ORDER NUMBER
3842

RADIATION SAFETY – DENTAL AND MEDICAL X-RAY EQUIPMENT

Date of Initial Issue  25/11/2008
Issue No.  302

PSI Amendments should be read in conjunction with this PSO

Date of Further Amendments
EXECUTIVE SUMMARY

STATEMENT OF PURPOSE

The purpose of this PSO is to ensure that Governing Governors have in place systems and protocols to protect staff, visitors, prisoners, contractors and others from the harmful effects of ionising radiation from diagnostic (dental and medical) x-ray equipment.

The requirements of this PSO apply only to establishments where responsibility for the delivery of Health Care remains with the prison and had not transferred to a PCT or private health care provider. However, arrangements made by the PCT or private health care provider should reflect the guidance and advice given in this PSO. (See PSI 39/2007)

DESIRED OUTCOME

The desired outcomes include:

- Safe systems for the use of diagnostic x-ray equipment;
- The protection of staff and others from the harmful effects of ionising radiation;
- The protection of patients through ensuring that all exposures are justified, authorised and evaluated and that radiation doses are restricted whilst achieving the intended diagnostic result;
- Compliance with relevant ionising radiation legislation.

MANDATORY ACTIONS

Where medical and dental x-rays are used Governing Governors must:

- Consult a Radiation Protection Advisor (RPA) and medical physics expert (MPE);
- Carry out an assessment of the risks from ionising radiation equipment;
- Notify any ionising radiation equipment to the local Health and Safety Executive (HSE) office;
- Ensure that appropriate employers’ procedures and written protocols are in place and are complied with;
- Issue local rules for the safe use of ionising radiation equipment;
- Designate controlled and supervised areas where appropriate:
- Appoint and adequately train Radiation Protection Supervisors (RPSs);
- Ensure that staff who operate diagnostic x-ray equipment are appropriately qualified;
- Arrange for equipment performance measurements to be carried out;
- Ensure that an appropriate quality assurance (QA) programme is maintained;
- Ensure that appropriate service contracts are in place for all diagnostic x-ray equipment.

RESOURCE IMPLICATIONS

This PSO replaces PSO 3842, Radiation Safety Strategy and Operational Procedures for Ensuring Protection against Ionising Radiation Used in Health Care Centres, which has been in place since 1998. This PSO reflects changes made to ionising radiation legislation since then. There are no new resources required to implement this PSO.
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<th>IMPLEMENTATION DATE:</th>
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<td>8 December 2008</td>
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(signed)

Robin Wilkinson  
HR Director, NOMS  

Further advice or information on this PSO is available from:  
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PSO 3842 RADIATION SAFETY – DENTAL AND MEDICAL X-RAY EQUIPMENT

CONTENTS

1. **INTRODUCTION**
   1.1 Legislation
   1.2 Scope of PSO

2. **RADIATION SAFETY STRUCTURE- RESPONSIBILITIES**
   2.1 Governing Governors
   2.2 Radiation Protection Advisor
   2.3 Medical Physics Expert
   2.4 Radiation Protection Supervisors
   2.5 Notification of Specified Work

3. **RISK ASSESSMENT**
   3.1 Carrying out Risk Assessment
   3.2 Remedial Action
   3.3 Review of Risk Assessment

4. **EQUIPMENT**
   4.1 Equipment Selection and Use
   4.2 Maintenance of Equipment
   4.3 Equipment Replacement Programmes
   4.4 Critical Examination
   4.5 Acceptance Testing
   4.6 Checks of Equipment by the RPA
   4.7 Regular surveillance checks carried out by operators

5. **LOCAL RULES (PROCEDURES)**
   5.1 Local Rules
   5.2 Designated Areas
   5.3 Dose Assessment
   5.4 Adverse Incidents
   5.5 RPA Operational File

6. **TREATMENT OF PRISONERS AT OUTSIDE HOSPITALS**
   6.1 Diagnostic Radiography
   6.2 Nuclear Medicine Procedures

7. **THE IONISING RADIATION (MEDICAL EXPOSURE) REGULATIONS 2000**
   7.1 Scope of the Legislation
   7.2 Duty Holders
   7.3 Standard Operating Procedures
   7.4 Quality Assurance programmes
   7.5 Training
   7.6 Justification of Exposure
   7.7 Clinical Audit
   7.8 Equipment Inventory
QUALITY ASSURANCE PROCEDURES

8.1 Introduction
8.2 Checks prior to patient exposures
8.3 Performance of Complete Imaging System
8.4 Reject Film Analyses
8.5 Assessment of the Output of X-ray Equipment.

ANNEXES

Annex 1 Notification of Ionisation Equipment to the HSE
Annex 2 Critical Examination of Medical or Dental X-ray Equipment
Annex 3 Standard Operating Procedures
Annex 4 Written Exposure Protocols and Referral Criteria
Annex 5 Training Requirements for Practitioners and Operators
1. INTRODUCTION

Legislation

1.1.1 The Ionising Radiation Regulations 1999 apply whenever ionising radiation is used in the workplace. The Regulations require employers to establish a framework for ensuring that exposure or potential exposure to ionising radiation, resulting from work activities is kept as low as is reasonably practicable to protect staff and others from the effects of ionising radiation. In particular the Regulations require employers to:

- Consult a Radiation Protection Advisor (RPA);
- Carry out an assessment of the risks from ionising radiation equipment;
- Notify the local Health and Safety Executive office of their use of ionising radiation;
- Issue local rules for the safe use of ionising radiation equipment;
- Designate controlled and supervised areas where appropriate;
- Appoint and adequately train Radiation Protection Supervisors (RPSs);
- Ensure that staff who operate x-ray equipment are adequately trained;
- Arrange for equipment performance measurements to be carried out;
- Establish Quality Assurance (QA) programmes for diagnostic radiography;
- Arrange for radiation dose assessments to be carried out if appropriate.

1.1.2 The Ionising Radiation (Medical Exposure) Regulations (IRMER) 2000 requires the employer to protect persons undergoing medical exposures. In particular the Regulations require employers to:

- Consult a medical physics expert (MPE);
- Maintain an inventory of all x-ray equipment;
- Include provision for carrying out clinical audit;
- Establish employers' procedures and written protocols;
- Ensure that x-ray equipment is operated by appropriately qualified personnel.

1.1.3 This PSO sets out the actions that Governing Governors must take to ensure that:

- Radiation doses to staff, inmates and other persons from diagnostic x-ray equipment are kept as low as reasonably practicable;
- Relevant legislation is complied with.

1.2 Scope of this PSO

1.2.1 The requirements of the PSO apply to:

- Dental radiography undertaken at prison establishments;
- General medical radiography undertaken at prison establishments;
- The occasional need to care for patients undergoing diagnosis or treatment off-site e.g. medical radiography;
- Diagnosis or treatment using radioactive materials;
- Radiotherapy.

1.2.2 The requirements of this PSO apply only to establishments where responsibility for Health Care had not transferred to a PCT or private health care provider. On transfer of health care to either a PCT or private health care provider they as the “employer” are responsible for ensuring that the requirements of relevant legislation are met.
1.2.3 Further information on arrangements where health care has transferred to a PCT or private health care provider is given in PSI 39/2007, Transfer of Health Care-Arrangements for the Appointment of Radiation Protection Advisors.
2. RADIATION SAFETY STRUCTURE - RESPONSIBILITIES

2.1 Governing Governors

2.1.1 Where diagnostic x-ray equipment is used Governing Governors are responsible for ensuring that:

- The Health & Safety Executive has been notified of any work with ionising radiation being undertaken at his/her prison;
- All persons carrying out work with ionising radiation hold the appropriate qualifications;
- All persons involved in the work are aware of and adhere to local rules and other relevant procedures;
- All remedial action identified by the Radiation Protection Adviser (RPA) is implemented according to time scales;
- Appropriate service contracts for x-ray and ancillary equipment are set up;
- At least one Radiation Protection Supervisor (RPS) is appointed, the appointment is confirmed in writing and the name of the RPS is notified to the RPA;
- All RPSs have been adequately trained;
- Written procedures are in place and complied with by the practitioner and operator;
- Written protocols are in place for every type of standard radiological practice for each item of medical or dental x-ray equipment;
- Referral criteria have been established and are made available to referrers;
- Diagnostic reference levels are in place;
- QA programmes are in place for standard operating procedures;
- Any suspected over-exposures are investigated in conjunction with the RPA and any appropriate notifications made.

2.2 Radiation Protection Advisor (RPA)

2.2.1 Where ionising radiation is used the employer must consult an RPA to advise him/her on the measures that must be taken to ensure compliance with the Ionising Radiation Regulations 1999.

2.2.2 The Prison Service has appointed the Radiation Protection Division of the Health Protection Agency (RPA-RP) as its RPA. The RPA is responsible for:

- Providing the Prison Service with general advice on radiation protection for staff and others who may be affected, including advice on compliance with relevant statutory requirements and new developments in radiation safety;
- Giving specific advice on radiation protection of staff and others to each prison where diagnostic x-ray equipment is used;
- Advising on the completion of the assessments of the risks to staff from ionising radiation and on the control measures that must be implemented to eliminate or reduce the risk;
- Visiting each prison where diagnostic x-ray equipment is used at least once per year. These visits will include a survey of all diagnostic x-ray equipment and reviews of radiation safety;
- Compiling a report following each visit identifying any problems, the remedial work that needs to be done to rectify any identified problems and a time scale for completing the work;
- Providing information and insets for the RPA Operational File for each establishment;
- Giving advice when requested on new equipment and facilities;
• Providing advice on remedial action and undertaking investigations and dose assessments as appropriate in the event of any accident resulting in radiation exposure of staff or others;
• Providing the Prison Service with an annual contract report describing the work carried out within the scope of the RPA contract.

2.3 Medical Physics Expert

2.3.1 Under IRMER 2000 employers are required to appoint a medical physics expert (MPE).

2.3.2 The Prison Service has appointed the Radiation Protection Division of the HPA-RP as its MPE.

2.3.3 The MPE is responsible for:
• Giving advice on patient dosimetry and QA programmes;
• Giving advice on all matters relating to radiation protection concerning medical exposures.

2.4 Radiation Protection Supervisors

2.4.1 Where diagnostic x-ray equipment is in use Governing Governors must appoint a Radiation Protection Supervisor (RPS). Where there is more than one RPS, one of the appointees should be designated as the principal RPS, with the others being considered to have the role of deputy.

2.4.2 Where diagnostic x-ray equipment and security x-ray equipment are present in a prison an RPS must be appointed for each area.

2.4.3 For dental x-ray equipment the dentist or dental surgery assistant may carry out this role, provided that they have received appropriate training.

2.4.4 The RPS must have sufficient line management authority and time to undertake the relevant duties.

2.4.5 The RPS must be adequately trained to carry out this role as soon as possible following his/her appointment. Training for RPSs is available through Newbold Revel.

2.4.6 RPSs are responsible for:
• Ensuring that Local Rules are available to equipment operators and are being complied with;
• Making arrangements for the appropriate operational training of all staff who work with the equipment;
• Ensuring that adequate arrangements have been made for the supervision of contractors, visitors and other persons who may come into contact with the x-ray equipment;
• Ensuring that the QA programmes are kept up to date;
• Ensuring the satisfactory operation of suitable maintenance contracts for all medical and dental x-ray equipment;
• Seeking advice from the RPA about the suitability of any new medical or dental x-ray equipment before a commitment to purchase is made. Arranging for the RPA to visit the prison to make base line QA measurements for newly installed or re-sited medical x-ray equipment of any existing equipment;
• Being the principal point of contact for liaison with the RPA;
- Maintaining the RPA operational file;
- Ensuring that remedial action required as the result of an RPA inspection is completed and recorded;
- Notifying the RPA if any prisoner is to undergo a radiopharmaceutical procedure.

2.5 Notification of Specified Work

2.5.1 The HSE must be notified of work involving ionising radiation twenty-eight days before any such work begins. Notification should be made to the local HSE office.

2.5.2 *The Governing Governor is responsible for ensuring that the HSE is informed of work involving ionising radiation.*

2.5.3 Further information on notifying the HSE of work involving ionising radiation is given at Annex 1.
3. **RISK ASSESSMENT**

3.1 **Carrying out Risk Assessment**

3.1.1 An assessment of the risks to staff and others from x-ray equipment must be carried out before any new activity involving work with ionising radiation is undertaken. The purpose of this assessment is specifically to identify the measures required to restrict exposure during normal operations and in the event of an accident. In particular, all hazards with the potential to cause a radiation accident must be identified and measures must be implemented to prevent any such accident or limit the consequence should such an accident occur.

3.1.2 The RPA will assist in the completion of risk assessments of diagnostic x-ray equipment. These risk assessments are generic to the type of equipment in question. However, it is the responsibility of the Governor to ensure that all specific hazards and conditions are considered when assessing the risks. Risk assessments are documented in the RPA Operational File.

3.1.3 *Governing Governors must ensure that a risk assessment of all diagnostic x-ray equipment is completed and any identified control measures are implemented.*

3.2 **Remedial Action**

3.2.1 *Governing Governors must ensure that any remedial action required either as a result of the risk assessment or annual checks carried out by the RPA are completed in accordance with the timescales set out by the RPA.*

3.3 **Review of Risk Assessments**

3.3.1 Risk assessments must be reviewed when there are any changes in the equipment or the circumstances in which it is used. The RPA must be informed of any such changes so that risk assessments can be reviewed and revised if necessary. Annual inspections by the RPA will form part of the review process.

3.3.2 If an equipment operator declares herself to be pregnant, the risk assessment must be reviewed, to ensure that there will be sufficient protection for the unborn child for the rest of the term of pregnancy. The RPA should be contacted to discuss this. In most cases there will be no requirement to alter the working arrangements of a pregnant employee, for the purposes of radiation protection.
4 EQUIPMENT

4.1 Equipment Selection and Use

4.1.1 The key requirement for diagnostic x-ray equipment is that it should be designed, installed and maintained so that it is capable of restricting patient doses as far as reasonably practicable. Equipment must only be used for its intended application.

4.1.2 Governing Governors are responsible for ensuring that diagnostic x-ray equipment is suitable for its intended use.

4.1.3 Governing Governor must consult with the RPA with regard to the choice of new or replacement equipment. This includes the construction and layout of the radiography room and ancillary equipment such as films, cassettes, etc. as well as x-ray sets.

4.2 Maintenance of Equipment

4.2.1 Governing Governors must ensure that all diagnostic x-ray equipment is fit for the purpose for which it was purchased and is properly maintained.

4.2.2 The RPA is not responsible for the maintenance of x-ray equipment and Governing Governors must ensure that a contract for maintaining this equipment is in place with a suitable supplier.

4.3 Equipment Replacement Programmes

4.3.1 Governors must inform the RPS of the impending purchase of any new or replacement diagnostic x-ray equipment and should ensure that there is adequate co-operation and communication with the equipment supplier.

4.4 Critical Examinations

4.4.1 Regulation 31(2) of IRR 99 requires equipment installers to undertake a “critical examination” of the way in which new equipment is installed for the purpose of ensuring, in particular, that:
- The safety features and warning systems operate correctly;
- The equipment provides sufficient protection for all persons against exposure to radiation.

4.4.2 This applies to new equipment, to equipment that is transferred from another location (including within the same establishment), and following replacement of any component that directly affects radiation exposure.

4.4.3 The installer should be asked provide a written report of the critical examination, which should include the minimum information specified in Annex 2.

4.4.4 Governing Governors must ensure that a critical examination is carried out whenever new equipment is installed or existing equipment is relocated before the equipment is put into normal use and that a written report is provided.

4.4.5 The installer will generally be a representative of the supplier. Prison Service personnel must not undertake this work.
4.5 **Acceptance Testing**

4.5.1 Before diagnostic x-ray equipment enters clinical use, it must undergo acceptance testing to ensure that it operates safely and performs to specification.

4.5.2 Commissioning tests should be carried out to provide baseline results for subsequent quality assurance measurements. These measurements should also be used to determine the optimum exposure settings.

4.5.3 For dental x-ray equipment, the acceptance testing will be carried out by the installer. For medical x-ray equipment the acceptance tests will be carried out by the RPA. The Prison should contact the RPA in advance to arrange this.

4.5.4 A copy of the commissioning tests carried out during acceptance testing must be retained in the Quality Assurance or RPA Operational File.

4.5.5 *Governing Governors are responsible for ensuring that acceptance testing is carried out on any radiological equipment before it enters clinical use.*

4.6 **Checks of Equipment by the RPA**

4.6.1 Checks on output of x-ray sets will be carried out by the RPA during the annual visits to determine whether or not:
- The equipment continues to meet relevant standards;
- Operation of the equipment can be achieved whilst maintaining doses to staff and other persons as low as reasonably practicable.

4.6.2 Details of the checks carried out are given at Annex 2.

4.6.3 A report of the measurements and checks undertaken will be included in the visit report, which will include any recommendations for remedial action where this is required.

4.7 **Regular surveillance checks carried out by operators**

4.7.1 Operators must constantly check the functioning of the safety and warning systems associated with the x-ray equipment when it is in use. This applies to warning lights (both on the equipment and any room warning lights), warning buzzers, exposure controls, DAP meter indicators (where fitted) and the overall general condition of the x-ray equipment.

4.7.2 It is not necessary to keep a daily record, but a log should be kept at monthly intervals to confirm that these regular surveillance checks have been carried out and that the equipment continues to function satisfactorily or that any necessary remedial actions have been carried out. The RPA will review the log during annual visits and comment on it in the subsequent report.
5. LOCAL RULES (PROCEDURES)

5.1. Local Rules

5.1.1 Work with ionising radiation must be carried out in accordance with written safety procedures, referred to as Local Rules.

5.1.2 Local rules are a set of instructions laying down how the work should be carried out so as to restrict exposure to radiation and ensure compliance with relevant legislation.

5.1.3 The RPA will provide local rules based on a standard template. It is the responsibility of the Governing Governor to ensure that local rules adequately reflect local conditions.

5.1.4 Local rules must include:
- Details of the RPS(s);
- Details of persons permitted to carry out diagnostic x-ray examinations;
- A description of any designated areas (see section 5.2 below);
- General operational procedures (which are pertinent to radiation safety);
- Written arrangements for entry into controlled areas by non-classified persons;
- Actions to be taken in the event of an incident involving the x-ray equipment;
- Dose investigation level of 1 mSv.

5.1.5 The RPS must ensure that adequate local rules are available and are being complied with by all staff and others who may come into contact with the x-ray equipment.

5.2 Designated Areas

5.2.1 In certain circumstances an area where x-ray equipment is used may be designated as a controlled or supervised area.

5.2.2 A controlled area is designated if the risk assessment has shown that it is necessary to follow special procedures to restrict exposures or to limit the possibility of an accident.

5.2.3 Supervised areas are designated on the basis that it would be prudent to keep conditions under review.

5.2.4 Designated areas will be identified in the local rules.

5.2.5 The RPS must ensure that any additional measures required when an area is designated are in place and enforced.

5.3 Dose Assessment

5.3.1 Risk assessments of diagnostic x-ray equipment in use in the prisons indicate that the work is not likely to result in significant radiation doses to dentists, nurses or other personnel. It is not necessary, therefore to designate any staff as “classified” radiation workers and it will not be necessary to require them to wear dosemeters.

5.3.2 Radiographers are working in a controlled area and must wear personnel dosemeters. Dentists must also wear personal dosemeters if they work in a controlled area (most dentists remain outside the controlled area during an exposure, but sometimes this is not the case).
5.3.3 On occasions the radiographer may be escorted by a member of Prison Service staff who stays with the radiographer throughout the procedure. In these circumstances the member of staff will also be required to wear a dosemeter. The prison will be responsible for providing the dosemeter and having it analysed.

5.3.4 Dosemeters must be appropriate for the type of radiation in use and advice should be sought from the RPA.

5.3.5 Dosemeters are available from:
Personal Dosemetry Service
Health Protection Agency
Centre for Radiation, Chemical and Environmental Hazards
Chilton
Didcot
Oxon, OX11 0RQ
Telephone:01235 822759/26

5.3.6 Used dosemeters should be returned to the above address for analysis.

5.4 Adverse Incidents

5.4.1 In the event of any incident involving x-ray equipment the contingency plans given in the local rules must be followed.

5.4.2 If any x-ray equipment or associated safety or warning systems are suspected of being faulty they should be taken out of use and repaired.

5.4.3 If it is suspected that any person (member of staff or other, but not the patient) may have received a radiation dose above the dose investigation (1 mSv) level the RPA must be contacted for further advice. The RPA will decide whether further investigation is required.

5.4.4 If it is suspected that a patient may have received an exposure that is much greater than intended (see table below) the RPA must be contacted for further advice. An investigation will be carried out. If it is found that a patient has received a dose which is much greater than intended, then the appropriate authority must be informed. If the overexposure was due to an equipment fault, this is the Health and Safety Executive. If the overexposure was due to operator error, the appropriate authority is the Healthcare Commission.

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<tr>
<th>Types of Patient Exposure</th>
<th>Level above intended dose which is much greater</th>
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<tr>
<td>Extremities, skull, dentition, shoulder, chest, elbow, knee</td>
<td>20 times greater</td>
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<tr>
<td>Other diagnostic procedures</td>
<td>10 times greater</td>
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5.5 RPA Operational File

5.5.1 The RPA, with the co-operation of the RPS, will compile and update the RPA Operational File. One copy will be held by the RPA and another held and maintained by the RPS. The file will include:

- A description of each item of equipment including manufacturer, model, serial number, year of manufacture and installation and its location;

- Names, addresses and contact numbers for all persons having a radiation protection role in the use of diagnostic X-ray equipment:
• The training schedule for all persons involved in the work with the equipment;
• Risk assessments:
• A description of designated (controlled or supervised) areas:
• The local rules for radiation safety, including contingency plans;
• Copies of the RPA’s reports and any other relevant correspondence;
• Results of the checks on the safety and warning system/s or reference to where the results of these checks can be found;
• Results of critical examination and service reports provided by the service engineer.
6. TREATMENT OF PRISONERS AT HOSPITALS OUTSIDE THE PRISON

6.1 Diagnostic radiography

6.1.1 When it is necessary to escort prisoners to hospitals outside the prison for x-ray or any other procedure using ionising radiation, e.g. fluoroscopy, nuclear medicine procedures or radiotherapy the escorting staff should follow the guidance of hospital staff, regarding the use of lead aprons and gauntlets, protective screens, etc. The escorting staff should remain as far as possible away from the patient and the x-ray beam.

6.1.2 Where possible the escorting officer should stand behind the fixed screen with the radiographer. Where this is not possible a double length chain which allows the escorting officer to stand as far away as possible from the prisoner and the x-ray tube should be used.

6.1.3 Pregnant members of staff must not be detailed for escorting duties where the prisoner is to undergo an x-ray procedure.

6.2 Nuclear medicine procedures

6.2.1 If it is known that a prisoner is to attend a hospital outside the prison to receive treatment with radioisotopes, the prison should contact the RPA at the earliest opportunity, so that the relevant risk assessments can be carried out.

6.2.2 The hospital administering the treatment will also provide guidance on the management of the patient following treatment to ensure that radiation doses to staff and others coming into contact with the patient are restricted. Any such guidance must be followed.
7 THE IONISING RADIATION (MEDICAL EXPOSURE) REGULATIONS 2000

7.1 Scope of the Legislation

7.1.1 The Ionising Radiation (Medical Exposure) Regulations 2000 impose a duty on those responsible for administering ionising radiation to protect persons undergoing medical exposure.

7.1.2 The Regulations apply to the following medical exposures:
- The exposure of patients as part of their own medical diagnosis or treatment;
- The exposure of individuals as part of occupational health surveillance;
- The exposure of individuals as part of health screening programmes;
- The exposure of patients or other persons voluntarily participating in medical or biomedical, diagnostic or therapeutic, research programmes;
- The exposure of individuals as part of medico-legal exposures.

7.2 Duty Holders

7.2.1 The IRMER places responsibilities on the employer, practitioner, operator and referrer.

7.2.2 Duties of the Employer

7.2.2.1 Where the provision of health care for prisons remains the responsibility of the prison the Governing Governor is considered the employer and under the requirements of the legislation must:
- Consult a medical physics expert;
- Maintain an inventory of all x-ray equipment;
- Include provision for carrying out clinical audit;
- Establish Quality Assurance Programmes for diagnostic radiography;
- Establish employers' procedures and written protocols;
- Ensure that x-ray equipment is operated by appropriately qualified personnel;
- Arrange for measurements of emissions to be carried out before equipment is put into use and at yearly intervals;
- Establish QA programmes for both medical and dental radiography.

7.2.3 Referrer

7.2.3.1 The referrer must be a registered medical or dental practitioner entitled to refer individuals for a medical exposure. Within HM Prison Service the following post-holders are considered referrers:
- Dental radiography - the contracted dentist;
- Medical radiography - general practitioners or the contracted radiologist;

7.2.3.2 The referrer does not need to be named. Referrers can be specified by groups, e.g. general practitioners.

7.2.3.3 The referrer is responsible for supplying the practitioner with relevant medical data to enable the practitioner to decide whether there is sufficient net benefit for to the patient for the exposure to be justified.

7.2.3.4 The Referrer must be identified within, and follow the relevant IRMER procedures. (see Annex 3).
7.2.4 Practitioner

7.2.4.1 The practitioner will be a registered medical or dental practitioner, or other health professional. The primary function of the practitioner is to take responsibility for the justification of an individual exposure. In the prisons the following post-holders are considered practitioners:

- Dental radiography - the contracted dentist;
- Medical radiography - the contracted radiologist(s).

7.2.4.2 The Practitioners must be identified within, and follow, the relevant IRMER procedures (see Annex 3 and Annex 4).

7.2.5 Operator

7.2.5.1 An operator is any person entitled, in accordance with the establishment’s IRMER procedures to carry out all, or part of the practical aspects associated with the radiographic examination. Practical aspects include:

- Patient identification;
- Positioning the film, patient and x-ray tube;
- Setting the exposure parameters;
- Pressing the button to initiate the exposure;
- Processing films;
- Clinical evaluation of radiographs;
- Aspects of Quality Assurance Tests;

7.2.5.2 Any single exposure could involve a number of different operators performing the various functions.

7.2.5.3 In prisons the following are considered to be Operators:

- Dental radiography- the contracted dentist or dental nurse;
- Medical radiography - contacted radiographers or radiographers’ assistant;

7.3 Standard Operating Procedures

7.3.1 Regulation 4 of IRMER requires the employer to establish written standard operating procedures. These procedures are intended to provide a framework under which professionals can practice. These include:

- Correct identification of the patient (prisoner) and making enquiries of female prisoners to establish whether they might be pregnant;
- The carrying out and recording of a clinical evaluation of each exposure;
- The assessment of patient doses and the use of diagnostic reference levels;
- QA programmes;
- Clinical audits;
- The identification of individuals entitled to act as referrer, practitioners or operator and maintaining a list of those individuals;
- Reducing as far practicable the probability and magnitude of accidental or unintended doses to patients;
- Referral criteria for radiographic examination, together with the procedure for authorisation of a radiograph as justified;
- Written protocols (guideline exposure settings) for every type of standard projection for each item of x-ray equipment including identification of the types of exposure that the x-ray equipment is or is not suitable for.

7.3.2 Further information on written exposure protocols and referral criteria is given at Annex 3.
7.3.3 Governing Governors must ensure that standard operating procedures and protocols are in place.

7.4 Quality Assurance Programmes

7.4.1 QA Programmes must be established for both dental and medical radiography.

7.4.2 Governing Governors are responsible, on advice from the RPA, for ensure that quality QA programmes are established and maintained.

7.4.3 The overall objective of the QA programme is to ensure that radiographs consistently provide adequate diagnostic information whilst ensuring that radiation doses to patients (prisoners) and staff are kept as low as reasonably practicable. There are three main areas of quality assurance:
- Image quality;
- Film processing;
- Equipment output.

7.4.4 The progress of ongoing programmes, areas of responsibility and results of checks and measurements are documented in the RPA Operational File held at each establishment.

7.4.5 For dental radiology, a dedicated QA folder with appropriate inserts is provided by the RPA. This should be maintained by the operators and RPS, as appropriate.

7.4.6 For details of the QA programme for diagnostic x-ray equipment see Section 8.

7.4.7 Before new or modified equipment is used on patients baseline QA measurements must be carried out by the installer. For medical equipment this will be conducted by the RPA who should be contacted in advance to arrange for measurements to be carried out.

7.4.8 Governing Governors are responsible for ensuring that baseline QA checks are carried out on all new or modified diagnostic x-ray equipment before it goes into use.

7.5 Training

7.5.1 IRMER 2000 sets out the training requirements for practitioners and operators. These requirements are given at Annex 5. A copy of qualification certificates for these personnel must be retained.

7.6 Justification of Exposure

7.6.1 The practitioner is responsible for the justification of each individual exposure, based on his/her knowledge of the hazard associated with the exposure and the clinical information, including previous x-ray examinations, provided by the referrer.

7.6.2 The practitioner must also provide guidelines to the operator on the justifications of exposure.

7.6.3 All x-ray examinations must be clinically evaluated.
7.7 Clinical Audit

7.7.1 Arrangements for clinical audit of x-ray procedures should be included in the Health Care’s procedures for clinical audit and clinical governance.

7.8 Equipment Inventory

7.8.1 An up-to-date inventory of diagnostic x-ray and related equipment such as automatic processors must be maintained at each establishment. This inventory will be compiled by the RPS and included in part 1 of the RPA operational file and must include the following information:

- name of manufacturer;
- model number; serial number, or other unique identifier;
- year of manufacture;
- year of installation.

7.8.2 Governing Governors are responsible for maintaining an equipment inventory of dental and medical x-ray equipment as described above.
8 QUALITY ASSURANCE PROCEDURES FOR MEDICAL X-RAY EQUIPMENT

8.1 Responsibility

8.1.1 Quality assurance of standard operating procedures is a requirement under IRMER2000, in order to ensure that good quality radiographs are produced, with minimum patient dose.

8.1.2 The Governing Governor is responsible for ensuring that appropriate procedures are in place at the Prison.

8.1.3 The RPA will review compliance with QA procedures during each visit and comment on this in the visit report. The Governing Governor will follow up any deficiencies identified.

8.2 Checks Prior to Patient Exposures

8.2.1 It is essential that all equipment is known to be working correctly before patients are exposed to x-rays. This can be achieved by radiographing a test object and ensuring that a consistent image is produced on the processed film. A test exposure must be carried out immediately prior to use of equipment that is used infrequently, eg. only one day per week. Similarly, a test exposure must be carried out immediately following every change in the change of processing chemicals.

8.3 Performance of Complete Imaging System

8.3.1 Based on information supplied by/obtained from the supplier of the processor, the Head of Health Care must ensure that a schedule of checks is drawn up and implemented. The actual checks required will depend on the type of processor in use, but will typically include:

Prior to each session
Developer temperature log

Each time activity takes place
developer and fixer change log
processor cleaning log
servicing log

When new stock received
film stock control log
processing chemicals stock control log

Annually
darkroom integrity check
intensifying screen inspection record
viewing facilities inspection record

8.4 Reject Film Analyses

8.4.1 An analysis of those films that had to be rejected because they were deemed to be clinically unsatisfactory can be used to identify any areas where there may be consistent problems. A log should therefore be kept of the number of films that are rejected and, most importantly, the reason for rejection as follows:

• Too dark
• Too light
8.4.2 The log will include the date of the exposure, the name of the radiographer and the radiographic view being taken. If an explanation for the problem is immediately apparent, it should also be recorded. *The log must be examined at intervals not exceeding 6 months to determine whether any trends can be identified (and so rectified), at which time the percentage of rejected radiographs should be calculated and recorded.*

8.5 **Assessment of the Output of X-ray Equipment**

8.5.1 During annual visits, the RPA will carry out performance measurements on each piece of x-ray equipment in the health care centre. These measurements will be similar to those carried out on new equipment (detailed in Annex 2). The results of the measurements will be given in the subsequent visit report along with any necessary comments and recommendations.
NOTIFICATION OF IONISING RADIATION EQUIPMENT TO THE HSE

The following particulars on ionising radiation must be provided to the HSE:

a) The name and address of employer and a contact telephone number or fax number or electronic mail address;

b) The address of the premises where or from where the work activity is to be carried out and a telephone number or fax number or electronic mail address at such premises;

c) That the nature of business of the employer is a prison and that the type of ionising radiation in use is diagnostic x-rays.

d) That the x-ray set(s) are only to be used at the site identified above; and

e) Dates of notification and commencement of the work activity (strictly, the notification should take place 28 days in advance).
CRITICAL EXAMINATION AND ACCEPTANCE TESTING OF DIAGNOSTIC (MEDICAL OR DENTAL) X-RAY EQUIPMENT

Critical Examination Testing

Installers undertaking a critical examination in respect of the installation of new medical or dental x-ray equipment, or relocation of existing equipment must provide a written report of the examination. As a minimum this should include the following:

- Full details of the equipment in question: make, model, serial number, year of manufacture and location of installation;
- Full details of the manufacturer, supplier and installer;
- Name(s) of the person(s) undertaking the critical examination;
- Name of the Radiation Protection Adviser (RPA) for the installer;
- Signed confirmation that:
  a) A Critical Examination has been carried out in accordance with Regulation 31(2) of IRR99;
  b) The results of the examination are satisfactory, in that;
     - The location of the equipment is appropriate;
     - The equipment’s warning signals and exposure controls are satisfactory; and
     - There are sufficient safety features in place, relating to beam dimensions, alignment and filtration and cut out switches and timer control.

The critical examination should clearly state that the following has been met:
- The safety features are operating correctly;
- There is sufficient protection from radiation;
- The user has been provided with adequate information about proper use, testing, and maintenance of the equipment.

Acceptance Testing

For dental x-ray equipment acceptance tests will normally be carried out by the service engineer. For medical x-ray equipment the RPA will carry out the tests.

Acceptance testing must be carried out before the equipment is put into use.

Acceptance tests comprise of the following:
- Measurements to determine whether the equipment is operating within agreed performance parameters (see below);
- An assessment of typical patient dose, for comparison with the Diagnostic Reference Levels.

Performance Parameters

The parameters listed below must be measured, and the results included in the visit report. The results should be compared against the required standards listed below and a statement made as to whether or not the result is satisfactory. Where a result is deemed to be unsatisfactory, the proposed remedial action must also be stated.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Medical x-ray sets</th>
<th>Dental x-ray sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>kV accuracy</td>
<td>± 5 kV or ± 5% of set value, whichever is greater</td>
<td>≥ 50 kV, and within ±10% of stated value</td>
</tr>
<tr>
<td>X-ray output and consistency</td>
<td>Should be directly proportional to tube current (mA). Should increase with approximately the square of the kV. Consistency should be ± 10%</td>
<td>Graph of output vs. time set should be approximately linear and output should be within ± 25% of optimum dose for all examinations</td>
</tr>
<tr>
<td>Timer accuracy and consistency</td>
<td>± 10% for exposures ≥ 0.1s</td>
<td>Zero error should be in keeping with current DXPS standards</td>
</tr>
<tr>
<td>Light beam diaphragm or beam collimator</td>
<td>X-ray beam must always be within ± 1 cm of the light beam. Collimated beam must always be within ± 1 cm of stated beam size and position.</td>
<td>Rectangular collimation, ≤ 35mm x ≤ 45 mm</td>
</tr>
<tr>
<td>Total beam filtration</td>
<td>Not less than 2.5 mm aluminium equivalence, of which 1.5 mm must be permanent.</td>
<td>≤ 70 kV: ≥ 1.5 mm Al, &gt; 70 kV: ≥ 2.5 mm Al, of which 1.5 mm must be permanent</td>
</tr>
<tr>
<td>Focal spot size(2)</td>
<td>greater than 1.5 times the nominal quoted size</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

(1) Many of these parameters cannot be easily measured or quantified for capacitor discharge systems, in which case advice should be sought from the RPA.
(2) Only required to be done at the time of the critical examination.

**Warning lights**

- Warning lights must be fitted on the control panel to indicate:
  1. that mains is supplied to the generator;
  2. that an exposure is taking place.

- Warning lights are also normally required at the entrance to medical x-ray rooms, and in certain circumstances at the entrance to dental x-ray rooms. This will be assessed on a case by case basis by the RPA.

- The critical examination report must include a brief description of the function of each warning signal, together with a statement as to whether it was functioning correctly at the time of the examination. In the event of a failure, proposed remedial action must be stated.
Operation of exposure control

The function of the exposure control, and the additional means of termination, should be described and tested against the appropriate standards contained in paragraphs 4.27 to 4.31 (general medical equipment) and paragraphs 6.25 to 6.30 (Dental equipment) of the medical and dental guidance notes.

Protection provided by the room

It must be confirmed that the X-ray room provides adequate protection for persons in adjacent areas (including those on the floors above and below, if applicable). At the X-ray energies involved, it may be possible to achieve this by inspection alone, but appropriate measurements must be made if there is any doubt.
STANDARD OPERATING PROCEDURES

IONISING RADIATION (MEDICAL EXPOSURE) REGULATIONS 2000 (IRMER)

Standard Operating Procedures

- The following are examples of the details that must be included in standard operating procedures. Individual health care centres must review these procedures and amend them as necessary to ensure that they are appropriate to the individual site. Standard written procedures must be in place for:

Enabling the correct identification of the patient

- The patient should be asked for their full name, date of birth and prison number. The operator must ensure that these match the information on the request card and/or in the patient's notes to ensure that the correct patient is being exposed. Care must be taken where there may be two patients with similar names in the Health Care Centre.

- If the patient is unable or unwilling to provide the appropriate information, the patient’s identity must be verified by a staff member or by other appropriate means, eg. identification card.

Identifying referrers, practitioners and operators

- Referrers, practitioners and operators must be identified in writing. Information on who might be a referrer, practitioner and operator is given in Chapter 7 of the PSO.

Being observed in the case of medico-legal procedures

- Medico-legal procedures are those which do not have a clinical benefit to the patient, but are carried out to provide legal evidence, eg. in the case of an allegation of assault.

- A medico-legal exposure must still be justified in that there is a net benefit to the individual or to society. The procedure should only be justified if it is not possible to use alternative techniques involving no or less exposure to ionising radiation.

- If the exposure has already been performed during the routine clinical management of the patient, unnecessary repeat exposures should be avoided.

- A request for a medico-legal procedure must still be referred by a referrer and justified by a practitioner. The referrer must provide sufficient information to allow justification.

- Once justified and authorised, medico-legal exposures should be performed as for other standard diagnostic exposures, ie. taking care to keep doses as low as reasonably practicable, within the diagnostic reference level, noting the exposure settings for the calculation of effective dose, and making a clinical evaluation of the outcome of the exposure.
Making enquiries of females of childbearing age to establish whether the patient is or may be pregnant

Regulation 6(1)(e) of IR(ME)R2000 prohibits the carrying out of a diagnostic exposure of a female of child-bearing age without an enquiry as to whether she is pregnant, if this is relevant.

Such an enquiry will not be necessary for most dental examinations and for medical examinations of the extremities (eg. arms, legs, skull). However, if the patient is or may be pregnant and is concerned about the radiological exposure, an acceptable course of action would be for the operator to explain to the pregnant patient that these types of radiograph deliver such small doses to the fetus that the associated risk can be regarded as negligible. However, because of the emotive nature of radiography during pregnancy, the patient could be given the option of delaying the radiography until after delivery.

For radiographic examinations where the abdominal or pelvic area might be irradiated:

- a) The operator must ask the patient whether she is, or might be, pregnant and record the response;
- b) If there is no possibility of pregnancy, the radiographic examination can proceed;
- c) If the patient is definitely, or probably, pregnant, the IRMER practitioner should review the justification for the proposed radiographic examination and decide whether to defer the investigation until after delivery. If the examination is undertaken, the fetal dose must be kept to a minimum consistent with the diagnostic purpose. In such situations the use of a lead apron is advised, principally because of the reassurance that it provides;

Assessment of the patient dose

In order that an assessment of patient dose can be carried out for any medical or dental exposure, the operator must record the factors relevant to patient dose for every exposure. These should be recorded in the patients notes and must include:

- Type of examination, including views;
- Exposure settings as appropriate (eg. kV, mA or mAs, time);
- Focus to film distance (for medical radiography);
- Dose area product ((DAP), if available);
- Reason, if exposure is different to standard exposure factor stated in exposure protocol.

Incidents

If the operator suspects that a patient has received a dose much greater than intended (including any exposure to the wrong patient) they must follow the appropriate procedure, given in the local rules. The operator must also provide information to the RPA, to enable a patient dose assessment to be carried out (see above).

Dose monitoring

The RPA/MPE will carry out typical exposures in order to assess patient doses during annual visits and compare these with Diagnostic Reference Levels. This will be recorded in the report issued by the RPA/MPE following the visit.
Using Diagnostic Reference Levels

- Radiological exposures should not routinely exceed appropriate diagnostic reference levels (DRLs).

- For dental radiography, the RPA/MPE will advise on an appropriate DRL for individual x-ray sets, taking into account the recommendations made in the equipment performance report and appropriate national guidelines.

- For medical radiography, DRLs will be set in line with national recommendations, published by the Health Protection Agency in Doses to Patients from Medical X-Ray Examinations in the UK:2000 Review (NRPB-W14).

- As indicated in the procedure for assessment of patient dose, the RPA/MPE will assess patient doses during annual visits and compare these with the DRLs described above. The results of this comparison will be recorded in the report issued by the RPA/MPE following the visit.

- If a significant number of exposures (>10%) exceed the relevant DRL, the reasons for this will be investigated by the RPA/MPE, in conjunction with the relevant personnel in the health care centre (eg. radiographer, radiologist, dentist or health care manager). Recommendations for ensuring that DRLs do not continue to be exceeded in significant numbers will be documented and implemented by the Health Care Centre.

Carrying out and recording of an evaluation of each diagnostic exposure

- Every diagnostic exposure must be clinically evaluated and the result recorded. In particular, if evaluation is to take place outside the prison Health Care Centre (eg. by a radiologist at an external hospital), any delay in the provision of the evaluation must be considered when authorising the exposure. Practitioner and operators must not justify or authorise a diagnostic exposure if it is known that a clinical evaluation will not take place.

- The x-ray view(s) taken must be recorded in the patient record.

- The practitioner or other qualified person authorised by the employer must undertake an evaluation of each diagnostic exposure. This should include details of the diagnostic findings, which should be documented in the patient record, with a signature to indicate who carried out the evaluation.

- If a radiograph is found to be unsatisfactory, such that a repeat is required, the reason for this should be recorded in the patient record and in the radiographic record/logbook.

Ensuring that the probability and magnitude of accidental or unintended doses to patients are reduced so far as is reasonably practicable

- The identity of the patient must be confirmed before any x-ray examination, in accordance with the IRMER procedure;
- All equipment is maintained in accordance with the manufacturer’s recommendations;
- A QA programme is maintained for all equipment;
- Equipment faults are logged and reported to the RPS;
Equipment that is exhibiting faults likely to cause patient overexposure must be taken out of use until it has been repaired by a service engineer, and written confirmation obtained that the unit is fit for clinical use. Quality Assurance checks must also be undertaken before the equipment is used clinically following major repairs; All staff are appropriately qualified professionals, working in accordance with the written protocols listed in Annex 5;

All incidents are reported to the Health Care Manager and investigated in conjunction with the RPA/MPE.
ANNEX 4

IONISING RADIATION (MEDICAL EXPOSURE) REGULATIONS 2000 (IRMER)

WRITTEN EXPOSURE PROTOCOLS AND REFERRAL CRITERIA

Written Exposure Protocols

➢ Regulation 4(2) of IRMER requires the employer to establish written exposure protocols for every type of standard radiological procedure for each individual piece of equipment. The governing governor shall ensure that the following protocols are in place and are being adhered to:

Medical radiography

➢ Appropriate written protocols should be drafted by the radiologist and/or radiographer(s) at each prison for the medical x-ray units. The protocol should include information on patient positioning, film/focus distance, exposure factors, receptor speed and selection of equipment options. The radiographer must follow the protocol where appropriate and record the reason for any deviation from it in the radiography record.

➢ The RPA/MPE will review the protocols to ensure that the above requirements are met. Patient doses due to exposures carried out in line with the written protocols will be derived by the RPA/MPE and compared with the DRLs.

Dental radiography

➢ The RPA/MPE will use the results of the equipment performance assessment to derive recommended exposure settings for each type of radiological view for each x-ray set. These settings will be used as the written exposure protocol for dental radiography and will be reported to the Health Care Centre in the report following the RPA/MPEs visit. The dentist must follow the protocol where appropriate and record the reason for any deviation from it in the radiography record book.

Referral Criteria

Medical radiography

➢ The radiologist must set appropriate referral criteria for the Health Care Centre, taking into account current best practice and publications such as ‘Making the Best Use of a Department of Clinical Radiology’ from the Royal College of Radiologists. Referrers must follow the referral criteria.

Dental radiography

➢ The dentist must set guidelines for referral criteria for radiographic examinations, taking into account current best practice and publications such as ‘Selection Criteria for Dental Radiography’, published by the Faculty of General Dental Practitioners (UK) - Royal College of Surgeons of England. Referrers must follow the referral criteria.
ANNEX 5

TRAINING REQUIREMENTS FOR PRACTITIONERS AND OPERATORS

Medical radiography

- The Radiologist must be a Fellow of the Royal College of Radiologists. Proof of qualification should be available for inspection at the prison for all radiologists undertaking the role of practitioner.

- The Radiographer must be registered as a radiographer with the Health Professions Council. An up to date copy of the registration for all radiographers working at the prison should be available for inspection.

Dental radiography

- Dentists must be registered as a dentist with the General Dental Council. An up to date copy of the registration for all dentists working at the prison should be available for inspection.

- Dental nurses, therapists and hygienists (Dental Care Professionals (DCPs)): If undertaking the role of the operator, must hold a certificate in dental radiography, unless working under the direct supervision of a qualified operator. From 30 July 2008, all DCPs must be registered with the General Dental Council. If a DCP holds such a registration, a copy should be available for inspection at the prison.