ICRP activities on Medical Imaging

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Background/Introduction

Committee 3 (Protection in Medicine) of the International Commission on Radiological Protection (ICRP) develops recommendations and guidance for protection of patients, staff, and the public against radiation exposure when ionising radiation is used for medical diagnosis, therapy, or biomedical research (ICRP, 2007). Recently, the Main Commission of the ICRP decided to also include Veterinary Medicine as part of the C3 mandate.

During the 2013-2017 term, Committee 3 is composed of 16 members with expertise in different areas of radiological protection in medicine: medical physics; nuclear medicine; radiology (including several subspecialties within radiology); and radiation oncology. They are: Eliseo Vano (Chair); Donald Miller (Vice Chair); Madan Rehani (Secretary); Katrine Ahlstrom-Riklund; Kimberly Applegate; Michel Bourguignon; Lawrence Dauer; Sandor Demeter; Keon Kang; Pek-Lan Khong; Reinhard Loose; Pedro Ortiz Lopez; Colin Martin; Pierre Scalliet; Yoshiharu Yonekura; and Baorong Yue. Fig. 1 shows the Members of C3 and a representative (O. Holmberg) of the IAEA.

The membership of Committee 3 demonstrates a wide geographical distribution. Members are from 12 different countries. C3 currently has two emeritus members, Sören Mattsson and Marvin Rosenstein, who contribute actively to the ongoing reports. A public summary of the annual meetings is available on the ICRP website (http://www.icrp.org/icrp_group.asp?id=9).

ICRP maintains formal relations with other organisations with an interest in radiological protection through specific agreements, or by granting special liaison status to organisations whose work is relevant to the ICRP mandate. Representatives from the World Health Organization (WHO) and from the International Atomic Energy Agency (IAEA) attend the annual meetings of Committee 3.

International organisations and stakeholders are encouraged to propose topics of interest for new reports. In addition, a new mechanism, introduced at the second ICRP symposium, provides opportunities for symposium participants to provide input on suggested topics to the Commission’s Committees. The members of each Committee review the proposals relevant to their Committee’s area of responsibility, and evaluate the need to produce reports on specific topics. Each Committee forwards its recommendations to the Main Commission. The work suggested by the Committees is subject to approval by the Main Commission.
Images for this section:

Fig. 1: Members of C3 and a representative (O. Holmberg) of the IAEA.

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Description of activity and work performed

The reports led by Committee 3 over the last several years and that are relevant for diagnostic and interventional radiology, are as follows.

Publication 113. Education and training in radiological protection for diagnostic and interventional procedures (ICRP, 2009).

This report expands previous basic ICRP recommendations with regard to various categories of medical practitioners and other healthcare professionals who perform, provide support for, or refer patients for diagnostic and interventional procedures that utilise ionising radiation, or nuclear medicine therapy. It provides guidance regarding the necessary radiological protection education and training for use by: (a) regulators, health authorities, medical institutions, and professional bodies with responsibility for radiological protection in medicine; (b) the industry that produces and markets the equipment used in these procedures; and (c) universities and other academic institutions responsible for the education of professionals involved in the use of ionising radiation in health care. Advice is also provided on the accreditation and certification of the recommended education and training. In the context of this report, the term 'accreditation' means that an organisation has been approved by an authorised body to provide education or training on the radiological protection aspects. The term 'certification' means that an individual medical or clinical professional has successfully completed the education or training provided by an accredited organisation.

Publication 117. Radiological protection in fluoroscopically guided procedures performed outside the imaging department (ICRP, 2010).

There has been a general neglect of radiological protection coverage of fluoroscopy used outside imaging departments. Lack of radiological protection training of those working with fluoroscopy outside imaging departments can increase radiation risk to workers and patients. Procedures such as endovascular aneurysm repair, renal angioplasty, iliac angioplasty, ureteric stent placement, therapeutic endoscopic retrograde cholangiopancreatography, and bile duct stenting and drainage have the potential to impart skin doses exceeding 1 Gy. Although tissue reactions among patients and workers from fluoroscopy procedures have, to date, only been reported in interventional radiology and cardiology, the volume of fluoroscopy use outside imaging departments creates potential for such injuries. Specific aspects of protection are included for vascular surgery, urology, orthopaedic surgery, obstetrics and gynaecology, gastroenterology and the hepatobiliary system, and anaesthesia and pain management. Information on radiation dose levels to patients and workers, and recommendations for
dose management are presented for each speciality. Radiological protection for pregnant patients and pregnant workers is also covered. Specific needs for the target groups in terms of orientation of training, competency of those who conduct and assess specialists, and guidelines on the curriculum are also provided. The report emphasises that patient dose monitoring is essential whenever fluoroscopy is used. See Fig. 2.

Publication 120. Radiological protection in cardiology (ICRP, 2013a).

Cardiac nuclear medicine, cardiac computed tomography (CT), interventional cardiology procedures, and electrophysiology procedures are increasing in number and account for an important share of patient radiation exposure in medicine. Complex percutaneous coronary interventions and cardiac electrophysiology procedures are associated with high radiation doses. These procedures can result in patient skin doses that are high enough to cause radiation injury and increased risk of cancer. Treatment of congenital heart disease in children is of particular concern. Additionally, staff in cardiac catheterisation laboratories may receive high doses of radiation if radiological protection tools are not used properly. This report provides guidance to assist the cardiologist with justification of procedures and optimisation of protection in cardiac CT studies, cardiac nuclear medicine studies, and fluoroscopically guided cardiac interventions. It includes discussions of the biological effects of radiation, principles of radiological protection, protection of staff during fluoroscopically guided interventions, radiological protection training, and establishment of a quality assurance programme for cardiac imaging and intervention. As tissue injury, principally skin injury, is a risk for fluoroscopically guided interventions, particular attention is devoted to clinical examples of radiation-related skin injuries from cardiac interventions, methods to reduce patient radiation dose, training recommendations, and quality assurance programmes for interventional fluoroscopy. See Fig. 3.

Publication 121. Radiological protection in paediatric diagnostic and interventional radiology (ICRP, 2013b).

Paediatric patients have a higher average risk of developing cancer than adults who receive the same radiation dose. The longer life expectancy in children allows more time for any harmful effects of radiation to manifest, and some developing organs and tissues are more sensitive to the effects of radiation. This report aims to provide guiding principles of radiological protection for referring clinicians and clinical staff performing diagnostic imaging and interventional procedures for paediatric patients. It begins with a brief description of the basic concepts of radiological protection, followed by the general aspects of radiological protection, including principles of justification and optimisation. Guidelines and suggestions for radiological protection in specific modalities - radiography and fluoroscopy, interventional radiology, and CT - are subsequently covered in depth. The report concludes with a summary and recommendations. The importance of rigorous
justification of radiological procedures is emphasised for every procedure involving ionising radiation, and the use of imaging modalities that are non-ionising should always be considered. Special consideration should be given to the availability of dose reduction measures when purchasing new imaging equipment for paediatric use. Major paediatric interventional procedures should be performed by experienced paediatric interventional operators, and a second, specific level of training in radiological protection is desirable for these individuals (in some countries, this is mandatory). For CT, dose reduction should be optimised by adjusting scan parameters according to the patient’s weight or age. This report will assist institutions in encouraging the standardisation of procedures, and may help to increase awareness and ultimately improve practices for the benefit of patients.

**Publication 129. Radiological protection in cone beam computed tomography** (ICRP, 2015).

The objective of this report is to provide guidance on radiological protection in the new technology of cone beam computed tomography (CBCT). The new applications of CBCT and the associated radiological protection issues are substantially different from those of conventional CT. The perception that CBCT involves lower doses was only true in initial applications. CBCT is now used widely by specialists who have little or no training in radiological protection. This report provides recommendations on radiation dose management directed at different stakeholders, and covers principles of radiological protection, training, and quality assurance aspects. Advice on appropriate use of CBCT needs to be made widely available. Advice on optimisation of protection when using CBCT equipment needs to be strengthened, particularly with respect to the use of newer features of the equipment. Manufacturers should standardise radiation dose displays on CBCT equipment to assist users in optimisation of protection and comparisons of performance. Additional challenges to radiological protection are introduced when CBCT-capable equipment is used for both fluoroscopy and CBCT during the same procedure. Standardised methods need to be established for tracking and reporting of patient radiation doses from these procedures.

**Completed documents in the process of approval.**

**Diagnostic reference levels in medical imaging.**

This report was posted on the ICRP website for public consultation in January 2016. The updated version, is under review by the Main Commission for potential approval and publication. The report contains chapters on methods for surveys to establish DRLs; radiography and diagnostic fluoroscopy; interventional procedures; digital radiography, CT, nuclear medicine, and hybrid (multi-modality) imaging procedures; paediatrics; and application of DRLs in clinical practice. The report contains main points at the beginning
of each chapter, and concludes with a summary of the Commission’s recommendations. Previous ICRP recommendations (ICRP, 2001a) have been taken into account, and appropriate contact with the Consortium preparing the European guidelines on paediatric diagnostic reference levels (DRLs) has been maintained to avoid discrepancies between the two reports. See Fig. 4.

**Occupational radiological protection in interventional procedures.**

The draft document includes chapters on trends in the use of interventional procedures, an overview of exposures and reported tissue reactions, application of the principles of radiological protection to occupational exposures in interventions, staff protection, dose constraints and investigation levels for occupational protection (body, eye, and hands), protection of pregnant workers, exposure monitoring, protective methods and devices, and the hospital radiological protection programme. The document has been reviewed and approved by C3 and submitted to the Main Commission for potential approval and will be posted on the ICRP web site for public consultation in 2017. See Fig. 5.

**An Internet Resource on Radiation Protection for Health Care Providers.**

This is an update of the ICRP web-based educational document entitled ‘Radiation and your patient: a guide for medical practitioners’ (2001b) (http://www.icrp.org/docs/Rad_for_GP_for_web.pdf). Substantial material on radiological protection already exists, published by organisations such as WHO, IAEA, and the U.S. National Council on Radiation Protection and Measurements (NCRP). The goal of this document is to create concise short educational pieces that highlight and reflect what ICRP contributes to the topic. A final draft has been completed and is ready to be posted on the ICRP web site for public consultation.

**Future work.**

Committee 3 provided input into the work of Task Group 79 on the Use of Effective Dose as a Risk-Related Radiological Protection Quantity.

C3 has identified several topics for potential future work: framework for optimisation in medical imaging for individual patients; radiological protection aspects in imaging in radiotherapy (IGRT); protection of the lens of the eye, cardiovascular system and brain as implications of Publication 118 (ICRP,2012) for medicine.
Fig. 2: Radiological Protection in Fluoroscopically Guided Procedures performed outside the Imaging Department

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**Fig. 3:** Radiological Protection in Cardiology

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Fig. 4: Diagnostic Reference Levels in Medical Imaging

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**Fig. 5:** Occupational Radiological Protection in Interventional Procedures

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Conclusion and Recommendations

ICRP has developed, maintained, and elaborated the International System of Radiological Protection based on current understanding of the science of radiation exposures and effects and value judgements. These value judgements take into account societal expectations, ethics, and experience gained in application of the system.

Committee 3 produces specific recommendations and guides to promote radiation safety in medicine taking into account the topics of interest suggested by international organizations and stakeholders.
Personal/Organisational information


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