SOP RSC 3.1 Optimisation of Exposures in Radiology

Version and Date of Issue: V6 October 2025
Written by: Radiation Safety Committee
Review due date: October 2028

Purpose

The Protection from Harmful Radiation Act 1990 and Protection from Harmful Radiation Regulation 2025 (the Regulation) obligates the university to optimise exposure of ionising radiation to maximise the benefit-to-risk ratio of medical exposure for a given patient or research exposure for a research participant.

Once clinically justified, each examination should be conducted so that the dose to the patient is the lowest necessary to achieve the clinical aim. The quality of the images and the complexity of the examination must be sufficient for the intended clinical task by aiding diagnosis to guide management and/or intervention. It is crucial that the procedure is performed safely and as prescribed.

Responsibilities

The Radiation Medical Practitioner (the Radiologist)

The Radiologist (who must be a registered medical practitioner) is responsible for the clinical management of the patient undergoing a clinical diagnostic procedure or interventional radiology procedure.

As per the Australian Radiation Protection and Nuclear Safety Agency's (ARPANSA) Radiation Protection Series C-5 [10], the Radiological Medical Practitioner (RMP) must:

- decide to proceed with a diagnostic or interventional radiology procedure based on the specialist's knowledge of the potential risks and benefits of the procedure, considering the clinical information, and the sensitivity and specificity of the procedure.
- ensure all radiation exposures are justified.
- only authorise a procedure if a written referral is provided, which contains all the information necessary to be able to justify the exposure. make information on the benefits and risks associated with the procedure available to the patient (or their person responsible), including risk to embryo/foetus for pregnant patients undergoing procedures likely to result in more than 1 mSv to the embryo or foetus.
- ensuring that protection of the patient is optimised within the scope of parameters under the RMP's control, and in accordance with section
- liaise with the referrer and the patient (where relevant), following an interventional radiology procedure where the patient is identified as likely to experience radiation-induced skin effects to ensure follow-up of the patient

The Operator

The operator is typically the radiographer but for interventional radiology cases can be the interventionalist.

As per ARPANSA's Radiation Protection Series C-5 [10], the Operator is responsible

for:

- ensuring that a person is not exposed to ionising radiation unless the procedure (i) has been authorised by the Radiological Medical Practitioner or, (ii) is in accordance with written protocols (either site-specific or generic) endorsed or established by the Radiological Medical Practitioner or an acknowledged professional college or authority.
- following the established protocol for the procedure. ensuring that protection of the patient is optimised within the scope of parameters under the Operator's control, and in accordance with section
- correct identification of patient, site, and prescribed procedure prior to performing the procedure.
- ensuring that valid consent is obtained for all radiological procedures.
- taking reasonable steps to establish the pregnancy status of patients of childbearing capacity where an authorised procedure is conducted in accordance with (ii) or seek confirmation from the Radiological Medical Practitioner that the pregnancy status of the patient has been established.
- ensuring that only persons necessary to the procedure are present when performing exposures, and exposure of persons other than the patient is minimised.
- reporting any instance of accidental, abnormal, or unplanned exposure to the RSC, and where required.
- ensuring that following any fault or error of the equipment or system, or unusual operating behaviour that the immediate use of the equipment is ceased until the issue is rectified, that record is made, and that the RSC is notified.

The Researcher

All research involving the use of ionising radiation on human subjects requires additional approval and considerations in addition to any roles you may have as noted above in this SOP. As per the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) Code of Practice for the Exposure of Humans to Ionizing Radiation for Research Purposes (RPS No. 8), the primary contact for all research studies involving exposure of humans to ionising radiation must be the Chief Investigator or the Principal Supervisor for student research projects. The Chief Investigator/Principal Supervisor must:

- follow the RPS No.8;
- gain Human Research Ethics Committee (HREC) approval for the project prior to commencing any exposure to ionizing radiation;
- gain Radiation Safety Committee (RSC) approval for the project prior to commencing any exposure to ionizing radiation;
- justify the reasons why it is necessary to exposure research participants to ionising radiation for the purpose of research;
- gain a radiation dose assessment and risk assessment prepared by a Medical Physicist;
- keep radiation exposure to a minimum;
- provide written information to research participants relating to radiation doses and risks associated with their participation;
- follow all other relevant procedures and legislative requirements for the safe use of ionising radiation.

Radiation Safety Committee (RSC)

The RSC will oversee and provide advice on radiation safety within schools/departments performing diagnostic radiology.

The Medical Physicist

The Medical Physicist is required to be available for consultation on optimisation of medical exposures, including patient and foetal dosimetry and quality assurance, and to give advice on matters relating to radiation protection. The Medical Physicist works in collaboration with the Radiological Medical Practitioner and Operator in the optimisation of diagnostic and interventional radiology procedures. In addition, a medical physicist is required to provide Human Research Ethics Committees with a radiation dose estimation and risk assessment for any research studies that involve the research participants receiving an exposure from ionizing radiation, in accordance with the requirements of RPS No.8 Code of Practice for the Exposure of Humans to Ionizing Radiation for Research Purposes

Details of procedure

Procedures for the correct identification of the patient, procedure and sites

All staff must comply with the Australian Commission on Safety and Quality in Healthcare to ensure the correct identification of patient, procedure and site prior to exposure with ionising radiation. This includes review of the referral documentation, patient identification (which must be documented) and confirming the procedure with an appropriate level of consent gained. Pregnancy status must also be ascertained prior to commencing the procedure where appropriate.

A series of protocols have been developed to support matching of patients to their care in the areas of radiology, nuclear medicine, radiation therapy and oral surgery for national use.

A series of protocols have been developed for specific clinical areas.

As per the definition of ARPANSA's Radiation Protection Series C-5 a carer or comforter is a person who willing and voluntarily help (other than their occupation) to care, support and comfort of patients undergoing a radiological procedure for medical diagnosis or in the course of their medical treatment.

Where it is clinically justified for a carer or comforter to be present during a radiological procedure, the carer or comforter must give consent to receiving an exposure and consent must be documented. They must receive, and have indicated understanding of, the risks and benefits of being present during the exposure to radiation. A person should not be a carer or comforter if it is possible that they may be pregnant. Any radiation protection procedures that the carer or comforter must follow during the exposure must also be explained by the Operator at this point. A dose constraint of 1 mSv must be used in the optimisation of protection and safety in radiological procedures where an individual is acting as a carer or comforter [10]. The carer or comforter should be provided with a lead-equivalent radiation protection apparel for the procedure.

PROCEDURES FOR EXPOSURE OPTIMISATION

Radiography

The radiographer will:

- tailor the kVp, beam filtration, and mAs to the patient's specific anatomy;
- restrict the number of exposures per examination to the minimum necessary;
- choose the most efficient image receptor required to achieve the diagnostic information
- avoid the universal use of anti-scatter grids, most particularly in the context of radiography and fluoroscopy of patients under the age of 18 years;
- collimate the primary X-ray beam to within the size of the image receptor in use, and only expose the clinically relevant region of interest. This has the added benefit of simultaneously improving image quality and lowering dose;
- avoid the use of extremely short source to clinical target distances, as this can lead to unnecessarily high skin doses;
- shield radiosensitive organs such as the gonads, lens of the eye, breast, and thyroid whenever feasible, unless they are the clinical target; and
- (Note: where the use of shielding will obscure the desired information relevant to the examination (e.g. ovarian shields in an abdominal radiograph) the use of such shielding is discouraged;
- Note: protective drapes do not guard against radiation scattered internally within the body and only provide significant protection in cases where part of the primary X-ray beam is directed towards structures outside the immediate area of interest)
- exercise extra care when using digital radiography systems with wide dynamic ranges, such as Computed Radiography (CR), Direct Digital Radiography (DDR), and image intensifiers/flat panel detectors. Choosing the appropriate image processing parameters is just one aspect of the procedure that the operator needs to consider. Patient dose may be increased to excessive levels without compromising image quality in the phenomena known as 'exposure creep' and it is therefore recommended that radiographers carefully monitor exposure indices to ensure that over exposure is not occurring.

Additional information can be obtained from the European guidelines which have been developed to provide specific advice on good technique when radiographing paediatric patients and adult patients, respectively, and from the IAEA Radiation Protection of Patients website.

Fluoroscopy

The radiographer will:

- use automatic brightness control (ABC), low frame rate, pulsed fluoroscopy, and last image hold (LIH) routinely when they are available;
- optimise the radiographic geometry (i.e. avoid geometric magnification) as poor technique combined with poor geometry can cause patient skin doses to be unnecessarily elevated such that deterministic effects may occur. The X-ray tube should be kept at recommended distance from the patient, and the imaging receptor as close to the patient as possible;
- use the largest image intensifier or flat panel field size collimated down to the region of interest that is consistent with the imaging needs. That is, avoid electronic magnification

(i.e. use of small field sizes). Electronic magnification results in dose rates to the patient that may be several times higher than those that apply when the largest field size is chosen;

- choose the lowest dose rate options available commensurate with image quality requirements. This may mean keeping tube current as low as possible by keeping the tube voltage as high as possible, or using pulsed fluoroscopy if it is available;
- avoid the universal use of anti-scatter grids. Remove the grid when examining small patients or when the imaging device cannot be placed close to the patient;
- minimise the fluoroscopy time. However, operators should be aware that elapsed fluoroscopy time is not a reliable indicator of dose. Patient size and procedural aspects such as locations of the beam, beam angle, image receptor dose rate, and the number of acquisitions can cause the maximum skin dose to vary by a factor of at least ten for a specific total fluoroscopy time;
- choose the lowest frame rate and shortest run time consistent with diagnostic requirements during digital image acquisition procedures (e.g. digital subtraction angiography (DSA) and cardiac angiography);
- consider employing additional strategies, including the use of additional or k-edge beam filtration, and radiation-free collimator adjustment whenever possible;
- consider options for positioning the patient or altering the X-ray field or other means to alter the beam angulation when the procedure is unexpectedly long so that the same area of skin is not continuously in the direct X-ray field (skin sparing); and
- be aware that dose rates will be greater and dose will accumulate faster in larger patients. However, in complex procedures, operator choices and clinical complexity are more likely to affect patient dose than the physical size of the patient.

CT Procedures

CT procedures are increasingly common and give rise to some of the highest radiation doses in diagnostic medical imaging. Accordingly, all common CT procedures should follow protocols which have been optimised for patient dose and image quality. The operator of a CT scanner should tailor the technical factors of the examination (kVp, mAs, nominal collimated X-ray beam width, pitch, volume of patient scanned) to the:

- individual patient anatomy; and
- diagnostic information being sought.

Pregnancy and Protection of the Embryo/Foetus

The risk to the embryo or foetus from exposure to ionising radiation is related to the dose received and to the stage of pregnancy at which the exposure occurs. The possible effects include stochastic effects (induction of cancer and hereditary disease to their offspring), and deterministic effects (including foetal death, malformation and abnormal development).

The radiologist or radiographer will:

- enquire about the possibility of pregnancy in all female patients of childbearing age;
- indicate to the patient why there is a need to know, to avoid them taking offence and refusing to answer, or answering less than truthfully;

- use an interpreter if there is any possibility that a language barrier would prevent the patient from understanding the question;
- not proceed with diagnostic radiology if there is any doubt about the status of pregnancy unless determined in consultation with the responsible Radiology Medical Practitioner and with the patient's informed consent;
- ensure signs are displayed in prominent places throughout each facility where X-rays are used advising patients to notify staff if they may be pregnant. These signs will be written in several languages relevant to the community. An example might read as follows:

IF IT IS POSSIBLE THAT YOU MIGHT BE PREGNANT,

NOTIFY THE RADIOGRAPHER BEFORE YOUR X-RAY EXAMINATION.

However, the posting of signs in no way absolves staff of their responsibility to enquire about the possibility of pregnancy in all female patients of childbearing age. When asking the patient about the possibility of pregnancy it is also important to indicate to the patient why there is a need to know, to avoid them taking offence and refusing to answer or answering less than truthfully. When language barriers exist, it may be useful to seek the service of an appropriate interpreter.

Use of ionising radiation on human subjects in medical research

Clause 33 of the Regulation places limits on how much ionising radiation human subjects can receive during research, in accordance with the document published by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Code of Practice for the Exposure of Humans to Ionizing Radiation for Research Purposes (RPS No. 8) (2014). This Code of Practice is designed to ensure that researchers proposing to expose research participants to ionizing radiation provide the participants and the Human Research Ethics Committees with information that allows consent to be properly considered by the research participants and approval considered by the Human Research Ethics Committee. It further explains how radiation protection, safety and security can work individually and collectively to manage radiation risks. Finally, it presents ten principles and their application in management of radiation risks.

In line with the requirements of RPS No. 8, all scientific or research projects involving the use of ionising radiation on human subjects in NSW need to be approved by the appropriate Human Research Ethics Committee, constituted in accordance with the National Statement on Ethical Conduct in Research Involving Humans (NHMRC 1999).

Audit

Survey of doses against the Diagnostic Reference Levels

References and relevant links

PD2019_044 WHS Exposure to Ionising Radiation

https://www.safetyandquality.gov.au/sites/default/files/migrated/ECPCSCP_FactSheet.pdf

https://www.safetyandquality.gov.au/our-work/communicating-safety/patient-identification/patient-procedure-matching-protocols/ensuring-correct-patient-correct-site-correct-procedure-protocol-other-clinical-areas

Safety Guide – Radiation Protection in Diagnostic and Interventional Radiology

https://www.arpansa.gov.au/sites/default/files/legacy/pubs/rps/rps8.pdf

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REVISION & APPROVAL HISTORY

Date	Revision No.	Author and Approval
Dec 2014	Version 1	William Bartolo, Bartolo Safety Management Service
May 2016	Version 2	William Bartolo, Bartolo Safety Management Service
Dec 2016	Version 3	Radiation Safety Committee, Charles Sturt University
Jan 2017	Version 4	William Bartolo, Bartolo Safety Management Service and Radiation Safety Committee, Charles Sturt University
Nov 2022	Version 5	Radiation Safety Committee, Charles Sturt University
Oct 2025	Version 6	Dr Praneel Titheradge; Radiation Safety Committee, Charles Sturt University