

EDITORIAL



IAEA support to radiotherapy dosimetry

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This edition of *Acta Oncologica* includes two articles that arose from the coordinated research activities and services of the IAEA related to quality assurance and auditing of radiotherapy dosimetry in clinical hospital beams. The IAEA has historically supported the standardization, traceability and accuracy of medical radiation dosimetry for more than 50 years, through services and the development of guidance documents and dosimetry codes of practice [1]. In this endeavor a remote postal radiotherapy dosimetry audit service was conceived in 1969 in cooperation with the WHO. A secondary standards dosimetry laboratory (SSDL) was subsequently also established in 1976, which has become the central laboratory of the IAEA/WHO SSDL network, which includes laboratories in 71 Member States, 5 Collaborating Organizations and 16 Affiliated Members. These services have promoted the harmonization of dosimetry world-wide based on international consensus recommendations of organizations like the ICRU and ICRP, which ensures scientific integrity in practices and traceability in dosimetry in accordance with developments in primary standards laboratories. Currently the IAEA SSDL supports the calibration of dosimetry standards in low, medium and high energy photon teletherapy, low and high dose rate brachytherapy, mammography, diagnostic radiology and radiation protection level dosimetry.

Medical applications of ionizing radiation are widespread, and technology driven. As a result, there is a need to monitor developments and continually provide guidance especially in the therapeutic applications of radiation. Radiotherapy has existed as a clinical discipline for more than a century and involves the delivery of high doses of radiation with specialized machines. The most recent developments in radiotherapy techniques target small cancerous lesions, which are often considered inoperable. This has resulted in the need for new audit methodologies to assure that higher doses of radiation are being delivered precisely. Concurrent developments in imaging technologies has also facilitated the use of image guidance in radiotherapy practice. As a result, the traditional boundaries between the application of low and high dose procedures is being eroded and the extent of quality assurance and dosimetry expertise in radiotherapy medical physics is expanding.

The IAEA published the Human Health Series No. 31 guidance document on Accuracy Requirements and Uncertainties

in Radiotherapy in 2016 [2]. Not only was it recommended that all forms of radiotherapy be applied as accurately as reasonably achievable, with technical and biological factors being considered, but that regular independent dosimetry audits be conducted using remote or on-site visits (or equivalent). Tables of the levels of accuracy that are practically achievable in each of the different steps in the radiotherapy process, were provided. The article by Healy et al. [3] in this volume provides a snapshot of the extent and depth of quality assurance and quality control activities being performed in radiotherapy clinics across the world that participated in a coordinated research project.

The IAEA Dosimetry Laboratory has not only provided a remote dosimetry service to hospitals for the auditing of high energy photon beam reference dosimetry and supported quality improvement through comprehensive team audits in radiotherapy but has also been involved in the development of more complex dosimetry audit methodologies [4–8]. An IAEA Dosimetry Audit Network Database has been created to maintain a register of national and international dosimetry audit programs for radiotherapy. Many different dosimetry audit methodologies were developed from a series of four IAEA coordinated research projects, which were conducted between 1994 and 2017. The philosophy behind the development of these audit methodologies was to begin with an audit of basic dosimetry, progressing to increasingly complex aspects of radiotherapy by addressing audits of advanced treatment techniques. Audits methodologies for non-reference conditions, electron beams, heterogeneities, treatment planning systems and small field dosimetry have been developed.

In this volume of *Acta Oncologica*, two articles have been published that arise from these endeavors. Izewska et al. [9] highlights the significant improvement in the results of the IAEA/WHO reference dosimetry postal audits of high energy photon beams that has been observed over the past 50 years and the positive impact of standardization from the implementation of modern international dosimetry codes of practice, regular participation in the audit and more modern equipment. By the end of 2018, 2364 radiotherapy centers have been audited in 136 countries world-wide and the results have improved significantly over time. Individual follow-up of poor results (using a 5% acceptance limit between

the stated and measured dose) was initiated in 1996 and this has facilitated a more in-depth analysis of the audit results. Kazantsev et al. [10] presents the results of an international pilot study of an on-site end-to-end audit methodology for head and neck treatment using advanced technologies that was developed through an IAEA coordinated research project. The methodology not only tests the integrity of treatment delivery, but also includes aspects of imaging and treatment planning quality assurance.

Several new developments in radiotherapy dosimetry are currently underway, as highlighted in the International Symposium on Standards, Applications and Quality Assurance in Medical Radiation Dosimetry (IDOS) held at the IAEA in June 2019 [11]. These include updates to existing dosimetry codes of practice, new detector technologies and developments in dosimetry for new technologies like MR-guided radiotherapy. The IAEA continues to assist in safe and effective radiotherapy practice through promotion of quality improvement, coherence in dosimetry and best practice in clinical medical physics.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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