The Role of the Radiographer in DXA and Osteoporosis Services

ISBN: 978-1-911738-10-7

Reviewed January 2025
Next review date 2029

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Executive summary

Dual Energy X-Ray Absorptiometry (DXA) is the established standard method of measuring bone mineral density (BMD). It is a low radiation dose examination used to help diagnose bone conditions such as low bone mass and osteoporosis[1]. It is used within the National Health Service (NHS) and in the independent sector for a range of procedures but, most importantly, it is recognised for its value in the diagnostic pathway of patients at risk of fracture.

The radiographic workforce is integral to the multi-disciplinary team in modern DXA and osteoporosis services. Through advanced and consultant practice, radiographers can effectively develop flexible models of care and integrate with fracture liaison services (FLSs) and primary care to deliver safe and efficient fracture detection and care pathways.

Radiographers have expert skills in the delivery of medical and non-medical exposures of ionising radiation and in the radiation protection of patients, the healthcare workforce and the public. DXA may be used for research purposes and in certain justified cases, to help understand body composition changes in health and disease[2].

The purpose of this document is to promote the expert skills of the radiographer working in DXA and illustrate their role within osteoporosis services. Relevant to commissioners and service managers, it considers service quality, including the key skills, knowledge and behaviours (personal attributes and conduct) required to work in DXA and as part of a wider osteoporosis service. It provides assurance to patients and service users of the professional standards the College of Radiographers (CoR) considers essential for radiographers involved in the delivery of high-quality specialised fracture prevention, detection and ongoing care.

1. Introduction

Osteoporosis is a condition that causes bones to lose their strength and become more likely to break. It can develop slowly over years and the first sign of the disease may be when an apparently minor injury results in a fracture, most commonly in the wrist, hip or spine. This is termed a fragility fracture and results from a fall from standing height or less, or a force not normally expected to result in fracture[3].

It is estimated that more than three million people in the UK have osteoporosis and it causes around five hundred thousand osteoporotic fractures every year. After the menopause women may experience bone loss as a result of a decrease in the production of oestrogen, a hormone that

protects bones, but osteoporosis can also affect both men and women increasingly with age[4].

As people are living longer, the incidence and associated cost of osteoporosis and fragility fractures is likely to rise. The importance of early detection of osteoporosis, or low bone mass, is well documented and radiographers working as part of a multi-professional osteoporosis team or FLS are ideally placed to undertake targeted assessments of fracture risk[5].

Current evidence shows that BMD at the hip is the most reliable measurement for predicting hip fracture risk, and spinal BMD should be used for monitoring treatment[6].

The CoR believes patients have the right to expect the highest professional standards of care and be treated with compassion and integrity in an environment that listens and responds to their individual needs.

The Society of Radiographers (SoR) and the CoR work in partnership with patients and the public and considers their involvement integral to the achievement of high standards of radiographic practice. Working together enables us to appreciate what works well and what requires improvement and crucially to understand what matters to our patients. We are most grateful to Linda and Paul for sharing their personal stories here.

2. Personal stories

2.1 Linda—in her own words

"In 2007 I suffered a fracture to my arm and shoulder. Following this, I underwent a DXA scan which was reported as normal and no medical intervention was indicated. In 2014, I visited my GP because I had severe back pain and spasms. It got to a point where I was unable to do the flower arranging classes I attend because I couldn't stand for long enough without extreme pain. At these visits I was prescribed pain killers and referred to a physiotherapist. The physiotherapist recommended exercises, including one, exercising with a ball against a wall, which I found very difficult. I was also having hip pain and had to keep on sitting down when walking. I found I was unable to lift my arms without pain in my back and my chest feeling as though it was being squeezed, but the GP concluded that there was nothing wrong with my chest. After 6 weeks of physiotherapy, I carried on as normal, but was told I had weak hips. Between January 2015 and January 2016 I saw my GP three times about my back pain. After swimming one day in January 2016, I bent over to put on shoes and had acute back pain. I went to the GP again and was given pain killers. One week later, I went to the GP again and was prescribed yet more pain killers. The

pain was not improving, so I went to A&E and was given still more pain killers. At no time was I referred for an x-ray or had any suggestion that I might have vertebral fractures. Eventually, in February 2016, I was referred for an x-ray and I had four vertebral fractures noted on this. In March 2016, I had a further DXA scan, which still showed osteopenia, but also demonstrated an additional two vertebral fractures since my x-ray. I have subsequently sustained a further vertebral fracture, so now have a total of 7. I had been saying for a long time that I'd lost 1.5 inches in height and I've now lost 3.5 inches. I have fractured vertebrae merely turning my body or coughing. I live in constant pain and discomfort and now have such a deformity in my spine that I have to carry a cushion everywhere with me to make sitting more comfortable when I am out. I feel that there were many missed opportunities to detect my vertebral fractures and prevent me from having more, but instead I was just given pain killers or physiotherapy and they didn't consider osteoporosis or vertebral fractures. I would like to see improved osteoporosis awareness across all healthcare professionals to prevent others suffering in the way I have and am. In 2016 when comparing both DXA scans it was reported that my T-score in 2007 was - 1.8 and that I wasn't investigated. How I wish I was told that I needed treatment then. I often think that I was not considered to be osteoporotic because I had the fractures at a relatively young age and was considered to be fit and healthy."

2.2 Paul

Paul is fit, active and a keen cyclist. He also has osteoporosis. Paul was involved in an accident when a motorist drove into him while he was cycling and he sustained multiple fractures as a result. Paul sustained vertebral, leg and arm fractures and was hospitalised for three weeks following the collision. He spent three months in an orthosis (a brace to support the spine or limbs) for his vertebral fractures and has spent the last two years regaining his fitness. At the time of the accident, Paul was not known to have osteoporosis, but this was identified three months after his fractures were sustained. Paul had previously sought a bone density scan through his doctor, because his mother had suffered from severe osteoporosis, but this was refused as he was considered a low risk. This same conclusion was reached when he questioned the need for a scan while still in hospital. Paul is keen to raise the profile of osteoporosis in men and highlight that even when fractures occur through trauma, underlying osteoporosis may be present.

2.3 Impact of patient stories

Linda and Pauls' stories illustrate the different circumstances that may lead to someone discovering they have osteoporosis. Their personal experiences demonstrate variations in practice and highlight opportunities for improvement. Radiographers and other healthcare professionals (HCPs) should

make best use of early opportunities to diagnose fractures. They have a duty of care to every patient and their representative if they have one, at every point of contact with them. Radiographers and HCPs should listen and be receptive to individuals' stories. They have a crucial role as patient advocates, for example helping people to understand their diagnosis so they can make personal decisions about their health. Every person has different circumstances, beliefs, and preferences; advocates can help safeguard consistent and high standards of compassionate care.

3. Who uses DXA and what for (what can service users expect)

Osteoporosis diagnosis is undertaken using a holistic approach, involving consideration of clinical risk factors, using fracture risk assessment tools such as FRAX[7,8] or QFracture[8] alongside the results from a DXA scan, which is currently recognised as the gold standard for diagnosing osteoporosis[9]. Clinical risk factors are also used to identify those patients with a high fracture risk and most likely to develop osteoporosis, with such risk factors yielding appropriate justification for a DXA scan under The Ionising Radiation (Medical Exposure) Regulations (IR(ME)R) 2017[10], IR(ME)R (NI) 2018[11], and The Ionising Radiation (Medical Exposure) (Amendment) Regulations 2024[12] (hereafter referred to collectively as IR(ME)R). A DXA scan generally takes 15 to 20 minutes, with the standard World Health Organization (WHO) recommended sites for measurement being the lumbar spine, unilateral or bilateral proximal femora and in some cases, the forearm[13]. The use of DXA Vertebral Fracture Assessment (VFA) scans provide a low-dose visual assessment of vertebrae from the fourth thoracic vertebra (upper spine) to the level of the fourth or fifth lumbar vertebra (lower spine) for fractures in patients meeting scan criteria[14,15]. Since a much lower dose of ionising radiation is used for VFA scans in comparison to thoraco-lumbar spine radiographs, these scans can be undertaken on those who present clinical risk(s) for osteoporosis, even in the absence of a strong clinical suspicion of fracture[16].

In some circumstances, a total body DXA for body composition may be a useful addition to central DXA. However, the impact on clinical outcomes when this scan is performed is uncertain in many cases[14]. Total body scans are used to evaluate bone and muscle mass percentage in the assessment of poor body balance and sarcopenia, which is the progressive reduction in skeletal muscle mass and muscle strength. DXA is also used to measure changes in bone mass over a period of treatment, or to monitor rates of bone loss with the aim of directing treatment at the appropriate threshold. Typical scan intervals are no less than 24 months but may be up to 5 years.

3.1 Other clinical applications of DXA

Depending on local expertise, equipment and available applications, radiographers working in DXA may provide a range of additional services including whole body scanning and Body Composition Analysis (BCA). Some examples of the people who may benefit from this are:

- Infants 0–3 years of age — assessment of bone mineral content
- Paediatrics 3–5 years and adolescents 5–20 years of age for BMD, e.g.:
    - » Aged 5–20 years for BMD of the total body less the head (TBLH) Z scores in line with International Society for Clinical Densitometry (ISCD) guidelines[14,15]
    - » Growth deficiency and failure to thrive — baseline and follow up scans
    - » Muscle wasting in Duchenne Muscular Dystrophy (DMD)
- People aged 20 years and over BMD and BCA:
    - » Longitudinal studies in BMD
    - » Body composition studies using fat/lean ratios and visceral adipose tissue (VAT) estimates in:
        - › Athletes — where there are concerns regarding low body fat and as a one-off measurement which is not repeated within three months[17]
        - › Obesity, diabetic and bariatric clinics[18]
        - › Sarcopenia
        - › Lipodystrophy (redistribution of appendicular fat into visceral fat as a side effect of anti-retroviral drugs)
        - › Cardiovascular metabolic disease (high VAT estimates, although waist–hip or waist–height ratios may provide a useful alternative)
        - › Eating disorders
        - › Coeliac disease
        - › Following organ transplant treatment with immunocompromising drugs/steroids

3.2 Non-medical imaging exposures in DXA

In addition to the medical use of DXA, radiographers have the knowledge and skills to deliver non-medical exposures safely. IR(ME)R applies to non-medical imaging exposures, which are defined as "any deliberate exposure of humans for imaging purposes using medical radiological equipment, where the primary intention of the exposure is not to bring a health benefit to the individual being exposed"[11,12]. Examples of non-medical DXA exposures are:

- Ethically approved research studies
- Total body scans for body composition information in limited, justified cases, for example in sports science

In response to a request by the Department of Health and Social Care (DHSC), the Committee on Medical Aspects of Radiation in the Environment (COMARE) has produced advice on medical radiation doses associated with DXA scans for sports performance assessments and other non-medical practices[19].

4. The role of the radiographer

4.1 A radiographer's story

"After I qualified as a diagnostic radiographer, I was working a shift in a community hospital when a lady in her late 60's arrived straight from her GP for thoracic spinal imaging due to sudden onset and worsening back pain. The imaging revealed a severe osteoporotic vertebral fracture. All I could do was make the lady as comfortable as I could during the imaging procedure and reassure her that I would ensure the images would be reported immediately and her GP would receive the results later that day.

This event left me feeling that people with osteoporosis may not receive the same support as people with injuries caused by major trauma, even though the pain and suffering were comparable. I therefore began to research osteoporosis not only from a bone structure point of view, but from the patient support angle. I became aware of the National Osteoporosis Society (NOS) [Royal Osteoporosis Society from 2018] and the wonderful support, education and training they provide for patients and Allied Health Professionals (AHPs), together with information that The National Institute for Health and Care Excellence (NICE) and The National Osteoporosis Guideline Group (NOGG) publish. I realised that osteoporosis is a worldwide health concern. I was keen to pursue this patient pathway further and I am now a Fracture Liaison Radiographer, identifying fragility fractures in an effort to capture patients at risk of osteoporosis and to facilitate faster access to treatment to lessen the burden of serious fractures in later life."

Radiographers recognise the suffering that a delayed diagnosis may cause. They are well placed to influence service delivery, providing assurances of high-quality diagnosis and care, facilitating diagnosis, and improving the experiences that people with osteoporosis have when entering the diagnostic imaging pathway. Radiographers can develop their careers through further education with the Royal Osteoporosis Society (ROS) (previously the National Osteoporosis Society (NOS)), which provides foundation and advanced modules in 'Fracture Prevention Practitioner Training' for healthcare professionals[20], and through postgraduate study with the University of Derby[21]. They may also have the opportunity to work as part of a multi-professional team within an integrated FLS.

The scope of practice of a radiographer working with DXA may include:

- primary and secondary prevention advice
- image acquisition
- recognition and diagnosis of fractures (including provision of a written report)
- fracture risk assessment
- diagnosis of osteoporosis
- assessment of rates of bone loss
- treatment recommendations under protocol
- follow-up care
- health promotion and patient advocacy

4.2 Radiographers' role in public health

Radiographers working within osteoporosis services, including DXA scanning and the wider provision, have key skills to raise the profile and understanding of this condition within the communities they support. While osteoporosis is the most prevalent metabolic bone disease within the western world, its profile is still lower than many less common diseases such as cancer and diabetes. With the burden of osteoporosis set to increase[22], greater engagement of radiographers in public health and health improvement is essential[23]. Radiographers specialising in osteoporosis are experts in its diagnosis and these skills can be utilised to help influence local and national strategies, to promote healthy environments, disease prevention strategies, and early diagnosis and intervention. Falls and osteoporosis go hand in hand to result in fractures and, as such, a falls prevention agenda needs to be high on the priority list for radiographers and service managers. Identifying frequent fallers and referral to appropriate services is a key addition to the scanning and

diagnostic responsibilities of radiographers. Making every contact count (MEEC) can be used as a framework to underpin the health promotion responsibilities of radiographers[24]. Currently, smoking, and drinking more than three units of alcohol per day are both clinical risk factors for osteoporosis, both being modifiable lifestyle choices[25]. Patients may record such behaviours in questionnaires; this information can be used either at initial contact to provide lifestyle advice regarding bone health, or by the reporting radiographer (or other reporting healthcare professional) to make recommendations in their report. A sedentary lifestyle is related to reduced bone density[26] and obesity is related to increased lower limb fracture rate[26, 27]. On a day-to-day basis, radiographers may offer lifestyle advice while interacting with each patient during their scan. In addition to this, they may offer group educational activities for patients diagnosed with osteoporosis or those at risk of developing osteoporosis. These activities can be multi-professional and provide an excellent way to share a range of information on diet, exercise, treatment options, treatment instructions and compliance, and modifiable lifestyle changes which can reduce clinical risk factors for osteoporosis and fracture. Public events also give people the opportunity to share their experiences. In addition, radiographers can aid patient understanding and support by signposting organisations such as the ROS.

5. Knowledge and skills

Radiographer and diagnostic radiographer are titles protected by law. Radiographers are registered healthcare professionals bound by the Health and Care Professions Council (HCPC) standards of conduct performance and ethics[28]. The HCPC approves pre-registration BSc (hons) and MSc level degrees in diagnostic radiography. This provides an assurance to patients, employers and commissioners that radiographers have met a recognised standard of skills, knowledge and behaviour. There is a professional expectation for radiographers to behave in a way that reflects the vision and values[29], and to practice in a safe and competent manner within a written scope of practice[30].

Radiographers, assistant practitioners (APs) and other HCPs working as part of a DXA service should have a robust knowledge of local and national guidance for best practice. The ROS recommend guidance relevant to the UK[31], including NICE guidance and quality standards[3], and the Scottish Intercollegiate Guidelines Network (SIGN)[32].

Radiographers are required to bring particular skills to DXA and osteoporosis services. In addition to acquiring images, like all HCPs, they have a responsibility for safeguarding adults and children. Radiographers must undertake continuing professional development and perform quality assurance and clinical audit. They are often involved with mentoring and clinical supervision of peers,

preceptorship of newly qualified radiographers, supervision of APs and other trainees, and the development and delivery of advice and educational material. They may also be responsible for clinical interpretation.

Some patients present with special requirements such as mobility difficulties. Radiographers need to understand the principals of safe manual handling to protect themselves and others. They should demonstrate compassion, patience and empathy with everyone, but in particular with people who find it difficult to move or lie down. Patients may be confused or anxious about the results of their scan and they may fear the impact a diagnosis of osteoporosis or increased fracture risk will have on their daily activities. They may have dementia or be experiencing learning, vision, hearing or speech difficulties. They may have cognitive impairment. With due regard to the principles of the Mental Capacity Act (2005) and the Care Act (2014), the radiographer must have the ability to recognise and adapt to individual patients' needs and, without making judgement or assumption, provide a high standard of care to every patient. Radiographers and managers should ensure patients are partners in the design and delivery of services and that dignity, diversity and equality are respected at all times.

DXA services may be provided in remote or mobile locations and radiographers should understand the challenges presented by lone working in terms of the safety and wellbeing of themselves and their patients. Employers have a responsibility to provide written procedures for lone working to safeguard patients and staff.

6. Training and education

To ensure DXA services are safe, high quality and effective, it is important that HCPs undertaking any of the practical aspects of DXA are appropriately trained. Errors caused by inadequate training or education put the patient at risk of missed or delayed diagnosis. It is a requirement in law under IR(ME)R Schedule 3[10–12], that 'Practitioners' and 'Operators' must have successfully completed training, which includes theoretical knowledge and practical experience. Radiographers and CoR accredited APs will meet the IR(ME)R requirements for adequate training to be entitled by the employer to act as an 'Operator'. Employers should consider this the benchmark against which they define adequate training for other HCPs carrying out practical aspects of a DXA exposure. The SoR and CoR do not consider that trainee APs or student radiographers should act as an 'Operator'[33].

Consistent positioning and technique is of particular importance in DXA to ensure reproducibility, accuracy and precision for patients having follow up scans. Radiographic positioning is a tactile skill and radiographers should be aware of consent[34] and chaperone[35] policies and procedures. Practical

aspects of the exposure such as pillow height and patient leg height as well as post processing techniques all influence the diagnostic result. Radiographers need to understand avoidable and unavoidable artefacts and the impact these may have on BMD measurements. From time to time, DXA images may demonstrate incidental findings that require action. Radiographers who report DXA images should have the knowledge, skills and competence to follow the correct procedure for communication of findings in accordance with The Royal College of Radiologists (RCR) reporting standards[36].

6.1 Training pathways

Radiographers working in DXA will have achieved an approved BSc (hons) degree in radiography. There are two main pathways for the development of individuals working in DXA services:

- Specific equipment training provided by the manufacturers and delivered by an applications specialist. For example, the CoR approved training 'IR(ME)R Theory for DXA Operator' is provided by Vertec.
- Training schemes, courses and professional resources such as:
  - » The ROS 'National Training Scheme for Bone Densitometry' **click here for further information**; approved by the CoR and delivered every 18 months.
  - » 'Bone Densitometry Foundation Course', a CoR-approved online course and assessment which is available to all HCPs and individuals working in DXA **click here for further information**. This course is accessible through the e-Learning for Healthcare portal at www.e-lfh.org.uk or via the Electronic Staff Record (ESR).
  - » The ROS online foundation and advanced modules and assessments in 'Fracture Prevention Practitioner Training' **click here for further information**, offering HCPs the opportunity to further extend their knowledge in fracture prevention for people at risk of osteoporosis and fragility fractures.
  - » The International Society for Clinical Densitometry provide certification courses for clinicians and technologists. Further information is available at **click here for further information**.
  - » Reporting radiographers and radiologists have an essential role to play in systematically identifying fractures. They should use clear terminology to expedite appropriate management in order to avoid further fragility fractures. The NOS (2017) *Clinical Guidance for the Effective Identification of Vertebral Fractures* assists clinicians in establishing processes to maximise identification of patients with vertebral fractures, and enable timely assessment and treatment[5].

Although pre-registration radiography training will provide adequate education and practical skills, there is a clear need for supplementary training in DXA. There is much scope for the addition of DXA-specific performance competencies. Employers should assess individuals at each level of practice against a locally agreed competency framework which takes into account the type of equipment available and the needs of the local community. An example framework can be found in appendix 2.

DXA and osteoporosis services provide opportunities for radiographers to advance their core skills and knowledge, to facilitate flexible and patient-responsive service development within an integrated care pathway.

7. Enhanced, advanced and consultant practice

Radiographers may develop their skills to enhanced, advanced and consultant level where the essential four domains of higher-level practice are demonstrated[37]. In 2017 Health Education England reinforced and defined advanced clinical practice[38]. The SoR and CoR believe that, with CoR approved MSc-level further education and training, and agreement from the local employing health care provider, e.g. trust or board, radiographers can use their expert skills and knowledge to extend their scope of practice to reporting. Reporting describes the activity of radiographers and other professionals who produce a diagnostic report. It is an element of enhanced and advanced practice, where the radiographer is working alongside radiologists and other clinicians within an effective multi-disciplinary team. Radiographers wishing to report DXA images are able to benchmark their practice using an established gold standard available through the ROS. ROS published (in 2012 as NOS) DXA reporting guidance in line with the International Society for Clinical Densitometry (ISCD) and the University of Derby[39]. This standard forms the basis for the delivery of a Postgraduate Certificate in Bone Densitometry available at the University of Derby.

Radiographer enhanced and advanced practice can improve the quality and efficiency of DXA and osteoporosis services when integrated into a planned care pathway. The impact of enhanced and advanced radiographer practitioners can be measured across a range of complex activities including reporting[40].

Consultant radiographers within DXA services manage the whole patient pathway and are integral to the delivery of effective evidence-based care. They are nationally and often internationally recognised experts in their field, providing leadership and influence. They will undertake research, be responsible for the design of innovative models of care and demonstrate expert clinical and educational skills to inspire a learning and development culture within an organisation[37].

7.1 Radiographers and prescribing of medicines in DXA

Patients who use DXA services for diagnosis and follow up frequently require prescription only medicines to manage and improve their condition. These medicines are prescribed by General Practitioners (GPs), hospital doctors or appropriately trained and entitled members of the hospital-based multi-disciplinary team such as nurse prescribers or physiotherapist prescribers but currently not radiographers. Unlike therapeutic radiographers, diagnostic radiographers are not legally entitled to train as independent prescribers; however, they are ideally placed to support patients with their medication during the review process. Diagnostic radiographers may train as supplementary prescribers[41] and prescribe in partnership with a doctor. They may only do so under the terms of a patient specific clinical management plan agreed with the doctor, after a diagnosis is made. Therefore, supplementary prescribing does not lend itself to the DXA clinic.

Patient access to medicines via a patient group directive (PGD) in the delivery of bone health management is limited. Limitations arise due to the need for patients to fit specific criteria, for example patients who have osteopenia and fragility fractures would not have access to medicines via this mechanism where the PGD directs use only in those with diagnosed osteoporosis.

A vision for the future may be that of an advanced clinical practitioner working in DXA independently prescribing supplements to maximise bone turnover, such as calcium and vitamin D or prescribing therapeutic bone protection such as bisphosphonates.

Any non-medical independent prescriber must undertake an approved postgraduate programme of education and have an annotation on their professional register detailing their entitlement. Independent prescribing rights for diagnostic radiographers, if achieved, would be subject to the same rigorous training, competency and supervision as other HCPs already afforded those rights.

8. Continuing professional development (CPD)

Evidenced CPD is an explicit requirement of registration with the HCPC[28] and with other regulators such as the Nursing and Midwifery Council (NMC)[42]. It is a requirement for membership of the SoR and is required by law for examinations involving exposure to ionising radiations (IR(ME)R 2017 Regulation 6 (3) (b))[10–12]. CPD is more than a means of maintaining registration, it enables reflection of personal practice and drives evidence-based service improvement, innovation and patient safety initiatives. Opportunities presented through local, national and international conferences may facilitate and augment a culture of learning and collaborative working.

CPD is fundamental to safe practice and integral to good governance frameworks. Members of the SoR have access to an online CPD planning, recording and evaluation system called CPD Now which is available through the website https://www.sor.org/learning/cpd/cpd-now.

9. Accreditation

CoR accreditation of assistant-level practice[43] assures service users that APs have engaged with CPD to meet the professional body requirements of their role. Accreditation is not an assurance of clinical competence. It is the responsibility of the employer to ensure an individual is adequately trained and experienced.

10. Supervision

Professional supervision within DXA and osteoporosis services provides a means of monitoring, supporting and improving practice for the benefit of service users and should be used within a framework for continuing professional development[44].

11. Radiation protection

On 1 January 2018 the Ionising Radiations Regulations (IRR) 2017 (IRR17) replaced IRR99[45]. Anyone working with ionising radiations is now required to notify, register, or get consent for such work from the Health and Safety Executive (HSE) depending on the level of risk involved.

Radiographers and managers responsible for DXA services must be aware of their responsibilities under IRR17. They must appoint a Radiation Protection Adviser (RPA) and a Radiation Protection Supervisor (RPS) to oversee compliance with the local rules for the radiation protection of employees and the public within their working environment[45]. They should be aware of the standards for equipment used in connection with medical exposure[46] and the radiation protection advice for medical staff performing DXA given by the International Atomic Energy Agency (IAEA)[47].

As a diagnostic imaging pathway, DXA offers a low radiation dose technique. It is a complex process to estimate a person's radiation dose from a medical exposure as it will largely depend upon their size and the clinical indication for the exposure. The amount of radiation used during a DXA scan is similar to natural background radiation – less than one tenth of the dose of a chest x-ray[48].

Radiographers in DXA must have a thorough knowledge of radiation protection and understand their responsibilities under IR(ME)R and IRR17. The legislation provides a legal framework intended to protect the patient from risks associated with ionising radiation (under IR(ME)R) and also to

ensure that occupational and public exposures are kept as low as practicable (under IRR). The knowledge, skills and aptitude to recognise and avoid non-intended outcomes and errors is key to safe radiographic practice. There is a requirement under IR(ME)R 2017 for the patient to be provided, wherever practicable, with adequate information relating to the benefits and risks of DXA radiation exposure prior to the exposure taking place. The radiographer and AP should be aware of their local policies and procedures relating to this.

Radiographers may act as 'Operator' and/or 'Practitioner'. 'Practitioner' here refers to the particular IR(ME)R duty-holder role and should be distinguished from its use as part of a job title. IR(ME)R Practitioners must be registered healthcare professionals. Radiographers acting as Operators or Practitioners must comply with the employer's written procedures. A Practitioner or Operator must not carry out any exposure or any supporting aspects of an exposure without adequate training. Individuals named and entitled to undertake these roles will be responsible for their own practice.

The IR(ME)R Practitioner, which may be a radiologist or radiographer when entitled, is responsible for the justification of the medical exposure. Justification is an intellectual process that evaluates the potential diagnostic or therapeutic benefit to the individual against the risk of the exposure, taking into account special considerations such as age and pregnancy status. It also considers the suitability of alternative methods of investigation that do not involve ionising radiations. The Practitioner may issue guidelines within which the Operator may authorise an exposure but the Practitioner remains responsible for justification. This is a high-level task that would normally be associated with advanced or consultant level practice.

The IR(ME)R Operator, which may be a radiographer or AP when entitled, is responsible for any practical aspect of the medical exposure. In addition to undertaking the scan, this may include authorisation of the exposure under agreed and relevant authorisation guidelines as well as image interpretation or clinical reporting for appropriately trained registered healthcare professionals.

Responsibility for compliance with IR(ME)R and IRR rests firmly with the employer. Non-compliance can lead to the issue of improvement or prohibition notices by the regulator or in extreme cases, prosecution. Individuals undertaking exposures involving ionising radiation in DXA services must be adequately trained and entitled as Operators. Employers and radiographers must seek advice from a locally appointed medical physics expert (MPE).

The radiographer in DXA must be aware of dose constraints and European, National and eLocal Diagnostic Reference Levels (DRLs), where they exist, for the examinations they undertake[10–12]. They must take particular care when scanning young individuals who are particularly sensitive and vulnerable to greater cumulative lifetime risks of cell damage caused by radiation.

The radiographer must work within their scope of practice[30]. A trainee can undertake diagnostic exposures under direct supervision by an entitled Operator who is responsible for the task being completed correctly[44].

Both IR(ME)R Referrers and Practitioners are required to assess the patient's clinical needs and suitability for a particular medical exposure. Referrers must be registered healthcare professionals who are entitled in accordance with the Employer's Procedures to refer individuals for medical exposures. The Referrer must supply the Practitioner with sufficient medical data (such as previous diagnostic information or medical records) relevant to the exposure requested to enable the Practitioner to decide whether there is sufficient net benefit[10–12]. For example, writing "bone scan" on a request card is open to misinterpretation in the absence of a complete medical history. While DXA is itself a low-dose procedure, there is clear potential for the patient to receive an unintended exposure, in this case perhaps a nuclear medicine bone scan, which if performed, would be an error notifiable to the regulator.

IR(ME)R Implications for clinical practice in diagnostic imaging, interventional radiology and diagnostic nuclear medicine[49] provides practical support to employers and staff who provide clinical imaging and interventional radiology services using ionising radiations. This document will be updated to include The Ionising Radiation (Medical Exposure) (Amendment) Regulations 2024.

All medical exposures require optimisation and it is the joint responsibility of the Practitioner and Operator to ensure that the radiation dose is kept as low as reasonably practicable, consistent with the intended outcome. There will be many factors to take into account when considering optimisation of an individual exposure and radiographers use their skills, knowledge and expertise to achieve this. They will be involved in the development of robust governance procedures and examination protocols and undertake regular clinical audit to safeguard service users and others.

12. The patient pathway

Preventing fragility fractures benefits patients and makes financial sense for the NHS. With the ageing population, the NHS faces an increased likelihood of seeing more people with fragility fractures. This puts pressure on acute and community services as these injuries may result in bed occupancy and significant long-term disability. However, prompt identification and management of osteoporosis following the first fracture presents an opportunity to reduce the risk of second fracture.

There are many ways a FLS may identify patients at risk. These are a few examples, not intended as exhaustive, of the opportunities patients have to access treatment pathways:

- **Through a fracture clinic**

The patient either attends the fracture clinic in person or patient lists are checked against the radiology information system (RIS) or picture archive system (PACS) to confirm the age of the fracture, mechanism of injury and the type of fracture that has been sustained. The FLS nurse/ radiographer leads a proactive process to direct patients on to the FLS system.

- **From the retrospective interrogation of the RIS**

The RIS is retrospectively interrogated to provide a list of examination reports that match specific search criteria, for example reports that include the words “spinal fracture”. It is important that this task is performed by someone with the knowledge and understanding of clinically relevant examinations and is trained to understand the implications of the report.

- **Other systematic reviews**

The radiographer may undertake regular reviews of all reports and images for patients aged over 50 who have been referred by their GP for lumbar spine and thoracic spine x-ray examinations in order to identify newly reported vertebral fractures or other fractures such as stress fractures of the foot or sacrum.

- **Direct referral**

Wards and outpatient departments may refer patients to the FLS via an internal referral form.

These example pathways have been summarised as a flowchart, which is available in appendix 3. The ROS Service Delivery Team provides free and bespoke support to services interested in setting up or improving a FLS. Resources to support the development of a FLS can be found in the ROS FLS Toolkit and FLS Clinical Standards and Competency Framework[50,51].

12.1 National drive for Fracture Liaison Service (FLS)

Fracture Liaison Services can provide comprehensive care to all patients over the age of 50 who have suffered their first fragility fracture. A clear pathway for proactive engagement with patients attending these services, and detailed criteria for evaluation of service performance and quality standards are provided by ROS[51,52].

13. Research

Research is one of the four core pillars of enhanced, advanced and consultant level practice and is an integral part of developing services and improving patient care and outcomes[37]. Radiographers at all levels should be able to critically appraise research to ensure their practice is underpinned by the latest evidence-base, while advanced and consultant practitioners should be undertaking and leading research[53]. Osteoporosis services sit within a rapidly changing environment, with varying patient demographics, new guidelines to align to, and pharmacological advances. Radiographers working in these services are required to contribute to the development of new guidelines, to implement them and assess their clinical effectiveness. The WHO criteria, developed in 1994, considers the diagnosis of osteoporosis in Caucasian postmenopausal women based on evidence available at the time[13]. Over the last 24 years, users of osteoporosis services have diversified and include more men, premenopausal women, children, people with cancer and a wide range of people with secondary osteoporosis related to their frequently complex comorbidities. This means that services need to adapt to ensure everyone receives appropriate care. While the postmenopausal group of 1994 typically contained optimal weight females, and the original precision studies were undertaken in this type of patient, with increasing population obesity, a more varied range of patients now attend. This means further research is required to explore the impact of obesity on precision errors in DXA, for example to underpin recommendations for time intervals between scans for treatment monitoring[54].

While DXA is generally used to measure BMD, it does provide imaging potential as well, at a lower dose than projection radiography. This makes it a useful tool with which to assess the presence of vertebral fractures using VFA, which are often occult or missed in the osteoporosis group[16,55]. While VFA can be a useful addition to a patient pathway, if a vertebral fracture is detected, further imaging is then required to characterise the fracture. However, due to the much lower exposure needed, VFA can be undertaken with lower levels of clinical suspicion compared to a thoraco-lumbar spine series or other imaging such as MRI, via a protocol used to identify those at risk of vertebral fracture.

14. Recruitment and retention

14.1 A student radiographer's perspective

"I am a third year Diagnostic Radiography student. As a student I have not had a lot of clinical exposure to DXA, this is probably due to the shortness of my placements. However, in my second year we had to complete group presentations where one group were assigned DXA. Their

presentation included the physics behind the equipment, everyday use and why DXA is used. I am hoping that in my third year I will have more exposure to DXA clinically."

Opportunities to introduce DXA practice at pre-registration level are variable. Students do not routinely rotate through DXA services during training, partly due to the lack of available clinical placements and partly due to the local emphasis placed on learning DXA at individual universities. It may also depend upon the skills, expertise and interests of the radiography program directors and local provision of DXA services. In addition to this there are a variety of clinical specialities that might host or operate a DXA service within a trust, such as nuclear medicine, medical physics or rheumatology, perhaps limiting routine exposure via radiographer rotation. Consequently, students' experience and motivation to explore DXA as a postgraduate career pathway is inconsistent. Despite some of these perceived barriers, DXA services clearly have the potential to provide opportunities for radiographers to progress, develop additional skills and undertake research as part of a wider fracture prevention and detection system.

There is currently no recognised national occupational standard for a DXA practitioner. AHPs, health care scientists and nurses may provide this role within a service. In order to future-proof services and ensure the radiographic profession continues to influence the delivery of osteoporosis care it is important to recognise the impact that student and newly qualified radiographer rotations through DXA may have on career development.

Currently there is poor recognition in the healthcare and radiographic communities of DXA as a specialism, but the increasing opportunities for practice development that allow radiographers to spend more time with a patient, take clinical histories, analyse and report on scans may appeal to the future workforce and have a positive impact on retention.

15. Summary

Patients and service users deserve consistent, high-quality diagnostic imaging delivered in a safe and well-managed service by adequately trained healthcare professionals who respect their values and beliefs. The radiographic workforce is integral to the effective delivery of DXA and osteoporosis services and the promotion of bone health. Radiographers have the skills, knowledge, behaviours and importantly, the opportunity to contribute to fracture prevention, diagnosis and treatment pathways. Other HCPs, once adequately trained, may also undertake DXA scans and help to deliver integrated osteoporosis services.

Revised legislation that came into effect on 6 February 2018 includes the use of non-medical

imaging using medical radiological equipment, which may include some of the uses of DXA. These regulations apply to all employers using ionising radiations in the NHS and in the independent sector.

Multi-disciplinary team working is an essential component of modern, flexible and responsive DXA and osteoporosis services. Advanced and consultant practitioner radiographers are well placed to develop and deliver new models of evidence-based care and inspire future generations of the radiographic workforce to consider DXA as a career pathway.

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Appendix 1: DXA working party members

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SCoR would also like to thank Lisa Field, Consultant Radiographer (The Mid Yorkshire Hospitals NHS Trust) for her review of this work.

Appendix 2: Example competency framework

<table>
<tr><th colspan="4">Core competencies</th></tr>
<tr><th colspan="2">Competency 1: Professional</th><th>Competency 2: DXA equipment</th><th>Competency 3: DXA technique</th><th>Competency 4: Underpinning knowledge</th></tr>
<tr><td>Patient care</td><td>Ensures that patient care is of a high standard and individualised to each patient.</td><td rowspan="2">Proper use of medical imaging equipment is an essential component in the safe delivery of healthcare. In demonstrating competence, staff should be able to operate the equipment appropriately and understand the basic principles underlying its configuration and operation.</td><td>Positioning and acquisition</td><td rowspan="2"></td></tr>
<tr><td>Working safely</td><td>Has an understanding of policy and legislation on Health and Safety and maintains a safe working environment for self, patients and colleagues.</td><td>Scan analysis</td></tr>
</table>

Core competency 2: DXA equipment			
2.1 Skills		**Date**	**Sign off by (signature)**
2.1.1	Performs start up and shut down procedures correctly		
2.1.2	Demonstrates safe use of table and gantry controls		
2.1.3	Is able to perform QA procedures for the system concerned		
2.1.4	Is able to register a patient manually or from a RIS scheduler		
2.1.5	Is able to access and select specific protocols		
2.1.6	Can locate and where necessary manipulate scan parameters		
2.1.7	Understands & can demonstrate appropriate windowing and image presentation		
2.1.8	Can use manual reporting function correctly including changing of report format		
2.1.9	Can print off relevant reports or scan printouts		
2.1.10	Is able to archive, retrieve and transfer to and from other locations or storage media		
Core competency 3: DXA technique			
3.1 Clinical scanning skills positioning and acquisition		**Date**	**Sign off by (signature)**
3.1.1	Selects correct scan parameters for the examination		
3.1.2	Prepares the patient for the examination and assesses the patient questionnaire (where applicable)		
3.1.3	Positions the patient on the scanning table correctly for the examination		
3.1.4	Is aware of any safety issues relating to positioning patients		
3.1.5	Is aware of variations in protocols e.g. replacement of hip joint, spinal surgery, patient condition		

3.1.6	Can demonstrate how to change scanning speed/mode where necessary		
3.1.7	Correctly positions the anatomical area under examination		
3.1.8	Correctly positions the anatomical area under examination: • Lumbar spine • Proximal femur • Forearm • Total body • Lateral Spine (VFA)		
3.1.9	Can demonstrate when to reposition a scan and how		
3.1.10	Can manipulate automatic image produced when necessary (adjusting window)		
3.1.11	Reviews images for quality, patient movement, artefact and pathology		
3.1.12	Attends to post examination needs of the patient and explains how the results can be obtained		
3.2 Clinical scanning skills: Scan analysis		**Date**	**Sign off by (signature)**
3.2.1	Verifies correct positioning of anatomical area scanned		
3.2.2	Reviews images for quality, patient movement, artefact and pathology		
3.2.3	Positions the regions of interest (ROI) correctly		
3.2.4	Identifies vertebral levels and knows when to exclude		
3.2.5	Prepares scan archive/print out for reporting		

Core competency 4: Underpinning knowledge			
4.1 Underpinning knowledge: DXA equipment		**Date**	**Sign off by (signature)**
4.1.1	Is able to explain the term dual energy x-ray absorptiometry		
4.1.2	Is able to identify the direction of the x-ray tube		
4.1.3	Is able to identify exact scanning area on table		
4.1.4	Is able to identify stand-by/emergency off switch		
4.1.5	Is able to identify procedure if QA test fails or phantom is outside of tolerance		
4.2 Underpinning knowledge: positioning and acquisition		**Date**	**Sign off by (signature)**
4.2.1	Understanding of contra-indications for performing hip or spine scan		
4.2.2	Understanding of circumstances under which the scan time/mode would be changed		
4.2.3	Understanding of anatomy of the hip and spine areas, and correct positioning		
4.2.4	Is able to state WHO definition of osteoporosis		
4.2.5	Is able to state the clinical risk factors for fragility fracture		
4.2.6	Is able to state the clinical indications for DXA		
4.3 Underpinning knowledge: scan analysis		**Date**	**Sign off by (signature)**
4.3.1	Understanding of BMC/area/BMD		
4.3.2	Understanding of reference data selection/differences		
4.3.3	Understanding the importance of correct region of interest placement in relation to reference data		
4.3.4	Understanding the limitations and reliability of measurements		

Appendix 3: Example FLS Structure

Flowchart to illustrate an example structure of a hospital-based FLS

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