

26 Medical Diagnostic X-ray Equipment

Scope

1. The instructions in this Chapter apply to MOD units and establishments; they do not apply within Joint Hospital Group Units (within NHS Trusts) where responsibility for health and safety in general and radiation safety in the particular context of this publication, rests with the Chief Executive of the NHS Trust concerned.
2. This chapter covers medical diagnostic X-ray equipment (including fluoroscopes). The following information describes the requirements for keeping and using such equipment.

Statutory Requirements

3. In addition to the general requirements of the Health and Safety at Work etc. Act 1974 and the Management of Health and Safety at Work Regulations 1999, the following specific legislation applies directly:
 - a. Ionising Radiations Regulations 2017 (IRR17);
 - b. Ionising Radiation (Medical Exposures) Regulations 2017 (IRMER17).

Duties

4. Duties as detailed in Chapter 39 apply. In addition, the following duties also apply.

Radiation Protection Supervisor (RPS)

5. The RPS is to ensure that X-ray equipment is correctly used in accordance with local orders for radiation safety including local rules, instructions and procedures. The RPS is also to ensure that reporting procedures for any incidents are followed (see Chapter 14). The RPS is normally the superintendent radiographer within the unit and should be appropriately trained for the role. This training should be refreshed at least every five years.

Practitioners, Operators and Referrers

6. Practitioners, operators and referrers have specific duties under IRMER17. These are detailed in the Employer's Procedures.

Employees

7. It is the responsibility of all employees to ensure that X-ray equipment and personal protective equipment is used correctly and not deliberately misused or interfered with and that work is carried out in accordance with local orders, instructions and procedures. Any incidents are to be immediately reported to the RPS.

Hazard

8. X-ray sets generate an in-beam exposure hazard. In addition, radiation from X-ray head leakage and scatter from the beam may affect areas around the X-ray head and beam.

Radiation Safety Assessment for New or Refurbished Facilities

9. For new or refurbished X-ray facilities the RPA is to be consulted at the design stage to ensure that design of the facility, including any shielding required, is sufficient to keep doses to personnel as low as reasonably practicable. General guidance on design of radiology facilities is given in Reference A.

Acceptance Testing of New X-Ray Equipment

10. Acceptance tests are to be carried out as advised by the Medical Physics Expert (MPE) on all newly installed medical X-ray equipment and when an X-ray tube is replaced to ensure that radiological functions are satisfactory and to specification.

11. All new installed X-ray equipment is to be fitted with a dose area product (DAP) meter.

Critical Examination and Design of New X-Ray Facilities

12. A critical radiation safety examination including an assessment of the adequacy of room shielding is to be carried out as advised by the RPA on all new or structurally modified X-ray rooms prior to being brought into routine use.

Controlled and Supervised Areas

13. General requirements relating to controlled and supervised areas are contained in Chapter 4.

14. A dedicated X-ray room containing installed X-ray equipment is designated as a controlled radiation area during exposures.

15. For mobile X-ray sets, the controlled radiation area extends in the direction of the X-ray beam until the beam is sufficiently attenuated by distance (approximately 8 m) or shielding (e.g. solid floor or wall) and out to 3 m in all other directions.

Exposure Protocols

16. Written protocols are to be in place for each type of standard radiological practice and for each type of X-ray equipment. For radiography equipment this will involve noting exposure factors, focus to film / detector distance, grid use and automatic exposure control (AEC) use as appropriate for each type of examination. For fluoroscopy equipment the protocol is to include, e.g. collimation, magnification and dose settings. Where exposure settings are programmed into the console, these are to match the values in the exposure chart. Exposure settings are normally recorded in the form of an exposure chart, which is to be signed and dated by a responsible person.

17. After each examination, a record of exposure factors, DAP meter reading or exposure time is to be made in the patient's notes.

Practitioners, Operators and Referrers

18. Reference B requires that each individual medical exposure is justified by an IRMER Practitioner and any practical aspect associated with the exposure carried out by an IRMER Operator.

19. In MOD medical facilities, the role of IRMER practitioner and responsibility for justifying medical X-ray exposures normally lies with DCA Radiology. Justification is effected through radiography protocols and guidelines issued by DCA Radiology and implemented by authorisation of the radiographer for each medical exposure. Justification of individual exposures (particularly for CT) will be undertaken by defence radiologists working within these guidelines.

20. Requests for a radiological examination are initiated by the Referrer i.e. any registered medical or dental practitioner or other health professional who is entitled to refer individuals for medical exposure to an IRMER practitioner.

Training

21. Adequate training in the radiation protection of patients, as defined at Reference B, is required for IRMER Practitioners and IRMER Operators. Adequate training is obtained during professional training and qualification, or a MOD recognised course together with practical experience, mentoring and continuing education and training as appropriate.

22. In most circumstances, adequate training will be met by satisfying the requirements of the appropriate professional bodies, i.e. the Royal College of Radiologists and the College of Radiographers.

23. Each establishment or unit is to maintain a register of adequate training for IRMER practitioners and IRMER operators providing details and dates of training undertaken.

Employer's Procedures for Patient Protection

24. Written standard operating procedures for the radiation protection of patients are to be provided. The written procedures are to be signed by the DCA Radiology, and / or Head of Establishment / Principal Medical Officer.

Referral Criteria

25. Referral criteria for medical exposures, including information on radiation doses to patients, are to be made available to those health professionals who refer patients for radiological examination. In MOD medical X-ray departments, referral criteria normally take the form of the RCR Guidelines at Reference C.

Quality Assurance and Patient Dose Assessment

26. All units and establishments are to operate a quality assurance (QA) programme for medical X-ray and DR equipment. The QA programme is to include routine equipment tests carried out by department staff and annual / biennial tests by medical physicists. Guidance on QA tests is provided at Reference D or may be obtained from the Medical Physics Expert (MPE).

27. The QA programme is to include an assessment of radiation doses received by patients from different types of examination. This will normally be carried out by the medical physicist on the basis of exposure information provided by the department. Patient doses will be used for comparison with diagnostic reference levels (DRLs) such as the national DRLs available at Reference E.

Personal Protective Equipment

28. X-ray personal protective equipment (PPE) for staff includes aprons, gloves, glasses and thyroid shields incorporating lead to reduce radiation exposure during X-ray examinations. This PPE is not designed to provide protection from the primary beam, but only from scattered radiation and that transmitted through the patient.

29. Guidance on specific requirements for PPE is given in Reference A.

30. Each piece of X-ray PPE is to have its own identifying number. Gloves, aprons, and thyroid shields are to be visually examined at 3-monthly intervals and radiographically examined at least every 12 months for the determination of deterioration or reduction in shielding effectiveness. X-ray protective glasses should be visually inspected at 3-monthly intervals. Records of examinations are to be kept for 2 years.

Protection of Patients

31. Radiation doses to patients are to be as low as reasonably practicable in accordance with the intended clinical purpose.

32. Notices are to be displayed requesting patients of childbearing potential to inform radiographers if they suspect or know that they are pregnant.

33. The patient record is to be annotated to confirm that each exposure has been justified / authorised, and that an evaluation of each radiograph has taken place.

X-ray Equipment Records

34. All units and establishments are to maintain the following records for X-ray equipment:

- a. an inventory of equipment including the name of manufacturer, model number, serial number or other unique identifier, year of manufacture and year of installation; and
- b. a record of all equipment defects, maintenance and QA tests.

Comforter and Carer

35. Where it is necessary for a patient to be supported during a medical exposure, a record of persons acting as supporters is to be maintained.

36. The supporter is preferably to be an adult relative or friend of the patient and should not be pregnant. The supporter must be adequately protected from exposure to X-rays during the examination. The exposure of the Comforter / Carer is a medical exposure and must be justified and authorised as such.

Recording and Reporting of Accidental or Unintended Exposures

37. If a person undergoing a medical X-ray is known to have or is suspected to have received an accidental or unintended exposure the procedure detailed in Chapter 14 must be followed.

References

38. A - Medical and Dental Guidance Notes, Prepared by Institute of Physics and Engineering in Medicine, 2002 ISBN 1 903613 09 4
39. B - Ionising Radiation (Medical Exposure) Regulations 2017
40. C - iRefer: Making the best use of clinical radiology, eighth edition, 2017, The Royal College of Radiologists
41. D - Institute of Physics and Engineering in Medicine (IPEM) Report 91, Recommended Standards for the Routine Performance Testing of Diagnostic X-ray Imaging Systems 2005
42. E - Doses to Patients from Radiographic and Fluoroscopic X-ray Imaging Procedures in the UK – 2010 Review HPA-CRCE-034 (2012)