Royal Osteoporosis Society

Better bone health for everybody

Reporting dual energy X-ray absorptiometry scans in adult fracture risk assessment:

Standards for quality

Reporting dual energy X-ray absorptiometry scans in adult fracture risk assessment: Standards for quality

Bone mineral density measurement (BMD) using dual energy X-ray absorptiometry (DXA) scanning of the central (axial) skeleton is the accepted technique for the diagnosis of osteoporosis[1]. Measurements performed in the context of a comprehensive fracture risk assessment are interpreted using additional information about individual clinical risk factors and the patient's relevant medical history. DXA scans are also performed to monitor change in BMD, in ethically approved research studies, and may be used as part of medical health screening and for non-medical purposes[2,3].

This UK guidance describes the reporting of DXA measurements of the proximal femur and lumbar spine in adults within the context of fracture risk assessment. Additional components of a comprehensive fracture risk assessment, such as vertebral fracture assessment (VFA) scanning and detailed clinical risk factor profiles, are also considered. It supports healthcare professionals reporting axial DXA scans to meet standards outlined in *Quality Standards for Osteoporosis and Prevention of Fragility Fractures*[4].

Population: This guidance applies to adults aged 20 years and over in the UK who have had a DXA scan.

Audience:

- Healthcare professionals in the UK undertaking the reporting of DXA scans as part of fracture risk assessment.
- Medical or other autonomous practitioners in the UK supervising non-medical health professionals who are reporting scans.
- Healthcare professionals in the UK who use DXA reports.
- Service managers and commissioners in the UK.

Outside of scope: The following topics are outside of the scope of this guidance:

- Measurement of total body DXA for purposes of body composition assessment or BMD.
- Ultrasound, computed tomography (CT) and peripheral DXA bone measurement techniques.
- Trabecular bone score techniques.
- DXA in children and young people under the age of 16 years.
- DXA in young people aged 16-20 where adolescent reference data is not locally available.

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B.S.S.R. British Society of Skeletal Radiologists

IOF International Osteoporosis Foundation

RCGP Royal College of General Practitioners

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Contents

Background

Bone mineral density (BMD) measurements derived from dual energy X-ray absorptiometry (DXA) are the World Health Organisation[1] (WHO) validated diagnostic test for osteoporosis and measurement of bone mass, and provide the best estimate of fracture risk in an individual.

Where DXA assessment is indicated, Ionising Radiation (Medical Exposure) Regulations 2017 (IR(ME)R) stipulates the need for the outcome to be recorded[2,3]. As well as meeting regulatory requirements, a well-structured DXA report provides the referring clinician with a personalised management plan for each patient.

The majority of treatment to reduce fracture risk is prescribed by general and non-specialist practitioners in primary care, and comprehensive DXA reporting plays a pivotal role within the patient care pathway. Specialist knowledge is required to interpret DXA scans and prepare a report that clearly communicates the information and advice in a way that both the referring clinician and the patient can understand[5].

Use of fracture risk assessment tools

DXA assessment is indicated in people at increased risk of fracture, identified through use of a risk probability calculator (either FRAX or QFracture can be used in accordance with national guidance[6,7]).

Femoral neck BMD can be incorporated into the online fracture risk assessment tool, FRAX[8]. BMD cannot be incorporated into calculations from QFracture and so this guidance focusses on the use of FRAX.

Use of BMD in FRAX improves fracture prediction and allows for clinical interpretation against national guidance[6,9]. However, FRAX with BMD does not allow inclusion of some risk factors (for example, information about lumbar soine BMD), and it underestimates the predictive value of important risk factors e.g. vertebral fractures and high-dose glucocorticoids.

National guidance produced by the Scottish Intercollegiate Guidelines Network (SIGN)[7] places greater emphasis on the use of absolute BMD in treatment decision-making and QFracture as the preferred fracture risk assessment tool.

In either case, fracture risk assessment results alone must not replace the detailed DXA report. Local protocols should be developed in-line with relevant national guidance.

DXA report checklist

The DXA report will normally take no more than a single A4 sheet (or digital equivalent) and follow a standardised reporting template to allow systematic reporting. An example of a generic template is included in Appendix 1.

The wording must be clear, concise and unambiguous, and any abbreviations should be explained. It may also be feasible to enable the recipient access to the DXA images, particularly if digital systems (such as a picture archiving and communication system (PACS)) are available, but this must not replace the report.

All reports will include the following information.

1.	DXA scanning service name, address and contact information	
2.	Date of report	
3.	Patient demographic data	Name, age, sex, ethnicity, BMI.
4.	Unique identifier	Hospital/NHS/centre number.
5.	Name and address of referrer	
6.	Date of assessment	
7.	Make and model of DXA scanner where relevant	This information may be useful in centres with more than one densitometer.
8.	Primary reason for referral	
9.	Details of any fragility fractures	
10.	Osteoporosis treatments and relevant supplements	
11.	Valid BMD results (may be tabulated)	For each region scanned, results are expressed as g/cm^2, T-score (standard deviation (SD)) providing the patient is over age 30, and Z-score (% or SD).
12.	Rate of change for serial BMD measurements	Differences exceeding the least significant change (LSC) are reported as a percentage change from baseline and/or previous scan.
13.	WHO diagnostic category	Given for adults who have attained peak bone mass (over age 30) based on the locally agreed reference database. Recorded using the terms *normal*, *osteopenia* or *osteoporosis* to facilitate diagnostic coding.

14.	Commentary on reliability of measurements	Include consideration of vertebral exclusions, artefacts and patient positioning.
15.	Commentary on statistical significance of rate of change	Factors influencing the percentage LSC in individual patients must be considered in deciding whether a significant change has occurred. Factors that increase LSC include very low BMD, excluded vertebrae, high body mass index and significant weight change.
16.	Commentary on the clinical significance of rate of change	Comment on whether the change is expected (e.g. postmenopausal/age-related bone loss) or unexplained (e.g. bone loss despite osteoporosis treatment).
17.	Results of any other relevant investigations	E.g. VFA[10], other imaging modalities, laboratory tests.
18.	Summary of clinical risk factors for fracture	Make use of all available sources of information, including referral, clinical risk factor questionnaire, information obtained by DXA operator, clinical records. Include risk factors for falls as well as risk factors for bone fragility.
19.	Clinical interpretation including a clear statement to quantify absolute fracture risk	Where applicable, include results from FRAX using BMD with further clinical interpretation based on additional information from the assessment, such as number of fragility fractures, low vertebral BMD or high dose steroid use. Where this is not applicable, use high/moderate/low based on clinical judgement.
20.	Management advice including relevant recommendations	Include need for treatment, lifestyle modification, falls risk assessment, additional investigations, onward referral, further BMD assessment (including recommended timing).
21.	Reporters identification	Include name, professional title, signature, professional registration (GMC/HCPC/NMC) number, date. Digital systems will include this automatically.
22.	References and resources	For example, local/national guidelines and signposting to facilitate management, and a list of abbreviations. Include hyperlinks in digital reports.

Aim of the DXA report

The DXA report is a standalone clinical document, used to facilitate the comprehensive management of the patient to reduce fracture risk by the non-expert referring clinician.

The report must contain sufficient information to allow the referring clinician and patient to understand the diagnosis, limitations of the scan and advice for further assessment, intervention and follow-up.

Where a DXA examination is carried out, a recorded outcome, such as a report, is required to comply with IR(ME)R[2,3]. The report will be recorded in the patient's clinical record and will also be archived digitally, ideally alongside the DXA scans on PACS, and easily retrievable.

Local agreements will direct to whom the report is copied but this may include the referrer, the patient's GP (where this is not the referrer) and the patient. It is considered good practice to ensure the patient receives the report directly and care should be taken to ensure the content is as clear as possible[4].

Reporting standards and audit

DXA reports will meet the following standards. These must be audited to measure local performance using the audit template in Appendix 2.

1. The DXA scan report is a standalone document that is issued within three weeks of the scan and contains sufficient detail to enable optimal management by the non-specialist referrer.
2. Reports are produced by healthcare professionals with specific training and experience in DXA interpretation. Reporting clinicians will be entitled to act as an operator under IR(ME)R.
3. DXA scan reports are quality assured as part of routine audit, clinical governance and peer review processes, and are archived and retrievable.
4. Local protocols are in place to standardise reporting to include reference database selection, diagnostic thresholds, treatment and follow-up advice.
5. Where a mild vertebral fracture is identified using VFA, further spine radiographs are recommended in the report to clarify the diagnosis and differentiate from non-fracture deformity.
6. Referrers have access to support and advice from a clinician with expertise in bone health and DXA in relation to the management of individual patients. Referrers will also have access to specialist clinics for the management of complex patients.

DXA measurements in diagnosis

Osteoporosis diagnosis is based on use of the WHO-defined T-score thresholds[1]. T-scores were originally defined for use in postmenopausal women, and are applicable to measurement of BMD at the lumbar spine, proximal femur or distal forearm (1/3 radius) in postmenopausal women and in men over age 50[10]. T-scores describe BMD results expressed as a standard deviation (SD) score in comparison to the mean value derived from healthy adults at the age of peak bone mass. Table 1 gives the WHO definitions for T-score measurements.

BMD T-score (SD)	WHO diagnosis
≥-1	normal bone mass
<-1 to >-2.5	osteopenia
≤ -2.5	osteoporosis
≤ -2.5 and fragility fracture	established osteoporosis

Table 1: WHO definitions for BMD T-score measurements

T-score thresholds must not be applied to measurements obtained in adults prior to attainment of peak bone mass (i.e. below 30 years of age). Prior to peak bone mass, the age-matched Z-score alone must be reported and cannot be used to diagnose osteoporosis[10]. Z-scores are derived in comparison to age-matched reference data.

In premenopausal women over 30 years of age and men between ages 30 and 50, T- and Z-scores are broadly similar. Either may be reported providing this is applied consistently within the service. Caution must be exercised in applying WHO thresholds in this age group, recognising the low absolute fracture risk in younger adults.

DXA results underestimate volumetric BMD and overestimate absolute fracture risk in individuals with very small skeletal size and must be interpreted accordingly (i.e. height below 2.5th centile - approximately 150 cm in women).

Reporting DXA measurements

Local protocol for BMD results

A local agreement will state which BMD results are routinely included in reports. This should include results for:

- Lumbar spine *and*
- *Either* femoral neck *or* total hip.

Report either total hip or femoral neck consistently but where there is a clear discrepancy between the two, mention this in the report and give the result that is judged by the operator and reporter to be from the more reliable measurement.

Use of a single hip site is statistically more significant. The WHO threshold of -2.5 SD T-score should be adjusted if more than two sites are used because it increases the likelihood of finding a low result. If total hip is selected locally for reporting (as the larger area is more precise and so better for monitoring) and the referrer is expected to calculate FRAX with BMD, then femoral neck BMD would also need to be recorded in the report.

A single diagnosis is reported

Diagnosis will be based on the lowest result for each patient. Separate diagnoses for each skeletal site must not be given.

Use of forearm measurements

Diagnosis may be based on T-score at the distal forearm (1/3 radius) site if neither spine nor hip can be measured reliably, such as in the presence of bilateral hip prostheses and marked degenerative or sclerotic changes at the spine, or in patients who have primary hyperparathyroidism or another condition primarily affecting cortical bone[10].

Management recommendations based on forearm BMD alone must be given with an understanding of the limitations involved in the use of a single peripheral measurement site.

Use of lateral spine measurements

Lateral DXA BMD measurement of the spine has a limited clinical role in diagnosis of osteoporosis or monitoring of bone loss due to insufficient reference data and poor precision.

Use of bilateral hip measurements

If bilateral hip BMD is measured, there is insufficient data to determine whether the use of mean T-score confers any advantage over measurement of a single hip. Mean bilateral hip measurement provides a larger region of interest (ROI) so may improve precision for monitoring[10].

Young adults

T-scores were developed for use in post-menopausal women and are also applicable in men over the age of 50. In young adults who have not reached peak bone mass (<30 years), results are given as Z-scores with a statement to describe the lowest result:

- Z-scores may be interpreted as:
  - *'Above average for age'* if Z>0
  - *'Below average for age'* if Z≤0 and ≥-2
  - *'Low for age'* if Z<-2
- Allow for impact of delayed puberty/growth retardation
- The use of either T- or Z-scores may be used between ages 30 and 50

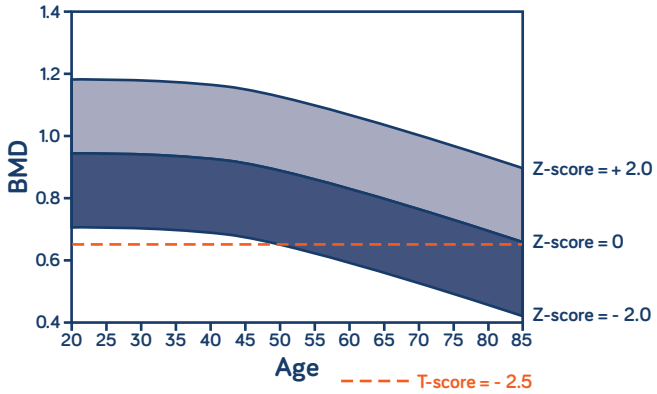


Figure 1: Relationship between BMD and age, illustrating the difference between T- and Z-score thresholds

Only report reliable and valid results

It is the responsibility of the DXA operator and reporter to determine the reliability of the results and include only clinically useful results in the report. The recipient of the report will usually not have access to the DXA images or the expertise to assess validity of the results. Inclusion of a falsely high result in the report risks providing false reassurance and, although less common, a falsely low result risks over-treatment even if the report includes a comment indicating the result may be an over or underestimate. Where there were difficulties in obtaining reliable measurements for whatever reason, it is good practice to include details in the report.

Vertebrae will be excluded from analysis where:

1. There is a focal abnormality, regardless of the magnitude of impact on BMD. Examples include vertebral fracture, degenerative changes, vertebroplasty and implantable devices such as orthopaedic implants, stents, grafts etc. (illustrated by Figures 2 to 4).

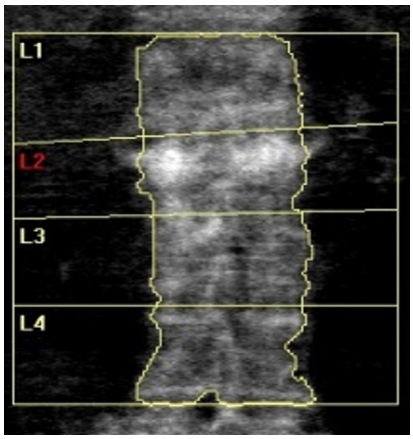


Figure 2: DXA image with vertebral fracture at L2

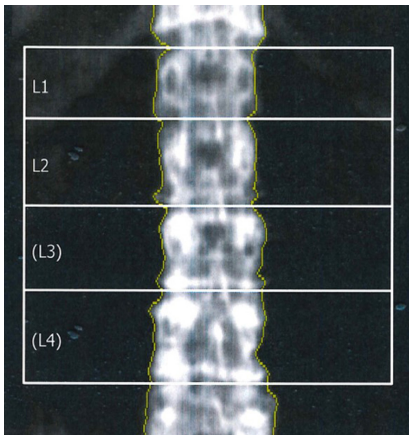


Figure 3: DXA image showing degenerative change at L3 and L4

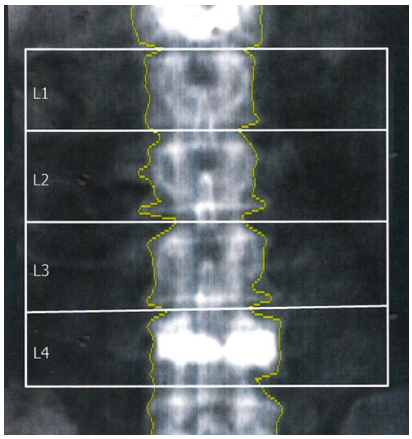
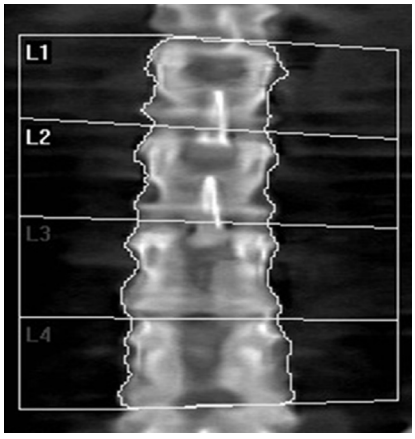


Figure 4: DXA image showing vertebroplasty at L4 and T12

2. The result differs by > 1SD from adjacent vertebra(e) *and* there is a visible abnormality to inform which vertebra(e) to exclude[10] (illustrated in Figure 5).

3. There is an artefact overlying the vertebra(e) or in the soft tissue adjacent to the vertebra(e) affecting the validity of the measurement in accordance with the manufacturer's user manual (ilustrated in Figure 6).



T-score	
L1	-1.4
L2	-1.3
L3	-2.5
L4	-2.6

Figure 5: DXA image of the spine showing laminectomy at L3 and L4

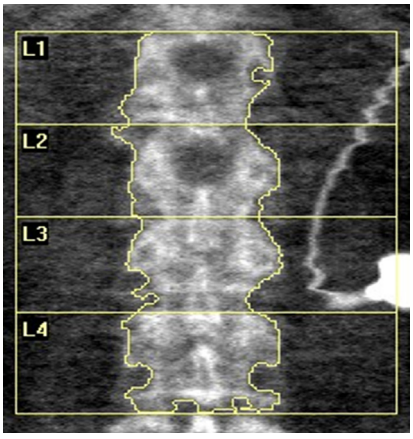


Figure 6: DXA image showing soft tissue artefact from gastric band adjacent to L1 to 3

If more than two vertebrae are unreliable the spine result should not be reported. However, in unusual circumstances, an unreliable result should be included if it adds value and alters the clinical recommendation[10] (e.g. if the spine BMD is considerably lower than the hip BMD even in the presence of several lumbar vertebral fractures).

In the study below, the lumbar spine BMD is likely to be artificially increased by the presence of degenerative scoliosis, but is still worth reporting as otherwise the patient's fracture risk will be underestimated (Figure 7).

WHO diagnostic category

The report will include the WHO diagnostic category for adults who have attained peak bone mass (30 years of age or older) based on the locally agreed reference database.

The WHO category will be given as 'normal', 'osteopenia' or 'osteoporosis' to facilitate diagnostic coding[1]. Whilst the term osteopenia as defined by WHO should be included in the report as it is used by referrers for coding, the term is poorly understood by patients and risks medicalising a result that is at the expected level for the patient and does not require intervention. Use of descriptive expressions such as "low bone density" or comparison to age-matched levels (e.g. "above/below average for age") should be included to aid understanding in the discussion of findings with the patient.

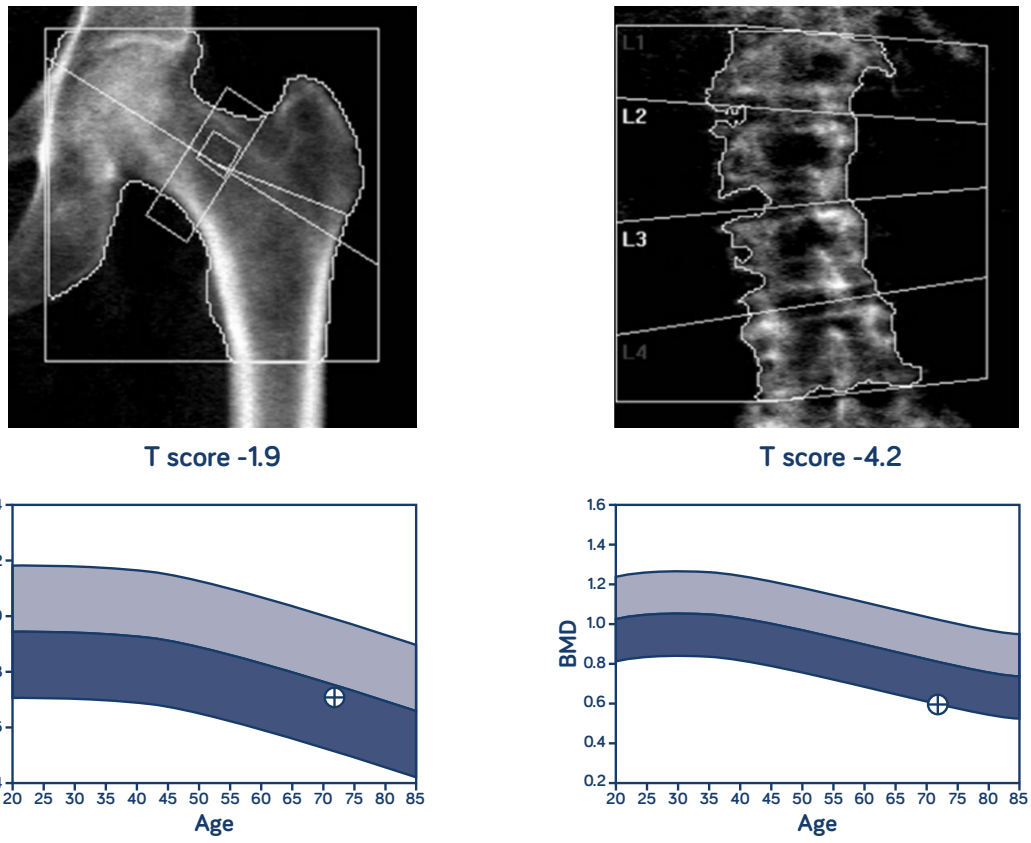


Figure 7: DXA scan with degenerative scoliosis and unreliable spinal measurements

Reference databases

Local protocols will define the appropriate reference databases to be used for populations routinely examined.

The following reference databases are recommended[10]:

- NHANES III reference data for proximal femur (hip) DXA measurements.
- DXA scanner manufacturers' UK reference data for lumbar spine and forearm.
- Adolescent reference database where the service reports scans in young adults aged 16-20 years.

It is recognised that the postmenopausal female reference dataset is the most robust and provides the best assessment of absolute fracture risk for all adults, whilst ethnicity- and gender-matched databases enable the comparison of an individual against their peer group. A combination of these approaches may be used.

For example, a local agreement may stipulate:

- Use of the gender-matched Caucasian reference data to derive T-scores to inform treatment decisions, together with;
- Use of ethnically matched Z-score to inform decisions about the need for further investigation for secondary causes of low BMD.

Special consideration should be given to the interpretation of BMD measurements in transgender patients. Results will usually be reported in comparison to the currently applicable gender-matched reference data, but allowance for skeletal size may need to be made in interpreting the results.

Serial BMD measurement

Serial BMD measurements may be made to monitor response to therapy. They may also be used to monitor for bone loss in untreated individuals, especially when baseline BMD is close to an intervention threshold or there is a risk factor for accelerated bone loss. This will include: people at risk due to their age or recent menopause; those taking medication known to cause bone loss; or those with diseases associated with bone loss.

Calculating interval to next DXA scan

The interval between BMD measurements should be based on an individual's clinical status, taking account of baseline BMD, anticipated change and LSC of the measurement. The LSC is the amount by which a measurement must change in order for the reader to be confident that it is reflective of a real change in bone mass, rather than due to error of the measurement.

The calculation of short-term LSC from duplicate measurements should form part of a DXA service's routine quality assurance processes[10]. It may be expressed as an absolute change in BMD (g/cm^2) but is generally expressed as a percentage as this is how serial changes are reported. It is defined as:

- *2.77 x the precision error (coefficient of variance) for the scanning equipment at a centre*[11]

Long term precision error for lumbar spine and total hip BMD has been calculated as 1.6%, suggesting a LSC of 4.5% is applicable for serial measurements made in clinical cohorts[12].

The LSC determined for the service should be evaluated in a population appropriate to the clinical service (e.g. older individuals rather than healthy young adults). In the interpretation of serial changes in BMD, the LSC may need to be further adjusted based on the individual patient. For example, if only two vertebrae can be measured, the precision error of the lumbar spine measurement will be greater and the LSC will be accordingly greater. Similarly, a patient who experiences a significant weight change between measurements will have greater precision error and greater LSC.

Serial measurements at the forearm site are generally not clinically useful due to the high proportion of cortical bone and slower bone turnover at this site. The forearm is also not a responsive site to currently available therapeutic agents. The intervals required to detect a statistically significant change in bone mass in the forearm are therefore likely to exceed the clinical decision-making time frame.

Interpretation of serial BMD measurement

Any serial BMD measurement must be evaluated for accuracy and context. The reporter must ask themselves 'is this a real change?' If so, 'what is its clinical significance?' The assessment follows three steps:

1. Evaluate the scans for reproducibility in positioning and analysis, and any clinical change such as progression of degenerative change at the spine or of overlying aortic calcification.

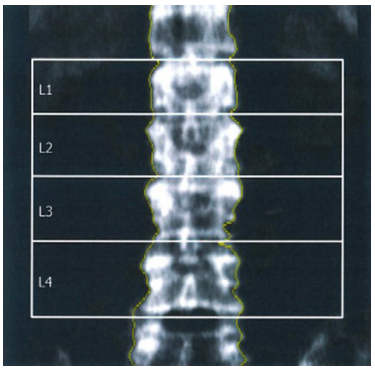


Figure 8: DXA image of the spine demonstrating good positioning.

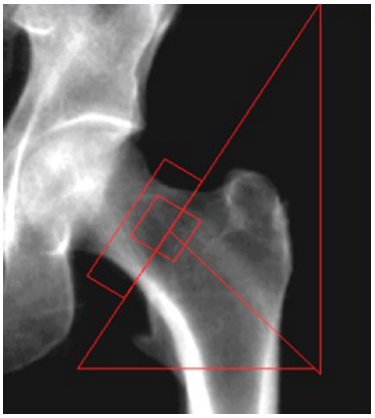


Figure 9: DXA image of the hip demonstrating good positioning.

2. Determine if there has been a statistically significant change in BMD, taking account of the LSC for the machine, department and the individual patient. Does the percentage change exceed the LSC?
3. Determine if the change in BMD is clinically significant and/or unexplained by the patient's clinical circumstances, in which case it may indicate the need for further investigation and/or treatment.

The results of the evaluation of change in bone mass must be recorded clearly on the report. Examples are given here and illustrated by Figure 10.

Example 1: A 9.7% decrease in BMD has been measured over 4.5 years in a 62-year-old woman who stopped use of HRT after the baseline scan. There has been no change in weight and she has no new risk factors.

- The decrease is consistent with bone loss following oestrogen withdrawal and is therefore clinically not unexpected. Additional investigation is not indicated on the basis of this change, even though the current results now indicate a high risk of fracture and a need for therapeutic intervention.

Example 2: A 9.7% decrease in BMD has been measured over 4.5 years in a 62-year-old woman who went through menopause at 48 and who has taken bisphosphonate treatment since the baseline measurement, which was made after she sustained a low impact wrist fracture.

- This decrease cannot be explained by oestrogen withdrawal as accelerated perimenopausal bone loss generally persists for 3-5 years. Further, it is unexpected in the context of her bisphosphonate treatment. It is necessary to consider reasons such as poor compliance, malabsorption or underlying causes of osteoporosis.

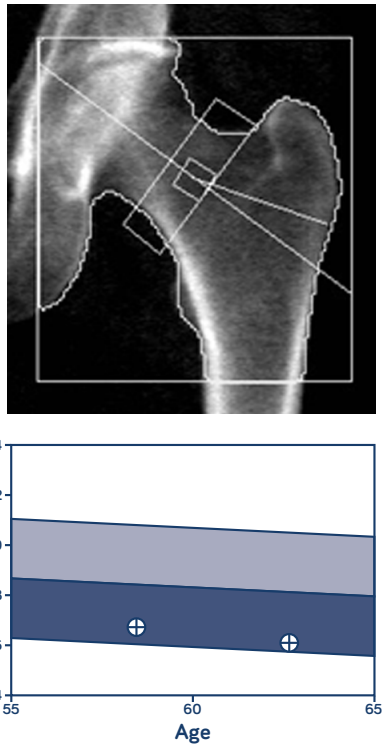


Figure 10: DXA image of the hip illustrating Examples 1 and 2.

Vertebral fracture assessment (VFA)

The presence of vertebral fracture is strongly predictive of further fracture[13,14] independently of BMD, but only a minority of vertebral fractures present clinically. In addition to measurement of BMD, fan beam DXA scanners enable the acquisition of anteroposterior and lateral images of the thoracic and lumbar spine. These vertebral fracture assessment (VFA) images are of lower resolution than conventional spine radiographs, but in most patients allow visualisation of vertebrae T4 to L4.

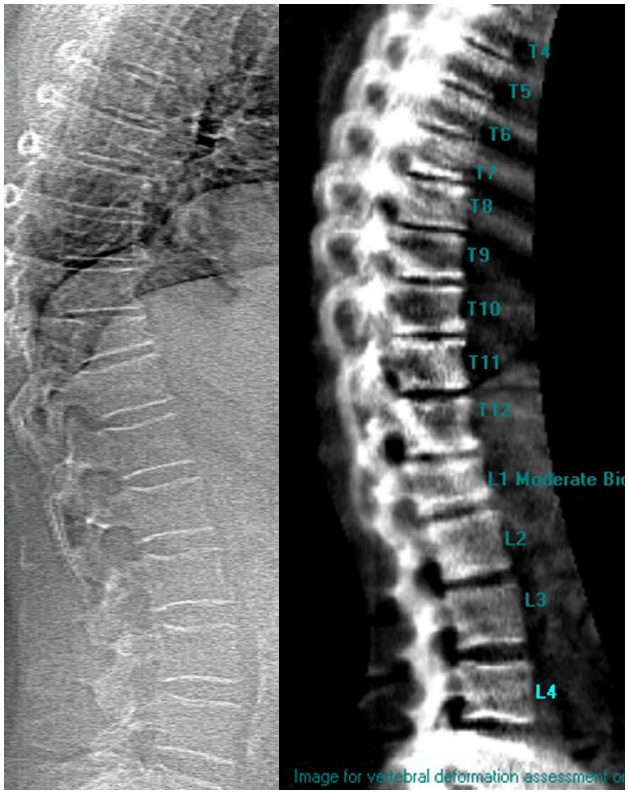


Figure 11: VFA obtained using Hologic scanner (left, vertebral fracture at T10) and GE scanner (right, vertebral fracture at L1).

As VFA involves use of very low doses of ionising radiation, it provides a valuable opportunity to screen for the presence of vertebral fractures[14] and refine the fracture risk assessment. Indications for VFA have been proposed[10] to include higher risk individuals undergoing DXA assessment, especially where identification of vertebral fracture would alter the management plan.

Interpretation

VFA images should be interpreted using visual evaluation by an experienced and appropriately trained and entitled healthcare professional using validated methodology, such as semi-quantitative morphometry[15] or the algorithm-based qualitative method[16].

DXA scanners include software that enables the application of quantitative morphometry (QM) – an approach involving semi-automated point placement with measurement of vertebral heights. QM cannot differentiate between vertebral fractures and non-fracture deformities, leading to a high rate of false-positives. QM also fails to identify mild vertebral fractures where there is a clear deformity of the vertebral end plate but with minimal height loss. QM must not therefore be used to interpret VFA images without a concurrent expert visual read.

Further imaging

If a previously undiagnosed vertebral fracture is identified or suspected on VFA, further imaging may be required for:

- Confirmation of the presence of vertebral fracture.
- Differential diagnosis, especially in patients with history of malignancy.

The report should include comment on the validity of the VFA evaluation and whether vertebrae were adequately visualised. If not, and depending on the index of suspicion, further imaging might be recommended.

Interpretation of fracture risk with BMD

Treatment recommendations are based on an individual's absolute risk of fragility fracture and the risks and benefits of the treatment under consideration. FRAX[8] enables the estimation of the 10-year probability of fracture from the result of femoral neck BMD, combined with information about common and easily evaluated risk factors[17]. However, additional information will be available from a comprehensive fracture risk assessment which will enable further refinement of the risk, including:

- Results of spine BMD
- "Dose effects" including:
  - Multiple fractures
  - Vertebral fractures
  - High dose glucocorticoid treatment
- Risk of falls

FRAX is not validated for younger adults (under 40 years of age) and it underestimates short term risk in the elderly because it factors in the impact of estimated life expectancy.

Management advice and recommendations

Management decisions are further influenced by the context of the measurement and the report will include guidance on individual management covering the following areas:

Need for pharmacological treatment	• Recommendations will be made using clinical expertise and in accordance with national guidance and local Standard Operating Procedures (SOP), defining choice of intervention thresholds. Refer to contextual guidance (e.g. breast cancer treatment, glucocorticoid-induced osteoporosis). • Non-prescribing reporters will refer to local management protocols for therapeutic recommendations and must not give specific treatment advice. • Clinical information may influence specific treatment recommendations. Consider: - History of upper gastrointestinal pathology/symptoms - Malabsorption - Previous intolerance - Cognitive impairment without adequate supervision to manage complicated oral dosing regime - Renal impairment
Lifestyle modification[14]	• Diet • Exercise • Smoking • Alcohol consumption • Safe sun exposure
Falls risk assessment[19]	• Falls in previous 12 months • Number of medications • Walking aid use • Falls referral
Additional investigations and onward referral	• Bloods tests • Further imaging • Osteoporosis/metabolic bone clinic
Further BMD assessment	• Recommended time interval to consider repeat DXA

Quality, governance and professional development

Quality assurance

Quality assurance for DXA reports will be undertaken as part of a local compliance assurance framework, which includes:

- Peer review
- Double reporting
- Audit cycle
- Agreed text for frequently used recommendations
- Reference to local treatment algorithms, especially if reports are generated by non-prescribers who cannot make individual medication recommendations
- Feedback from users

Governance

The multidisciplinary DXA team will consist of:

- A clinical leader (who is responsible and accountable for the service)[4]
- Reporting clinicians (who are registered healthcare professionals entitled as operators under IR(ME)R)[2,3]
- And adequately trained operators (radiographers and DXA technicians entitled as operators under IR(ME)R)[2,3]

The team will have opportunity to meet regularly to discuss clinical and policy issues.

Reports will be undertaken in accordance with a departmental standard operating procedure and use an agreed template (see Appendix 1 for an example template). Reports will be archived and available electronically[4], ideally using a Radiology Information System (RIS) and PACS. Referrers will have access to support and advice from the DXA service in relation to the management of individual patients. This may be accessed by letter, secure email or telephone contact in accordance with local arrangements. Referrers will also have access to specialist clinics for the management of complex patients.

Professional development

A healthcare professional reporting DXA scans must be adequately trained and entitled to act as an operator in accordance with IR(ME)R. Nurses, clinical scientists and allied health professional clinicians must:

- Work within a clearly defined scope of practice
- Have completed post registration level 7 education and training to support DXA reporting. (The Health Education England standard is that professionals undertaking this should be from a regulated professional group)
- Undertake regular audit of their practice
- Are working within a multidisciplinary team
- Take an active part in local discrepancy meetings
- Attend relevant multidisciplinary meetings
- Undertake an annual appraisal
- Undertake continuing professional development (CPD)

The role of the reporting clinician is characterised by the need for a wide range of competencies that include knowledge of basic physical science as well as the clinical, diagnostic and therapeutic aspects of osteoporosis. The following considerations should be taken into account (consistent with Royal College of Radiologists reporting standards[5]):

- Familiarity with DXA technology and with the IR(ME)R[2,3].
- Understanding of reference databases and their limitations.
- Familiarity with the acquisition of DXA studies, their analysis, the identification of artefacts.
- Understanding of basic statistics and the impact of confounders on DXA accuracy and precision.
- Understanding of the link between BMD, clinical risk factors and fracture risk, and of the secondary causes of osteoporosis.

- Up-to-date understanding of therapeutics relating to osteoporosis.
- Familiarity with current guidance, cost effectiveness and local and national strategies.
- Evidence of having met the learning outcomes of relevant formal post-graduate training at Masters' level or equivalent.
- Commitment to CPD and clinical audit.
- Working within a bone densitometry service that has a defined relationship with a local specialist bone metabolism clinical service.

Training can be provided in-house, evidenced by competency attainment and supported through mentorship. The following training courses are recommended for healthcare professionals reporting DXA scans:

- Royal Osteoporosis Society
  - Bone densitometry foundation course
  - National Training Scheme for Bone Densitometry
- University of Derby
  - DXA Reporting for Clinicians short course
  - Bone Densitometry Reporting postgraduate certificate
- The International Society for Clinical Densitometry (ISCD) certification

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Appendix 1:
Clinical risk factor questionnaire template

A clinical risk factor questionnaire can be completed by patients in advance of their DXA scan. The questionnaire should be used as a prompt to elicit further information from the patients and may provide an opportunity to record compliance with IR(ME)R provisions, such as identity and pregnancy checks.

DXA scan patient questionnaire Any hospital NHS trust			
Name			
Date of birth		Weight and height	kg cm
Hospital/NHS number		ID confirmed? Operator initials	
Could you be pregnant?	Y N	Date of last menstrual period	
Age at starting menstruation		Age at menopause	
Have you had a DXA scan before?	Y N	Where and when?	
Have you had any fractures (broken bones) in your adult life?	Y N	Which bone(s) and how did it occur?	
Have you had any operations on your spine or hips?	Y N	Which operations and when?	
Do you drink alcohol every day? (3 or more units)	Y N	Are you a current smoker?	Y N
Have either of your parents broken their hip?	Y N	How did this happen?	
Have you ever been prescribed steroid tablets?	Y N	When and for how long?	
Have you been diagnosed with or are you being treated for any long-term medical conditions?	Y N	Have you been diagnosed with rheumatoid arthritis?	Y N
Have you fallen in the last year?	Y N	If so, how did this happen?	
Please list your regular medications here:			

Appendix 2:
Example report template

Address of DXA Scanning Service

Date of report

Referrer name/address

Patient details: Name, address, date of birth, unique identifier, ethnicity, BMI

Introduction:

The above patient attended for a bone mineral density (BMD) assessment by DXA (equipment make) on dd/mm/yyyy.

Primary reason for referral:

Indications, fractures, current osteoporosis treatments/relevant supplements.

Results table

Site	Area	Date of measurement	BMD g/cm^2	T-score (young adult)	Z-score or % (age matched)	Change since baseline (%)
Spine	L1-L4					
Hip*	Total hip					
Femoral neck**						

* Either total hip or femoral neck may be used depending on local protocol.
** Include for use in FRAX calculations depending on local protocol.

BMD interpretation: WHO diagnostic category (where appropriate), commentary on reliability of measurements, commentary on rate of change and statistical and clinical significance.

Other investigations: Comment on VFA if performed, other imaging or laboratory tests where appropriate.

Summary of risk factors: Clinical risk factors for fracture and falls.

Clinical interpretation of fracture risk: Either as a 10-year fracture probability from FRAX or high/moderate/low. Comment on dose dependent factors and effect on assessment.

Suggestions on further management:

Provide treatment recommendations, lifestyle modification, falls risk assessment, additional investigations, onward referral.

Provide a recommendation for appropriate time interval to consider repeat DXA assessment.

Reported by:

Name, title, signature, GMC/HCPC/NMC number, date.

Appendix 3:
Audit of reporting standards

Reporting standard	Audit questions	Target
1. The DXA scan report is a standalone document that contains sufficient detail to enable optimal management by the non-specialist referrer and is issued within three weeks of the scan.	1. Proportion of reports sent to referrer within three weeks of measurement (electronically or physical)	100%
2. Reports are produced by healthcare professionals with specific training and experience in DXA interpretation and entitled to act under IR(ME)R as operators.	1. Proportion of reporting clinicians with additional and specific DXA training	100%
	2. Proportion of non-medical reporters registered with HCPC/NMC	100%
	3. Proportion of reporting clinicians entitled to act under IR(ME)R in employers procedures	100%
3. DXA scan reports are quality assured as part of routine audit, clinical governance and peer review processes and are archived and retrievable.	1. Proportion of reports included in routine quality audits	10%
	2. Proportion of reports conforming to reporting protocol standards	>90%
	3. Proportion of audited reports archived to RIS/PACS system	100%
4. Appropriate protocols are in place to include reference database selection, diagnostic thresholds, treatment and follow up advice.	1. Proportion of reports conforming to reporting protocol	100%
5. Mild vertebral fracture diagnosis derived from vertebral fracture assessment (VFA) includes validation or recommendation for further imaging[1].	1. Proportion of VFA scans reporting a previously unidentified mild vertebral fracture/ deformity that trigger referral for further imaging	100%
6. Referrers have access to support and advice from the DXA service in relation to the management of individual patients.	1. Proportion of reports that include advice and contact invitation	100%

1 Further information about Vertebral Fracture identification and audit can be found in 'Clinical Guidance for the Effective Identification of Vertebral Fractures'[19].

Appendix 4:
Audit for the referrer

The recipient of the DXA report has a responsibility to ensure the patient receives and understands the results of the assessment in a timely manner and that they are offered any management recommendations made in the report.

Reporting standard	Audit questions	Target
1. Content of the DXA report is discussed with/transmitted to the patient within three weeks of receipt.	1. Discussion with patient about DXA report documented in records	100%
	2. Documentation that discussion took place within three weeks of receipt	100%
2. Treatment is offered to all patients in accordance with the recommendations in the report.	1. Documentation showing discussion about treatment recommendations has taken place	100%
3. Lifestyle advice is offered to all patients in accordance with the recommendations in the report.	1. Documentation showing discussion about lifestyle recommendations has taken place	100%
4. Any recommendations for further investigation or assessment such as falls risk assessment are offered to the patient.	1. Documentation that further investigations or referral have been offered/implemented	100%

Appendix 5:
Glossary of terms

BMD	Bone mineral density *A measurement of the amount of bone mineral in bone tissue.*
BMI	Body mass index *BMI is defined as the body mass (weight) divided by the square of the body height. It is universally expressed in units of kg/m².*
CT	Computerised tomography *A type of imaging which uses X-rays and a computer to create detailed images of the inside of the body. CT scans are sometimes referred to as CAT scans or computed tomography scans.*
DXA	Dual energy X-ray absorptiometry *A means of measuring bone mineral density.*
FRAX	*Online fracture risk assessment tool which can incorporate BMD: www.sheffield.ac.uk/FRAX*
GMC number	General Medical Council number *Unique reference number for registered doctors.*
HCPC number	Health and Care Professions Council number *Unique reference number for registered health and care professionals such as radiographers and clinical scientists.*
IR(ME)R	Ionising Radiation (Medical Exposure) Regulations *The regulations that govern the use of ionising radiation for medical purposes, such as DXA, X-rays and nuclear medicine scans, and treatments such as radiotherapy.*
LSC	Least significant change *The amount by which a BMD measurement must change between two scans to be certain that the change is real, rather than a measurement of precision error. Expressed as a percentage which is easily understood in clinical practice and by members of the public.* *It may also be expressed in g/cm².*

NMC number	Nursing and Midwifery Council number *Unique reference number for registered nurses and midwives.*
PACS	Picture archiving and communications systems *Software which provides storage and access to images from different imaging tests.*
RIS	Radiology information system *Software for managing medical imaging records and associated data.*
ROI	Region of interest *The portion of an image identified for a specific purpose. E.g. neck of femur measurement box, vertebral segmentation boxes.*
SD	Standard deviation *A statistical measure of how far a value is from the mean value of a data set. Expressed in DXA as T- and Z-scores.*
SOP	Standard operating procedure *A set of step-by-step instructions compiled by an organisation to define how workers carry out complex routine operations.*
T-score	*An expression of a measured BMD value in relation to young adult mean value of reference data. Expressed in terms of standard deviations.*
VFA	Vertebral fracture assessment *Imaging of the spine for the evaluation of vertebral fractures using a DXA scanner.*
Z-score	*An expression of a measured BMD value in relation to age matched mean value of reference data. Expressed in terms of standard deviations.*

About us

The Royal Osteoporosis Society is the only UK-wide charity dedicated to ending the pain and suffering caused by osteoporosis. The charity works tirelessly to help and support people with the condition as well as promoting good bone health to prevent osteoporosis. We do this by:

- Providing a range of information resources covering all aspects of osteoporosis for healthcare professionals and the public.
- Providing a free helpline staffed by nurses with specialist knowledge of osteoporosis and bone health.
- Investing in research to ensure future generations are freed from the burden of osteoporosis.
- Influencing government and campaigning to improve and maintain essential services.
- Educating healthcare professionals to ensure they are kept up to date about osteoporosis – through events, accredited training courses and our leading conference on osteoporosis and bone health.
- Working in partnership with the NHS to set up and improve Fracture Liaison Services, which can reduce the number of fractures caused by osteoporosis.

To find out more about our information, support and services, visit our website: **theros.org.uk**

Professional Membership

Professional membership of the Royal Osteoporosis Society will ensure you become better informed and able to deliver the best care possible to people with osteoporosis or fractures.

As a professional member, you'll have all the information you need at your fingertips and can stay up to date on best practice, care, delivery, new treatments and the latest news on osteoporosis research findings.

You'll also feel proud to be part of an organisation working hard to help those affected by osteoporosis.

To **join a growing network of professional members** like you, call our membership team on **01761 473287** or visit **theros.org.uk/HCPs**

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0808 800 0035 (specialist nurse Helpline)

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