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Contents

From the Editor

This issue of SSDL Newsletter (No 72) is dedicated to the report of 19th Scientific Committee of the IAEA/WHO Network of Secondary Standards Dosimetry Laboratories SSC-19. The meeting was held at the IAEA Headquarters in March 2020. The SSC-18 reviewed the activities reported by the Dosimetry and Medical Radiation Physics (DMRP) section for the biennium 2018 – 2019 and noted the actions following the SSC-18 recommendations. Particularly, the activities of the present and future programmes for biennium 2020 – 21 and 2022 – 23 were discussed and prioritized recommendations were made. These recommendations will be used to target our activities accordingly.

One of the requirements for the SSDL Network members is to submit their annual report. This year the annual reporting was performed for the first time through DOLNET web interface. Each SSDL was assigned to one DOLNET contact person and the information related to SSDL contacts, equipment and services was reviewed and updated. In the annual reporting part, the SSDLs provide information about annual calibrations and training activities.

Based on the annual reports, the database on calibration services provided by the SSDL Network will be updated and the information is shared on the DOLNET Services web page. This tool can be used by any end-user who needs a calibration for their dosimetry equipment.

The members of the Scientific Committee of the IAEA/WHO SSDL Network present in person at the 19th Scientific Committee meeting: (from left) David Followill (Chair), Jan Seuntjens, Maria-Ester Brandan, Penelope Allisy (Rapporteur), Mehenna Arib, John Dickson and David T Burns. Zhang Jian could not attend the meeting and he is missing from the photo. See page 4.

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Services provided by the IAEA in 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 has been reviewed and accepted by the Joint Committee of the Regional Metrology Organizations and the BIPM (JCRB). The IAEA Calibration and Measurement Capabilities (CMCs) have been reviewed and published in Appendix C of Comité International des Poids et Mesures (CIPM), Mutual Recognition Arrangement (MRA).

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

The range of services is 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 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 IAEA services can be addressed to the Dosimetry Contact Point.

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

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

Scientific Committee of the IAEA/WHO Network of Secondary Standards Dosimetry Laboratories

Report of the Nineteenth Meeting of the SSDL Scientific Committee
IAEA, Vienna, 2-6 March 2020

1 FOREWORD

The Scientific Committee of the IAEA/WHO network of Secondary Standards Dosimetry Laboratories (SSDLs) is a standing committee (SSC) within the framework of the International Atomic Energy Agency. It is tasked with conducting periodic reviews and evaluations of the Dosimetry and Medical Radiation Physics (DMRP) Sub-programme and reporting the results of the reviews to the Directors General of the IAEA and the WHO. The report of the eighteenth meeting of the SSC, which was held from 12 to 16 March 2018, was published in the SSDL Newsletter No. 68 in September 2018.

The nineteenth meeting was held in Vienna at the Agency Headquarters from 2 to 6 March 2020. Opening remarks were made by Ms Debbie van der Merwe, Head of the Section of Dosimetry and Medical Radiation Physics and Co-Secretary of the IAEA/WHO SSDL Network, on behalf of Ms May Abdel-Wahab, Director of the Division of Human Health (NAHU), and Ms Adriana Vélazquez Berumen, Diagnostic Imaging and Medical Devices, World Health Organization, Geneva, the Co-Secretary of the IAEA/WHO SSDL Network, who participated via web-based video transmission. The members of the SSC-19 are: Mehenna Arib, SSDL, King Faisal Specialist Hospital and Research Centre, Saudi Arabia, specialist in dosimetry at the SSDL level; Maria-Ester Brandan, Instituto de Física, National University of Mexico (UNAM) representing the International Commission on Radiation Units and Measurements (ICRU); David T Burns, representing the Bureau International des Poids et Mesures (BIPM); John Dickson, University College London Hospital, UK, specialist in nuclear medicine imaging physics; David Followill as Chair, MD Anderson Cancer Center, USA, specialist in dosimetry audits; Jan Seuntjens, McGill University Health Centre, Canada, specialist in reference dosimetry and radiotherapy physics and Zhang Jian, NIM, China, specialist in primary radiation dosimetry standards, who was unable to attend the meeting in person because of the coronavirus epidemic in China but participated through web-based audio and electronic transmission.

1.1 Introductions

Ms May Abdel-Wahab, Director of NAHU, conveyed her opening remarks through the Head of the Section of DMRP where she apologized for being unable to personally welcome all members and looked forward to hearing their advice on the DMRP programme. She remarked that the committee had first been established in 1985 for the dosimetry laboratory and then expanded in 1988 to include all DMRP activities. She expressed the view that having independent advice had contributed to the success of the DMRP programme and the impact it had on Member States. She particularly welcomed the new committee members who were appointed by the Directors General and the two who were nominated from international organizations, the Bureau International des Poids et Mesures (BIPM) and the International Commission for Radiation Units and Measurements (ICRU). She explained that the SSC-19 report would again be published in the SSDL Newsletter to give it maximum exposure. She then acknowledged the breadth of expertise in the SSC that would enable a full and thorough evaluation of the programme and she looked forward to the recommendations to be made by the SSC for the biennium 2022/23. These would be presented to the Deputy Director General, Ms Najat Mokhtar, towards the end of the meeting.

Ms Adriana Velázquez Berumen, the Joint Secretary of the SSDL Network and Senior Adviser on Medical Devices at the WHO, joined the meeting by video conference and gave a short presentation about the WHO involvement. She apologized for not being present in person but would follow the meeting, discuss the recommendations and join again by video conference on the last day. The WHO is very supportive of the DMRP programme and uses the data of DIRAC for WHO assessments of need in Member States. She acknowledged the importance of the committee's work and wished the SSC-19 members a very successful meeting.

Ms Debbie van der Merwe, Section Head of the DMRP, thanked the SSC members for coming to the meeting and stressed how much the advice of the SSC was welcomed and

that having representatives from the WHO, the ICRU and the BIPM on the SSC is key in supporting the appropriate activities of the SSDL network. As the SSC-19 was made up of newly appointed members she explained the rationale behind the appointments and invited the members, through the Chairman, David Followill to introduce themselves to each other and to the staff. She then presented the staff of the DMRP, pointing out that there had been many changes in the last 2 years and only 5 staff members had been in post longer than she herself. In attendance for at least part of the meeting were: Eduardo Zubizarreta from Applied Radiobiology and Radiotherapy Section, Diana Páez from Nuclear Medicine and Diagnostic Imaging, and from Radiation Safety and Monitoring were Ola Homberg and Rodolfo Cruz Suárez.

Ms van der Merwe then outlined the structure of the meeting which would include a new way of presenting the activities of the Section that would allow more time for discussion. Following these presentations, time had been allocated for a brain-storming session involving the staff and the Committee members on the programme for the next biennium 2022/23. A visit to the Seibersdorf facility was planned for the second day, which would include laboratory staff presentations as well as a tour of the facilities, to include the new linear accelerator (linac) installation. She requested that the SSC-19 prioritize their recommendations into high and medium. Any additional comments on the programme would also be acknowledged and implemented where appropriate. She explained that, once the SSC-19 report had been submitted and approved by the Director General (DG), the programme would be finalized and its implementation could start. She expressed her thanks to David Followill who would Chair the meeting and to Penelope Allisy who would act as *Rapporteur*.

Mr David Followill expressed his pleasure to Chair the meeting, feeling confident that the new Committee would have fruitful discussions and be productive in terms of recommendations for the DMRP's work within the NAHU Division and for the SSDL network. It was satisfactory to learn that the SSC-19 report will be perceived as useful in planning for the Agency programme and budget for 2022 to 2023 and future programmes.

In his capacity as Chairman, he presented the agenda explaining that it represented a full week's work, and the agenda was then duly adopted.

1.2 General discussion

1.2.1 Programme of the Meeting

The first item on the agenda was to review the actions following the SSC-18 recommendations. This was reported by Ms van der Merwe and was followed during the remainder of the first day of the meeting by DMRP staff members presenting reports on the activities of the Section. On the second day, the SSC-19 was taken to Seibersdorf where further presentations were made by staff on the laboratory's scope of work and the SSC-19 was able to see the laboratories and work at first hand, including the new system for the regular dosimetry postal audits and the installation of the linac with its robotic arm for the placement of the dosimetry water phantom for absorbed dose to water measurements. On the third day there was a wrap-up session on the DMRP activities and then the SSC-19 met in closed session, deliberating on the accomplishments and direction of the DMRP's sub-programme, and developing specific recommendations for the present but particularly the next biennial programme. Discussion continued on the draft recommendations and their prioritization on the fourth day followed by a brainstorming session with the staff on their ideas for future projects and direction. Some 30 draft recommendations were finalized on the final morning and then presented to the DMRP staff that afternoon. During the feedback, the Chairman of the SSC-19 thanked the DMRP staff on behalf of the whole committee, for the very full DMRP written report (submitted prior to the SSC-19 meeting), for their carefully prepared presentations and their patience with the committee's numerous interruptions with questions to which they fully responded. He also mentioned that the brain-storming session had been particularly useful.

1.2.2 Programme evaluation

In preparation for its report, the SSC-19 reviewed the activities reported by the DMRP for the 2018/19 biennium, noted the outcomes of the recommendations made by the SSC-17 and SSC-18 and discussed the present sub-programme activities for 2020/21, making some further recommendations. More importantly, the SSC also reviewed the results of the DMRP's "brainstorming" for the biennium 2022/23 and made some prioritized recommendations for this future programme. The SSC-19 evaluation was similar to that of previous SSCs and considered:

- The objectives of the sub-programme areas;
- The impact (benefit to the Member States);
- Opportunities to increase efficiency or reduce costs;
- The continuing relevance of Agency activities.

Specific recommendations from the SSC-19 are identified throughout the text and are also listed, in just two priority categories of high and medium, at the end of the report. Comments regarding specific aspects of the DMRP sub-programme are made throughout the text and the more important comments are also listed at the end of the report.

2 INTRODUCTION

The SSC-19 expressed its thanks to the DMRP staff members for having prepared a comprehensive report covering the activities of the sub-programme on Dosimetry and Medical Radiation Physics during the biennium 2018/19. This report had been provided electronically, well in advance of the meeting, enhancing the Committee's ability to develop relevant recommendations.

The DMRP Section objective is to enhance the capability of Member States to implement radiation imaging and treatment modalities safely and effectively through optimized dosimetry and medical physics practice. To further this objective, the work of the Section is divided into three projects whose titles are:

- Project 2.2.4.1: Calibration and auditing service;
- Project 2.2.4.2: Developments in radiation dosimetry;
- Project 2.2.4.3: Clinical medical radiation physics for imaging and radiation therapy.

This report of the SSC-19 follows the format established by previous reports and begins with a general discussion of administrative items and collaborative ventures within the Agency. The three project areas are then discussed in turn. In general, the report mentions only those activities of the DMRP Section for which the SSC-19 has comments or recommendations at this time. **It should be noted that when a particular service provided by the DMRP is not mentioned specifically, the SSC-19 strongly endorses its continuation**. The SSC-19 is particularly pleased to see the continuing support and involvement of the DMRP in appropriate CRPs where, of those in Nuclear Applications, 25% are in Human Health, and also the DMRP involvement in TC projects, noting that Human Health is currently involved in 28% of all the Agency TC projects. A list of acronyms is given in the Appendix.

3 REPORT

3.1 General Organizational Items and Major Facilities

The SSC-19 was pleased to learn that the 48 recommendations of the SSC-17 were either completed or implemented as far as possible, some of which are awaiting external input. It was reported that the project-specific comments of the SSC-17 had been helpful and these were all in progress or under consideration, as detailed in the written DMRP report. It was also noted with satisfaction that the 24 recommendations of the SSC-18 for the present biennium 2020/21 were programmed to be implemented except the end-to-end audit for radio-pharmaceutical therapy for which funding had not been successful.

The quality and volume of work produced by the DMRP is impressive and the Deputy Director General, Ms Najat Mokhtar, and the Director of the NAHU, Ms May Abdel-Wahab, are thanked sincerely for the support they give to the DMRP programme and budget.

The SSC-19 supports the DMRP in its collaborations with other sections within the Division and the Agency and with external organizations in support of its activities and provision of expert consultation. These collaborations are viewed by the SSC-19 to be vital to the performance of the DMRP's programme.

The SSC-19 encourages the DMRP to develop a strict procedure to ensure that all of its activities and data associated with them be stored/archived on their shared drive instead of each individual's computer hard drive. This will ensure continuity of access to data even when staff members depart from the DMRP.

The effort and investment needed to produce a document is always large, and the quality of documents originated in the Section is much appreciated. Promotion of these reports should be equally important in order to reach a large audience. The SSC-19 proposes that when the Human Health campus is migrated to a new platform, the DMRP promotes new publications and, if appropriate, provides audiovisual material, using e-mail and social media to disseminate the essential content of the documents.

The SSC-19 notes with concern that there is at present a significant backlog of documents waiting to be edited and published.

The SSC-19 is pleased to see the Dosimetry Laboratory (DOL) linac is now installed and being used. The SSC-19 supports the DMRP as it continues to assess the work programme of the linac in terms of the metrics that will be used to document its use and benefit to Member States.

Figure 1. The Linear Accelerator and Robotic Calibration arm installed in the new bunker at the Dosimetry Laboratory.

The SSC-19 appreciates the importance of the DMRP's involvement in TC projects. The SSC-19 encourages the DMRP to continue to seek ways to increase the efficiency and effectiveness of their efforts such that both TC projects and DMRP programme projects can be accomplished in a timely manner.

The positive feedback from the very successful International Dosimetry Symposium (IDOS) in 2019 demonstrates how important this Symposium is for the health of cancer patients throughout the Member States. The 50-year anniversary of radiotherapy dosimetry audits was celebrated during IDOS 2019 and the success of these audits in harmonizing radiotherapy dosimetry world-wide was felicitated.

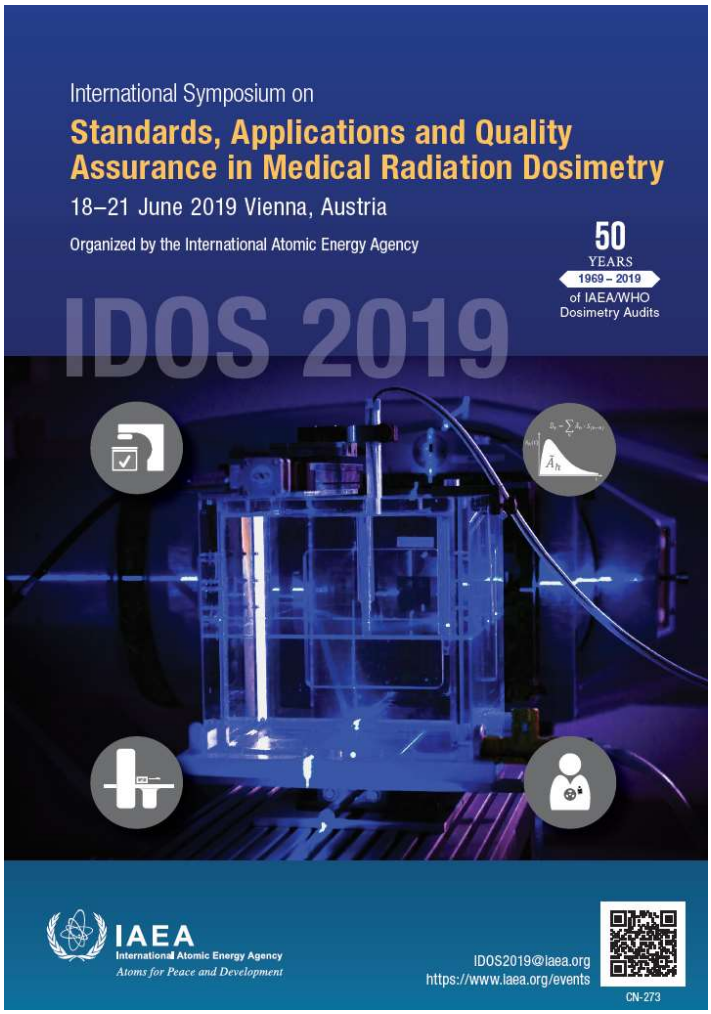

Figure 2. IDOS 2019 poster.

The SSC-19 recognizes and fully endorses the importance and uniqueness of the DMRP databases that continue to serve as a resource for the IAEA, the WHO and Member States. These databases include, in addition to many other data sets, the most comprehensive Directory of Radiotherapy Centres (DIRAC), listing radiation therapy sites and equipment around the world. The SSC-19 congratulates the DMRP for the considerable effort given to the DIRAC database and the other databases in order to provide Member States with the most up to date, accurate and reliable information. The SSC-19 is pleased to learn of the pending P2 IT appointment to support the databases. However, the SSC-19 is concerned that the majority of the data entry and validation is being performed by temporary interns who are replaced every year rather than by more permanent dedicated staff.

[R1] The SSC-19 recommends that the DMRP databases data entry and data validation be performed by dedicated Agency staff rather than relying solely on interns.

The DMRP should make every effort to ensure that the databases are continually updated and data validated in a timely manner such that the validity and benefits of the databases are not impaired.

Two of the most crucial elements to any database are the method used to collect new and updated information, and the graphic user interface (GUI) used to manipulate and query the database. The SSC-19 noted that various forms of data collection were being used from google docs to PDF forms. In an effort to improve efficiency and effectiveness, the variability in data gathering methods should be removed and a single software be used for all databases. A software that is friendly and easy to use by the end-user, and that can easily be modified to transfer the data to each database, is required, such as that produced by the IRIS Software Group technology platform.

[R2] The SSC-19 strongly supports the use of a single Agency-approved platform, one suitable choice being IRIS, to replace old PDF forms and surveys and recommends the use of the same platform for all the DMRP activities.

Over time, as new software platforms are developed and older ones are no longer supported, there arises the need to evaluate the GUI software being used to interface with the back end of the databases as to its effectiveness and supportability. The SSC-19 noted that the GUI used for the databases was reaching its lifetime limit. Consequently, the SSC-19 supports the commencement of planning to replace/update the database administrative components, including the GUI front end, to using web-based technologies and software as a service (SaaS) to create the front end of the databases.

The SSC-19 is pleased to note the continued efforts that are being made to promote the recognition of medical physicists and the establishment of structured clinical training programmes in all regions. The section should continue to develop, promote and evaluate the impact of the medical physics educational activities. E-learning offers a strong and effective tool for educating professionals in Member States. Additionally, the provision of online activities such as webinars with online discussions offer continuing professional development (CPD) and networking opportunities for professionals who work in isolation or in small teams. The DMRP has a strategy of providing high-quality e-learning and online activities, especially following the publication of guidelines, and has also developed resources from courses held at the ICTP and other training courses. The SSC-19 strongly encourages and supports these endeavours. The addition and development of supplementary online activities by the DMRP will also provide a framework for CPD-type learning, and the possibility of interaction between Member State medical physicists.

[R3] The SSC-19 recommends that the current strategy for e-learning opportunities continues, and develops in both its content and educational approaches.

With the digitization of healthcare worldwide, hospital environments are going through a digital transformation with patient data from different sources (imaging, pathology, blood tests, doctors' notes, geographic information, genomics, treatment plan information, etc.) becoming available in digital form in large quantities. In high-income countries, existing data storage platforms are being connected, the data made available and the ethics framework for use of data is being developed. In LMI countries there is an opportunity for capacity building to develop platforms that have the capability of data amalgamation built into the design of these systems.

[R4] The SSC-19 recommends that a group of expert consultants be commissioned to produce a white paper on the challenges of data federation and the opportunities of data-science in human health.

This could be most beneficial if it were in collaboration with the other sections within the Human Health Division.

It is apparent that the efforts of the DMRP to support the Agency, the WHO and the Member States are essential for the accurate and safe use of radiation to improve the wellbeing of patients around the world. The DMRP is in a unique position to be that international focal point where knowledge and data are gathered from all corners of the world. Making available and communicating the large amount of data that is collected, either as publications or by means of the Human Health Campus website or through social media, is essential. The SSC-19 noted that the WHO commented that it uses the DIRAC database information along with Ministry of Health information to assess the potential to support healthcare developments within the Member States. The SSC-19 wishes to express its support for the development and use of the various DMRP databases to enable the collected data to benefit health facilities in the Member States.

[R5] The SSC-19 recommends that the DMRP investigate methods to publicize the existence of the information that can be found in the databases to the Member States.

The use of SPECT/CT is expanding in the nuclear medicine community both for diagnostic nuclear medicine, and in the support of therapeutic nuclear medicine through the assessment of disease progression and tumour/organ dosimetry. Given that the outdated gamma camera facility has been closed, the purchase of a new SPECT/CT system would allow training courses in quality control and optimization to be organized for SPECT, SPECT/CT and stand-alone CT. Such an addition to the DMRP's resources would also support the provision of training materials, guidance documents, and the establishment of audit procedures and code of practice documents. Furthermore, the CT component of the system would complement dose-monitoring activities in radiology as well as treatment planning associated with the newly installed linac.

[R6] The SSC-19 reinforces the previous recommendation that, once all the other irradiators have been fully implemented into the services offered by the DOL, funding should be identified for the purchase, installation and maintenance of a SPECT/CT system at the DOL. This could be under the ReNuAl ++ initiative. Provisions for the purchase of diagnostic and therapeutic radiopharmaceuticals should also be considered to enable this work.

With regard to the organization of the SSC meeting by the Agency, the SSC-19 was very pleased to have all the documents in electronic format only. The SSC-19 also appreciated the visit to the Agency Dosimetry Laboratory (DOL) at Seibersdorf with presentations and tours of the new linac facility.

3.2 Project 2.2.4.1: Calibration and Auditing Services

This project covers the dosimetry audit services and dosimetry calibration services including related development and activities. The IAEA/WHO dosimetry audit programme helps hospitals in the Member States, either directly or through national audit networks, to have confidence in the radiation doses they are delivering to their patients that is crucial for proper patient treatment. The dosimetry audit services are considered as vital by the SSC-19.

Figure 3 demonstrates graphically the impact that the DMRP has on helping the Member States to verify the consistency of radiotherapy dosimetry worldwide.

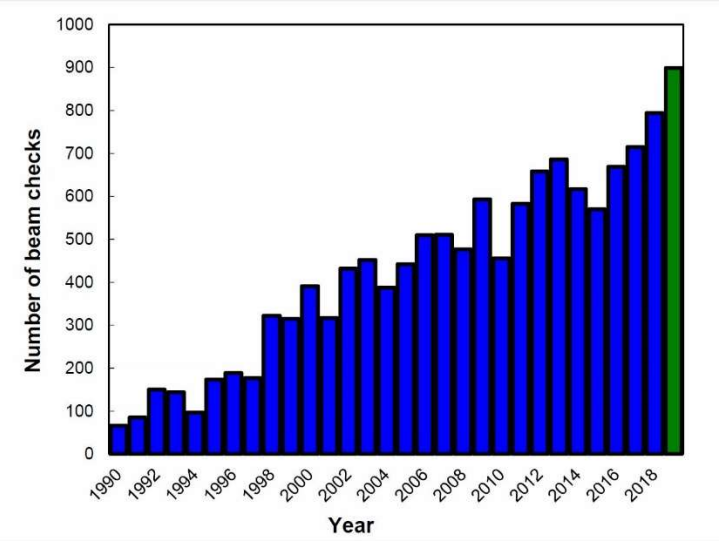

Figure 3. The growth in the number of radiotherapy beam dosimetry checks carried out by the DMRP for hospitals in Member States.

The system of fixed-term contracts at the IAEA presents a particular problem for quality assurance in laboratory work. The SSC-19 appreciates and is pleased with the plan to keep DOL staff cross-trained and to use consultants in order to preserve long-term continuity in dosimetry expertise with minimal lag in services provided by the DOL. The SSC-19 encourages the DMRP to continue this practice.

As a result of the visit to the Agency DOL at Seibersdorf and discussions with the staff, the SSC-19 has a number of comments that it would like to make. In particular, the SSC-19 appreciates the DOL's efforts to obtain customer feedback/interactions as a part of their QMS and encourages the use of IRIS to monitor and record these efforts.

The SSC-19 encourages the DOL staff and the IDEA database administrator to prepare the database for the processing of HDR brachytherapy audits including the reading of the dosimeters and generation of reports. The DIRAC database could usefully be augmented to include new treatment modalities such as proton facilities and radiotherapy imaging capabilities, for example.

[R7] The SSC-19 recommends that the DMRP support Dosimetry Audit Networks (DAN) that are set up in different regions by further developing verification audits to give them confidence in their local auditing.

The SSC-19 encourages the DMRP to continue supporting Member States that fulfil the SSDL Charter requirements (consolidated by Expert missions, evidence sent by the national regulatory authorities, DIRAC database, dosimetry comparisons etc.) noting that only one SSDL per country will be supported except in special circumstances.

The SSC-19 supports the concept of a Regionally Designated Centre for an SSDL that can then act as a focal point in updating the DMRP databases, in organizing training courses, hosting trainees and offering calibration services for the countries in the region that do not have an SSDL.

The SSC-19 is pleased to see that the training material of the ESSDOL documents can help Member States plan appropriately for their SSDL.

With regard to the SSDL Newsletter, the SSC-19 supports the production of at least two Newsletters per year; that SSDLs should publish their CMCs in the Newsletter; and that they should be encouraged to publish their success stories in the Newsletter, such as participation in comparisons, or finalizing their QMS and being audited, or obtaining accreditation.

The SSC-19 encourages the DMRP to continue participating in comparisons organized by the regional metrology organizations (RMOs) and to link SSDL comparisons to these when they have been registered appropriately in the BIPM key comparison database (KCDB).

The SSC-19 much appreciated the visit to the Agency Dosimetry Laboratory (DOL) at Seibersdorf with presentations and tours of the dosimetry facilities and particularly the new linac installation. Given that very few SSDLs have their own accelerator and that the IAEA will publish new kQ factors for megavoltage photon beams in a revision of TRS-398, the role of linac calibrations in an efficient and sustainable scenario needs to be clarified.

[R8] The SSC-19 recommends that a procedure be developed in which secondary standards held by SSDLs and calibrated in the IAEA linac can be used as an independent check on the quality of clinical reference dosimetry that is based on k_Q factors published in the revised TRS-398. This should avoid the Agency DOL from having to calibrate hospital ionization chambers in the linac beams.

The large number of qualities available for calibrations in kilovoltage x-rays, including mammography, represents a significant effort in both staff time and facility usage, and the SSC-19 recognizes the efforts already made to reduce these through the electrical calibration of electrometers.

[R9] The SSC-19 recommends that methods be studied to further alleviate this situation, including but not limited to irradiation times based on optimized statistical uncertainties, repeat measurements at selected qualities only, as well as a re-evaluation of the need for such a large number of beam qualities.

The SSC-19 commends the DOL on the electrometer calibration system that has been developed. The information on potential electrometer performance issues that has been obtained using this system is extremely valuable.

[R10] The SSC-19 recommends that the details of the electrometer calibration system and the results obtained be published in the peer-reviewed literature.

[R11] The SSC-19 recommends that guidelines be established for the SSDLs to transfer the DOL calibration of one electrometer to other electrometers held at the SSDL.

The SSC-19 congratulates the Agency on the very successful technical training meeting on the Establishment of a Secondary Standards Dosimetry Laboratory and a Quality Management System, held in December 2018. This was one of the largest such meetings that the Agency has held, potentially benefiting every Member State. The positive feedback from the participants and the stimulating discussions during the meeting was of great benefit to the SSDL members, many of whom work in near isolation. Given that many Member States are establishing new SSDLs or expanding activities in their existing SSDL:

[R12] The SSC-19 recommends that a technical meeting on SSDL work and QMS is run on a regular basis (e.g. every 5 years) to support the SSDL network.

The SSC-19 noted with satisfaction that a High Dose Rate Brachytherapy (HDRBT) remote after-loading system, that can operate with either a Ir-192 or a Co-60 source, had been installed and acceptance tested at the DOL and that the DOLP.012 procedure had been revised to include calibration services for HDRBT well-type chambers, used by members of the IAEA/WHO network of SSDLs. However, given the wide availability of Cs-137 check sources used for well-type ionization chambers;

[R13] The SSC-19 recommends that the DOL include a Cs-137 source in the determination of k_Q factors for the different well-chambers used for HDR brachytherapy dosimetry. This would enable wider dissemination of HDRBT calibrations but does not preclude the decommissioning of the Cs-137 source in the longer term.

3.3 Project 2.2.4.2 Developments in Radiation Dosimetry

This project focuses on research and development activities in radiation dosimetry, including the development and updates of dosimetry Codes of Practice.

There is a number of documents awaiting final publication and among these the SSC-19 is pleased that the IAEA TecDoc-1274 "*Calibration of photon and beta ray sources used in brachytherapy*" (2002) is finally being updated and that the update to TRS-398 and the white paper on plan-class specific reference fields are being finalized.

The SSC-19 is pleased to see that a CRP will be launched for the update of TRS-457 "*Dosimetry in Diagnostic Radiology: An International Code of Practice*" (2007) that is collaborative between the SSDL Officer and a Clinical Radiology Medical Physicist.

The SSDLs provide core service and expertise to the medical radiation diagnosis and therapy community, ranging from disseminating calibrations to providing expert advice to medical physicists in hospitals. Measurement science in SSDLs is a very specialized activity that requires personnel possessing a strong base in physics and specific expertise in measurement science. In SSDLs in some regions, the critical mass for developing and maintaining this type of expertise is not present. Hence, the training and continuing education of SSDL laboratory scientists is perceived as a challenge in some Member States.

[R14] The SSC-19 recommends that a blueprint for the training requirements for a radiation measurement scientist / calibration laboratory measurement scientist (e.g. a radiation metrologist) be developed. It is recommended that course material be developed and courses with theoretical and practical training including competency-based evaluation be organized at the Agency SSDL (DOL).

The joint report of the ICRU and the ICRP on Operational Quantities for External Radiation Exposure is expected to be published before the end of 2020. As well as extending the range of particles and energies covered, this report defines revised operational quantities based on the measurement of air kerma or fluence and new conversion coefficients for these operational quantities. The SSC-18 previously recommended that the DOL no longer invests in its reference standard for the operational quantities and the SSC-19 reaffirms that future calibrations of radioprotection instruments at the DOL should be in terms of air kerma only. This will require guidance to the SSDLs on the use of these calibrations for their radiation protection requirements. In parallel, it is worth noting that the DOL discontinued the services for CT chambers and KAP meters as there are no secondary standard reference detectors for air kerma-length product and air kerma-area product.

[R15] The SSC-19 recommends that the DOL offers calibrations of radiation protection and diagnostic radiology instruments only in terms of air kerma but with advice on dissemination.

In conjunction, the DMRP should provide guidance to the SSDLs on the dissemination of these air kerma calibrations in the SSDLs for radiation protection purposes. Similarly, guidance on the calibration of survey meters and personal dosimeters in terms of the operational quantities, and CT devices and KAP meters in terms of kerma-length and kerma-area product, respectively, would provide support for the SSDLs and their dissemination of these quantities for diagnostic radiology dosimetry.

The SSDL charter specifies that the SSDLs shall have technical and managerial personnel who have the authority, qualifications and competence to operate the specific equipment needed for radiation measurements, perform calibrations, evaluate the results and authorize calibration certificates. Recognizing that a shortage of adequately trained staff is a serious obstacle to the appropriate operation of an SSDL, the SSC-19 notes that calibrations and comparisons at the DOL offer a unique opportunity for information sharing and training for SSDL staff.

Figure 4. Dosimetry training at the DOL.

[R16] The SSC-19 recommends that, when appropriate, the DOL invite a member of staff of the SSDL to be present at the laboratory during the calibration of their equipment. This could be in parallel with a practical training workshop for several SSDLs on a regular basis e.g. half-yearly.

The doctoral contracts are a DMRP CRP activity awarded to institutions in low and middle-income countries for the benefit of students enrolled in a Ph.D. programme at a university of a Member State. The projects developed by these students are aimed at improving the care of patients in Member States either by investigating diagnostic imaging, radiation oncology or some other aspect of using ionizing radiation. One of the key efforts of the Agency and DMRP is the support and extensions of the SSDL Network and its oversight. The SSDLs provide a key resource towards accurate delivery of radiation doses through their assignment of calibration coefficients traceable to primary radiation standards. In order to accomplish this crucial step, the measurement of radiation dose must follow all of the principles defined in the field of metrology. The SSC-19 believes that a doctoral CRP is an efficient and justifiable activity that strengthens the local expertise in medical physics research. It also promotes the establishment of long-lasting academic collaborations and furthers the objectives of the Agency to promote quality and safety in healthcare by educating and training scientists in Member States. The benefit of these doctoral CRPs is evident in the number of peer-reviewed publications that have resulted from these efforts.

[R17] The SSC-19 recommends that a Doctoral CRP be initiated that would focus on radiation metrology as it applies to radiation oncology and diagnostic imaging. This would greatly benefit the SSDL network of the Member States.

Dose calibrators (activity meters for radionuclides) are used worldwide to measure the activity of both diagnostic and therapeutic radiopharmaceuticals. For centres without access to a primary standard laboratory, they can at best check the reproducibility of their activity measurements using a non-clinical long-lived check source at one gamma photon energy, and normally with a measurement standard uncertainty of 5%. This is clearly an area where SSDLs could support clinics' understanding of the uncertainty of activity measurements made with Member States dose calibrators. The provision of guidance for SSDLs would allow individual centres to use the services of the SSDL to have confidence in their activity measurements for a range of diagnostic and therapeutic radionuclides. The SSC-19 is aware of the DMRP presence on the Joint Ad-Hoc Group between IEC/SC 62C, IEC/TC 45, and ISO/TC 85/SC 2 on radionuclide calibrators/ionization chambers and strongly encourages this participation as a start to increased involvement at the DMRP in this area.

[R18] The SSC-19 recommends that a Code of Practice for the calibration of dose calibrators (activity meters) be produced as an outcome of joint ISO/IEC/IAEA deliberations and should include guidance for SSDLs on how to provide a verification/calibration service for dose calibrators.

In view of the need for SSDLs to be recognized both within and outside their region as providing a calibration service with assured quality, they should be audited for this service, as for any other service. The establishment of the QUADOL on-site service to perform such a review, organized by the DMRP, will enable the calibration and measurement capabilities of an SSDL to be recognized formally through the audit of their quality system and calibration procedures. Similar to the other audit services provided by the Agency, QUATRO and QUADRIL for radiation oncology and radiology, respectively, which have guidance documents specifying the audit requirements, QUADOL must have a similar guidance document with recommendations, comments and opportunities for improvement submitted to the SSDL.

[R19] The SSC-19 recommends that a guidance document be developed that identifies the review specifications when auditing an SSDL under QUADOL.

Every audit process can be improved once established. One of the best ways is to perform a pilot audit and then through feedback from the auditors and audited sites, corrections, additions and enhancements to the audit process can be made. Once a guidance document has been developed establishing the requirements of the QUADOL audit process, it should be used to initiate and guide the audit process in a similar manner.

[R20] The SSC-19 recommends that the DMRP conduct a pilot study of QUADOL as an audit of the performance of the Member State SSDL and to ensure that the SSDL is following the SSDL Charter requirements.

Although the guidance document published in 1999 as Safety Report Series 16 "Calibration of radiation protection monitoring instruments" remains relevant for the calibration procedure performed by the SSDLs, it is not up to date with

regards to the present internationally recognized guidelines and recommendations that have increased emphasis on implementing quality management systems and the reporting of uncertainties. In addition, the document is based on operational dose quantities that were defined 30 years ago and are now in the process of being redefined.

[R21] The SSC-19 recommends that SRS-16 be updated by incorporating recent international guidelines and recommendations, including the upcoming ICRU/ICRP report on Operational Quantities for External Radiation Exposure; and subsequently published.

Contamination monitors are key pieces of equipment for checking personal and environmental radioactive contamination, to ensure that both staff and members of the public are kept safe. Such monitors are also used to assess the levels of radioactivity in waste prior to disposal. The SSC-19 understands that SSDLs are currently facing many requests from end-users (Nuclear Medicine Departments and Radiation Safety Officers in particular) to have their contamination monitors calibrated, so that they can understand the level of radioactivity measured by the monitor.

[R22] The SSC-19 recommends the development of international guidelines on how to calibrate contamination monitors using small and large planar radioactive sources.

The DMRP DOL has acquired a high-energy medical linac with a wide range of photon and electron beam qualities that is located in a custom-built shielded building. In addition, advanced radiation calibration equipment has been installed including a robotic phantom positioning system. The accelerator could be the hub for a variety of activities including calibration, training, and research. At this moment, although a set of metrics to measure the use of the facility has been established, the relative priority of the DOL to perform different activities around the linac is not clear and a comprehensive operational plan to guide these priorities is required.

[R23] The SSC-19 recommends that the DMRP develop an operational plan for the use of the DOL linac to benefit CRP feasibility studies, DOL services and development, and training courses, in line with the metrics that have been established, and that this should be presented in summary form.

The publication of TRS 483 *"Dosimetry of Small Static Fields Used in External Beam Radiotherapy"* gives substantial guidance in the measurement of small field dosimetry and the calculation of small field output factors. However, the publication does not give any guidance towards modelling the measured dosimetry data in the treatment planning system (TPS). There is considerable variation between TPS beam modelling parameters when considering the need for accurate dose calculations for small treatment fields. This highlights the need for careful consideration in the commissioning of clinical beam models. The use of parameter values believed to be clinically acceptable, but that are far from typical, have been shown to contribute to potential deviations in dose calculations. Studies are needed to verify the impact that beam modelling of these small field output factors has on accurate dose delivery to patients within the Member States.

[R24] The SSC-19 recommends that a consultants meeting be held to determine whether guidance or a CRP is needed to develop a method/procedure to assess the implementation of TRS 483 data in treatment planning systems and the resulting implications.

In the medical field, doses to extremities and to the lens of the eye can be important during interventional procedures and in nuclear medicine and there is an increasing demand for calibrations of instruments used to monitor dose to the lens of the eye. This is because there is a risk of radiation-induced opacities and cataract in the lens of the eye at elevated exposures and separate dose limits for radiation protection are recommended by the ICRP. At present, the SSDLs cannot provide the relevant calibration services or meet the demand because there is no easy route to traceability. Furthermore, the joint ICRU/ICRP report on Operational Quantities to be published in the near future defines a new quantity for eye-dose monitoring.

[R25] The SSC-19 recommends that the DMRP formulate a plan to establish traceability of dose to the lens of the eye for SSDL network members.

Concern about increasing cumulative doses to patients and to occupationally exposed personnel for certain radiological procedures, such as CT and interventional cardiac studies, has led to the development and use of dose recording and monitoring systems. Optimization of patient doses in diagnostic radiology and the increasing use of image-guided interventional procedures requires knowledge of the doses, and the data acquired by these software tools should result in better radiation safety practices. Dose management software in radiology is a readily available tool for ensuring the appropriate setting and auditing of diagnostic reference

levels (DRLs) as well as the optimization required by the ALARA principle. A few tens of commercial systems have already been developed and others will probably soon come into the market.

[R26] The SSC-19 recommends that the DMRP produce guidelines for medical physicists on the content, analysis, and evaluation of dose management systems for radiology to help Member States understand, set up and use these systems appropriately.

3.4 Project 2.2.4.3: Clinical Medical Radiation Physics and Quality Assurance

This project aims at developing guidelines and training material for best practice in clinical medical radiation physics. It also promotes comprehensive audits and research in the clinical environment through CRPs. The project includes diagnostic radiology and nuclear medicine imaging physics as well as radiotherapy physics.

The SSC-19 was very encouraged to see all the education material that is now available through the DMRP and the Human Health Campus, notably the online e-materials, training courses, publications, slide sets, video tutorials and ICTP courses. However, the SSC-19 has noticed that the Human Health, Medical Physics and DMRP's websites contain links that do not function. These should be monitored by the DMRP staff and be corrected to function appropriately or be removed. The SSC-19 was also interested to see the positive impact of the courses on participants through the questionnaires completed pre and post course attendance. These educational activities are strongly supported by the SSC-19.

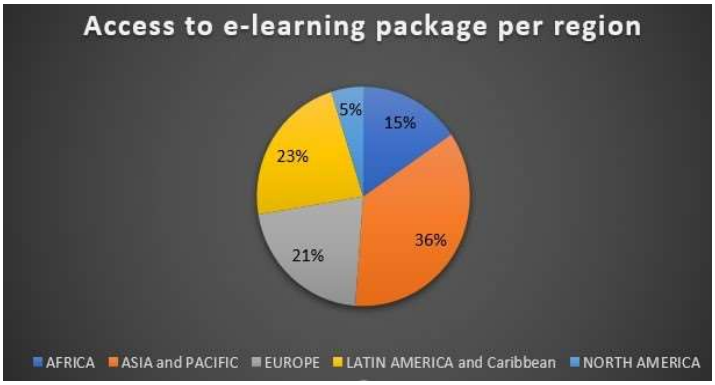

Figure 5. IGRT e-learning course participation per region.

With regard to introducing new course topics, the SSC-19 felt that numerous topics could be offered to the Member States through courses provided by the DMRP and the ICTP. These courses should span from basic topics to more advanced technologies for cancer therapy in Member States. The SSC-19 is pleased to recognize the work accomplished thus far in terms of offering the ICTP courses and their reach to the physicists in the Member States. In view of the evolving imaging and treatment techniques;

[R27] The SSC-19 strongly supports the educational courses run by the DMRP and recommends that the following topics be considered for future inter-regional and regional training courses: Train the trainers; beam modelling for treatment planning systems; MR-linac dosimetry; QA/QC of IGRT; electronic brachytherapy; data-science (application to AI and automation); hybrid imaging; emerging nuclear medicine therapies; radiomics.

Quantitative image analysis using texture analysis followed by statistical learning and deep learning known as radiomics has become prominent in the field of radiology. Commercial programs are becoming available to perform these types of analyses and they are increasingly used as part of the array of tools used in radiology. However, there is limited standardization on the methodologies to perform these texture analyses and subsequent statistical learning on textures. The reproducibility and performance of prediction models is affected by this lack of standardization and there is also a lack of guidance for medical physicists on the associated commissioning and quality assurance methodologies.

[R28] The SSC-19 recommends the formation of an expert consultancy group to work on the development of guidelines for standardization and quality assurance of quantitative image analysis tools used in radiology considering their final use in methods such a radiomics.

Different types of data on patients including imaging, treatment planning data, doctor's notes, lab tests, pathology, genomics, etc. enter the patient chart and provide value for diagnosis and treatment planning of cancer patients. As a quantitative physical scientist in a clinical environment, the medical physicist could be well placed to help healthcare providers maximize the benefit from the availability of these data. However, the medical physicist is generally unprepared for typical 'Big Data' analyses and only tangentially involved, while workers with different backgrounds but who lack expertise in radiation science are being recruited to perform these analyses.

[R29] The SSC-19 recommends the formation of an expert consultancy group that defines a curriculum to update the medical radiation physicist's knowledge and

academic education on data science, regression analysis, statistical learning and deep learning.

This could then form the basis of educational materials with courses and practical sessions for medical physicists in the area of radiation oncology and imaging.

Statistical learning techniques are entering the field of radiation oncology in applications such as automated planning, auto-contouring, adaptive radiation therapy, workflow optimization, etc. and manufacturers are providing software tools as 'black box' solutions to enable the use of these techniques by radiation oncologists, radiographers and medical physicists. The standard training curriculum of the medical radiation physicist does not currently have sufficient elements built into it that deal with the basis of these subjects as applied to radiation oncology.

[R30] The SSC-19 recommends the formation of an expert consultancy group that, following the curriculum to update the medical radiation physicist's knowledge and clinical training on data science, regression analysis, statistical learning and deep learning, develops one or more courses with practical sessions to train medical physicists in this area with the focus on applications in radiation oncology.

The SSC-19 appreciates that Quality Assurance Audits for Radiation Oncology, QUATRO, have become well known activities for Member States. However, the Quality Assurance Audit for Diagnostic Radiology Improvement and Learning (QUAADRIL) shows in the last two years a three-fold smaller number of audits than QUATRO, in spite of the much larger existence of diagnostic radiology centres with respect to the other two specialties. The SSC-19 proposes that a strong promotional strategy is adopted by the WHO to make the QUAADRIL benefits better known to radiology services in Member States.

The nuclear medicine community is seeing a significant increase in the use of radiopharmaceutical therapies, from radioiodine therapy of thyroid conditions to the treatment of prostate cancer with lutetium-177. Given the commitment of the pharmaceutical industry and the general nuclear medicine community to develop and introduce further radiopharmaceutical therapies, the SSC-19 is pleased to see that the DMRP is taking the steps necessary to establish an audit system (including an end-to-end QA phantom) for radiopharmaceutical therapy. With the growing importance of such therapies and in line with SSC-18:

[R31] The SSC-19 recommends that a consultants' meeting should be arranged to investigate possible approaches for implementing a radiopharmaceutical therapy audit, and further recommends that a CRP is started in 2022 to develop such an audit.

The three Agency Handbooks for Teachers and Students (and their slides) with educational content for physics in radiation oncology, nuclear medicine and diagnostic radiology (publications 1196, 1617, and 1564) and the three documents that guide the implementation of courses on Clinical Training of Medical Physicists specializing in radiation oncology, nuclear medicine, and diagnostic radiology (TCS numbers 37, 50, and 47) have had an enormous impact in Member States, strengthening the quality of the medical physics educational and training curricula. Given the ongoing advances in these fields:

[R32] The SSC 19 recommends that the medical physics course handbooks are reviewed periodically, to keep their contents and the associated training materials up-to-date and that priority is given to update or supplement the Radiation Oncology Handbook that was published in 2005.

Fluoroscopically-guided interventional (FGI) procedures are performed under the guidance of images generated by x-rays from tubes operating at voltages from 50 kV to 125 kV. Dose rate values to the skin can vary by many orders of magnitude depending on the procedure; the safe use of FGI requires the control of the conditions under which the clinical procedure is administered. The imaging performance of the fluoroscopic equipment also depends on the design of the equipment, its configuration, and its use. There is currently no Agency guidance document for Quality Control and Quality Assurance of fluoroscopic equipment and procedures in interventional radiology.

[R33] The SSC-19 recommends that the DMRP commissions a guidance document on QC/QA and optimization of equipment and procedures used in fluoroscopically-guided interventional radiology.

The DMRP has announced that a document with guidelines for the Remote and Automated QC tools for Diagnostic Radiology has been approved by the Publications Committee, is awaiting the assignment of an editor, and that the development of the associated media resources is ongoing. The project involved the development of methodologies based on simple test objects that can be manufactured locally. The procedures were defined to

exploit the advantages of networked imaging and automated processing of digital images.

[R34] The SSC 19 commends the DMRP for the publication of the work on *Remote and Automated QC tools for Diagnostic Radiology* and recommends that a training course is offered once the document is published and the corresponding educational tutorial video or seminar is produced, to further promote the use of these tools and the dedicated software.

4 SSC-19 Recommendations (Indicated as High or Medium Priority)

4.1 High Priority Recommendations

4.1.1 General organizational recommendations

[R1] The SSC-19 recommends that the DMRP databases data entry and data validation be performed by dedicated Agency staff rather than relying solely on interns.

[R2] The SSC-19 strongly supports the use of a single Agency-approved platform, one suitable choice being IRIS, to replace old PDF forms and surveys and recommends the use of the same platform for all the DMRP activities.

[R3] The SSC-19 recommends that the current strategy for e-learning opportunities continues, and develops in both its content and educational approaches.

[R5] The SSC-19 recommends that the DMRP investigate methods to publicize the existence of the information that can be found in the databases to the Member States.

[R6] The SSC-19 reinforces the previous recommendation that, once all the other irradiators have been fully implemented into the services offered by the DOL, funding should be identified for the purchase, installation and maintenance of a SPECT/CT system at the DOL. This could be under the ReNuAl ++ initiative. Provisions for the purchase of diagnostic and therapeutic radiopharmaceuticals should also be considered to enable this work.

4.1.2 Project 2.2.4.1: Calibration and Auditing Services

[R7] The SSC-19 recommends that the DMRP support Dosimetry Audit Networks (DAN) that are set up in different regions by further developing verification audits to give them confidence in their local auditing.

[R8] The SSC-19 recommends that a procedure be developed in which secondary standards held by SSDLs and calibrated in the IAEA linac can be used as an independent check on the quality of clinical reference dosimetry that is based on k_Q factors published in the revised TRS-398. This should avoid the Agency DOL from having to calibrate hospital ionization chambers in the linac beams.

[R9] The SSC-19 recommends that methods be studied to further alleviate this situation, including but not limited to irradiation times based on optimized statistical uncertainties, repeat measurements at selected qualities only, as well as a re-evaluation of the need for such a large number of beam qualities.

[R12] The SSC-19 recommends that a technical meeting on SSDL work and QMS is run on a regular basis (e.g. every 5 years) to support the SSDL network.

[R13] The SSC-19 recommends that the DOL include a Cs-137 source in the determination of k_Q factors for the different well-chambers used for HDR brachytherapy dosimetry.

[R14] The SSC-19 recommends that a blueprint for the training requirements for a radiation measurement scientist / calibration laboratory measurement scientist (e.g. a radiation metrologist) be developed. It is recommended that course material be developed and courses with theoretical and practical training including competency-based evaluation be organized at the Agency SSDL (DOL).

4.1.3 Project 2.2.4.2 Developments in Radiation Dosimetry

[R15] The SSC-19 recommends that the DOL offers calibrations of radiation protection and diagnostic radiology instruments only in terms of air kerma but with advice on dissemination.

[R17] The SSC-19 recommends that a Doctoral CRP be initiated that would focus on radiation metrology as it applies to radiation oncology and diagnostic imaging. This would greatly benefit the SSDL network of the Member States.

[R19] The SSC-19 recommends that a guidance document be developed that identifies the review specifications when auditing an SSDL under QUADOL.

[R20] The SSC-19 recommends that the DMRP conduct a pilot study of QUADOL as an audit of the performance of the Member State SSDL and to ensure that the SSDL is following the SSDL Charter requirements.

[R23] The SSC-19 recommends that the DMRP develop an operational plan for the use of the DOL linac to benefit CRP feasibility studies, DOL services and development, and training courses, in line with the metrics that have been established, and that this should be presented in summary form.

[R24] The SSC-19 recommends that a consultants meeting be held to determine whether guidance or a CRP is needed to develop a method/procedure to assess the implementation of TRS 483 data in treatment planning systems and the resulting implications.

4.1.4 Project 2.2.4.3: Clinical Medical Radiation Physics and Quality Assurance

[R27] The SSC-19 strongly supports the educational courses run by the DMRP and recommends that the following topics be considered for future inter-regional and regional training courses: Train the trainers; beam modelling for treatment planning systems; MR-linac dosimetry; QA/QC of IGRT; electronic brachytherapy; data-science (application to AI and automation); hybrid imaging; emerging nuclear medicine therapies; radiomics.

[R31] The SSC-19 recommends that a consultants' meeting should be arranged to investigate possible approaches for implementing a radiopharmaceutical therapy audit, and further recommends that a CRP is started in 2022 to develop such an audit.

[R32] The SSC 19 recommends that the medical physics course handbooks are reviewed periodically, to keep their contents and the associated training materials up-to-date and that priority is given to update or supplement the Radiation Oncology Handbook that was published in 2005.

[R33] The SSC-19 recommends that the DMRP commissions a guidance document on QC/QA and optimization of equipment and procedures used in fluoroscopically-guided interventional radiology.

[R34] The SSC 19 commends the DMRP for the publication of the work on *Remote and Automated QC tools for Diagnostic Radiology* and recommends that a training course is offered once the document is published and the corresponding educational tutorial video or seminar is produced, to further promote the use of these tools and the dedicated software.

4.2 Medium Priority Recommendations

4.2.1 General organizational recommendations

[R4] The SSC-19 recommends that a group of expert consultants be commissioned to produce a white paper on the challenges of data federation and the opportunities of data-science in human health.

4.2.2 Project 2.2.4.1: Calibration and Auditing Services

[R10] The SSC-19 recommends that the details of the electrometer calibration system and the results obtained be published in the peer-reviewed literature.

[R11] The SSC-19 recommends that guidelines be established for the SSDLs to transfer the DOL calibration of one electrometer to other electrometers held at the SSDL.

4.2.3 Project 2.2.4.2 Developments in Radiation Dosimetry

[R16] The SSC-19 recommends that, when appropriate, the DOL invite a member of staff of the SSDL to be present at the laboratory during the calibration of their equipment. This could be in parallel with a practical training workshop for several SSDLs on a regular basis e.g. half-yearly.

[R18] The SSC-19 recommends that a Code of Practice for the calibration of dose calibrators (activity meters) be produced as an outcome of joint ISO/IEC/IAEA deliberations and should include guidance for SSDLs on how to provide a verification/calibration service for dose calibrators.

[R21] The SSC-19 recommends that SRS-16 be updated by incorporating recent international guidelines and recommendations, including the upcoming ICRU/ICRP report on Operational Quantities for External Radiation Exposure; and subsequently published.

[R22] The SSC-19 recommends the development of international guidelines on how to calibrate

contamination monitors using small and large planar radioactive sources.

[R25] The SSC-19 recommends that the DMRP formulate a plan to establish traceability of dose to the lens of the eye for SSDL network members.

[R26] The SSC-19 recommends that the DMRP produce guidelines for medical physicists on the content, analysis, and evaluation of dose management systems for radiology to help Member States understand, set up and use these systems appropriately.

4.2.4 Project 2.2.4.3: Clinical Medical Radiation Physics and Quality Assurance

[R28] The SSC-19 recommends the formation of an expert consultancy group to work on the development of guidelines for standardization and quality assurance of quantitative image analysis tools used in radiology considering their final use in methods such a radiomics.

[R29] The SSC-19 recommends the formation of an expert consultancy group that defines a curriculum to update the medical radiation physicist's knowledge and academic education on data science, regression analysis, statistical learning and deep learning.

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5 SSC-19 Comments

5.1 General organizational comments

- The SSC-19 encourages the DMRP to develop a strict procedure to ensure that all of its activities and data associated with them be stored/archived on their shared drive instead of each individual's computer's hard drives. This will ensure continuity of access to data, even off-site, and systematic back up of data in the event that the computer drive can no longer be accessed.
- The SSC-19 appreciates the importance of the DMRP's involvement in TC projects. The SSC-19 encourages the DMRP to continue to seek ways to increase the efficiency and effectiveness of their efforts.
- The SSC-19 supports the DMRP in its collaborations with other sections within the Division and the Agency and with external organizations in support of its activities and provision of expert consultation.
- The effort and investment needed to produce a document is always large, and the quality of documents originated in the Section is much appreciated. Promotion of these reports should be equally important in order to reach a large audience. The SSC-19 proposes that when the Human Health campus is migrated to a new platform, the DMRP promotes new publications and, if appropriate, provides audiovisual material, using e-mail and social media to disseminate the essential content of the documents.
- While not necessarily within the direct control of the DMRP, the SSC-19 notes with concern that there is at present a significant backlog of documents waiting to be edited and published.

5.2 Project 2.2.4.1: Calibration and Auditing Services

- The system of fixed-term contracts at the IAEA presents a particular problem for quality assurance in laboratory work. The SSC-19 appreciates and is pleased with the plan to keep DOL staff cross-trained and to use consultants in order to preserve long-term continuity in dosimetry expertise with minimal lag in services provided by the DOL. The SSC-19 encourages the DMRP to continue this practice.
- The SSC-19 appreciates the DOL's efforts to obtain customer feedback/interactions as a part of their QMS and encourages the use of IRIS to monitor and record these efforts.
- The SSC-19 encourages the DOL staff and the IDEA database administrator to prepare the database for the processing of HDR brachytherapy audits including the reading of the dosimeters and generation of reports. The DIRAC database could usefully be augmented to include new treatment modalities such as proton facilities, radiotherapy imaging capabilities, etc.
- The SSC-19 encourages the DOL staff and the IDEA database administrator to prepare the database for the processing of HDR brachytherapy audits including

the reading of the dosimeters and generation of reports. The DIRAC database could usefully be augmented to include new treatment modalities such as proton facilities, radiotherapy imaging capabilities, etc.

- The SSC-19 encourages the DMRP to support Dosimetry Audit Networks (DAN) that are set up in different regions by providing verification audits to give them confidence in their local auditing.

- The SSC-19 encourages the DMRP to continue supporting Member States that fulfil the SSDL Charter requirements (consolidated by Expert missions, evidence sent by the national regulatory authorities, DIRAC database, dosimetry comparisons etc.) noting that only one SSDL per country will be supported except in special circumstances.

- The SSC-19 supports the concept of a Regionally Designated Centre for a SSDL that can then act as a focal point in updating the DMRP databases, in organizing training courses, hosting trainees and offering calibration services for the countries in the region that do not have an SSDL.

- The SSC-19 is pleased to see that the training material of the ESSDOL documents can help Member States plan appropriately for their SSDL.

- With regard to the SSDL Newsletter, the SSC-19 supports the production of at least two Newsletters per year; that SSDLs should publish their CMCs in the Newsletter; and that they should be encouraged to publish their success stories in the Newsletter, such as participation in comparisons, or finalizing their QMS and being audited, or obtaining accreditation.

- The SSC-19 encourages the DMRP to continue participating in RMO comparisons and to link SSDL comparisons to these when they have been registered appropriately in the KCDB.

5.3 Project 2.2.4.2 Developments in Radiation Dosimetry

- The SSC-19 is pleased that the IAEA TecDoc-1274 (2002) is being updated.

- The SSC-19 is pleased to see that a CRP will be launched for the update of TRS-457 (2007) that is collaborative between the SSDL Officer and a Clinical Radiology Medical Physicist.

- The SSC-19 is pleased to learn that the update to TRS-398 and the white paper on reference dosimetry in plan-class specific reference fields are being finalized.

5.4 Project 2.2.4.3: Clinical Medical Radiation Physics and Quality Assurance

- The SSC-19 appreciates that Quality Assurance Audits for Radiation Oncology, QUATRO, have become established activities for Member States. However, the Quality Assurance Audit for Diagnostic Radiology Improvement and Learning (QUAADRIL) shows in the last two years a three-fold smaller number of audits than QUATRO, in spite of the much larger existence of diagnostic radiology centres with respect to the other two specialties. The SSC-19 proposes that a strong promotional strategy is adopted by the WHO to make the QUAADRIL benefits better known to radiology services in the Member States.

- The SSC-19 is pleased to see that the DMRP has initiated a CRP on remote audits of HDR brachytherapy to begin in the current biennium.

- The SSC-19 is pleased to note that the Quality Control Handbook for all diagnostic radiology modalities is under preparation.

- The SSC-19 supports the continuation of Doctoral CRPs and other CRPs as these are key outputs from the DMRP.

- The SSC-19 encourages the radiology physicist to become involved in the DOL activities, for example with IGRT activities on the linac and with the SPECT/CT when purchased.

- The SSC-19 encourages the DOL to obtain physical wedges for the linac to be used in training courses since many of the Member State facilities will still be using physical wedges for many years.

Acronyms used in the SSC Reports

ARBR	Applied Radiation Biology and Radiotherapy Section of the Agency
BIPM	Bureau International des Poids et Mesures / International Bureau of Weights and Measures
CIPM	International Committee for Weights and Measures
CMC	Calibration and Measurement Capability
CoP	Code of Practic
CPD	Continuing professional development
CRP	Coordinated Research Project (of the Agency)
CT	Computed Tomography
DAN	Dosimetry Audit Network
DG	Director General (of the Agency)
DIRAC	Directory of Radiotherapy Centres
DMRP	Dosimetry and Medical Radiation Physics Section (of the Agency)
DOL	Dosimetry Laboratory (of the Agency)
DOLNET	Dosimetry Laboratories Network (Register)
HDR	High dose rate (brachytherapy)
IAEA	International Atomic Energy Agency
ICTP	The Abdus Salam International Centre for Theoretical Physics
ICRU	International Commission on Radiation Units and Measurements
IGRT	Image-guided radiation therapy
ILO	International Labour Organization
IMPCB	International Medical Physics Certification Board
IMRT	Intensity modulated radiation therapy
IRIS	IRIS Software Group Ltd
IT	Information Technology
KCDB	BIPM key comparison database
MRI	Magnetic resonance imaging
NAHU	Division of Human Health (of the Agency)
NMDI	Nuclear Medicine and Diagnostic Imaging (of IAEA)
NSRW	Radiation, Transport and Waste Safety (of IAEA)
QA	Quality Assurance
QC	Quality Control
QMS	Quality Management System
QUAADRIL	Quality assurance audit for diagnostic radiology improvement and learning
QUADOL	Quality audit for dosimetry laboratories
QUANUM	Quality assurance in nuclear medicine
QUATRO	Quality assurance team for radiation oncology
QS	Quality system
RBE	Radio-biological effect
RMO	Regional metrology organization
RPL	Radio-photoluminescence
RPT	Radio-pharmaceutical therapy
SBRT	Stereotactic Body Radiation Therapy,
SHANE	Shoulder, head and neck (phantom)

SPECT	Single photon emission computed tomography
SRS	Stereotactic Radiosurgery
SSC	SSDL Scientific Committee
SSDL	Secondary Standards Dosimetry Laboratory
TC	Department of Technical Cooperation (of the Agency)
TLD	Thermoluminescent dosimeter, or thermoluminescence dosimetry
WHO	World Health Organization

Courses, Meetings and Consultancies in 2020 and 2021

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

TC Courses and Workshops related to DMRP activities

- RER6036: Regional Training Course on Radiobiology for Radiation Oncologists and Medical Physicists, Russia, 02 – 13 November 2020
- RER6036: Regional Training Course on Practical Advanced Radiotherapy Treatment Planning, Russia, 09 – 20 November 2020
- RER6036: Regional Training Course on Radiation Protection and Safety and Accident Prevention in Radiotherapy, Russia, 30 November – 04 December 2020
- RER6036: Regional Training Course on Commissioning and Quality Assurance for Radiotherapy Treatment Planning Systems, Russia, 03 – 07 December 2020
- RLA9088: Regional Training Course on Calibration of Radiation Protection Equipment Using Neutron Sources (SSDL), Brazil, POSTPONED to 2021
- RLA9088: Regional Training Course on Calibration of Radiation Protection Equipment Using Beta Sources (SSDL), Brazil, POSTPONED to 2021
- RLA9088: Regional Training Courses on Neutron, Radiation Protection and Diagnostic Radiology calibrations, virtual events during the autumn 2020
- E2-TR-1905979 Joint ICTP–IAEA Workshop on Dosimetry in Radionuclide Therapy and Diagnostic Nuclear Medicine, Trieste, Italy, POSTPONED to 2021
- E2-TR-1904408 Joint ICTP – IAEA Workshop on Medical Physics Aspects of Stereotactic Radiotherapy Techniques, Trieste, Italy, POSTPONED to 11 – 15 March 2021
- RAS6095: Coordination Meeting to Prepare a Methodology for SSDL Quality Audits, Kuala Lumpur, Malaysia, TBD
- RAS6095: Regional Training Course on Diagnostic Radiology Calibrations for SSDLs, 8 September 2020 (virtual event)

Training courses and ESTRO Courses

- SP-RER6036-1907252 IAEA/ESTRO Training Course on Physics for Modern Radiotherapy (a Joint Course for Clinicians and Physicists), ONLINE COURSE, 7 – 10 September 2020
- SP-RER6036-1907253 IAEA/ESTRO Training Course on Dosimetry Audits, London, United Kingdom, POSTPONED to 2022
- SP-RER6036-1907257 IAEA/ESTRO Training Course on Image-Guided and Adaptive Radiotherapy in Clinical Practice, ONLINE COURSE, 5 – 7 October 2020
- SP-RER6036-1907247 IAEA/ESTRO Training Course on Dose Modelling Verification for External Beam Radiotherapy, Barcelona, POSTPONED to 2021
- SP-RER6036-1907262 IAEA/ESTRO Training Course on Best Practice in Radiation Oncology - Train the RTT (Radiation Therapists) Trainers – Part I, Vienna, Austria, POSTPONED to 2021
- SP-RER6036-1907251 IAEA/ESTRO Training Course on Evidence Based Radiation Oncology, Bucharest, Romania, POSTPONED to 15 – 19 November 2020
- E2-TR-1805156 Joint IAEA and Argonne National Laboratory Training Activity on Comprehensive Clinical Audits in Diagnostic Radiology under the Quality Assurance Audit for Diagnostic Radiology Improvement and Learning (QUAADRIL) Tool, Argonne, United States of America, TBD

DMRP Meetings and Consultancies

- Consultancy Meeting on Drafting a Document on Audit of Clinical Training in Medical Physics, Vienna, Austria, 14 – 18 September 2020 (virtually held)
- Consultancy Meeting to peer review the IAEA Dosimetry Laboratory QMS against the IEC/ISO 17025:2017 Standard, Vienna, Austria, 28 – 30 September 2020
- Consultancy Meeting on the Update of Technical Reports Series 398 (TRS–398), Vienna, Austria, 5 – 9 October 2020
- Consultancy Meeting on Ethics in medical physics and relevant education aspects, Vienna, Austria, 27 – 30 October 2020
- Consultancy Meeting on the Preparation of the CRP on Utilization of digital imaging in Diagnostic Radiology and Advanced tools for quality and dosimetry, Vienna, Austria, 2 – 6 November 2020
- Consultancy Meeting on Update of Code of Practice for Dosimetry in Diagnostic Radiology (IAEA TRS-457) as per SSC-17 Recommendation 18, Vienna, Austria, 10 – 13 November 2020
- Consultancy Meeting to review and update IAEA-TCS-56 guidelines, Vienna, Austria, 1 – 4 December 2020
- First Biennial Meeting of Dosimetry Audit Networks, Vienna, Austria, 17 – 21 May 2021

Other events

- International Day of Medical Physics, 7 November 2020
  https://humanhealth.iaea.org/HHW/MedicalPhysics/TheMedicalPhysicist/IDMP/index.html
- International Conference on Radiation Safety: Improving Radiation Protection in Practice, Vienna, Austria, 9 – 13 November 2020 https://www.iaea.org/events/international-conference-on-radiation-safety-2020
- International Conference on Molecular Imaging and Clinical PET–CT in the Era of Theranostics (IPET-2020), Vienna Austria, 23 – 27 November 2020 https://www.iaea.org/events/ipet-2020 (virtually held)
- International Conference on Advances in Radiation Oncology (ICARO-3), Vienna, Austria, 16 – 19 February 2021 https://www.iaea.org/events/icaro-3

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