IUPESM 2018 World Congress

IOMP SCHOOL

Editing: John Damilakis, Magdalena Stoeva

SESSION ON IOMP PROJECT "HISTORY OF MEDICAL PHYSICS"

Moderators: Slavik Tabakov, IOMP President; Perry Sprawls, USA; KY Cheung, IOMP History Sub-Com Chair; John Damilakis, IOMP ETC Chair, Magdalena Stoeva, IOMP MPWB Chair

During 2016 IOMP launched a large project "History of Medical Physics" aiming to show the creation and the evolution of different equipment and methods, as well as their clinical application; the overall development of the profession and the main contributors in the various topics in medical physics. The project will be developed over a number of years by independent teams. The first results of the project are being published as Special Issues of the IOMP Journal Medical Physics International.

The aim of the session is to present the current progress of the project – in particular the development of the volume related to Diagnostic Radiology and the volume(s) related to Professional development and Education and Training development. The session will present the current progress of the surveys developed and assessed in collaboration with the 6 Regional Organisations of IOMP (covering Asia, S-E Asia, Middle East, Africa, Europe, Latin America and North America).

The session will also form future teams for the development of the further volumes of the History (related to the professional sub-fields of the profession – Imaging, radiation Safety, Radiotherapy, etc).

CT DOSES AND RISKS

John Damilakis
University of Crete, Faculty of Medicine, Greece

CT is a valuable imaging method that can be used to examine organs and tissues, detect abnormalities and guide procedures. However, radiation dose associated with CT examinations and the potential of developing cancer due to radiation is an issue of concern. This presentation will provide an overview of the doses and the radiation-induced cancer risks from CT examinations. Specific groups of patients may be at greater risk from CT exposure and radiogenic risk should be considered carefully in these patients. The increasing use of CT has resulted in an increase in requests for imaging during pregnancy. Conceptus doses and associated risks from most CT examinations are very low especially if the unborn child is not exposed primarily to X-ray beam. The use of paediatric CT has been increasing rapidly. Children and adolescents are more radiosensitive than adults and they have long expected lifetime. CT has been used for screening of asymptomatic individuals. In lung cancer screening, individuals who have a high risk of developing lung cancer undergo low-dose CT examinations. CT colonography (CTC) has also been used as a method to screen for colorectal tumors as well as for large colorectal polyps. Patient dose from a low-dose chest CT examination is about 1 mSv and from CTC ranges from about 3 mSv for modern CT scanners to about 9 mSv. The ICRP and the BEIR committee have provided estimates of cancer mortality risks per unit dose. A single low-dose CTC would result in about a 0.01% lifetime cancer risk i.e. 1 in 10000 for a typical patient cohort. A novel method for the estimation of patient organ doses and risks from chest CT is currently being developed in the University of Crete as part of the MEDIRAD project. Results of this research effort will be presented during this lecture.

DOSE OPTIMIZATION STRATEGIES

Mahadevappa Mahesh
Johns Hopkins University School of Medicine

Radiation dose is of concern for patients undergoing medical x-ray imaging procedures. In order to ensure radiation burden is kept minimum, the approach of dose optimization is more holistic and effective than simple dose reduction. Dose optimization in medical imaging consists of not only keeping radiation burden as low as possible (ALARA principle) but at the same time maintain optimal image quality to ensure proper diagnosis. In this presentation, various dose reduction strategies will be discussed. Since among the medical x-ray imaging procedures, CT studies contributes the most radiation burden, hence dose optimization strategies with focus on CT will be discussed. Tube current modulation, tube voltage selection, limiting scan volume, patient positioning, use of iterative reconstruction methods are among the many dose optimization tools that will be discussed in this session.

DOSIMETRIC CHALLENGES OF PHOTON BRACHYTHERAPY IN TERMS OF ABSORBED DOSE TO WATER

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About 10% of all radiotherapy cancer treatments are performed by brachytherapy (BT). For BT with beta radiation, the ISO 21439:2009 *Clinical dosimetry – Beta radiation sources for brachytherapy* gives guidance. But for photon radiation-BT a corresponding recommendation is missing. Detailed recommendations have been prepared by the AAPM TG-43. Their recommendation to perform the calibration of photon radiation BT-sources in terms of the reference air kerma rate is still used world-wide. But, as the BT-dose is prescribed in terms of the biologically relevant quantity absorbed dose to water, it is the task of medical physicists to convert the data by using the AAPM TG-43 formalism. Recently different primary standards have been developed in several national metrological institutes for high-energetic (HE) BT-photon sources, like ^{192}Ir and ^{60}Co, as well as for low-energetic (LE) BT-photon sources, like ^{125}I and ^{103}Pd. Known transfer standards, such as well chambers, calibrated in terms of absorbed dose to water in water for every model of photon-BT-sources to be used, can be utilized for traceability to a primary standard. Secondary standards are still missing.

Photon-BT dosimetry measurements are really challenging as the response R of dosimetry detectors depends on several influence quantities. R can be described as product of the detector-to-water-dose-ratio and the intrinsic response, describing the conversion of the detector absorbed dose to a measurement indication, both dependent on the mean photon energy $\overline{E}$. Instead of complicated Monte-Carlo simulation calculations, $\overline{E}$ can precisely be determined from the BT-photon radiation quality index, the ratio of the primary dose at r = 2 cm to that at r = 1 cm (in water on the transverse plane of the source), easily derived from published attenuation coefficients and primary-and-scatter-separated (PSS-) dose data. Such source reference data for all commercially available photon-BT sources are published e.g. at (http://www.physics.carleton.ca/clrp/seed_database/).

OVERVIEW OF RADIATION SAFETY CULTURE IN HEALTHCARE

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Transitioning from individual actions on radiation safety to a culture of safety is a long process that requires concerted actions. Further, there are requirements in international Basic Safety Standards on radiation safety culture. There is a need to educate professionals on difference between radiation safety and radiation safety culture, create awareness about actions ongoing as a joint activity of IOMP with international organizations [World Health Organization (WHO), International Radiation Protection Association (IRPA) and International Atomic Energy Agency (IAEA)], inform about requirements, need to integrate actions with patient safety and to discuss how individuals and organizations can contribute.

QUALITY CONTROL FOR CBCT DEVICES ACCORDING TO EFOMP-ESTRO-IAEA

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Science and communication, Munich, Germany

The course covers the contents of the recent guideline published by a collaboration of EFOMP, ESTRO, IAEA and EURADOS, with authors from more than 19 countries. It is available for free online since October 2017. The document focuses on measurements of radiation output and objective image quality parameters, which are required to check CBCT devices, including applications in dental radiology; interventional and guided surgery; and guidance systems of linear accelerators for radiotherapy.

In particular, we will describe why and how to perform the measurements of uniformity, geometrical precision, voxel values (or Hounsfield units), noise, low contrast resolution and spatial (high contrast) resolution. We will also indicate how to use different phantoms, as well as examples of commercial and free software. A special section is devoted to measurements of radiation output, either using a kerma-area product meter or a conventional solid state dosemeter attached to the flat panel.

After the explanation of the theory, if time permits, we will simulate a practical application of the whole protocol and discuss recent developemts regarding patient dosimetry.

Participants who bring a USB stick may take with them a digital copy of the guideline and the article appeared in Physica Medica.

BREAST TOMOSYNTHESIS: WHERE ARE WE AND WHERE ARE WE GOING?

Ioannis Sechopoulos

LRCB, Dutch Expert Centre for Screening, Nijmegen, The Netherlands

The introduction of digital tomosynthesis for breast imaging has brought about many questions, regarding its optimal clinical application, dosimetry, artifacts, image quality, and quality control, among others. Given that breast tomosynthesis seems ideally suited for screening, its optimization for population-based screening implementation is an especially important topic of interest. The appropriate number of views to acquire, number of readings to perform, its use along real mammograms or synthetic mammograms, are all open questions that need to be addressed. However, the optimal combination of these parameters are most probably dependent on the manufacturer of the system in question. Furthermore, these issues will have a direct impact on the dose involved in screening tomosynthesis.

We will review the current state of digital breast tomosynthesis technology, its clinical applications and the challenges being faced with this modality. Current research and future developments, and how these might impact the use of this modality in the realm of breast cancer care will be discussed.

Conflicts of interest: Research agreement, Siemens Healthcare

PET/CT VS PET/MRI: QUO VADIS

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During the last few decades, PET-based molecular imaging has advanced elegantly and steadily gained importance in the clinical and research arenas. However, the lack of structural information provided by this imaging modality motivated its correlation with structural imaging techniques such as x-ray CT or MRI, which are well established in clinical setting. The advent by academia of combined PET/CT and PET/MRI systems, their commercial introduction and the fast and wide acceptance of the former in the clinic has had a significant impact on patient management and clinical research. However, the latter is still an "embryonic" technology having the potential to become a powerful tool and likely to play a pivotal role in clinical diagnosis and research. The additional capability of simultaneous acquisition of PET and MRI data bridges the gap between molecular and morphologic diagnosis. Since diagnostic imaging methods evolve from the anatomic to the molecular level, the mission of multimodal and multiparametric imaging becomes ever more essential. Whole-body hybrid PET/MR imaging is, since 2010, being investigated in clinical setting for clinical diagnosis and staging, treatment response monitoring and radiation therapy treatment planning of a wide range of malignancies. However, quantitative PET/MRI is still challenged by the lack of accurate and robust attenuation and motion compensation strategies to enable the production of artifact-free and quantitative PET images. This talk briefly summarizes the historical development of PET/CT and PET/MRI and then gives an overview of state-of-the-art and recent advances in the design and construction of clinical systems and discusses the challenges facing multimodality imaging.

MULTI-ENERGY (SPECTRAL) CT

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In x-ray computed tomography (CT), materials with different effective atomic numbers can have the same CT number (in HU), depending on the density of the materials and the energy of the x-ray beam. Discriminating between different tissue types or contrast materials is therefore very challenging. In dual-energy CT (DECT), a second attenuation measurement is acquired at a second energy (e.g., a second x-ray tube potential), allowing discrimination between the two materials. Clinical DECT systems are now available using two x-ray sources and detectors, sequential acquisitions of low- and high-tube potential scans, fast tube-potential switching, or dual detector layers. The use of photon-counting detectors, which can resolve individual photon energies and hence acquire data at more than two energy levels, is currently undergoing evaluation on research systems. Thus, dual- or multi-energy CT data, collectively referred to as spectral CT, can be acquired using a number of different approaches. Once the dual- or multi-energy data are collected, material decomposition algorithms are used to identify materials according to their effective atomic number and/or to quantify their mass density. These algorithms can be applied to either projection or image data. A number of different applications have been developed for clinical application, including those that automatically 1) remove bone and/or calcified plaque signal; 2) map out and/or quantify the concentration of iodine in contrast-enhanced CT images; 3) create virtual non-contrast images from contrast-enhanced scans; 4) identify perfused blood volume in the lung or myocardium; and 5) characterize materials according to their effective atomic number, which is useful for differentiating between uric-acid and non-uric-acid kidney stones or uric acid (gout) and non-uric-acid (calcium pyrophosphate) crystals in joints and surrounding tissues. In this presentation, the physical principles of spectral CT will be reviewed and current technical approaches described. In addition, current clinical applications will be introduced.

CHM: Research grant, Siemens Healthcare GmbH

FLAT PANEL DETECTOR FLUOROSCOPY

Mahadevappa Mahesh
Johns Hopkins University School of Medicine

Interventional and fluoroscopic imaging procedures are becoming more prevalent because of less-invasive nature of these procedures compared to alternatives such as surgery. Flat-panel x-ray detectors (FPD) are replacing conventional image intensifiers in fluoroscopy. There are two approaches to produce digital x-rays. One is based on indirect conversion of x-rays to light (using CsI scintillators) and then to proportional conversion to electrical charge/signal (using amorphous-silicone (a-Si) based thin film transistors). Second approach is the direct conversion of x-rays to electrical charge/signal (amorphous-Selenium (a-Se) based thin film transistors). Flat panel detector fluoroscopy systems mostly use the indirect digital conversion approach (a-Si based thin-film-transistor with CsI scintillator). Both of the approaches will be discussed in this session. The advantages of FPD system such as lower radiation dose burden with higher magnification modes compared to II, lesser geometric distortions, larger field of view, less geometric foot-print, improved detective quantum efficiency that allows radiation dose reduction will be discussed in this session.

NEW ASPECTS OF MEDICAL PHYSICS IN RADIATION ONCOLOGY AND IMAGING

Golam Abu Zakaria, Ph.D

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Medical Physics is the application of physics concepts, theories and methods to medicine and health care. Medical physicists play a vital and often leading role for any medical research team. Their activities cover some key areas such as cancer, heart diseases and mental illnesses. In cancer treatment, they primarily work on issues involving imaging and radiation oncology. Thus the medical physicists play a mandatory role in every radiation oncology team.

The capability of controlling the growth of any cancer with radiation dose is always associated with the unavoidable normal tissue damage. Accordingly, many physical-technical developments in radiotherapy facilities are aimed to give a maximum radiation dose to tumour cells and – at the same time – minimize the dose to the surrounding normal tissue.

For that reason, after the development of the 60-Co Irradiation Units in the 50ties medical Linear Accelerators were developed in the following decades. Advanced Linear Accelerators, Helical Tomotherapy and Cyber Knife machines have been developed over the past two decades. Last but not least, Neutrons, Protons and even heavier Ions have also been applied. At the same time, treatment calculation and delivery methods have been continuously improved from conventional multi-beam techniques to tumour shape conformal methods such as 3D- Conformal Radiotherapy (3DCRT), Radio Surgery, Intensity Modulated Radiotherapy (IMRT), Image Guided Radiotherapy (IGRT), Stereotactic Body Radiation Therapy (SBRT) and Adaptive Radiotherapy (ART).

The concentration of dose to tumour requires precise information on the shape and the anatomical geometry of the tumour within the body. The techniques providing such pieces of information in a visible form is summarized by the term of “Imaging”. X-ray has played a dominant role almost from the time of its discovery in 1895. Up to now, the use of x-rays has been extended to tomographic imaging with Computer Tomography (CT) and other imaging modalities like Ultrasound (US), Magnetic Resonance Imaging (MRI) or Positron Emission Tomography (PET) which have been developed over the last decades. By their combined use, the required information level on the clinical tumour target volume for radiotherapy has been tremendously raised.

The physical and technical development of radiation oncology and imaging are discussed in this talk covering aspects in biology as well.

SURVEY OF SITUATION IN 67 COUNTRIES AND WAY FORWARD

Madan Rehani
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The Statement in the side event of the World Health Assembly 2016 on "Are we making the right investments for Caner control" stated: It is estimated that 22,000 Medical Physicists will be required in LMICs by 2035 to provide equal access to radiation therapy. The total number of medical physicists in 2016 is around this number, of which approximately only 1/3rd are in LMICs. There is an urgent need to strengthen actions to address this demand.

The figures were drawn from an article in Lancet Oncology in September 2015.

The shortage of medical physicists has been recognized globally not only in radiotherapy but also in diagnostic radiology, more so in developing countries. There is a need to assess the situation, do cause analysis, assess implications and develop solutions.

TEACHING OF MEDICAL PHYSICS TO RADIOLOGY RESIDENT: EUROPEAN SITUATION AND SUGGESTED SOLUTIONS

Carmel J. Caruana
Medical Physics Department, University of Malta, Malta

A Medical Physics component is integral to the curricula of all Radiology resident programmes in Europe. However, breadth and depth vary between one country and another leading to loss of harmonization across European states. The European Training Curriculum for Radiology should go a long way in addressing this issue. This presentation will describe and discuss the physics component of this curriculum.

IOMP/IUPAP WORKSHOP ON MEDICAL PHYSICS PARTNERING WITH THE DEVELOPING WORLD

Moderators: Slavik Tabakov, IOMP President; Yakov Pipman, IOMP PRC Chair; Fridtjof Nuesslin, IUPAP AC4 Chair; Libor Judas, Co-President WC2018

The aim of this regular IOMP/IUPAP Workshop is to support the medical physics capacity building in the Low-and-Middle-Income countries (LMIC). Special attention will be given to the activities necessary to address the expected tripling of the profession in the coming 20 years.

This extended IOMP Workshop is expected to attract about 100 participants. It is made on purpose as a satellite activity to the large World Congress of Medical Physics WC2018, which will attract approx. 2000 specialists from almost all 86 IOMP national member societies. This event will include various plenary and public lectures.

The Workshop attendees will benefit from these lectures, and all state-of-the-art presentations, and also from networking with senior specialists, aiming to boost the future expansion of the profession. IOMP expects significant impact from the Workshop, what is based on our very positive experience from the previous Workshop in Toronto, as well as similar Workshops in Eastern Europe and Asia.

The Workshop session will consist of presentations from the representatives of the main IOMP Regional Organisations (Federations in Asia, S-E Asia, Middle-East, Africa, Latin-America and Europe) followed by Panel discussion and drafting a Working plan.

Workshop opening and address from IUPAP – Prof. Fridtjof Nuesslin (Chair IUPAP AC4)

-Aims of the Workshop – Dr Yakov Pipman (IOMP PRC Chair)

-Challenges to the profession – Prof. Slavik Tabakov (President IOMP 2015-2018)

-Status of Medical Physics and Activities to Boost the Professional Development in the AFOMP Region – Prof. Arun Chougule (India, Vice-President AFOMP)

-Status of Medical Physics and Activities to Boost the Professional Development in the SEAFOMP Region – Prof. Anchali Krisanachinda (Thailand, Past-President SEAFOMP)

-Status of Medical Physics and Activities to Boost the Professional Development in the MEFOMP Region – Mr Nabil Iqeilan (Jordan, Chair ETC of MEFOMP)

-Status of Medical Physics and Activities to Boost the Professional Development in the EFOMP Region – Dr Hrvoje Hrsak (Croatia, nominated by EFOMP President)

- Status of Medical Physics and Activities to Boost the Professional Development in the FAMPO Region – Dr Taofeeq Ige (Nigeria, President FAMPO)

- Status of Medical Physics and Activities to Boost the Professional Development in the ALFIM Region – Dr Rodolfo Alfonso (Cuba, President ALFIM)

IAEA activities towards Capacity Building in LMI countries – Dr Harry Delis

WHO activities towards Capacity Building in LMI countries – Dr Maria Perez, Dr Adriana Velazquez

Open discussion and Way Forward

STATUS OF MEDICAL PHYSICS AND ACTIVITIES TO BOOST THE PROFESSIONAL DEVELOPMENT IN THE AFOMP REGION

Arun Chougule, Ph.D.
Vice President AFOMP

Asia-Oceania Federation of Organizations for Medical Physics (AFOMP) is founded in July 2000 and today 21 countries national medical physicist associations (NMPO) with over 5000 medical physicists in Asia-Oceania region are members of AFOMP. If we look at socio-economic & educational status of AFOMP countries we found huge diversity and therefore task of AFOMP to homogenies the medical Physics education and profession is quite challenging.

To cater to the needs of the medical physicists and their education, AFOMP has created three main following committees to work on number of important tasks.

1. Professional development committee (PDC)
2. Education and training Committee (ETC)
3. Scientific Committee (SC)

These committees have drafted policy statements to deal with minimum level of education and training of medical physics, continuous professional development and career progression for clinical medical physicist in AFOMP countries.

Medical physicist is a health profession recognized by International Labour Organization (ILO) needs high level of professional competency and therefore medical physicist working in clinical environment must have undergone structured training program which is, 3 year undergraduate in science plus 2 year masters in medical physics followed by minimum of 1 year residency under experienced medical physicist in recognized institution. To access the present medical physics education, training and professional status in AFOMP member countries, a survey was undertaken by sending questionnaire to all AFOMP NMPO's. The questions were framed to get information such as, medical physics education program with their duration and the eligibility level education to pursue the medical physics education program etc.

Though officially we received responses from only four NMOP's however from personal contacts and understanding we compiled the information and observed that only few countries have master level medical physics education programme with proper residency and accreditation. The detail outcome of the survey and possible remedies to make it compatible with IAEA recommendations, teaching & education structural requirements are suggested.

AFOMP works in many areas to enhance medical physics by organizing various scientific activities, conferences and officially publishes & endorses various journals & newsletter. Also promotes students & young professional through various grants.

One of the most important scientific events organized by AFOMP every year is Asia-Oceania congress of Medical Physics (AOCMP). This congress gives a strong platform to AFOMP region medical physics communities to unite, exchange their scientific research & expertise and discuss professional issues.

Official publication of AFOMP includes Australian Journal of Physics and Engineering Sciences in Medicine (APESM) and AFOMP newsletter. Apart from this AFOMP officially endorses two journals i.e. the Biomedical Imaging and Interventional Journal (BIIJ), Radiological Physics and Technology (RPT). In December 2017 MOU between AFOMP & MFOMP is signed to enhance collaboration and exchange of science between AFOMP & MEFOMP countries. The "AOCMP 2019" is being organized in conjunction with MEFOMP meeting in Kuwait to enhance the collaboration.

AFOMP is playing a lead role in scientific and professional development of medical physics communities in Asia-Oceania region. Due to its continuous efforts in subsequent years surely the status of medical physics and physicist has increased but still there is long way to go ahead to reach its goals.

STATUS OF MEDICAL PHYSICS AND ACTIVITIES TO BOOST THE PROFESSIONAL DEVELOPMENT IN THE SEAFOMP REGION

Anchali Krisanachinda
President, Thai Medical Physicist Society, Past-President SEAFOMP

ASEAN is an organization comprising of 10 nations located in Southeast Asia. The organization was formed on 8 August 1967 by its five original member countries, i.e. Indonesia, Malaysia, Philippines, Singapore and Thailand. Over the years, the organization grew when Brunei Darussalam joined in as the sixth member on 8 January 1984, Vietnam on 28 July 1995, Laos and Myanmar on 23 July 1997 and Cambodia on 30 April 1999. Its objectives include the acceleration of economic growth, social progress and cultural development among its members, as well as to promote regional peace. (ASEAN Secretariat, 2007). The idea of setting up an organization for South-east Asian medical physics societies was first mooted in 1996. During the International Organization of Medical Physics (IOMP) World Congress at Nice, the formation of SEAFOMP was endorsed by member countries. The South East Asian Federation of Organizations for Medical Physics (SEAFOMP) was officially accepted as a regional chapter of the IOMP at the World Congress in Chicago in 2000 with five member countries. Indonesia, Malaysia, Philippines, Singapore and Thailand. At that time, the founding members of SEAFOMP were Anchali Krisanachinda and Ratana Pirabul from Thailand, Kwan-Hoong Ng from Malaysia, Agnette Peralta from the Philippines, Djarwani S Soejoko from Indonesia and Toh-Jui Wong from Singapore. Three other countries joined subsequently: Brunei (2002), Vietnam (2005) and Myanmar (2016). The objectives of SEAFOMP are to promote (i) co-operation and communication between medical physics organizations in the region; (ii) medical physics and related activities in the region; (iii) the advancement in status and standard of practice of the medical physics profession; (iv) to organize and/or sponsor international and regional conferences, meetings or courses; (v) to collaborate or affiliate with other scientific organizations. SEAFOMP has a complementary and synergistic relationship with AFOMP in moving medical physics forward in the region. SEACOMP has initiated the tradition of awarding the best student presentation awards and this has stimulated much interest among the students. The students were given awards for best student presentations, both oral and poster, to encourage excellence in this field. Book prizes were generously donated by Medical Physics Publishing.

The abstracts and full papers were published in Proceedings, in hard and soft copies, and distributed to all the participants.

Medical physics profession was first started in Thailand in 1959 while the medical physics education was started in 1972, followed by Philippines, Malaysia, Indonesia and Vietnam. The IAEA structured program on clinical training in radiation oncology was piloted in 2007 in Thailand. Diagnostic radiology clinical training was started in 2008 in Philippines and in nuclear medicine in Thailand in 2010. Those who completed the program become Clinically Qualified Medical Physicist. In 2016, Thailand piloted the IAEA e-learning of medical physics clinical training which the residents from Vietnam and Myanmar could practice at their own department and obtain the on-line supervision from Thailand. AMPLE (Advance medical physics leaning environment) platform had been demonstrated and become available in all branches of medical physics in SEAFOMP country members. The activities are cooperated by national professional societies and university hospitals. Certification of medical physics will be available within a couple of years in south-east Asian region. The establishment of ASEAN College of Medical Physics is well supported at the annual congress- SEACOMP which the venue of the College/Congress is rotating among SEAFOMP country members.

STATUS OF MEDICAL PHYSICS AND ACTIVITIES TO BOOST PROFESSIONAL DEVELOPMENT IN THE MEFOMP REGION NABIL

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Middle East Federation of Organizations of Medical Physics (MEFOMP) was born in 2009 as one of regional organizations of Medical Physics in the world. There are twelve (12) countries involved, namely Qatar, Oman, Iraq, Syria, Jordan, Kuwait, Lebanon, Saudi Arabia, Palestine, Bahrain, United Arab Emirates and Yemen. The process of activities for establishing local Medical Physics Societies varies among the 12 countries, and this creates a wide divergence among medical physics programs in the Middle East. Most of the medical physics programs have succeeded since its establishment; whereas others have not due to the conditions beyond the control of medical physicists; although, a few are still trying to survive.

In spite of the instability in the region, there are enormous efforts and achievements from fellow medical physicists who continuously work and support for the development of the Medical Physics Profession in the Middle East. It is vital that such efforts be sustained to further accelerate the growth of Medical Physics profession in the region.

Although the number of Medical Physicist in the Middle East has been constantly increasing, there is a continuous demand for more qualified medical physicist. It is also good to note that the local authorities started to realize its importance in the medical practice. However, it is a challenge to acquire qualified medical physicists due the following: 1) limited number of universities offering this specialty; 2) limited awareness on how vital this profession is within the medical practice and within the society in general; and 3) absence of, or under-recognition of the profession by the local authorities.

In view of this, there is a strong need to establish and formulate new rules, guidelines and standard specific to this field. Improvement of professional recognition which would promote interest within the new generation of professionals is essential. A Medical Physicist Education System and Certification Board in the region would further establish the profession, and this can be made possible through a collaborative effort between the MEFOMP and local/regional authorities.

The need for education and training of clinical medical physicists is fundamental in defining role, responsibilities and status; hence, it is important that senior academic positions of medical physics at universities should be established in every country; in such a manner that they should have dual responsibilities in the faculty of Medical Physics and hospitals.

STATUS OF MEDICAL PHYSICS AND ACTIVITIES TO BOOST THE PROFESSIONAL DEVELOPMENT IN THE EFOMP REGION

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Introduction: In most of the European countries, Medical Physics is a well-defined profession. However, differences in the status, level of development and harmonisation of the Medical Physics profession across Europe are still considerable, especially for lower-middle-income (LMI) countries. For those countries, the status is ranging from the unrecognised profession without appropriate qualification framework to fully recognised independent profession. A short survey was conducted to get an insight into the status of profession and activities needed to boost the professional development of Medical Physics in the European LMI countries.

Methods and materials: A questionnaire was prepared and sent to the National Member Organisation (NMO) for Medical Physics of each LMI country member of European Federation of Medical Physics (EFOMP). Those country members are Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, Moldova, Romania, Russian Federation and Serbia. 5 out of 8 country members responded (Bosnia and Herzegovina, Bulgaria, Croatia, Moldova and Serbia). The questionnaire was divided into six parts: General, Requirements to enter Medical Physics education, Training and education programme, National requirements and position of Medical Physicists, Medical Physicists registration and Medical Physics profession management.

Results: In all countries that responded to this questionnaire, the number of Medical Physicists was significantly increased in the last ten years (by 40% to 230%). The basic educational requirement to enter Medical Physics is a university degree. National training and education program in Medical Physics exists in two countries (Bulgaria and Serbia), resulting in the qualification "Medical Physics Specialist". However, the program is approved at the national level only in Bulgaria. Only Bulgarian program follows the recommendations given in the European Guidelines for Medical Physics Experts and EFOMP Policy Statement No. 12.1. In three countries this program is in the status of the ongoing project (Bosnia and Herzegovina, Croatia, Moldova). In all countries except Moldova, there are legal requirements for Medical Physicist involvement in medical procedures. However, only in Bulgaria and Serbia Medical Physics is recognised as an independent profession. National legislation is harmonised with the EU Directive EURATOM 2013/59 in Bulgaria, Bosnia and Herzegovina and Croatia. There is an organised Register for Medical Physicists only in Serbia, while in Bulgaria it is being developed. A formal Continuing Professional Development programme (CPD) exist only in Bulgaria.

Conclusions: There is a significant increase in the number of Medical Physicists in the European LMI countries (on average more than 100% in last ten years) due to the high demands of the national healthcare and modern technologies in medicine. It is expected that this number will continue to increase at the even steeper rate. However, the current status of profession and level of development are not following that trend. Therefore, there is an urgent need for close cooperation between Medical Physics societies, hospitals and national policy stakeholders in healthcare to boost the development of Medical Physics profession.

STATUS OF MEDICAL PHYSICS AND ACTIVITIES TO BOOST THE PROFESSIONAL DEVELOPMENT IN THE FAMPO REGION.

Taofeeq A. IGE
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FAMPO President

FAMPO as the youngest regional federation of the IOMP was created on 12th December 2009 and got its charter in May 2010. It currently has membership from 30 member states in the region and those with national member organization (NMO's) are Algeria, Cameroon, Egypt, Ghana, Libya, Morocco, Niger, Nigeria, South-Africa, Sudan and Tunisia. The remaining countries at present do not have the critical mass to establish NMOs and they include Angola, Burkina Faso, Cote D'Ivoire, Ethiopia, Gabon, Kenya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Namibia, Rwanda, Senegal, Sierra Leone, Uganda, Tanzania, Zambia and Zimbabwe.

Training and recognition of medical physicists in Africa faced a number of challenges and through IAEA and AFRA, three publications on E&T of MPs in Africa have been produced.

FAMPO has been tasked to form the axis for medical physics activities in Africa through the 3 committees (education and training, professional and scientific) with E&T looking at development of academic education and training materials, Professional – accreditation, recognition and CPD, Scientific – endorsements of documents, promotion of research, exchange of scientific information and matters with membership.

FAMPO has created a basic database of medical physicists in Africa to facilitate communication. This can be used for surveys of activities, e.g. infrastructure, trainers,

Professional Development Committee (PDC) of FAMPO is further mandated to establish regional mechanism by which CQMPs can be recognized through formal process of certification and registration. Working closely with E&T Committee to help increase the number of accredited academic training programmes and establish accredited clinical training programmes in the region. This is necessary for development of MP profession in the Africa region, ensuring that trained MPs from accredited institutions automatically receive registration from FAMPO.

Moving forward, FAMPO's role is key to achieving harmonized and high standard of education and training programmes in Africa, which leads to improved quality and quantity of trained MPs who would readily be in position to practice competently and independently, thereby improving medical imaging and radiotherapy treatment delivery in the region.

STATUS OF MEDICAL PHYSICS AND ACTIVITIES TO BOOST THE PROFESSIONAL DEVELOPMENT IN THE ALFIM REGION

Dr Rodolfo Alfonso
Cuba, President ALFIM

During the last decade, Latin America has witnessed an accelerate development in the available radiation medicine technologies, both for diagnosis and therapeutic purposes. In several countries of the region, governments have promoted investment in high-end technologies for increasing the coverage of Radiotherapy and Nuclear Medicine public services. So currently, although large inequities in distribution and accessibility still prevail, the access to advanced diagnosis and treatment radiation facilities is continuously growing. In parallel, the private health sector is also introducing very sophisticated radiation technologies, even in low-income countries. While in 1990 there were about 400 MV units (25% linacs, 75% Cobalt machines) and 260 medical physicists (MPs) in Latin America (0.65 MPs/MV machine), 25 years later the numbers grew to 1000 machines (75% linacs and 25% Cobalt) and 650 MPs. Therefore, although the proportion MPs/MV did not changed, the significant increase in complexity of technology and sophistication of procedures means that the gap in demand of MPs has broaden.

This boom has pushed forward the demand of highly qualified medical physicists in the region, stimulating universities to establish academic training programs; in 2017 there were 19 master programs in medical physics, and even 16 programs at bachelor level (which is not the approach supported by ALFIM). Most of the academic programs do not have enough hours of supervised clinical practice to be able to meet the minimum training requirements required for the clinically qualified MP. Recognition of the MP as a health professional is still an issue in most of the countries; this could be partly the cause of the shortage of residency type, clinical training programs. In general, clinical institutions, even university hospitals or national cancer institutes are not prone to hire medical physics residents. Consequently, there is not balance between the number of graduates from academic programs and the availability of positions for clinical training. Recently, some universities have started an intermediate solution, the so-called professional master, which combined the academic and the clinical training in the same program. Regarding certification, in many countries this process has been fulfilled by the national nuclear regulatory bodies, which requires a minimum education and training for providing the corresponding license for working in radiation medicine practices.

The Latin American Association of Medical Physics (ALFIM) is working jointly with the Latin American Association of Therapeutic Radiation Oncology (ALATRO) and the Latin American Association of Societies of Biology and Nuclear Medicine (ALASBIMN), in order to gain support from our medical counterparts, for the recognition of the MP as a health professional, as well as understanding the role of MP resident in corresponding departments.

ALFIM is promoting a network of educational programs in medical physics in the region, using as starting point the existing Latin American Network for Education of Nuclear Technologies (LANENT) and the Latin American Network for Radiation Protection in Medicine (LAPRAM). ALFIM which to promote, in coordination with IOMP and the IMPCB, the accreditation of a regional certification body and its recognition by national regulatory and health authorities.

MRI-GUIDED RADIATION THERAPY

Colin Orton

The latest versions of commercial treatment planning systems include the option to employ radiobiological optimization. We will review the basic principles involved in both conventional and radiobiological optimization and discuss why biological optimization might lead to better plans. Topics presented will include volume effect modeling, equivalent uniform dose (EUD), tumor control probability (TCP), normal tissue complication probability (NTCP), bioeffect dose relationships, and the linear quadratic model. A review of the specific algorithms available in various commercial treatment planning systems will be presented.

AN INTRODUCTION BY THE INTERNATIONAL SOCIETY OF RADIOLOGY (GLOBAL PERSPECTIVE)

Guy Frija, Donald Frush
International Society Of Radiology

The mission of the International Society of Radiology (ISR) is 'to facilitate the global endeavours of its member organisations to improve patient care and population health through medical imaging'. To this end, the ISR formally established the Quality and Safety Alliance (ISRQSA) in 2016.

The ISRQSA is co-chaired by Drs Guy Frija (EuroSafe Imaging Chair of the European Society of Radiology) and Donald Frush (Image Gently Alliance Chair). Current members of ISRQSA are: AFROSAFE (E-Afrosafe and F-Afrosafe), ArabSafe, Canada Safe Imaging, EuroSafe Imaging, Image Gently, Image Wisely, Japan Safe Imaging, and LatinSafe. These are independent professional organisations lead primarily by radiologists and supported by their regional societies of radiology. Most of them are also multi-stakeholder organisations, having on board medical physicists and radiographers.

The ISRQSA acts as a convener and facilitator for continental, regional and national quality and safety campaigns in radiation protection and drives the ISR’s quality and safety agenda. The ISR is a non-state actor in official relations with the World Health Organization (WHO) and is also collaborating with the International Atomic Energy Agency (IAEA). The ISRQSA manages the relations with these international organisations.

CLINICAL DRLS FOR ADULTS: A NOVEL APPROACH

Guy Frija
International Society Of Radiology

Diagnostic reference levels (DRLs) are an important tool for optimisation. With the new Basic Safety Standards Directive (Council Directive 2013/59/Euratom) DRLs have been included in European legislation. The BSS Directive defines DRLs as “dose levels in medical radiodiagnostic or interventional radiology practices, or, in the case of radio-pharmaceuticals, levels of activity, for typical examinations for groups of standard-sized patients or standard phantoms for broadly defined types of equipment".

Usually, DRLs are specified in relation to the body region without specification of the clinical indication. However, different clinical tasks of the same anatomical area do not require the same image quality. For example, a chest CT can have different clinical indications, different protocols and different exposures. Thus, EuroSafe Imaging, the European Society of Radiology’s radiation protection campaign, is promoting the concept of clinical DRLs. Exposure protocols should rather be based on clinical indications and not on anatomical locations, which means that DRLs should also be established for clinical indications.

EuroSafe Imaging launched a working group dedicated to clinical DRLs in 2016, which prepared a preliminary list of clinical indications, which are proposed for the establishment of clinical DRLs. In addition, the European Commission launched the 33 month-tender project "European Study on Clinical Diagnostic Reference Levels for X-ray Medical Imaging" (EUCLID) in 2017, which is carried out by the ESR and supported by the EuroSafe Imaging campaign. In the course of this project, a list of clinical indications for CT and interventional radiology for which adult data from selected European facilities will be collected has been set up. In further consequence, data will be analysed to specify up-to-date clinical DRLs for Europe.

EUCLID – A EUROPEAN COMMISSION FUNDED EUROPEAN STUDY ON CLINICAL DRLS

John Damilakis
University of Crete, Faculty of Medicine, Greece

The European Commission (EC) has launched the 'European study on clinical diagnostic reference levels for x-ray medical imaging' (Abbreviation: EUCLID) project to provide up-to-date clinical dose reference levels (DRLs). The main objectives of the project are to a) conduct a European survey to collect data needed for the establishment of DRLs for the most important, from the radiation protection perspective, x-ray imaging tasks in Europe and b) specify up-to-date DRLs for these clinical tasks. EUCLID started in August 1, 2017. During the first months of the project, a comprehensive review was carried out to identify the status of existing clinical DRLs for CT, interventional radiology and radiography in Europe and beyond by analysing recent studies and publications. Information about existing clinical DRLs has also been collected from national competent authorities and other organisations involved in the project. A few national radiation protection authorities, only, have defined a limited number of DRLs for CT clinical indications and interventional radiology procedures, so far. Although a large number of studies on doses from x-ray imaging are available, there is very limited information about clinical-indication specific DRLs. A survey has been developed for collection of data needed for DRLs determination. To establish clinical DRLs, EUCLID will collect information from European hospitals for specific CT clinical indications and fluoroscopically guided interventional procedures. This presentation will provide a brief update on EUCLID project.

E-LEARNING EXPERIENCE: BUILDING EDUCATIONAL MODULES IN MEDICAL PHYSICS AND ENGINEERING WITH MOODLE VLE

Dr Vassilka Tabakova
King's College London, UK

The session will illustrate a practical solution of eLearning in Medical Physics and Engineering based on the free e-Learning VLE platform Moodle.

It will be of interest to educators in all fields related to Medical Physics and Engineering. No prior knowledge of Moodle and no advance preparation is needed.

The session will consist of a brief overview of e-Learning in Medical Physics, after which there will be an illustration of the application of the free e-Learning platform Moodle in the profession.

In the first part of the session the types and effectiveness of e-Learning will be discussed. A brief overview of e-Learning in Medical Physics based on the projects EMERALD, EMIT, EMITEL and others will be given, followed by a review of e-Learning platforms and an introduction to the Moodle platform.

The second part will illustrate the development of an educational e-module on Moodle step by step (based mainly on the example of a module on Physics of Medical Imaging). The roles of a Manager, Teacher and Student and their functions will be discussed. The symposium will deal also with Formatting and settings and an illustration of building a complete module will be given (with lectures, coursework, quizzes etc.). It will be discussed how to gather effectively information from Moodle (student participation, grade information, etc.)

The Session will highlight the advantages of e-Learning and focus on the prerequisites for its successful introduction in the teaching of Medical Physics and Engineering.

The Session is based on the author's own experience of e-Learning in the field of Medical Physics and Engineering since the mid-1990-ies and of applying Moodle in the past 7 years in the MSc programmes in Medical Physics and Engineering at King's College London, UK and other courses.

SESSION ON MEDICAL PHYSICS E-ENCYCLOPAEDIA AND DICTIONARY UPDATE

Moderators: Slavik Tabakov, IOMP President; Perry Sprawls, USA; Franco Milano, Italy; Magdalena Stoeva, IOMP MPWB Chair; Sameer Tipnis, USA, Tracy Underwood, UK

Since its launch at the World Congress in Munich (2009) the EMITEL on-line Encyclopaedia of Medical Physics and Multilingual Dictionary of terms established itself as a very useful reference source for the profession. Currently this large reference has about 5,000 users per month.

EMITEL (www.emitel2.eu) includes about 3100 articles with over 2000 illustrations (with volume about 2100 pages). During 2013 it was published on paper by CRC Press.

Currently EMITEL has a contract for Second editing of the Encyclopaedia to be completed by 2020. This will include update of the Dictionary as well.

The aim of the session will be to present to the colleagues the Update project and to discuss additional terms to be included both in the Encyclopaedia and the Dictionary. Special attention will be given to the feedback from current users of these large Reference materials. Colleagues from Low-and-Middle-Income countries will be asked for additional topics to be included aiming to support their education and training needs.

EXERCISES IN STRATEGIC MEDICAL PHYSICS LEADERSHIP - CASE STUDIES FROM THE TRENCHES

Carmel J. Caruana
Medical Physics Department, University of Malta, Malta

The EUTEMPE-EFOMP module Leadership in Medical Physics, development of the profession and the challenges for the Medical Physics Expert (D&IR) is perhaps the most comprehensive module on medical physics leadership worldwide. One of the very attractive features of the module is the discussion of case studies of real world issues faced by medical physicists in clinical practice. Two examples are shown below. We will together discuss possible ways of tackling these case studies.

Case study 1: There are 5 chest radiography rooms in your hospital each run by a different team of radiographers. You have noticed that one of the rooms is repeatedly exceeding the local DRLs which you have established. How would you tackle it? You know that the team of radiographers don't like people investigating their techniques.

Case Study 2: Consider a particular Medical Physics department. With respect to D&IR: (a) Describe the present situation of the department (b) Describe a future vision: how should the department to be in 10 years time? (c) List 3 gaps between the present situation and future vision (d) List the Strengths and Weaknesses of the department with respect to the vision (e) List the external Opportunities available and Threats it faces with respect to the vision (f) Give ideas on how to reduce each gap using the SWOT methodology.

No conflicts of interest.

HOW IAEA SUPPORTS EFFORTS TO INCREASE THE NUMBER OF QUALIFIED MEDICAL PHYSICISTS WORLDWIDE

H. Delis, K. Christaki, J. Izewska, G. Loreti, G.L. Poli, S. Sarasanandarajah, P. Toroi, D. van der Merwe

Dosimetry and Medical Radiation Physics Section, Division of Human Health, Department of Nuclear Sciences and Applications, International Atomic Energy Agency

The International Atomic Energy Agency has been working to increase capacities of Member States in medical physics, aiming to enhance safe and effective use of radiation in medicine. The role of the medical physicist as a member of the multidisciplinary team of clinical professionals is underlined in all IAEA publications, starting from the International Basic Safety Standards.

Important activities, such as dosimetry, quality assurance and clinical computing are only some of the elements necessary for safe and effective use of radiation medicine that requires the competencies of adequately qualified medical physicists. However, there is an important shortage of medical physicists in most countries.

Recognizing the difficulty of stakeholders to understand the benefits that a new professional team member can bring to long established practices, especially in medical imaging, the IAEA organizes awareness activities to introduce the roles and responsibilities of the medical physicist in radiation medicine. These activities include development of awareness material, organization of high level meetings and publication of IAEA guidelines. The appreciation of the medical physics roles and responsibilities is a vital step to facilitate professional recognition that is also lacking in many Member States, although medical physics has been recognized as a profession by the International Labour Organization since 2008.

Direct support to Member States to develop capacities is also provided, either through individual training, to support emerging needs, or through assistance in developing National education and training schemes that will ensure sustainability.

Additionally, the IAEA has been one of the main stakeholders that support the Master of Advanced Studies in Medical Physics (MMP) programme, together with the Abdus Salam International Centre for Theoretical Physics (ICTP) and the University of Trieste. The contribution of the programme to medical physics capacities is noticeable, since 87 students, from 48 countries have participated since its establishment in 2013.

Although a lot has been achieved in support of Member States to increase medical physics capacities, more work is required by all relevant stakeholders, as these efforts will have a direct impact on the quality and safety of radiation medicine services delivered.

MRI-GUIDED RADIATION THERAPY

Geoffrey S. Ibbott
MD Anderson Cancer Center, Huston, TX, USA

The history and benefits of image-guidance in radiation therapy will be covered very briefly, to lead into a description of the potential benefits of MRI-guided RT. The installation, commissioning and initial experience with the Elekta MR-Linac will be discussed. Issues that arise when using dosimetry equipment in magnetic fields will be covered, and our experience and developments in calibration and performing QA measurements will be described.

MEDICAL PHYSICS INTERNATIONAL – THE IOMP JOURNAL

Slavik Tabakov and Perry Sprawls
MPI Journal Co-Editors-in-Chief

The IOMP Journal Medical Physics International (MPI) successfully completed its first term in 2017. During this time the IOMP Journal that is dedicated to educational and professional issues published more than 650 pages of reviewed papers and c. 1300 pages with abstracts of IOMP- supported Conferences. A number of the papers in the first 10 issues were downloaded more than 5,000 times each.

The success of the MPI Journal proved the need of a forum for discussion of our educational, professional and other related issues. This is especially important for topics related to e-Learning (e-L), as often e-L materials have short period of life and require quick dissemination and use. Behind the establishment of the Journal was the necessity of an e-L forum. This was identified in the Special Issue on "e-Learning in Medical Engineering and Physics", published by the Journal Medical Engineering and Physics (Guest-Editor S Tabakov, 2005). The IOMP ExCom approved the idea of Journal establishment in 2012 and by the end of the year the foundations of MPI were laid down: the name was suggested by W. Hendee; an ISSN number was obtained (2306-4609), a web site was made by M Stoeva (www.mpijournal.org), and an Editorial Board was formed including colleagues from IOMP ExCom and representatives of the IOMP Regional Organizations (Federations).

Special Gratitude should be expressed to all Founding members of the MPI Editorial team: KY Cheung; Madan Rehani; William Hendee; Tae Suk Suh; John Damilakis; Virginia Tsapaki; Raymond Wu; Simone Kodlulovich-Renha; Anchali Krisanachinda; Taofeeq Ige; Technical Editors: Magdalena Stoeva and Asen Cvetkov; Editorial Assistant: Vassilka Tabakova.

MPI Journal is also specially grateful to the authors of all papers submitted and published in the MPI Journal. It was mainly due to them that the Journal had such a successful start and continues to engage an ever growing number of readers and authors.

The official statistics from the server of MPI Journal includes not only the readers, but also the geographical spread of the Journal usage and the most frequently read papers. For example only in one randomly selected day (10 Sep 2017) there have been between 10 and 50 readers per hour. The MPI server statistics during the period covering August 2017 to April 2018 shows more than 11,000 visits per month, while their geographical spread indicates that more than 50% of readers are from LMI countries.

At the IOMP ExCom meeting in Jaipur (Nov 2017), the Founding MPI Editors-in-Chief (S Tabakov and P Sprawls) were approved to continue leading the Journal for another period of 4 years and additional members were included in the Editorial Board. The new period of the MPI Journal started with the first Special Issue of MPI, dedicated to the large IOMP Project "History of Medical Physics". This Special Issue is available for free download from: www.mpijournal.org/pdf/2018-SI-01/MPI-2018-SI-01.pdf It includes the first chapters of the History of the profession, related to X-ray Tubes, Radiographic Receptors and e-Learning. Apart from the refereeing papers, the new current issue includes abstracts from the IOMP School during WC2018. We are looking forward to the further success of the MPI – the IOMP Journal dedicated to education, training and professional issues.

IOMP MEDICAL PHYSICS WORLD

Magdalena Stoeva
Chair IOMP Medical Physics World Board; Department of Diagnostic Imaging, Medical University – Plovdiv, Bulgaria

Medical Physics World (MPW) has been the official bulletin of the International Organization for Medical Physics for over 30 years. The first issue of the bulletin was published in 1982 presenting a challenge to the IOMP and the medical physics societies around the world: "… to make 'Medical Physics World' worthy of its title".

The last several years mark a great progress in Medical Physics World. The new style and layout introduced in 2012 increased the interest towards MPW not only among our professional society, but also among corporate members and professionals from other disciplines. MPW is now regularly distributed on all major professional events – AAPM meetings, RPM, ICMP, many regional events.

Medical Physics World has always been in-line with IOMP's initiatives and hot topics. Besides providing the regular organizational reports, we have actively supported some of the IOMP's most successful activities – IOMP's 50th anniversary, the foundation of the Medical Physics International Journal (MPI), the International Day of Medical Physics (IDMP) and the formation of the IOMP Women subcommittee (IOMP-W). MPW successfully conducted a dissemination campaign that resulted in MPW's wide recognition among world's leading institutions. The journal is now regularly delivered to the European Congress of Radiology (ECR), the UNESCO International Center for Theoretical Physics (ICTP) and to the US Library of Congress. The latest achievement of MPW's editorial team is including Medical Physics World in the International Standard Serial Number registrar. With all the contemporary technology our world turned into an electronic world, so did Medical Physics World. We often call it eMPW now, but we are still devoted to the very first promise "… to make 'Medical Physics World' worthy of its title".