



Higher National Unit specification: general information

Unit title: Dental Radiography: Operator

Unit code: H0AH 36

Superclass: PF

Publication date: December 22

Source: Scottish Qualifications Authority

Version: 06 (December 2022)

Unit purpose

This Unit is intended for candidates who will be acting as operators working with x-ray generating equipment. It will develop the candidates' skills and knowledge as they expose patients to ionising radiation taking a range of radiographs requested of them by a registered dental practitioner(s). The completion of this Unit should meet the legislative requirements associated with Ionising Radiation (Medical Exposure) Regulations 2017 (IR(ME) R) 2017 although successful completion does not provide entitlement which still is a process that is required with the candidate's employer. The Unit will develop a more detailed understanding of candidate knowledge and skills in relation to radiation production, the fundamentals of radiation physics, radiation protection and the production and quality assurance of dental radiographs.

On completion of the Unit the candidate should be able to:

- 1 Explain the production, properties and interactions of x-rays.
- 2 Explain the principles of radiation protection.
- 3 Produce intra and extra oral radiographs using traditional and/or digital systems.
- 4 Demonstrate the principles of film handling, imaging and quality assurance.

Recommended prior knowledge and skills

Candidates undertaking this Unit should be qualified Dental Care Professionals who are currently registered with the General Dental Council. It is essential that the candidate has the support (and direct supervision) of a registered dental practitioner(s) or, depending on their workplace, an appropriately qualified person who will validate workplace evidence generated against entries made in the candidate's portfolio.

General information (cont)

Credit points and level

2 Higher National Unit credits at SCQF level 9: (16 SCQF credit points at SCQF level 9*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the Support Notes of this Unit specification.

There is no automatic certification of Core Skills or Core Skill components in this Unit.

Context for delivery

If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

This Unit is contained within the optional section of the HND Dental Nursing.

Higher National Unit specification: statement of standards

Unit title: Dental Radiography: Operator

Unit code: H0AH 36

The sections of the Unit stating the Outcomes, Knowledge and/or Skills, and Evidence Requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed, and different items should be sampled on each assessment occasion.

Outcome 1

Explain the production, properties and interactions of x-rays.

Knowledge and/or Skills

- ◆ Electromagnetic spectrum
- ◆ Natural and artificial radiation
- ◆ Production of x-rays
- ◆ Components of the dental x-ray equipment
- ◆ Relationship of energy, frequency and wavelength
- ◆ Attenuation of ionising radiation and factors affecting attenuation
- ◆ Properties of radiation
- ◆ Scattering and absorption
- ◆ Biological effects of radiation
- ◆ Risks/benefits of radiation
- ◆ Dose optimisation
- ◆ Dosimetry — absorbed dose, dose equivalent, effective dose and their units
- ◆ Factors affecting radiation dose
- ◆ Image quality versus radiation dose

Higher National Unit specification: statement of standards (cont)

Unit title: Dental Radiography: Operator

Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills to include:

- ◆ Electromagnetic spectrum; low energy radio waves, high energy x-rays and gamma rays
- ◆ Natural background radiation; gamma radiation from rocks and soil, ingested radioisotopes; cosmic, radon. Artificial background radiation; nuclear explosions radioactive waste, diagnostic radiation for medical and dental exposure, radiation from occupational exposure
- ◆ Atomic structure nucleus, protons, neutrons and orbiting electrons
- ◆ Production of x-rays; electrons, filament, electron cloud, electrons from cathode to anode, focal spot on target, ionization, x-ray producing collisions, heat producing collisions, heat absorption, copper block and oil
- ◆ Components of dental x-ray equipment; tubehead, glass x-ray tube, step up and step-down transformer, oil and spacer cone
- ◆ Relationship of energy; 1% electron energy, 99% heat. Low energy absorbed by patients' soft tissues, high energy pass through soft tissues
- ◆ Continuous and characteristic spectrum
- ◆ Scattering, absorption, attenuation; ionisation
- ◆ Interactions of x-rays at the atomic structure; pure scatter, photoelectric effect pure absorption, Compton effect scatter and absorption, pure absorption
- ◆ Properties of radiation; packet of energy-photons, x-ray beam millions of photons, travel in straight lines, can travel in a vacuum, originate at the atomic level, interaction with matter at atomic level, blacken film emulsion, cannot be detected by human senses, can damage human tissue
- ◆ Biological effects of radiation; somatic deterministic; somatic stochastic; genetic stochastic effects; direct and indirect damage
- ◆ Dose Units and dosimetry; Radiation Absorbed Dose (D); Equivalent Dose (H); Effective dose(E) in dental radiography
- ◆ Risks/benefits of radiation magnitude of risk involved comparison of risk with other activities
- ◆ Dose optimisation; reference dose; radiation dose limits, natural background radiation dose
- ◆ Image quality versus radiation dose; kV energy of photons quality of the beam; increasing kV increase contrast on radiographic image; mA and time quality of photons produced; increasing mA and Time increase degree of blackening on film

The candidate will be required to label a diagram of the components of the tube head and complete a range of short answer and multiple-choice type questions to cover the Evidence Requirements.

Higher National Unit specification: statement of standards (cont)

Unit title: Dental Radiography: Operator

Outcome 2

Explain the principles of radiation protection.

Knowledge and/or Skills

- ◆ The range of principles of radiation protection associated with dental radiography

Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills associated with:

- ◆ General radiation protection; equipment operating range 60-70kV aluminium filtration; DC constant potential output, collimation, focal skin distance, audible and visual warnings, timer switches, film speed, rare earth intensifying screens, digital CCD or phosphor plates
- ◆ Clinical judgement
- ◆ Radiographic technique: film holders with beam aiming devices, minimum number of films, avoid retakes, processing conditions, quality assurance
- ◆ Optimisation (ALARP)
- ◆ International Commission on Radiological Protection; limitation; classified, non-classified workers, public
- ◆ The use of radiation protection devices; film badges, thermoluminescent dosimeters and lead protection
- ◆ Procedures for untoward incidents involving overexposure to ionising radiation
- ◆ Justification of the individual exposure including selection criteria new patients, recall patients, high caries, moderate caries, low caries periodontal disease, child, primary dentition, child mixed dentition, adolescents, adults and edentulous, include caries, implants, panoramic radiography, periodontal tissue
- ◆ Patient identification and consent; confirm patient identity; confirm which radiographs will be taken; confirm patient is consenting to exposure, parental consent before x-raying children
- ◆ Use of existing appropriate radiological information
- ◆ Alternative techniques
- ◆ Clinical evaluation of Outcome; Justification, Optimisation, Limitation
- ◆ Medico-legal issues
- ◆ Regulations; Ionising Radiation Regulations 2017 (IRR17); notify Health and Safety Executive, prior risk assessment, limitation, critical examination and acceptance reports on installation of new equipment, maintain equipment, contingency plans for equipment malfunction and over exposure, appoint a Radiation Protection Adviser, staff informed instructed and trained, designated controlled areas, appoint a Radiation Protection Supervisor, produce update local rules, quality assurance programme; employees and legal duties

Higher National Unit specification: statement of standards (cont)

Unit title: Dental Radiography: Operator

- ◆ Legislation Ionising Radiation (Medical Exposure) Regulations 2017 (IRR(ME)2017); duties of the employer, the referrer, the practitioner and the operator. Written procedures for all medical exposures, Justification, Optimisation, clinical audit, equipment inventory to be maintained, operators and practitioners received adequate training and undertake continual education
- ◆ Local rules and procedures; written set of local rules, name of Radiation Protection Supervisor, name of a Medical Physics expert MPE which is required of IR(ME)R, identification and description of controlled area, summary of working conditions, names of staff qualified to use X-ray equipment, information relating to their training and instructions on the safe use of equipment, contingency plans for equipment malfunction and accidental exposure to radiation, name of the person legally responsible for compliance with regulations, arrangements for personal dosimetry arrangements for pregnant staff
- ◆ Clinical Audit

Candidates should complete a range of short answer and multiple-choice type questions to cover the Evidence Requirements.

Outcome 3

Produce intra and extra oral radiographs using traditional and/or digital systems

Knowledge and/or Skills

Positioning requirements and radiographic technique associated with:

Intra-oral techniques (using conventional and digital systems)

- ◆ Bitewings
- ◆ Periapical views - paralleling technique
- ◆ Image receptor holders and beam aiming devices
- ◆ Endodontic radiography

Extra-oral techniques (using conventional and digital systems)

- ◆ Panoramic radiography (dental panoramic tomography)
- ◆ Cephalometry

Higher National Unit specification: statement of standards (cont)

Unit title: Dental Radiography: Operator

Evidence Requirements

The candidates will require the opportunity to gain a broad a range of practical experience to ensure they are trained to the highest standard to produce dental radiographs demonstrating the optimum diagnostic quality and using the minimal radiation dose.

- ◆ Setting up for the procedure to include a selection of direct and indirect action films; film holders with beam aiming devices; cassettes/intensifying screens, sensors, patient preparation to include children and special care patients, communication of risk to patient and cross infection control.
- ◆ Positioning requirements to include image receptor; tooth; X-ray beam for dental panoramic, bitewing, periapical-parallel and cephalometric radiographs.
- ◆ Principles of quality assurance and quality control to include image quality rating for radiographs.

Candidates should complete a portfolio containing a minimum of 40 log sheets. An example log sheet has been produced and is available to download from the SQA website.

Principles of quality assurance and quality control to include image quality rating scale for radiographs. Candidates should complete a portfolio containing a minimum of 40 log sheets. An example log sheet has been produced and is available to download from the SQA website. The candidate/operator should their grade performance against agreed standards and commit to the principles of quality assurance and quality control to include the quality rating scale for radiographs (Guidance Notes for Dental Practitioners on the Safe Use of X-ray Equipment 2nd Edition, FGDP).

Due to the importance of ensuring radiation dose limitation and justification it is essential that the candidate must be fully supported by a dentist(s) or other appropriate person who will have the responsibility of ensuring accurate positioning requirements as detailed in the evidence requirements before agreeing to allow the operator to make the exposure.

The supervising dentist(s) will discuss with the candidate/operator his/her performance and the supervising dentist(s) will have the overall responsibility of grading and commenting on each entry (see guidance notes Outcome 4).

NOTE: When the candidate exposes the patient to ionising radiation, the supervising dentist (a named individual) must hold legal responsibility in terms of IR(ME)R — it is not advised that the candidate is a named ‘operator’ in the Employers IR(ME)R procedures until training is complete and competence is achieved.

Higher National Unit specification: statement of standards (cont)

Unit title: Dental Radiography: Operator

Outcome 4

Demonstrate the principles of film handling, imaging and quality assurance

Knowledge and/or Skills

- ◆ Films and film faults.
- ◆ Radiological anatomy and Identification of common dental pathology
- ◆ Film handling, processing, and storage
- ◆ Image receptors
- ◆ Audit
- ◆ Image Quality Grading

Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills associated with:

- ◆ Films; direct and indirect action, intensifying screens, black and white final image production, solid state detectors, photostimulable phosphor plates. Conventional and digital film faults; film too dark/too light; inadequate contrast; blurred image; film marked; poor positioning and patient preparation errors
- ◆ Radiological anatomy; number, defects, shape positional defects, developmental jaw defects, acquired diseases affecting the jaws. Common dental pathology; caries, periapical and periodontal disease
- ◆ Film handling; storage, protection from heat, damp and radiation, data storage and retrieval, data protection, maintenance of film packets, cassettes and digital systems. Processing; dark room design, safe lights, chemistry, wet and automatic processing
- ◆ Audit

A QA programme must ensure the consistent production of radiographs of adequate quality for diagnostic purposes, while minimising patient doses so far as possible. It is therefore important to monitor image quality performance on a regular basis and a simple subjective image quality rating system is proposed for this. Guidance Notes for Dental Practitioners on the Safe Use of X-ray Equipment 2nd Edition [FGDP DGN2e X-ray Book Outer Covers.indd \(rqia.org.uk\)](http://www.rqia.org.uk)

The candidate should carry out a non-clinical audit resulting in the formulation of a short report to represent the Outcomes of the audit and where appropriate recommended actions.

The audit will require the candidate to:

- ◆ Use the radiographs they have produced as evidenced in Outcome 3 **(this should only include exposed radiographs only, not simulations e.g., used for cephalometric cases)**
- ◆ Employ the use of the standardised image quality grading ratings ('A' or 'N')
- ◆ Record the findings of the audit
- ◆ Identify areas for improvement
- ◆ Formulate a report as evidence

The supervising dentist/appropriate person must sign the audit report as evidence of successful completion.

Higher National Unit specification: support notes

Unit title: Dental Radiography: Operator

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 80 hours.

Guidance on the content and context for this Unit

The Evidence Requirements contained within this Unit specification focus on the core curriculum of dental radiography as outlined in the British Society of Dental and Maxillofacial Radiology Core Curriculum in Dental Radiography for Dental Care professionals.

Regulation 17 paragraph 1 of the Ionising Radiation (Medical Exposure) Regulations 2017 (IRMER)¹ states that no **practitioner** or **operator** shall carry out a medical or dental exposure or any practical aspect without having been adequately trained. The requirements for adequate training are set out in Schedule 2 of the Regulations. The Schedule states that **operators** shall have completed training, including theoretical knowledge and practical experience in:

- i) Radiation production, radiation protection and statutory obligations relating to ionising radiations, as are relevant to their functions as practitioner or operator; and
- ii) Diagnostic radiology as relevant to their specific area of practice.

The prescriptive range of panoramic, bitewing and periapical radiographs associated with **Outcome 3** are the types most commonly required/requested within a general dental/private practice. Cephalometric radiographs are mainly associated with specialists' practices, and it is the Centres responsibility to ensure that arrangements are made to provide the candidate with this practical experience. In non-routine circumstances it is acceptable to carry out a minimum of two simulations on fellow learners or work colleagues, to achieve the minimum evidence requirement. If simulation is practiced, it should not result in an exposure being made.

Given the health and safety and quality assurance implications of this unit it is a requirement that all approved centres comply with 100% internal and external verification procedures.

Note: an example of an 'appropriate person' could include a specialist dental radiographer or radiography manager who has IR(ME)R responsibilities.

Higher National Unit specification: support notes (cont)

Unit title: Dental Radiography: Operator

Guidance on the delivery of this Unit

It is recommended that the Outcomes are delivered in the order they are presented in.

Assessment evidence produced for Outcome 3 will provide the basis of the audit and report required for Outcome 4.

Outcomes 1 and 2

Lectures, self directed learning and research will be used to develop the candidate's knowledge.

Outcome 3

Lectures will be given by individuals who are occupationally competent. Self-directed learning, research and simulated practical lessons will also be used to support the candidate's skills and knowledge. The practical training/instruction will be the responsibility of the dentist(s) or, depending on their workplace, an appropriately qualified person.

Outcome 4

Lectures, self-directed learning and research will be used to support the candidate's knowledge. Discussion and support from a dentist or appropriately qualified person will guide the candidate to complete an audit demonstrating competence to quality rate the range of processed radiographs which were produced as evidence for Outcome 3.

Guidance on the assessment of this Unit

There is a mix of assessment methods used throughout this Unit. Candidates must all Evidence Requirements for each Outcome to pass the

Outcome 4 of this Unit: *Demonstrate the principles of film handling, imaging and quality assurance* may provide the foundation for the audit associated with the optional Unit within the HND in Dental Nursing framework: *Managing Quality in Dental Practice* FN3W 35.

Assessment Guidelines

Outcome 1

It is recommended that this assessment, i.e., the labelling of the diagram and the completion of set questions, takes place under closed-book conditions.

Outcome 2

It is recommended that this assessment, i.e., completion of set questions, takes place under closed-book conditions

Outcome 3

The candidate portfolio should contain a minimum of **40** standardised log sheets detailed as follows:

- ◆ Ten logs to evidence dental panoramic radiographs
- ◆ Ten logs to evidence bitewing radiographs (pairs)
- ◆ Eighteen logs to evidence paralleling technique periapical radiographs this **must** include evidence of endodontic radiography
- ◆ Two logs to evidence cephalometric skull views. Note candidates may have to make arrangements with specialist dental practices/dental teaching hospitals to gather this evidence. It is acceptable for this evidence to be gathered by simulation to avoid exposure within these dental environments. If simulation is practiced, it should not result in an exposure being made.

This **must** be directly supervised by a registered dentist(s) or another appropriately qualified person who retain legal responsibilities under IR(ME)R.

The log sheets will require the candidate/operator to evidence the following:

- ◆ Patient identification
- ◆ Patient communication
- ◆ Infection prevention and control
- ◆ Identification and set up of the equipment for the prescribed radiograph
- ◆ Operator technique
- ◆ Image quality

An example 'Log Sheet' has been produced and is available to download from the SQA website.

Higher National Unit specification: support notes (cont)

Unit title: Dental Radiography: Operator

Outcome 4

Using the radiographs produced from Outcome 3, the candidate's report will present the findings of their audit based on the grading systems detailed below. It will also require evidence of the following:

- ◆ The types of films used
- ◆ Where appropriate, film faults and the reason for this
- ◆ A description of the radiological anatomy associated with each film
- ◆ Where appropriate details of the dental pathology
- ◆ The method(s) used to process and store the film
- ◆ Image Quality Grading

Quality Grading

A QA programme must ensure the consistent production of radiographs of adequate quality for diagnostic purposes, while minimising patient doses so far as possible. It is therefore important to monitor image quality performance on a regular basis and a simple subjective image quality rating system is proposed for this.

Quality Rating	Basis	Target (percentage of rating radiographs or CBCT images in sample)	
		Digital Imaging	Film imaging
Diagnostically acceptable ('A')	No errors or minimal errors in either patient preparation, exposure, positioning, image (receptor) processing or image reconstruction and of sufficient image quality to answer the clinical question	Not less than 95%	Not less than 90%
Diagnostically not acceptable ('N')	Errors in either patient preparation, exposure, positioning, image receptor) processing or image reconstruction which render the image diagnostically unacceptable	Not greater than 5%	Not greater than 10%

Table 1: Guidance Notes for Dental Practitioners on the Safe Use of X-ray Equipment 2nd Edition [FGDP DGN2e X-ray Book Outer Covers.indd \(rqia.org.uk\)](#)

Online and Distance Learning

This Unit could be delivered by Open Learning, although candidates studying for this Unit as part of a Group Award would have to attend a placement to complete it. This Unit could also be attractive as a standalone Unit and could be delivered via open learning to Dental Care Professionals who are employed within a dental practice and have the agreed supervision of a registered dentist(s). Centre-devised supervision agreement should detail controlled conditions to ensure authenticity of evidence.

Opportunities for developing Core Skills

Core Skills in *Communication* will be developed as the candidate acts as the operator, supporting and engaging with the patient, using verbal communication skills prior to, during and following the use of x-ray generating equipment and completing accurate records and reports.

Communication and Working with Others will also be developed as the operator discusses and agrees the Outcomes of their performance with the prescribing dentist(s).

There is opportunity to develop *Information and Communication Technology* if candidates are operating digital x-ray generating systems as this will require the candidate to display and store patient data using computerized systems.

The core skill of *Problem Solving* will be developed through the planned audit attributed to the Outcome covering quality assurance systems associated with conventional and digital imaging systems. The audit will encourage the candidate to critically analyse and grade processed radiographs and make recommendations for improvement.

Disabled candidates and/or those with additional support needs

The additional support needs of individual candidates should be considered when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website www.sqa.org.uk/assessmentarrangements

History of changes to Unit

Version	Description of change	Date
06	Revision of Outcome 3 evidence requirements to remove unnecessary Occlusal and Bisecting Angle techniques with a reduction of replication in the quantity of cases required. Updated Outcome 4 to reflect new Quality Rating Criteria	19/12/22
05	Dates of IR(ME)R updated	04/05/18
04	Minor revisions to reflect that the Ionising Radiation Regulations have been updated	08/03/18
03	Guidance on Content and Context for Outcome 3 (Page 9) expanded.	13/06/17
02	Clarification on 'appropriately qualified person' who can undertake supervision duties. References to 'oblique lateral' removed from Outcome 3.	13/02/13
	Dates of IR(ME)R updated	

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General information for candidates

Unit title: Dental Radiography: Operator

This Unit is intended for those who will be acting as operators working with x-ray generating equipment.

It will develop your skills and knowledge as you expose patients to ionising radiation taking a range of radiographs requested by a registered dental practitioner. The completion of this Unit should meet the legislative requirements associated with Ionising Radiation (Medical Exposure) Regulations 2017, (IR(ME) R) 2017, although successful completion does not provide entitlement which still is a process that is required with your employer. The Unit will develop your detailed knowledge and skills in relation to radiation production, the fundamentals of radiation physics, radiation protection and the production and quality assurance of dental radiographs.

This Unit is for you if you are a qualified Dental Care Professional, currently registered with the General Dental Council. It is essential that you have the support (and direct supervision) of a registered dental practitioner or other appropriately qualified person who will validate your workplace evidence.

On completion of the Unit, you should be able to:

- ◆ Explain the fundamentals of radiation physics, the production of ionising radiation and the properties of and interaction of x-rays
- ◆ Explain the principles of radiation protection
- ◆ Produce intra and extra oral radiographs using conventional and/or digital systems
- ◆ Demonstrate the principles of imaging, film handling and audit

Assessment for this Unit is a mix of question papers, reports based on your research and completion of patient log sheets.