Radiography: Risk Assessment in Dental Radiography

Aim: This article aims to provide an overview of the steps that need to be considered when carrying out a risk assessment for dental radiography within a dental practice.

Objectives: On completion of this verifiable CPD article the participant will be able to demonstrate, through completion of a questionnaire, the ability to:

- Be able to list the five key steps to risk assessment.
- Be able to explain some of the requirements of the IRR2017 and IR(ME)R2017 regulations.
- Know how often to review a radiation risk assessment.
- Know how to access relevant legislation and guidance for conducting a radiation risk assessment, including the IRR17 Approved Code of Practice and the Public Health England (2020) Guidance Notes for Dental Practitioners on the Safe Use of X-Ray Equipment.
- Identify the controlled area in respect of dental radiography.
- Be able to identify contents of the local rules in relation to radiography.
- Identify the annual dose limits for staff working with ionising radiation.
- List some of the required information that should be kept in a practice radiation folder.
- Identify training requirements relating to dental radiography.

Introduction

Radiography is an invaluable tool for the dentist, providing information that is impossible to obtain by clinical examination alone.[1]

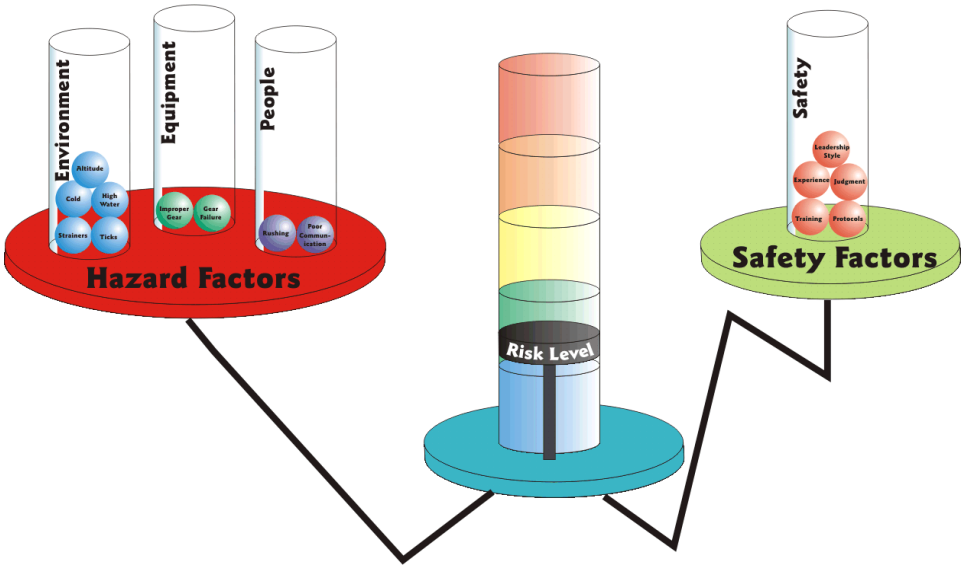
Risk assessment is an important step in protecting, workers, patients and a business as well as complying with the law. The law does not expect you to eliminate all risk, but you are required to protect people as far as is possible.[2]

In dentistry, the use of radiography equipment and the taking of radiographs must be in accordance with two sets of regulations. Firstly, there are the Ionising Radiations Regulations 2017 (IRR2017) which are concerned with the protection against exposure to ionising radiation as a result of work activities. It is administered by the Health and Safety Executive (HSE) as part of the Health and Safety at Work Act 1974.[3] Secondly, there are the Ionising Radiation (Medical Exposure) Regulations 2017 (IR(ME)R2017).

These are enforced in the UK by: the Care Quality Commission (CQC) in England; the Healthcare Inspectorate Wales (HIW) in Wales; the Scottish Executive (SE) in Scotland; and the Regulation and Quality Improvement Authority (RQIA) in Northern Ireland and are primarily concerned with the protection of the patient.[4]

The main aim of the IRR17 regulations is to ensure that exposure to ionising radiation from work activities is kept as low as practically possible and that doses received by patients do not exceed the dose limits specified for individuals. Risk assessments are also required in accordance with Regulation 8 of the IR(ME)R17.[5]

Five Key Steps to Risk Assessment



A major part of managing health and safety in the workplace is to control the risks. In order to do this, it is necessary to consider what may cause harm to people and then ensure that reasonable steps are being taken to prevent that harm. There are five main steps to conducting a risk assessment:

1. **Identify the hazard** – exposure to ionising radiation.

2. **Who is at risk?** – staff and any person who might receive an accidental exposure.

3. **Evaluate the risks and decide on precautions** – Can I reduce exposure levels? Are potential doses significant? Can the hazard be eliminated? What is in place to control the risk?

4. **Record your significant findings** – Record the assessment and maintain in a place of safety.

5. **Review and Audit** – Review findings on a regular basis and change when needed[6]

Carrying Out Risk Assessment for Radiation

The IRR17 are primarily concerned with the radiographic equipment, the workers and the public and the legislation covers:

- Registration with the HSE
- Equipment, including critical examinations
- The appointment of a Radiation Protection Advisor (RPA) and Radiation Protection Supervisor (RPS)
- Dose limits for occupational exposure
- Design of dental and radiography facilities including safety and warning signs and contingency plans
- Additional requirements for controlled areas
- **Radiation risk assessment**
- Personal Protective Equipment
- Local rules
- Training

The employer will need to demonstrate that they are complying with IRR legislation.

It is an employer's responsibility to carry out a risk assessment before carrying out any work involving ionising radiation. When carrying out a risk assessment, employers must consult a Radiation Protection Advisor. The risk assessment must be:

- Recorded (if there are five or more employees)
- Kept up to date
- Discussed with workers and others who could be affected by the risks identified.[6]

The Health and Safety Executive Document, Ionising Radiations Regulations 2017 Approved Code of Practice and Guidance states, "the risk assessment should demonstrate that:

a) All hazards with the potential to cause a radiation accident have been identified; and,

b) The nature and magnitude of the risks to employees and other persons arising from those hazards have been evaluated.

Where the assessment made for the purposes of this regulation shows that a radiation risk to employees or other persons exists from an identifiable radiation accident, the radiation employer shall take all reasonably practicable steps to –

- Prevent any such accident,

- Limit the consequences of any such accident which does occur; and,

- Provide employees with the information, instruction, and training, and with the equipment necessary, to restrict their exposure to ionising radiation.

The requirements of this regulation are without prejudice to the requirements of regulation 3 (Risk assessment) of the Management of Health and Safety at Work Regulations 1999."[5]

Paragraph 70 of the Approved Code of Practice to IRR17 (the ACoP) specifies the matters that (where relevant) must be considered when undertaking a risk assessment, and paragraph 71 specifies the subjects that (where relevant) must be included in the decisions arising from the risk assessment. The ACoP can be downloaded from the link at the end of this article for further reading and should be referred to before conducting a risk assessment.

Dose constraints and Restricting Exposure

One of the considerations when undertaking a radiation risk assessment is estimating dose rates to which anyone can be exposed.[5] The International Commission on Radiological Protection[7] cover all aspects of radiological protection. The recommended system of dose limitation is summarised into three basic components. That is that there should be:

- ✓ Justification of practice
- ✓ Optimisation of radiation protection
- ✓ Dose limits for individuals at work and for members of the public

The primary concern is to keep exposures at the lowest practicable level. In English law this is known by the acronym ALARP which is keeping exposures:

As
Low
As
Reasonably
Practicable

This requirement is specifically included in the IRR17, and employers deemed not to be keeping exposures as low as they reasonably can, could be at risk of prosecution.

When work is carried out in a controlled area under written arrangements, the employer must demonstrate that doses are being restricted. This can be done using one of the following methods which are outlined in the 2020 Guidance Notes for Dental Practitioners on the Safe Use of X-ray Equipment: -

- Issuing all staff who enter controlled areas with a personal dosemeter provided by an approved dosimetry service (ADS) which reports the assessed doses to the employer.

- Issuing staff with direct-reading electronic personal dosemeters that are suitable for use with X-rays and keeping a log of the doses locally.

- Estimating the annual doses based on measurements made at the operator's position as part of the arrangements for area monitoring.[8]

Individuals who work with ionising radiation are divided into two subgroups depending on the level of occupational exposure. These are:

1) <u>Classified workers</u>

These are individuals who receive high levels of exposure to radiation at work. This will be any employees who are likely to receive an effective dose greater than 6 mSv in a calendar year or an equivalent dose to the lens of the eye greater than 15 mSv per year, or greater than 150 mSv per year to the skin or extremities. An upper annual effective dose limit of 20mSv is set for classified workers. These individuals require compulsory personal monitoring and annual health checks. If local rules are observed this is highly unlikely in dental practice.

2) <u>Non classified workers</u>

These individuals receive low levels of exposure to radiation at work. If local rules are observed, all dental staff should receive an annual effective dose of considerably less than the non-classified limit of **6mSv**.

IRR17 states that the dose investigation level must not exceed 15 mSv and where appropriate should be set at a lower level. For this reason, the latest 2020 Guidance Notes for Dental Practitioners on the Safe Use of X-ray Equipment, states that "Doses to employees arising from routine dental radiography that is conducted in X-ray rooms designed and laid out in accordance with this guidance, and following the working procedures set out in this guidance, should be well below 1 mSv" The guidance notes advise that **1mSv** is an appropriate value for the dose investigation level but that whatever level is chosen, it should be documented in the risk assessment and in the local rules.

Personal Protective Equipment

The results from your risk assessment will determine the need for Personal Protective Equipment (PPE) and whether this will contribute to reduction of exposure. The Health and Safety Executive state that “use of PPE should be a last resort when all other control measures to reduce the risk of radiation exposure have been considered, such as engineering controls and safe systems of work.” Advice should be sought from the Radiation Protection Advisor (RPA).[5]

Lead aprons would only usually be required by operators carrying out exposures of patients if it is necessary to assist the patient or hold the image receptor during an exposure. According to the Dental Guidance Notes, there is no reason to provide the patient with a lead apron on radiation grounds, even in the case of a patient who is or may be pregnant.[8]

Pregnant employees

The ACoP also state that employers must take account of the “risks arising from radiation exposure to those who are pregnant or breastfeeding and, in particular, the likely doses to the foetus or breastfed infant.”[5] The Dental Guidance Notes state that no special protection measures should be necessary since the dose received is expected to be significantly less than mSv per year. However, the employer may consult with the RPA and decide that they will provide personal dosimetry if they wish to confirm that doses are low.[8]

Carers and Comforters

Carers and comforters are people who knowingly support patients during their medical exposure and dose constraints, guidance and procedures must be established in consultation with the Medical Physics Expert.

X-ray Equipment

Another consideration during a risk assessment involves implementing advice from the manufacturer or supplier of equipment about its safe use and maintenance.[5] When x-ray equipment is installed, the company installing it will provide a critical examination report.

The critical examination report should incorporate an overall conclusion as to whether or not the equipment's safety features are operating correctly, the installation is providing sufficient protection for persons from exposure to x-rays and should also include a statement as to whether the user has been provided with adequate information about proper use, testing and maintenance of the equipment.

This, in conjunction with the acceptance, routine tests and maintenance/servicing reports will provide sufficient information for the risk assessment.

Local rules specify the working instructions of x-ray equipment, the controlled area, and the contingency plans in case of an accident.

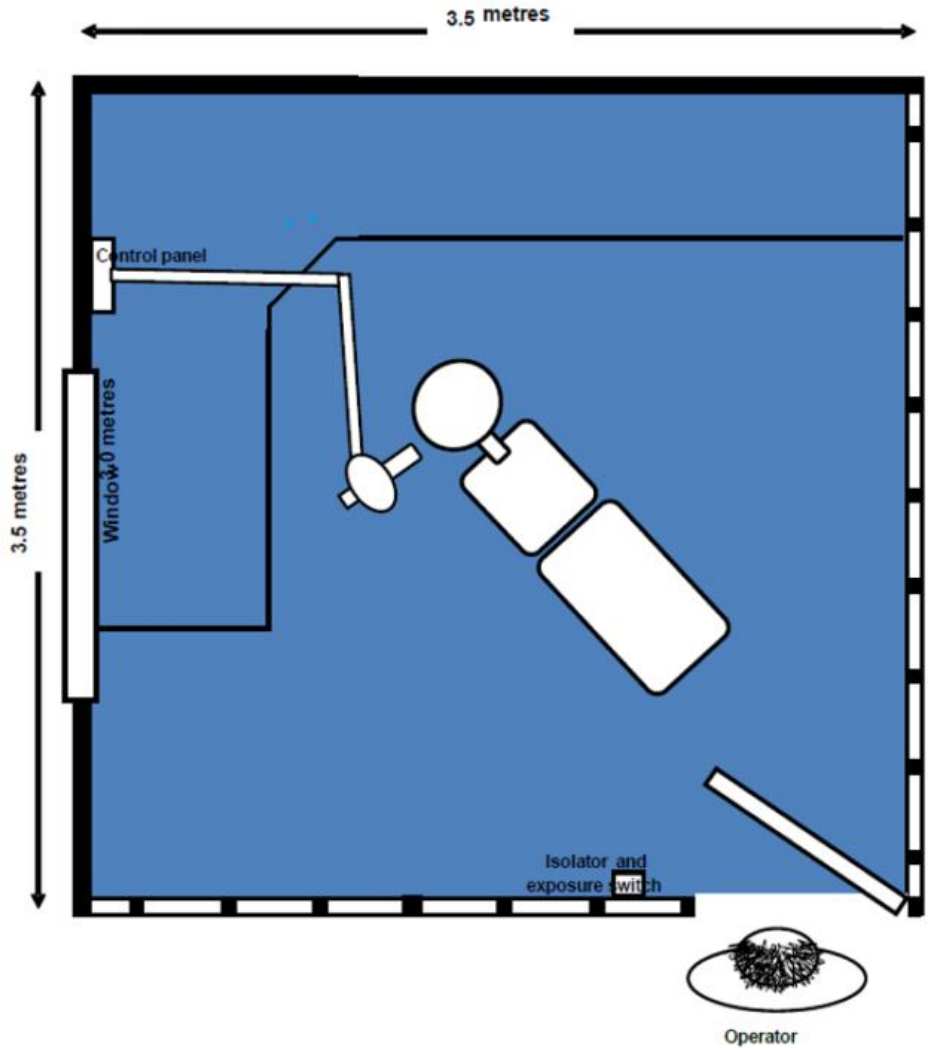
The Controlled Area

The controlled area or x-ray room is the area in which the radiograph equipment is installed, and specific rules apply to the positioning of the equipment.

IRR specifies the following requirements for controlled areas:

- "The local rules must describe the extent of the controlled areas and when they are considered to exist.
- Access to controlled areas must be restricted to classified persons who enter in accordance with written arrangements (this does not apply to the patient who is undergoing the x-ray examination).
- Where reasonably practicable, controlled areas should be physically demarcated.
- Controlled areas must be furnished with warning signs in suitable positions indicating the area's designation and the nature of the radiation source (e.g. x-rays).
- The radiological conditions in and around the area must be monitored to ensure the area remains correctly designated."[8]

The extent of the controlled area must be decided in consultation with the Radiation Protection Advisor. The Dental Guidance Notes recommend that the whole room containing the x-ray equipment is designated as a controlled area and that it is always used when using CBCT equipment due to the higher levels of scatter radiation. An example of the controlled area is pictured below.[9]



Where it is not possible to designate the whole room as a controlled area, the controlled area should be designated:

- Within 1.5m pf the x-ray tube head and patient, in any direction, while the equipment is in a state of readiness to emit x-rays, and,
- In the case of intra oral equipment, within the primary x-ray beam until it has been sufficiently attenuated by distance or shieling."

Access to the Controlled Area and Procedural Controls

Access to the controlled area should be restricted and the most appropriate way of doing this should be identified from the risk assessment and taking into account the hierarchy of controls set out in IRR17.[8] The Dental Guidance Notes state that, unless the risk assessment identifies that it is not practicable to do so, that warning signs should be visible at the entrance to the controlled areas. These signs may take the form of notices or lights but must comply with the Health and Safety (Safety Signs and Signals) Regulations 1996. Examples of appropriate signs from the Dental Guidance Notes are picture below. However, they must be removed or covered when the x-ray equipment is not in a state of readiness to emit x-rays so that it is clear when the controlled area restrictions are in place.

Example of a warning notice that should be placed outside entrances to the controlled area. [8]

Procedural controls required to further restrict exposure in a given situation should be identified in the risk assessment and will be specific to the dental practice. These should be identified in consultation with the RPA.

Contingency Plans

The aim of a contingency plan is to restrict exposures that arise from an accident so far as reasonably practicable. This will include exposures to dental staff and patients/members of the public.[5] The Dental Guidance Notes state that, although not an exhaustive list, reasonably foreseeable accidents for using dental x-ray equipment, would normally include the following, depending on what type of equipment is in use:

- "Failure of the timer to terminate the exposure after pre-set time has elapsed.
- Failure of the rotational or scanning motion of panoramic, cephalometric, or dental CBCT equipment, combined with a failure to terminate the exposure.
- Loss of shielding or damage to an x-ray tube.
- Failure of a system of work, such as the intra-oral beam is directed at the operator. or another person (either directly or through an unshielded door.
- Failure of a system of work, such that a person remains in the room during a panoramic, cephalometric or CBCT exposure.
- Loss or theft of a hand-held unit." [8]

For each identified scenario, the risk assessment should assess the likelihood of it happening, the magnitude of exposures to people that may result, and the actions necessary (for example by immediately releasing the exposure switch and, if necessary, switching off the power). If the contingency plan needs to be enacted, the circumstances should be discussed with the RPA to identify the cause and if any action is needed to prevent reoccurrence. The Dental Guidance Notes provide more examples of accident scenarios and can be accessed from the further reading section.

The Health and Safety Executive must be informed if it is suspected that the exposure exceeds a statutory dose limit.

Local Rules

Local rules must be provided for every controlled area. Local rules are a set of key working instructions for restricting exposure and include procedures for normal work as well as contingency plans for accidents and incidents and must be drafted with the RPA.

The Approved Code of Practice and Guidance gives the following information for content that should be included in the local rules:

Essential contents:

- The dose investigation level specified for the purposes of regulation 9 of IRR17.
- Identification or summary of any contingency arrangements indicating the reasonably foreseeable accidents to which they relate (regulation 13).
- Name(s) of the appointed RPS(s) (regulation 18(5)).
- Identification and description of the area covered, with details of its designation (regulation 19(1)).
- A summary of the working instructions appropriate to the radiological risk associated with the source and operations involved, including the written arrangements relating to non-classified persons entering or working in controlled areas (regulation 19(3)).

Optional Contents

Employers may also find it useful to include a brief summary or reference to the general arrangements in that area for:

- Testing and maintenance of engineering controls and design features, safety features and warning devices.
- Radiation and contamination monitoring.
- Examination and testing of radiation monitoring equipment.
- Personal dosimetry.
- Arrangements for pregnant and breastfeeding staff.
- Details of significant findings of the risk assessment, or where it can be found.
- A programme for reviewing whether doses are being kept as low as reasonably practicable and local rules remain effective.
- Procedures for initiating investigations etc.

- Procedures for contacting and consulting the appointed RPA.
- Details of the management and supervision of the work.
- Procedures for ensuring staff have received sufficient information, instruction, and training.[5]

Training on the employer's local rules can be provided by in staff training. Records should be kept confirming that staff have read and understood the local rules.

Training

Training needs should be identified in the risk assessment. Every employer should ensure that employees who are engaged in work with ionising radiation are given appropriate training in the field of radiation protection and receive such information and instruction as is suitable and sufficient for them to know: -

- Risks to health arising from exposure to dental X-rays.
- The significant findings of the risk assessment and precautions that need to be taken, in particular the specific requirements of the local rules and contingency plans at their place of work.
- The requirements of IRR17 relevant to dental radiography and the importance of complying with them.

Meeting IRMER Training Requirements

IRMER Practitioners, referrers or operators that take radiographs, need to ensure that they complete IRMER training that meets their needs. **The training that you complete depends on your needs at the time of completing it.**

The recommended radiation content of verifiable CPD courses for IRMER practitioners and operators who undertake radiography are also set out in the 2020 Guidance notes as follows:

- The principles of radiation physics
- Risks of ionising radiation
- Radiation doses in dental radiography
- Factors affecting doses in dental radiography
- The principles of radiation protection
- Statutory requirement.
- Selection criteria (IRMER Practitioners)
- Quality assurance

You should source training in any new equipment or techniques that you introduce to your daily practice. All additional training that you complete should be logged and recorded.[8]

Staff not directly involved with radiography

Staff that assist in other duties related to radiography such as processing films or phosphor plates, or non-clinical staff, should carry out training sufficient to their role and safety. This may include:

- Awareness that X-rays are used, the benefits and risks, and the need to avoid any personal exposure.
- Training in the requirements of the local rules

The General Dental Council highly recommend that dental professionals carry out 5 hours of verifiable CPD on the subject of radiography.

Review and revision of the Prior Risk Assessment

The risk assessment should be reviewed at three yearly intervals[8], to ensure that it remains current and relevant, and the risk assessment should be assessed if there is reason to suspect that it is no longer valid. The ACoP states that employers should decide the frequency of reviews by taking into account the nature of the work, the degree of risk and the extent of any change in the work activity.[5]

Recording Information

Every radiation employer should, in respect of any controlled area or, any supervised area, make and set down in writing local rules that are appropriate to the radiation risk and the nature of the operations carried out in that area (this means each surgery that contains x-ray equipment must have its own set of local rules). The radiation employer should ensure that the local rules are brought to the attention of those employees and other persons who may be affected by them and should appoint one or more suitable radiation protection supervisors for the purpose of securing compliance with these rules and the local rules should contain the names of the individuals appointed.

It is important to maintain a radiation file that is comprehensive. Some of the contents will include:

- Practice declaration that it complies with the IRR17 Regulations.
- Certificate of registration with the Health and Safety Executive to work with ionising radiation.
- Any reports provided by the Radiation Protection Advisor / Medical Physics Expert.

- Record of all staff involved in radiography at the practice and details of training each person has taken part in.

- Inventory of all x-ray equipment (including assessment reports/maintenance reports).

- Details of all processing equipment and chemicals.

- **Details of risk assessment carried out.** The risk assessment may be recorded electronically and should be an “effective statement of the risks the work presents and will make sure management take the necessary actions to protect employees and others exposed to ionising radiation.” [5]

- Local rules for each controlled area.

- Details of how patient safety is maintained.

- Details of your Quality Assurance programme.

- Audit reports.

- Evidence of the safe disposal of developer chemistry and lead foil.

Conclusion

It is a legal requirement that any business involved with ionising radiation complies with the IRR17 Regulations which are set out by the Health and Safety Executive (HSE) as part of the Health and Safety at Work Act 1974 and the IR(ME)R17 regulations. Part of these regulations are that and employer must undertake a risk assessment before commencing a new activity involving ionising radiation or when there is a significant change associated with radiation safety.

Personal Development Plan and Reflective Learning

This CPD is linked to the following GDC Enhanced CPD Development Outcome:

C. Maintenance and development of knowledge and skill within your field of practice.

Reflective learning is now a requirement of the GDC Enhanced Professional Development Scheme. As such, you will now need be given the opportunity to answer some reflective questions. You can also update this at any time from your CPD log. If you take a few moments to write your reflection on completion, you will have fulfilled the Enhanced CPD requirements.

Further Reading

We recommend that you take time to review the full radiation regulations as required to fulfil your particular role. These can be accessed from the links below and can be used as non verifiable CPD:

IRR(17)

IR(ME)R17

Controlling Risks in the Work Place

Health and Safety Executive: Working with Ionising Radiation Approved Code of Practice (this contains more detailed information on risk assessment)

Public Health England (2020) Guidance Notes for Dental Practitioners on the Safe Use of X-ray Equipment 2nd edition

References

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