IAEA WHO

SSDL Newsletter

Prepared by the Joint IAEA/WHO Secretariat of the Network of Secondary Standards Dosimetry Laboratories https://ssdl.iaea.org ISSN 1001-2669

No. 75, August 2022

Contents

From the Editor

Welcome to the 75th SSDL Newsletter. In this publication our featured article is the summary of the BIPM CCRI webinar on the ICRU 95 report. We also report on the co-ordinated research meetings that happened in 2021, the announcement of a new calibration service and a short article written by the DMRP interns.

The reporting of the SSDL Network members for the activities in 2021 has closed. We thank all the SSDLs that updated their information and submitted their reports. The SSDL website has now been updated using this information.

The SSDLs are reminded of the available training material and details may be found in DOLNET (https://ssdl.iaea.org/).

At the end of April 2022 we bade farewell to Ms Debbie van der Merwe who was the Section Head of the Dosimetry and Medical Radiation Physics (DMRP) Section. We thank her for all the valuable contribution to all our activities. Ms Olivera Ciraj Bjelac is currently acting in this position whilst we await the appointment of her replacement.

FIG.1 Ms Debbie van der Merwe

Staff of the Dosimetry and Medical Radiation Physics (DMRP) Section

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Services provided by the IAEA DMRP Section

The IAEA's Dosimetry and Medical Radiation Physics Section focuses on services provided to Member States through the IAEA/WHO SSDL Network and on a system of dose quality audits. The measurement standards of Member States are calibrated, free of charge, at the IAEA's Dosimetry Laboratory. The audits are performed through the IAEA/WHO postal dose assurance service for SSDLs and radiotherapy centres by using radiophotoluminescence and optically stimulated luminescence dosimeters (RPLDs and OSLDs).

The Dosimetry Laboratory's Quality Management System was reviewed and found to be in conformance with the requirements of the ISO/IEC 17025 standard under the mandate of the Inter-American Metrology System (SIM) in support of the expectations of the Comité International des Poids et Mesures (CIPM), Mutual Recognition Arrangement (MRA). The IAEA Calibration and Measurement Capabilities (CMCs) have been reviewed and published in Appendix C of the CIPM MRA..

The IAEA CMCs can be found at the following web site: https://www.bipm.org/kcdb/

The range of services offered by the IAEA's DMRP sectionare listed below.

Services	*Radiation quality*
Calibration of ionization chambers (radiation therapy, brachytherapy*, radiation protection, and diagnostic radiology including mammography) **	X rays and γ rays from ^{137}Cs and ^{60}Co beams ^{137}Cs, ^{60}Co and ^{192}Ir brachytherapy sources
Comparison of ionization chamber calibrations coefficients (radiation therapy, radiation protection, and diagnostic radiology including mammography) for SSDLs**	X rays and γ rays from ^{137}Cs and ^{60}Co beams
Dosimetry audits (RPLD) for external radiation therapy beams for SSDLs and hospitals***	γ rays from ^{60}Co and high energy X ray beams
Dosimetry audits (OSLD) for radiation protection for SSDLs	γ rays from ^{137}Cs
Reference irradiations and blind dose checks for dosimetry audit networks (radiotherapy)	^{60}Co and high energy X ray and electron beams
Reference irradiations to dosimeters for radiation protection	X rays and γ rays from ^{137}Cs and ^{60}Co beams

* Brachytherapy calibration services are not included in the IAEA CMCs.
** Technical procedures and protocols for calibrations and comparisons are available on our website https://ssdl.iaea.org/
***Thermoluminescence dosimeters (TLDs) were replaced by RPLDs in 2017.

Member States interested in these services should contact the IAEA/WHO SSDL Network Secretariat, for further details, at the address provided below. Additional information is also available at the web site: https://ssdl.iaea.org

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Note to SSDLs using IAEA calibration and audit services:

1. To ensure continuous improvement in IAEA calibration and audit services, SSDLs are encouraged to submit suggestions for improvements to the Dosimetry Contact Point.

2. Complaints on the IAEA services may be addressed to the Dosimetry Contact Point.

3. Feedback may be provided using the form on our website: https://ssdl.iaea.org/

https://iris.iaea.org/public/survey?cdoc=DOL00100

ICRU Report 95:Operational Quantities for External Exposure. What changes for radiation protection?

Summary from the CCRI webinar

Mr Thomas Otto (ICRU and CERN) and Ms Adela Tulic

1. Introduction

ICRU Report 95 was published in 2020. The report provides definitions for new operational quantities for external exposure, which shall replace earlier quantities found in previous ICRU Reports 39 and 51. Measurable operational quantities are used for both prospective and retrospective assessment of radiation fields by measurement or calculation, and personal dosimeters and area monitors are designed to measure operational quantities. An explanation is given on how the conversion coefficients from physical field quantities to these new dose quantities are calculated. The report also contains extensive appendices giving the values of conversion coefficients for the following types of particles over wide energy ranges: photons, electrons, neutrons, protons, muons, pions, and helium ions.

2. Protection vs Operational quantities

ICRP defines protection quantities as an average over an extended volume, organ or body, in particular the effective dose is an average over the whole body. They cannot be measured as only quantities defined in a point are measurable by an instrument.

ICRU 39 Defines, in a point, an operational quantity as the product of absorbed dose and the quality factor:

$$H(d) = D(d) \cdot Q(L)$$

3. What has changed?

- Anthropomorphic phantoms are used for the calculation of the effective dose. The ICRU Reporting Committee decided to move from the numerical calculation phantoms for the operational quantities to the anthropomorphic phantoms with the tissue and radiation weighting factors (w_T and w_R), which provide a better approximation of E simply by definition;
- Other changes in the report concern the fact that the quantities limiting the effects on tissues (local dose on the skin and on the lens of the eye) are now expressed as absorbed dose rather than equivalent dose;
- Conversion coefficents to operational quantities for more radiation types such as positrons, protons, and pions are listed, and a much broader energy range is covered since there are now many more accelerators not only for particle physics research but also for medical applications;
- Quantities for photons were calculated with full electron transport, wheras previous calculations in ICRU 57 and ICRP 74 assumed secondary electron equilibrium (Kerma approximation).

- ICRU 95 defines the operational quantities as the product of field quantity (fluence) and a conversion coefficient:

$$H = h_\varphi \cdot \Phi_{Ep}$$

where: Φ_{Ep} is the unperturbed external fluence spectrum, and conversion coefficient $h(E_p)$ is calculated from the effective dose divided by the fluence of the field at different predefined directions.

- The present quantity for the whole body dosimetry is the *Personal Dose Equivalent* $H_p(10)$, which is calculated as the dose at 10 mm depth in a slab phantom multiplied by the quality factor Q(L). This is replaced by *Personal Dose* H_p, calculated as the weighted sum (w_R, w_T) of the organ doses in the anthropomorphic phantom using the plane-parallel radiation fields from specific directions. The tables for H_p give conversion coefficients for angles in fifteen-degree steps, which allow to evaluate the performance of personal dosimeters under tilted radiation incidence.
- For the area/ambient dosimetry, the present quantity is called the *Ambient Dose Equivalent* $H^*(10)$ and is calculated as a product of the dose at 10 mm depth in the ICRU sphere of the radiation incidence and the quality factor Q(L). Here expanded and aligned fields need to be assumed, which means that all the radiation field components are assembled under zero degrees. This is a maximization rule, which makes it clear that this quantity is conservative under different radiation field directions. The isotropic detector is required for the measurement. This is replaced by the *Ambient dose* H^*, where the maximum dose of effective dose over directional coefficients listed in ICRP Report 116 is taken. It is obtained from the set of the conversion coefficients to E for AP, PA, LLAT, RLAT, etc orientations at a given energy, the highest of which is chosen and multiplied by the field quantity fluence.

- For eye lens dosimetry, *the Personal dose equivalent* $H_p(3)$, defined as a product of dose at 3 mm depth in the 20 cm square cylinder by quality factor $Q(L)$ is replaced by *the Local Absorbed Dose to eye lens* $D_{eye\ lens}$. This is the absorbed dose in the eye lens according to the Behrens-Dietze model, where the $Q(L)$ is no longer considered and only absorbed dose is considered. This results from the consideration that the effects on the tissue depend more on the absorbed dose than on the equivalent dose.
- For extremity dosimetry, there are only minor changes, with $H_p(0.07)$ calculated in the cylinder phantom for finger, wrist, or arm composed of ICRU tissue ρ = 1.0 g/cm^3 replaced by $D_{local\ skin}$ calculated in a cylindrical phantom with ρ = 1.11 g/cm^3 (including the density of the bone) and covered with 2 mm layer of ICRP-skin tissue.

4. *Consequences of the change*

a) Consequences of measurements in "real" radiation fields

- The comparison of $H_p(10)$–K_a in ICRP 74 and $H_p(10)$–Ka in ICRU 95 shows that:
  - the measured value of H_p for energies typical for radioisotopes is ≈ 0.86 H_p;
  - at low-energy X ray (backscatter from patient), around 20 kV it is ≈ 0.2 $H_p(10)$.
- For low energy X ray spectra:
  - For diagnostic X ray calibration spectra:

  $H^* \approx 0.5\, H^*(10)$ and $H_p \approx 0.5\, H_p(10)$ in broad, low energy X ray spectra.

  This may have influence on medical personnel working in interventional radiology and is currently under study.

- Generic prompt radiation study of radiation fields at particle accelerators operating with a beam of protons with energy between 100 MeV and 10 GeV proton beam (mainly neutron and proton radiation): From the comparison of the ratio of $H^*/\ H^*(10)$ conversion coefficients for neutron and proton spectra shows:
  - Neutrons dominate;
  - For 100 MeV, no change;
  - Above 1GeV, $H^* > H^*(10)$ for n,p and γ

Table 1. Ratio $H^*/\ H^*(10)$ for prompt radiation in a proton accelerator behind a thick shielding. The ratio is given for the components of the radiation field and the total.

Beam energy	100 MeV	1 GeV	10 GeV
Neutron	1.00	1.17	1.19
Proton		1.07	1.15
Photon	1.10	1.10	1.18
$e^{+/-}$	0.18	0.22	0.33
Total	0.99	1.16	1.18

Table 2. Ratio $H^*/\ H^*(10)$ for radiation from activation products. A copper target has been activated by a proton beam with an energy of 3.5 GeV. The ratio is given for the components of the radiation field and the total.

Decay time	1 hour	1 week	1 year
Photon	0.87	0.86	0.86
Electron	2.9	2.0	2.2
Positron	0.9	1.0	1.0
Total	0.87	0.87	0.86

- From a generic study of activation with a 3.5 GeV proton beam, the comparison of conversion coefficients for photon and electron spectra (1 h decay) the ratio of $H^*/\ H^*(10)$ shows:
  - Photons dominate;
  - $H^* < H^*(10)$ by 15 %;
  - Typical for radionuclides.
- For the dump of the linear accelerator, prompt radiation:
  - Behind the dump: high-energy particles, $H^* \geq H^*(10)$;
  - In front the dump: multiple scattered neutrons, $H^* < H^*(10)$.
- For the dump of the linear accelerator, activation:
  - $H^*/\ H^*(10)$ ratio depends initially on location;
  - For short decay time, high energy γ emitters-high ratio;
  - In front of the dump, multiple scattering, lower energy, lower ratio;
  - After one month, only medium- and long-lived radioisotopes with the "typical" ratio of 0.86.

❖ Consequences for the calibration of dosimeters

Calibration procedures remain unchanged, only the conversion coefficient from the determined fluence or kerma would be updated to the new operational quantity.

- Determine reference point in calibration field

- At this point, determine
  - K_a for Photons;
  - Φ for Neutrons;
  - D for Electrons.
- Calculate operational quantity, e.g. $H^* = \Phi h^*(E)$
- Place dosimeter at reference point (on calibration phantom, for personal dose)
- For photons, assure secondary electron equilibrium (SEE)
- Irradiate

- In different calibration laboratories, where the secondary electron spectrum of the pure calibration source can be very different, an artificial secondary electron equilibrium is created by placing a so-called build-up plate in front of the dosimeter, so that the calibration coefficients obtained in the different laboratories can be compared. ICRU 57 conversion coefficients for photons are calculated in kerma-approximation, i.e. assuming secondary electron equilibrium
- ICRU 95 uses conversion coefficients from Annex 5 with secondary electron equilibrium.

- For calibration in $D_{eye-lens}$ and $D_{local-ski}$, the existing dosimeters for $H_p(0.07)$ can be used unchanged, only some attention is required for the existing dosimeters for $H_p(3)$ at very low energy. However, for the calibration in H_p, the energy-dependent response function of whole-body dosimeters must be modified at small energies to be useful for the new quantities.

b) Consequences for the response of dosimeters

Response of the dosimeters is defined as the dose indication of a dosimeter (G) divided by conventional true value of the radiation field (C). When the quantity is changed from $C_{old} \rightarrow C_{new}$ the dose indication remains the same: $G \rightarrow G$. Response of the dosimeter in the new quantity is defined as: $R_{new} = R_{old} \frac{h_{old}}{h_{new}}$

- Area dosimeters with cut-off E> 50 keV are nearly unaffected, recalibration of sensitivity is needed;
- Extremity dosimeters – no change needed;
- Eye lens dosimeters – nearly unaffected, recalibration necessary;
- Whole-body dosimeters: overresponse at low photon energies. Redesign of filter required (or algorithm for multidetector types) necessary;
- Neutron monitors continue to give "good estimate". Recalibration, adaption of acceptance limits by IEC

c) Consequences for dose registers

- Dose registers (should) record effective dose, E;
- New quantities: closer approximation to E;
- For most workers, where monthly dose is (close to) zero, no difference;
- Measurement uncertainty at low dose (trumpet curve);
- Recorded value for workers with significant dose will be slightly lower;
- Case of medical staff in Interventional Radiology needs to be studied in more detail.

5. *ICRU 95- Conclusions*

- Operational quantities are defined in a consistent manner to the protection quantities by using the same phantoms and weighting factors;
- System of quantities that is easier to understand;
- Numerical values and their trends with energy are coherent with protection quantities;
- Changed dose values in real radiation fields: do not warrant change of RP practice;
    - Study required for fields in interventional radiology
- Calibration procedures unchanged, use new conversion coefficients, realize secondary electron equilibrium for γ radiations;
- Adaption of certain dosimeter types required:
    - Whole-body personal dosimeters for γ and β radiation at low energy.

References

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[4] INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS, Conversion Coefficients for Use in Radiological Protection Against External Radiation, ICRU Report 57, ICRU, Bethesda (1998).

[5] INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, Conversion Coefficients for use in Radiological Protection Against External Radiation, ICRP Publication 74, Annals of ICRP 26, No.3-4, Bethesda (1997).

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Calibration service in LINAC photon energy beams at DOL

Ms Zakithi Msimang

The IAEA DOL now has the capability of calibrating reference chambers in photon LINAC beams. The calibration may be performed at 6 MV, 10 MV and 18 MV energies and is traceable to the BIPM. This service is currently limited only to SSDL's that have activities in this area and preferable for farmer type chambers.

A request for this service may be made by completing the calibration service request form which can be downloaded from our website https://ssdl.iaea.org/Home/CalibrationServices and submitting it for the SSDL officer's consideration. We have also expanded the reference and blind irradiation services that we provide to dosimetry audit networks (DANs) to include LINAC photon and electron beams.

FIG. 2 Picture of a Linac calibration set-up at DOL

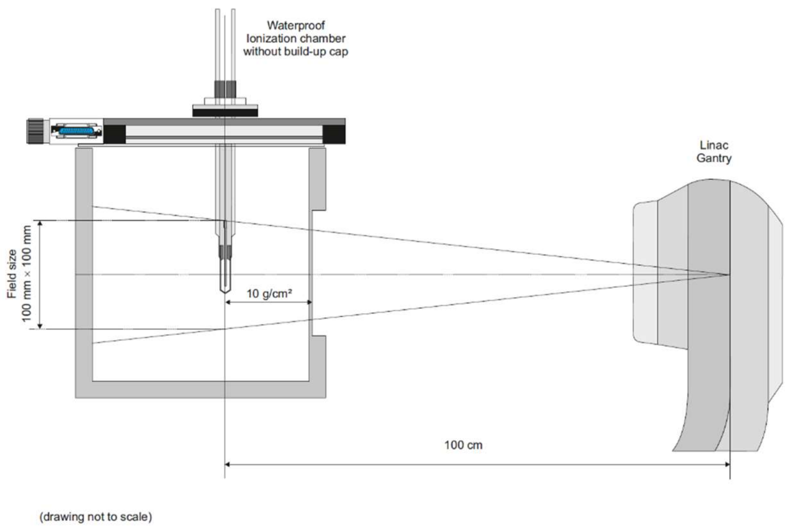

FIG.3. Calibration set up in a LINAC beam showing the reference conditions

Joint ICTP-IAEA Workshop on Dosimetry in Radionuclide Therapy and Diagnostic Nuclear Medicine

20 September – 1 October 2021, virtual

Experts: Manuel BARDIES (France), Carlo CHIESA (Italy), Gerhard GLATTING (Germany), Wesley BOLCH (US), Robert HOBBS (US), Michael LASSMAN (Germany), Martha CREMONESI (Italy), Lidia STRIGARI (Italy), Ludovic FERRER (France), Alex Vergara GIL (France)

IAEA staff: Peter KNOLL, Francesco GIAMMARILE, Giorgia LORETI

Summary

The IAEA together with the International Centre for Theoretical Physics (ICTP) organized a virtual workshop on Dosimetry in Radionuclide Therapy and Diagnostic Nuclear Medicine. Molecular radiotherapy has demonstrated unique therapeutic advantages in the treatment of an increasing number of cancer types. Such treatments can deliver high absorbed doses to specific targets (tumour lesions) and healthy organs (organs at risk) and, thus, require a patient specific dose assessment. Dosimetry calculations helps to optimize the amount of radioactivity to be administered and to reduce the risk of under- or over-dosing patients. The workshop, which was intended for clinically qualified medical physicists with experience in radionuclide therapy, provided the participants with a comprehensive review of the developments in the field of nuclear medicine image quantification and practical internal dosimetry. The workshop consisted of pre-recorded videos that were provided to the participants in advance. Afterwards, Q&A sessions with the lecturers were held to give the participants the opportunity to ask questions and clarifications to the lecturers. A part on the use of freeware software solutions to perform the calculations was also held. A total of 52 participants from 22 countries attended the workshop. The video material will be used to compile a virtual course on this topic.

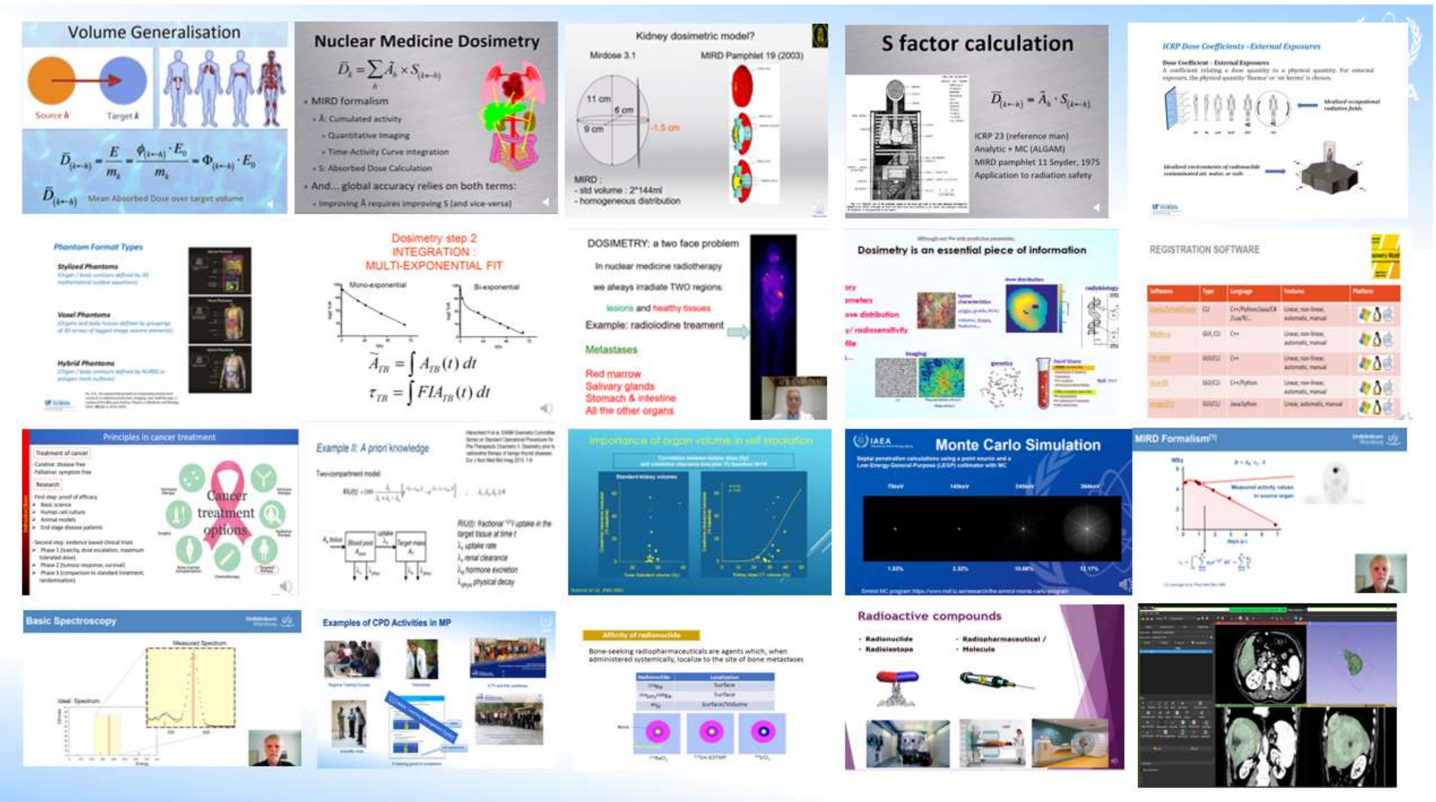

FIG.4. Summary of the presentations

Consultancy Meeting to Review and Update the IAEA Human Health Series No. 17

11 – 14 October 2021, virtual

Experts: Maria Del SOCORRO NOGUERA (Brazil), Paola BALDELLI (Ireland), Ruben Van ENGEN (The Netherlands), Simona AVRAMOVA-CHOLAKOVA (United Kingdom), Daniel LONG (USA)

IAEA staff: Olivera CIRAJ-BJELAC (Scientific Secretary), Zakithi MSIMANG, Virginia TSAPKI, Peter KNOLL, Elisabeth WEISS, Miriam MIKHAIL

Background

To address the critical need for ensuring quality and safety in mammography, IAEA developed two guidelines: Quality Assurance Programme for Screen Film Mammography (IAEA Human Health Series No. 2, IAEA) and Quality Assurance Programme for Digital Mammography (IAEA Human Health Series No. 17), published in 2009 and 2011, respectively. The IAEA Human Health Series No. 17 provided guidance on transition from screen film to digital mammography and an internationally harmonized approach to quality assurance in digital mammography. This technology has continued to develop, requiring periodic review of quality assurance programmes and its extension to the applications emerging from digital technology such as full field digital breast tomosynthesis (DBT), contrast enhanced mammography (CEM) or breast digital biopsy units.

Objective of the meeting

The objectives of the consultancy meeting were to discuss the existing version of the document IAEA Human Health Series No. 17; to identify gaps and needs for update of the document and to suggest steps for the practical implementation of the document update.

The expert group reached consensus on the need to update the IAEA HHS No. 17 for the recent technological developments in breast X ray imaging and extensively discussed the content of the updated document. The consultancy meeting resulted in draft content of the updated document and respective workplan and timelines.

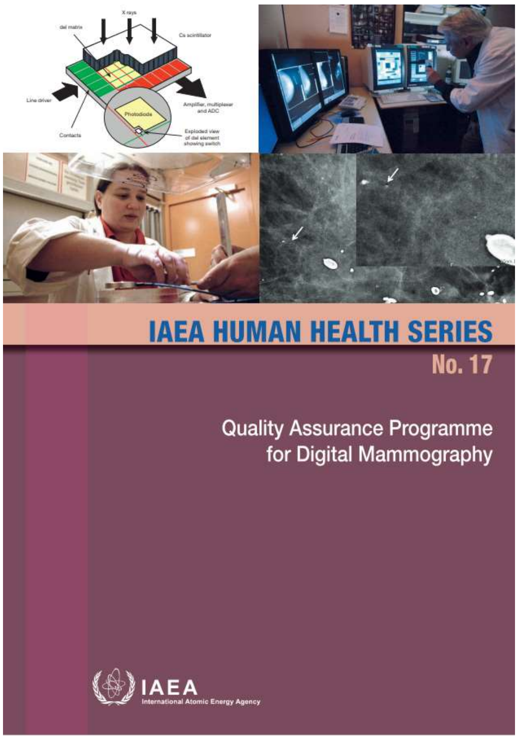

FIG.5. IAEA Human Health Series No. 17

Research Coordination Meeting for CRP E2.30.05: Dosimetry in Radiopharmaceutical Therapy for Personalized Patient Treatment

1 – 5 November 2021, IAEA, Vienna

Participating Countries: Colombia, Croatia, Cuba, France, India, Indonesia, South Africa, and the United States of America

IAEA staff: Peter KNOLL

Summary

In radiopharmaceutical therapy internal dosimetry establishes doses absorbed by the tumours and organs at risk. The treatment is usually delivered based upon an administered activity prescription and internal dosimetry is generally not integrated in the clinical practice. The result is that patients are often under- or over-dosed. The clinical benefit of performing dosimetry has now been demonstrated for several nuclear medicine therapies. Nevertheless, propagation of dosimetric methods into nuclear medicine practice has been slow and considerable uncertainties in the dose estimation remain.

The IAEA initiated CRP E2.30.05 "Dosimetry in radiopharmaceutical therapy for personalized patient treatment" to support the standardization and dissemination of dosimetric methods in nuclear medicine therapy. Molecular radiotherapy has demonstrated unique therapeutic advantages in the treatment of an increasing number of cancers.

The CRP will assist Member States in testing and adopting harmonized dosimetric protocols and to assess the typical accuracy with which dosimetry can be reached in nuclear medicine practice. The participants came from research institutes from the following countries: Colombia, Croatia, Cuba, France, India, Indonesia, South Africa, and the United States of America.

A patient SPECT/CT study was analysed by the participants. The results of the analysis and the used data set will be published on the IAEA website.

Additionally, the first use of ^{177}Lu-DOTATATE in Indonesia was performed under this CRP.

FIG. 6. Participants of the CRP E2.30.05 CRP meeting.

1st Research Coordination Meeting on "Development of Methodology for Dosimetry Audits in Brachytherapy (E2.40.23)

8 – 12 November 2021, IAEA, Vienna

Participating Countries: Brazil, China, Croatia, Greece, India, Iran, Mexico, Russia, Spain, South Africa, Iran

IAEA staff: Jamema SWAMIDAS and Daniel BERGER

Summary

The Dosimetry and Medical Radiation Physics (DMRP) section of the IAEA organized the first Research Coordination Meeting (RCM) of the Coordinated Research Project (CRP) "Development of methodology for dosimetry audits in brachytherapy" in a hybrid format. The primary goal of this CRP is to develop audit methodology for brachytherapy clinical process which could be implementable worldwide across diverse clinical settings, to improve clinical practice. The CRP will include developing and testing calibration and auditing methodologies for gynaecological high dose rate brachytherapy applications using ^{60}Co or ^{192}Ir sources.

The three major research investigation aims are:

- Verification of the Reference Air KERMA Rate of the high dose rate ^{60}Co and/or ^{192}Ir brachytherapy micro-source(s);
- Validation of treatment planning dose calculation for typical gynaecological treatment applications.
- Develop and pilot an end-to-end dosimetry audit methodology in the clinical environment.

The purpose of this meeting was to introduce the participants from the representing institutions and familiarize with national brachytherapy practice, available infrastructure, and current applicable national auditing methodology for brachytherapy through presentation of individual proposal defining detailed workplans and identifying common deliverables during the development of the methodology.

The meeting was attended by all participating Member States,– Brazil, China, Croatia, Greece, India, Iran, Mexico, Russia, Spain and South Africa. Participants from Brazil, China, Greece, India, and Iran joined the meeting online, while others attended in-person.

The meeting was held in accordance with the agenda, started with a presentation on the expectations from Nuclear Applications Contracts and Agreements (NACA), followed by annual reporting and contract renewal-related aspects. In addition, a video on the Agency's publishing guidelines from MTCD was played and the essential take home messages were summarised. All participants presented their research proposals and their infrastructure pertinent to the CRP, followed by a comprehensive discussion among the CRP participants. Additional presentations were made by the IAEA – Dosimetry Laboratory staff on the infrastructure and audit capabilities, this was followed by an on-site visit to the lab. An overview of the availability of solid-state detectors were discussed within the group. All participants then developed an individual workplan for their respective proposal, which were finalized during the meeting. The formation of sub-groups with specific objectives and common deliverables was discussed based on the types of detector(s) that will be used for the development of methodology. The discussions encouraged joint efforts, scientific exchange, and collaboration among the CRP participants.

During the last day, the group agreed on recommendations to the participants, Member States and to the Agency based on discussions that arose from the meeting. The results of this CRP will encourage the development of audit methodologies in brachytherapy among the national dosimetry audit networks in Member States.

FIG. 7. Participants of the CRP E2.40.23 meeting

1st Research Coordination Meeting on Advanced Tools for Quality and Dosimetry of Digital Imaging in Radiology" (E2.40.25)

15 – 19 November 2021, virtual meeting

Participating Countries: Argentina, Hungary, France, Greece, Ireland, Malaysia, Mexico, Philippines, Qatar, Sudan, Slovenia

IAEA staff: Olivera CIRAJ-BJELAC and Virginia TSAPAKI

Summary

It is well known that effective quality assurance (QA) and quality control (QC) programmes have a positive impact on improving image quality and reducing patient exposure in X ray medical imaging. In the last few years remote and/or automated QC tools have been utilized in daily or weekly testing to ensure consistency between comprehensive annual evaluations. Recently, the IAEA developed a remote and automated QC methodology for radiography and mammography using 2 simple phantoms and a dedicated software tool. The phantoms and software can be used on a daily or weekly basis, resulting in a state-of-the-art model observer performance metric detectability index (d') and other relevant parameters as homogeneity, spatial resolution, Contrast-to-Noise-Ratio, Signal-Difference-to-Noise-Ratio and Modulation Transfer Function. This allows for complete and automated evaluation of the main performance characteristics of the imaging chain. The phantoms can be built in hospitals using simple low-cost materials. The methodology can be applied locally, by a Clinically Qualified Medical Physicist (CQMP) or by groups of CQMPs responsible for a network of hospitals including smaller radiological facilities in a remote setting.

To investigate whether the IAEA methodology can be implemented in radiology centres worldwide across diverse radiological settings, a Coordinated Research Project (CRP) was initiated. The 1st Research Coordination Meeting took place in virtual format from 11 to 14 November 2021, the aim was to introduce participants and corresponding institutions, present to local experiences on the utilization of remote and automated QC in X ray imaging, agree on the methodology for common research activities, harmonize data collection methodologies, develop the CRP workplan and finally define possible individual research activities that will contribute to the CRP outcomes. Participants from 11 Member States (Argentina, Hungary, France, Greece, Ireland, Malaysia, Mexico, Philippines, Qatar, Slovenia and Sudan) presented their experiences in QC focusing on automated QC options and research proposals relevant to this CRP. Active discussion with main focus on phantom construction and data collection, resulted in detailed workplan and relevant timelines. The meeting was also a good opportunity to respond to possible questions related to structure of phantoms, using the software and/or data analysis. A list of questions and related answers was created and was made available to the participants to facilitate immediate application of phantom construction and implementation of IAEA remoted and automated QC methodology radiography and mammography.

1st Research Coordination Meeting on Evaluation of the Dosimetry Needs and Practices for the Update of the Code of Practice for Dosimetry in Diagnostic Radiology (TRS-457) (E2.40.24)

22 – 26 November 2021, IAEA, Vienna

Participating Countries: Cuba, Finland, Germany, Indonesia, Nigeria, Serbia and USA

IAEA staff: Debbie van der MERWE, Zakithi MSIMANG (Scientific Secretary), Olivera CIRAJ-BJELAC (Scientific Secretary), Simona CIORTAN, Adela TULIC

Summary

International standardization in dosimetry is essential for the safe and effective optimization of radiation technology in the clinical environment. In line with the IAEA's role to provide guidance in dosimetry, a need to investigate dosimetry for new X ray technologies and detectors that are now being used in the clinical environment was identified. Several contemporary imaging modalities and types of dosimeters were not in widespread use when the IAEA Code of Practice for Dosimetry in Diagnostic Radiology (IAEA TRS No. 457) was published in 2007. Therefore, the IAEA initiated a Coordinated Research Project (CRP) with the main objective to support the update of the IAEA TRS No. 457 and to standardise radiology medical physics dosimetry instrumentation, equipment and procedures in laboratories and hospitals.

Chief Scientific Investigators (CSI) from Standard Dosimetry Laboratories (Primary and Secondary) and hospitals from eight Member States (Cuba, Finland, Germany, Indonesia, Italy, Nigeria, Serbia and USA) met in Vienna from 22 to 26 November 2021, to kick-off this 5-year project. The meeting was an opportunity for the participants to familiarize themselves with the Coordinated Research Activities, mechanisms for collecting and managing data and requirements and process of publishing at the IAEA.

The CSIs presented their respective research proposals with an emphasis on participating institutes and research teams, facilities, and instruments available for the research, experience in diagnostic radiology dosimetry and activities that were being proposed for the scope of the CRP.

FIG.8. Participants of the CRP E2.40.24 meeting

An active discussion resulted in the agreed workplan and timelines for the entire duration of the project, focusing on four main areas: 1) Reference dosimetry; 2) Semiconductor-based dosimeters (X ray multimeters); 3) Air kerma-area product measurements in various X ray imaging modalities and 4) CT dose measurements. The group of CSIs made several recommendations relevant to this project and expected outcomes, underscoring a need to focus on reference dosimetry in different X ray imaging modalities, to test various X ray multimeters in the diverse radiation qualities, both in laboratories and hospitals, to investigate the need for further use of dosimetry phantoms and to provide guidance addressing transfer of traceability from reference instrument to dosimeters used in various imaging modalities.

Consultancy Meeting on Harmonization of Dose Measurement Reporting in Dosimetry Audits in Radiotherapy

29 Nov – 03 Dec 2021, Virtual

Experts: Andrew ALVES (Australia), Brigette RENIERS (Belgium), Claudio VIEGAS (Brazil), Nuria JORNET (Spain), Catherine CLARK (United Kingdom), Paola ALVAREZ (United States of America)

Internal staff: Jamema SWAMIDAS (Scientific Secretary), Godfrey AZANGWE, Alexis DIMITRIADIS, Pavel KAZANTSEV, Yaroslav PYNDA, Egor TITOVICH

Summary

The IAEA organized a Technical Meeting for the Dosimetry Audit Networks (DANs) during August 2021, which recommended guidance on harmonized practice for dose measurement reporting for 2-dimensional (2D) dose distributions, particularly, when using radio chromic films for dosimetry audits. Dose measurement reporting in 2D dosimetry and, particularly, dose distribution comparisons using gamma index for film measurements, strongly depends on the hardware and software used for film scanning, processing, and the measurement protocol used. Therefore, the IAEA invited experts from major dosimetry audit centers across the world, who routinely use films for dosimetry audits in radiotherapy with an objective to provide consensus guidelines on using radio-chromic films for dosimetry audits.

The scientific deliberations started with an overview of the IAEA experience of using films for dosimetry audits followed by a presentation by each expert who shared their experience, and a discussion about each centre's practice, heterogeneity. The need for harmonized terminologies and practices was emphasised during the presentations and discussions. The IAEA also invited technical specialists from major manufacturers of film dosimetry software, to give a presentation on the technical aspects of their film dosimetry and 2D dose distribution analysis software with an emphasis on gamma analysis. Each presentation was followed by a Q&A session to discuss only technical (non-commercial) matters of interest pertinent to the meeting objectives. The experts agreed that an inter-comparison experiment of dose determination using films among their institutions would be worthwhile, to generate the evidence of improved consistency of practice. Work is in progress for a Human Health Report on "Good Practice Guidance for using radio-chromic film in radiotherapy dosimetry audits".

Report on the Consultancy Meeting on Review and Drafting the Guidance Document for Calibration in Radiation Protection

6 – 10 December 2021, hybrid format

Experts: Hayo ZUTZ (Germany), Tetsuro MATSUMOTO (Japan), Miloš ŽIVANOVIC (Serbia), Steven JUDGE (UK), Nolen E. HERTEL (USA)

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Summary

In 1999, the IAEA published “Calibration of radiation protection monitoring instruments” (Safety Reports Series No. 16), which was a revision of the IAEA TRS No. 133 published in 1971. The IAEA SRS-16 has been used as a guidance document by many SSDLs for the establishment/upgrade of their calibration facilities. Since 1999, there have been changes in the international standards that were used as references in the drafting of the SRS-16. Also, the Mutual Recognition Arrangement of the International Committee for Weights and Measures (CIPM MRA) that was concluded in 1999 emphasizes the need for Calibration and Measurement Capabilities supported by a quality management system established following ISO/IEC 17025, which was updated in 2017. Lastly, the reporting of uncertainties for every calibration in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM) and the IAEA TECDOC 1585, needs to be included. The project to revise the IAEA SRS-16 was started in 2014 and was put on hold because most of the standards used as references were being revised. From the 2014 project, it was recommended that the publication be a technical report series instead of a safety report series.

The meeting objectives were to discuss the update to the IAEA SRS-16 and:

• Review the first draft update that commenced in 2014 and was paused because of the changes in the standards being referenced.

• Identify the gaps, if any, and suggest experts to write sections where gaps have been identified.

• Agree on the table of contents of the new TRS.

• Draft sections of the revised code of practice based on the current developments.

Internship programs in the Dosimetry and Medical Radiation Physics Section (DMRP) and Marie Sklodowska Curie Fellowships in the Dosimetry Laboratory (DOL)

Ms Adela Tulic

At the end of July, we bade farewell to three DMRP Section interns after one year of the IAEA internship program. The aim of the IAEA Internship programme is to provide motivated young people who are studying or have recently graduated with the opportunity to gain practical experience of working at an international agency. The IAEA Director General Rafael Mariano Grossi on March 8, 2020, in celebration of International Women's Day launched the IAEA Marie Sklodowska-Curie Fellowship programme. At the start of 2022, the IAEA DOL hosted three interns who had finished their master's programme under the Marie Sklodowska Curies' Fellowship Program (MSCFP).

Through daily engagement with their supervisors, the interns in DMRP Section can acquire new skills and experience in education and training, preparation, editing and proof reading of web and paper publications in all areas of medical physics; assist in the development and support of existing databases such as DIRAC, DAN, SSDL and IDEA; become familiar with services of the IAEA/WHO SSDL Network to gain experience in dosimetry; assist in data collection, verification, analysis for DIRAC, DAN and/or DOLNET databases and IRIS; support outreach in metrology, audits, professional and clinical medical physics activities, etc.

FIG.9. Interns at NAHU-DMRP Section

When asked what the internship at the IAEA has brought them, they responded:

Ms Elisabeth Weiss-DMRP (Austria): Working at the IAEA has brought me more insight on the different uses of atomic energy that can help people in all parts of their life. I also learned many different skills that will be useful to me in the future, ranging from interpersonal skills to the use of various programmes. Thank you for the great time, advice, and friendship.

Mr Maksym Yurechko-DMRP (Ukraine): Primarily, I was not focused on medical physics, but on programming, also in connection with general/nuclear/particle physics, as I studied it in Ukraine. It was a great opportunity to apply my skills, to work on international projects and gain valuable experience of how international organizations work.

Ms Adela Tulic-DMRP (Bosnia and Herzegovina): After a year as an intern in the DMRP section, I can take away some valuable learnings. Working in an international environment and learning from medical physics experts helped me grow as a person and as a physicist. I hope this program continues so that young people have the opportunity to achieve their professional goals.

Courses, Meetings and Consultancies in 2022

Please note that due to the COVID-19 crisis many events were postponed and the dates are still to be decided (TBD). In some cases, new dates have been proposed but there may be some further changes.

TC Courses and Workshops related to DMRP activities

- AFRA Regional Training Course on optimizing 3D radiotherapy for English-speaking countries, Arusha, Tanzania, 13 – 17 June 2022
- AFRA Regional Training Course on optimizing 3D radiotherapy for French-speaking countries, Mauritania, 3 – 7 July 2022
- Regional (AFRA) Training Course for French-speaking countries to train the trainers on implementation of the harmonized Quality Control programme in Nuclear Medicine and Diagnostic Radiology, Sousse, Tunisia, 29 August – 2 September 2022
- RLA6090 Regional Training Course on Quality Management in Radiotherapy (in Spanish), Argonne National Laboratory, Chicago, United States of America, 29 August – 2 September 2022
- Regional (AFRA) Meeting on establishment of Diagnostic Reference Levels (DRLs) (in collaboration with RAF9064), Vienna, Austria, 19 – 23 September 2022
- RLA6091 Regional (ARCAL) Training Course on Structured and Supervised Clinical Training Programmes in Medical Physics (RT-NM-RD), Rio de Janeiro, Brazil, 24 – 28 October 2022
- Regional (AFRA) Training Course for French-speaking countries to train the trainers on dose assessment and management in Diagnostic Radiology, Niger, 21 – 25 November 2022
- Joint ICTP–IAEA Workshop on Quality Assurance and Dosimetry in Brachytherapy, Trieste, Italy, 21 – 25 November 2022
- Joint ICTP–IAEA Advanced School on Radiotherapy Dosimetry Audits, Trieste, Italy, 28 November – 2 December 2022
- RLA6088 Regional Training Course on Quality Management in Radiotherapy (in English), Argonne National Laboratory, Chicago, United States of America, 28 November – 2 December 2022

Training courses and ESTRO Courses

- RER6040 IAEA/ESTRO Training Course on Physics for Modern Radiotherapy (a Joint Course for Clinicians and Physicists), Bucharest, Romania, 5 – 9 June 2022
- RER6040 IAEA/ESTRO Training Course on Basic Clinical Radiobiology, Tallinn, Estonia, 10 – 14 September 2022
- Regional Training Course on Dosimetry and Quality Assurance for Medical Physicists, Amman, Jordan, 21 – 25 September 2022
- RER6040 IAEA/ESTRO Training Course on Image-Guided and Adaptive Radiotherapy, Ljubljana, Slovenia, 2 – 6 October 2022
- RER6040 IAEA/ESTRO Training Course on Foundation of Leadership in Radiation Oncology, online, 9 November – 5 December 2022

DMRP Meetings and Consultancies

- Consultancy Meeting on the Update of Radiation Oncology Physics Handbook, Vienna, Austria, 19 – 23 September 2022
- Second Research Coordination Meeting on Development of Methodology for Dosimetry Audits in Brachytherapy, Vienna, Austria, 7 – 11 November 2022
- Consultancy Meeting on Developing Guidelines on Quality Assurance for digital X ray breast imaging modalities, Vienna, Austria, 7 – 11 November 2022

- Second Research Coordination Meeting on Advanced Tools for Quality and Dosimetry of Digital Imaging in Radiology, Vienna, Austria, 14 – 18 November 2022
- Third Research Coordination Meeting for the Doctoral CRP on Advances in Radiotherapy Techniques, Vienna, Austria, 21 – 25 November 2022
- Consultancy Meeting to advise on methodology for determining the appropriate factors for the calibration and interpretation of reference instrument results in different megavoltage photon beams, Vienna, Austria, 28 November – 2 December 2022
- Consultancy Meeting to advise on developing guidelines for standardisation and quality assurance of quantitative image analysis tools used in radiology, Vienna, Austria, 28 November – 2 December 2022
- Consultancy Meeting to advise on the CRP for the Evaluation on the requirements for medical physicists working in Radiopharmaceutical Therapies (RPT), Vienna, Austria, 28 November – 2 December 2022
- Consultancy Meeting to advise on developing a guidance document on setting up a diagnostic radiology programme, Vienna, Austria, 12 – 16 December 2022

Other events

- International Conference on Integrated Medical Imaging in Cardiovascular Diseases (IMIC-2022), Vienna, Austria, 13 – 16 December 2022

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Impressum

SSDL Newsletter No. 75, August 2022

The SSDL Newsletter is prepared by the Dosimetry and Medical Radiation Physics Section,
Division of Human Health, Department of Nuclear Sciences and Applications
International Atomic Energy Agency
Vienna International Centre, PO Box 100, 1400 Vienna, Austria
Printed by the IAEA in Austria, August 2022

22-03731