NCRRP is the main training provider on radiation protection for different groups of medical staff working with ionizing radiation.

Non-ionizing radiation and other physics factors. The second largest group of MPs is focused on the control and research in the sanitary hygiene connected with different non-ionizing factors. The Laboratory of Physical Factors including non-ionizing radiation at the National Centre of Public Health Protection (NCPHP) is very active and has a leading role in the field. Its functions include research, teaching, standardization and inspections throughout the country. This laboratory provides also training of MPs working in the field. The NCPHP is appointed to realize the harmonization of the Bulgarian legislation with the EU one in the

fields of non-ionizing radiation. At present it is implementing the National Programs on the WHO Policy for EMF Exposure.

Universities and Research Institutions. Another group of MPs works as lecturers and scientists in universities, research institutes and industrial laboratories. A good example is the successful research groups at the Institute of Electronics at the Bulgarian Academy of Science, working in the field of Biomedical photonics. There is a trend in the country for more "pure" physicists to take interest in a huge area of medical application. The pure physics integrates with the empirical medicine and biology from the past and so the modern medicine becomes more and more scientific and more precise. At the same time, medical physics becomes important and very prospective speciality – the strategic weapon of the modern medicine. The future and the number of people in this scientific group will depend on the governmental support for research activities.

Education, Training and Recognition of Medical Physicists

BSBPE has been closely involved in education and training of MPs. In the early years, the physicists entering the medical field should grow their knowledge and expertise mostly through self-learning. To strengthen the clinical training of physicists working in the health care, the Society initiated in the early 80's the introduction of formal structured postgraduate courses in Medical Radiation Physics and Medical and Hygiene Physics, and elaborated their curricula and syllabi. The society was also the engine for introduction of university education in Medical Physics in Bulgaria in the 90's.

The present scheme of education and training of medical physicists in Bulgaria is presented on Figure 1.

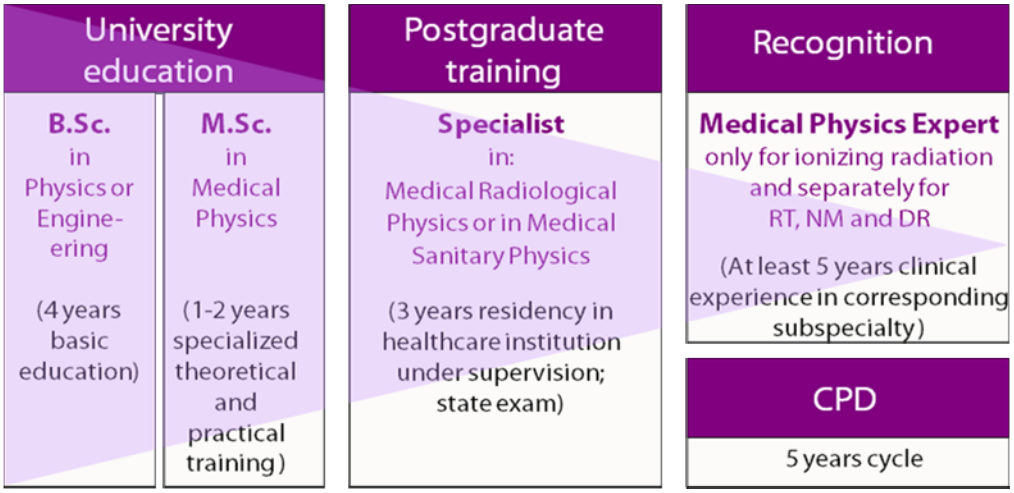


Fig. 1 Present scheme of education and training of medical physicists in Bulgaria

University Education

In 1992/93, the University of Shumen "Episkop Konstantin Preslvaski" introduced "Medical Physics and Radioecology" as a new specialization for physics students, within the 5-years university study in Physics. Following the reforms in the university education in Bulgaria, after 2001 two levels were introduced: 4-years B.Sc. program in general Physics and M.Sc. program in Medical Physics and Radioecology comprising an additional study of 3 terms (1.5 academic years). This program was initiated by the Department of Physics at the University of Shumen, but the curricula was developed with the active contribution of the Board of the BSBPE, who realized their long standing efforts for establishment of university

education in medical physics. This course was practically oriented to the application of ionizing radiation in medicine, as well as to the health physics and radioecology. The curriculum balanced efficiently theoretical and practical training and included courses on radiation dosimetry, radiation protection, medical electronics, physics of radiotherapy, physics of medical imaging, radioecology, non-ionizing physical factors, medical application of lasers, etc. Leading Bulgarian specialists from the relevant fields of medical physics were invited to lecture. A big advantage of this course was the close cooperation between the University and the Regional Hospital in Shumen providing a clinical base for practical training. The duration of this course was 1.5 academic years organized in 2 terms lectures and exams and 1 term practical training and preparation of M.Sc. thesis. For more than 10 years this program was the main supplier of the clinics with MPs. Unfortunately in 2008, the University of Shumen temporarily lost the accreditation for education in M.Sc. programs in Physics, and thus the Medical Physics education in the North East part of Bulgaria has been blocked, leading to the notable shortage of MPs in this part of the country in past years. The second M.Sc. course in Medical radiation physics and engineering was introduced in 1997 in the Inter-University Education Centre (IUC) in Plovdiv – the second biggest town in the country. This center was created under the frame of the EC TEMPUS project SJEP 09826, initiated by our fellow-countryman Slavik Tabakov, who leaves in London. Consortium of six universities was involved: three from Bulgaria -Medical University in Plovdiv; Technical University in Plovdiv, and University of Plovdiv, with the support of the King's College London, University of Florence, and the University of Dublin Trinity College. Curriculum was prepared in line with the best international standards and following the IPEM criteria. In order to arrange the contribution of highly experienced lecturers from different universities, hospitals and research institutions to the teaching process the course was developed as fully modularized. The course consisted of 12 modules, divided in two terms (one full academic year). The course syllabus was stressed mostly on clinical radiation physics including also elements of medical radiation equipment engineering. During the first five years the program run in English and was accredited by IPEM. Later after the TEMPUS project finished, the training changed to Bulgarian language and few years later the M.Sc. program in Medical Radiation Physics and Engineering moved under the umbrella of the Plovdiv University "Paisii Hilendarski".

The official opening of the Inter-University Education Centre (IUC) in Plovdiv in 1997

The third university program in medical physics was introduced in 1998 in the biggest university in Bulgaria, Sofia University "St. Kliment Ohridski". Initially it was designed as a

module in the Bc.S. degree, but soon later it was structured as a Mc.S. degree program with the broadest curricula on different physics aspects applied to medicine and biology. This course covers wide range of subjects like biophysics, biomechanics, optics and electro-optical methods in clinical practice, medical application of lasers and acoustics, signal and image processing as well as the radiation physics and physics of radiation therapy, nuclear medicine and medical imaging. Nowadays this M.Sc. program is the main supplier of MPs for hospitals and other healthcare institutions and research centers.

Postgraduate Training

In 1982 the Ministry of Health approved two postgraduate courses for physicists working in the healthcare: Medical Radiological Physics for physicists working in the radiological field and Medical Sanitary Physics for application of non-ionizing radiation. Thus, the Medical Physics was recognized in the country as one of the important paramedical specialities. These two courses still exist, being a part of the well established system of postgraduate training of healthcare specialists. The training is performed under the umbrella of the Medical University of Sofia. The admission to the training is given to physicists or engineers who already work in the field and successfully passed an admission exam. The training program is based on a 3 years residency under the supervision of experienced medical physicist, modules of lectures, individual clinical training, several intermediate exams and final state exam. The trainee who successfully completed the program gets a diploma of a Specialist in Medical Radiological Physics or Medical Sanitary Physics correspondingly. The ***training program in Medical Radiological Physics*** is provided for physicists working in radiotherapy, nuclear medicine, diagnostic radiology and radiation protection. The curriculum is composed of two parts: basic modules and specialised modules. Examples of basic modules are biology, anatomy and physiology; Interactions of radiation with matter; Ionising radiation in medicine, and specialised modules are Radiometry and dosimetry; Radiation protection; Physics of radiotherapy; Nuclear medicine; Medical imaging. For each trainee an individual training plan is agreed and a personal supervisor is appointed. This plan includes training elements for each module, its duration, and the institution where the training will be performed. The trainee keeps records of the implemented practical tasks and the created portfolio is presented at the examination board. Because of the insufficient number of supervisors, the training is performed only in few institutions in Sofia – National Hospital for Active Treatment in Oncology, National Centre of Radiobiology and Radiation Protection, Alexandrovska Hospital and University Hospital "Queen Giovanna". Only a holder of diploma of Specialist in Medical Radiological Physics can act as a MPE according to the Bulgarian legislation. The number of trainees entering the postgraduate program each year varies from 2 to 8, with a notable increase after the formal introduction in 2005 of the requirements for MPs involvement in radiological field. The ***training program in Medical Sanitary Physics*** is run by the Laboratory of Physical Factors incl. non-ionizing radiation at the National Centre of Public Health Protection (NCPHP). The curriculum is also composed of two parts: basic modules and specialised modules. Examples of basic modules are hygiene, biophysics, statistics, methodological aspects of investigation of the biological effects of physical factors, quality politics, databases and specialised modules are different physical agents (mechanical, climatic, optical, non-ionizing electromagnetic radiation, etc, as well as training in measurements, norming and protection from physical agents. The individual training program is adapted to the field of interest of every trainee.

Medical Physics Expert Recognition

Bulgaria became a member of the European Union in 2007 and the national legislation was harmonised with the European by an Ordinance of the Ministry of Health for protection of

individuals at medical exposure, enforced in October 2005. This regulation requires MPE to be recognised separately for Radiotherapy, Nuclear Medicine or Diagnostic and Interventional Radiology, and defines the training requirements. To act as a MPE, one should hold diploma of a Specialist in Medical Radiological Physics and should have at least 5 years clinical experience in the corresponding field. This recognition is not yet implemented in practice but is foreseen to be given by the State examination body in Medical Radiological Physics at the Ministry of Health on the basis of CPD system, which is under elaboration and discussion by the BSBPE.

Challenges and Future

The new realities created new challenges for the medical physics society. The globalisation process leads to a notable fluctuation of experienced MPs, often leaving the country after completing the postgraduate training. This resulted in a lack of enough specialists both for clinical practice and for supervision of young colleagues under training. For many years the academic carrier in the field of applied physics and particularly in medical physics has not been well stimulated, that resulted in the insufficient number of people with PhD degree who can teach Medical Physics in the graduate and postgraduate programs. This process should be overcome by preparation of more MPs with PhD degree and by inviting lecturers from abroad to teach in the postgraduate programs. The BSBPE is aiming at establishment of minimum training standards for Master degree in Medical Physics and for the further improvement of the post-graduate training. The insufficient local expertise in some newer methods like PET/CT, IMRT, radiosurgery, MSCT, digital radiology, digital mammography, MRI, etc, can be compensated by inviting lecturers from abroad and organizing specialized training courses. The recognition scheme for Medical physics experts should be finally approved and applied, and implementation of the prescribed staffing level for MPs in radiological field should be enforced. Medical Physics in the country should be included in the list of the recognized professions, following the International standard classification of occupations ISCO-08. Medical Physics is an applied specialty, and MPs work in very close collaboration with medical staff in rapidly developing areas of medicine. The reputation of MPs depends at a highest extend on their knowledge, skills and expertise, that should be kept up-to date. Our recognition requires continuous improvement and daily defense of the positions. Many years ago the reputable Bulgarian radiation oncologist Prof. Sakhatchiev used to say: "**You, physicists should every day convince us medical doctors that we could not work without you**". This is still valid at present and is a message for the future.

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