National Institute for Health and Care Excellence

Draft for consultation

Osteoporosis: risk assessment

[A] Risk factors for fragility fractures

NICE guideline <number>

Evidence reviews underpinning recommendations 1.1.1-1.1.4 in the NICE guideline

January 2026

Draft for Consultation

This evidence review was developed by NICE

1

Disclaimer

The recommendations in this guideline represent the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or service users. The recommendations in this guideline are not mandatory and the guideline does not override the responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient, in consultation with the patient and/or their carer or guardian.

Local commissioners and/or providers have a responsibility to enable the guideline to be applied when individual health professionals and their patients or service users wish to use it. They should do so in the context of local and national priorities for funding and developing services, and in light of their duties to have due regard to the need to eliminate unlawful discrimination, to advance equality of opportunity and to reduce health inequalities. Nothing in this guideline should be interpreted in a way that would be inconsistent with compliance with those duties.

NICE guidelines cover health and care in England. Decisions on how they apply in other UK countries are made by ministers in the Welsh Government, Scottish Government, and Northern Ireland Executive. All NICE guidance is subject to regular review and may be updated or withdrawn.

ISBN:

Contents

1

1 Risk factors for fragility fractures

1.1 Review question: What are the indications for identifying adults who should be assessed for fragility fracture risk?

1.1.1 Introduction

The review identifies the common and important risk factors that should trigger healthcare professionals to consider assessment of fragility fracture risk.

1.1.2 Summary of protocol

Table 1: PICO characteristics of review question

Population	Adult men or women (over 18 years), including those without known osteoporosis or previous fragility fracture
Prognostic factor	BMI, glucocorticoid use, family history of fracture, previous fracture, smoking, alcohol, history of falls
Outcomes	Risk of fractures including: • vertebral • hip • forearm • any fragility fracture
Inclusion/ exclusion criteria	Where meta-analyses based on individual patient data are available, these are reviewed and other types of evidence such as meta-analysis, systematic reviews, cohort studies, case-control studies, and cross-sectional studies are not included. Hierarchy of evidence (only go down a level if there is a lack of literature): • pooled analysis of patient-level data • systematic reviews • cohort studies. Minimum number of fractures reported in study (event rate): 100

1.1.3 Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual.

Declarations of interest were recorded according to NICE's conflicts of interest policy.

The committee discussed whether there was likely to be new evidence that was strong enough to change current recommendations from the NICE guideline on osteoporosis (published 2012). The full report is available in the supporting document G (NICE CG146 Osteoporosis Full Guideline and Appendices). They agreed that the risk factor review from the previous version of this guideline was still relevant and should be used to inform the

updated recommendations. It was agreed that an informal consensus approach was the most appropriate method to answer this question.

1.1.4 Prognostic evidence

An updated evidence review was not prioritised for this question, so no new literature searches were run. Evidence from the NICE guideline on osteoporosis (published 2012), was used alongside committee consensus. The committee reviewed this evidence when considering any amendments to the current recommendations. This included:

- Age as an independent risk factor
- Previous fracture
- Glucocorticoid use
- Family history of fracture

The original evidence review is available in the Supporting Document G1 (NICE CG146 Osteoporosis Full Guideline and Appendices).

1.1.5 Economic evidence

The 2012 economic evidence review did not identify any economic evidence and so new economic evidence was sought. For methods, see the health economic review protocol in Appendix A.

1.1.5.1 Included studies

No health economic studies were included.

See also the health economic study selection flow chart in Appendix C.

1.1.5.2 Excluded studies

No relevant health economic studies were excluded due to assessment of limited applicability or methodological limitations, as detailed in Appendix I.

1.1.6 Summary of included economic evidence

No health economic studies were included.

1.1.7 Economic model

This area was not prioritised for new cost-effectiveness analysis.

1.2 The committee's discussion and interpretation of the evidence

1.1.8 The outcomes that matter most

The outcomes from the original review protocol were not changed. Fragility fracture was defined as a fracture occurring spontaneously or following a minor trauma, such as fall from standing height or less.

1.1.9 The quality of the evidence

The evidence quality was not re-assessed for this update.

1.1.10 Benefits and harms

After discussing the benefits of updating the evidence review in the previous version of the NICE guideline on osteoporosis (published 2012), it was agreed that a new evidence review would not be undertaken. Therefore, the committee would use the evidence from the existing guideline as the basis of the evidence for the recommendations for this question.

It was noted that the introduction of a screening programme is outside the remit of NICE guidelines and so this question relates to case finding by clinicians. Our approach was discussed with the National Screening Committee to ensure we were not duplicating their work.

The committee made recommendations for people aged over and under 50 years in line with those from the NICE guideline on osteoporosis (published 2012). This cut-off also aligns to the Fracture Liaison Service (FLS), NOGG and SIGN guidance and is a universally accepted threshold used for fracture risk.

1.1.10.1 People aged 50 and over

The committee discussed the risk factors for people aged 50 and over who should be considered for risk assessment from the previous NICE guideline on osteoporosis (published 2012). The committee agreed all the risk factors listed were relevant and should be included. The risk factors were age, glucocorticoid use, previous fragility fracture, history of falls, family history of hip fracture, other causes of secondary osteoporosis, low body mass index, smoking, and alcohol use.

The committee discussed the recommendations on risk factors from the SIGN guideline and found them to be closely matched. The main difference between the two guidelines was that age was an independent risk factor in the NICE guidelines whilst SIGN recommended anyone aged over 50 years with a risk factor should be considered for risk assessment.

The committee discussed the evidence from NICE guideline on osteoporosis (published 2012) on age as a risk factor and agreed that it was an important independent risk factor. The evidence showed that risk of fracture increased with age but there was a marked increase in risk for women at 65 years and men at 75 years. The committee agreed that these age thresholds should continue to be used as a risk factor to consider risk assessment for fragility fractures.

The committee discussed that many people in this age category would likely have another risk factor anyway. NICE guidance uses gender inclusive language to describe population groups where possible. For this guideline, we have been unable to make specific recommendations for trans and non-binary people because the information available at the time of development for these groups of people was too limited.

Family history of hip fracture was amended to history of hip fracture in a first-degree relative as the risk is higher for parents than grandparents. The committee also highlighted that this relationship was dependant on the age at the time of the first-degree relative's hip fracture. The risk is increased when the parental fracture occurred at a younger age and those after the age of 80 had no significant impact on offspring's risk. The committee agreed that the consider recommendation allowed for clinical judgement regarding who needs risk assessment.

The risk factor, history of falls, was defined as 2 or more falls in the last year to align to the definition from the NICE guideline on Falls: assessment and prevention. It was noted that even traumatic falls that occurred more than once would warrant further consideration to investigate any underlying causes. For example, osteoporosis can affect your balance (as the weight of bones reduces) leading to falls. It could also identify people with undiagnosed osteoporosis who may also be at risk of falling and suffer fragility (or other) fractures. The committee noted that a comprehensive geriatric assessment states that anyone presenting with a fragility fracture must be screened for bone health.

The committee discussed that BMI may be altered by the presence of height loss when assessing people with a low BMI. This may mean their BMI calculation is higher than it actually is if a person's original height was used. However, the committee were unaware of any evidence that showed it impacts on the risk score from QFracture or FRAX.

The committee discussed the list of secondary causes of osteoporosis given within the recommendation. These are intended as examples and not an exhaustive list. These were kept mostly the same as listed in the original recommendation with some minor changes as described below. The committee noted that the metabolic disease homocystinuria covers a small population and broadened this to include other inherited metabolic diseases with homocystinuria as an example. Eating disorders related to low BMI was added as this is an important risk factor highlighted in the NICE guideline on eating disorders where osteoporosis risk assessment is linked with people with anorexia nervosa because of their low body mass index (BMI). Taking other medicines that have been associated with increased fracture risk was also added here as the committee thought this was an important example to highlight. Examples provided were, anti-convulsants, selective serotonin reuptake inhibitors, thiazolidinediones, proton pump inhibitors and anti-retroviral drugs. Under gastrointestinal examples, the committee agreed that Crohn's disease was important to highlight and added it alongside other inflammatory bowel disease. In the rheumatological section the committee added spondylarthritis and linked to NICE's guideline on Spondyloarthritis. Immobility due to neurological injury or disease as secondary cause of osteoporosis was updated to 'Prolonged immobility' to take into account people that live in care homes who often lead sedentary lifestyles which could lead to reduced mobility. This had been highlighted in the previous version of the guideline. It was noted that it is the prolonged immobility not the care home that is the risk factor and people living at home could be just as immobile.

In people without fracture but with other risk factors, the committee discussed that the presence of individual risk factors (such as smoking or alcohol intake) alone are a much

lower priority for risk assessment compared to the presence of multiple risk factors which would be a stronger indication for risk assessment. The committee acknowledged that more than one risk factor increases the likelihood of osteoporosis being present. However, this review question only investigated risk by single risk factors, and the committee was not able to make this statement. The committee agreed that the healthcare professional would have to make a clinical judgement when assessing a person's risk.

Previous fragility fracture and glucocorticoids in people aged 50 and over

The committee agreed that people with a previous fragility fracture or current or frequent use of systemic glucocorticoids should be risk assessed and strengthened this recommendation. People with these risk factors were considered to be the highest risk group and most beneficial to assess. This advice is in line with the Fracture Liaison Services (FLS) who are predicated on needing to do a risk assessment for people who have had a fragility fracture. The committee agreed that previous fragility fractures increase the likelihood of getting another fracture, especially when there have been multiple fractures, or a hip or vertebral fracture. The increased risk is partly explained by age, with risk being greatest in younger people and diminishes overtime. The committee noted that most people with a previous fragility fracture would have been assessed and treated (if applicable) at the time of fracture if fragility fracture was thought to be the cause. Therefore, the committee agreed that people who had not been picked up at initial time of previous fracture should be risk assessed.

The committee discussed what constitutes current or frequent use of systemic glucocorticoids as a risk factor for fragility fracture. It was agreed that a current daily dose of 5 mg prednisolone or equivalent or more for over 3 months or intermittent use of higher doses would be considered high risk. The committee discussed whether the high risk threshold should be 5mg or 7.5mg prednisolone and there were many points taken into consideration. However, it was agreed to use the 5mg threshold as it aligns with the dose used in the FRAX risk prediction tool. It was noted that there is a dose dependent effect so the higher the dose and the longer it was taken for the greater the risk. The committee discussed that people may be given much higher doses and then tapered down to lower doses. The committee revised the wording to remove 'recent' from 'frequent recent' use of glucocorticoids to include people who have short courses of high dose steroids several times a year without it being recent. This may be the case for people with asthma or inflammatory bowel disease who have intermittent high doses, but it may not necessarily be recent or for longer than 3 months.

The evidence from the NICE guideline on osteoporosis (published 2012) showed an increased risk for both these risk factors and supported the recommendation that they should be risk assessed. The NICE quality standard on osteoporosis includes a quality statement that adults who have had a fragility fracture or use systemic glucocorticoids or have a history of falls have an assessment of their fracture risk. This is line with a stronger recommendation and reflects what is already being done in practice.

1.1.10.2 People aged under 50

The previous NICE guideline on osteoporosis (published 2012) included previous fragility fracture as an example of a major risk factor (whereas the recommendation above refers to single non-hip, non-vertebral fractures). The committee agreed that it would be useful to be explicit in the type of fragility fractures that was being referred to as a serious risk factor. The committee agreed that people aged 50 and under with a previous hip or vertebral fracture or 2 or more major osteoporotic fragility fractures should be assessed for fragility fracture risk

and made an additional recommendation to highlight this. These fractures have a significant impact on a person's quality of life and may mean that they are at risk of having another fracture.

The committee agreed with the NICE guideline on osteoporosis (published 2012) that recommended to consider risk assessing people under 50 years who have not had a previous hip or vertebral fracture or 2 or more major osteoporotic fragility fractures only if they have a different major risk factor because they are unlikely to be at high risk. The examples of major risk factors to consider were current or frequent use of systemic glucocorticoids, untreated early menopause or premature ovarian insufficiency and a previous single non-hip, non-vertebral fragility fracture.

1.1.11 Cost effectiveness and resource use

No economic evidence was identified in the previous guideline for this question or in the update search.

Resource use relates to undertaking the risk assessment (for example: a GP appointment, appointment at a fracture liaison clinic or staff time during a hospital admission) and also down-stream costs related to BMD assessment and treatment (for those meeting additional criteria), and fractures. However, increases in treatment will also confer health benefits to patients due to fractures avoided. It was noted that treatments to reduce fracture risk (for example, bisphosphonates) have been found to be cost-effective.

The committee agreed that the approach previously recommended of targeting risk assessment at groups more likely to require treatment, rather than the whole population, was a more appropriate and better use of resources. The existing indications for risk assessment were retained largely the same although some recommendations were strengthened and/or clarified. The committee discussed the potential for resource use implications.

The committee strengthened the recommendation for people who had a fragility fracture as this was one of the highest clinical priorities. They highlighted that this group is the most likely to have risk assessment in current practice as fragility fracture is the criteria for referral to a fracture liaison service. It was noted that not all areas currently have a fracture liaison service but that the government has already committed to 100% coverage by 2030. In areas without a fracture liaison service, currently many people that have had a fragility fracture will still be getting risk assessment currently via primary care.

The committee also strengthened the recommendation for people without fragility fracture but with current or frequent systemic glucocorticoid use. They also added clarification about the relevant glucocorticoid dose and duration to avoid inappropriate assessment. The committee agreed it was difficult to know how widespread risk assessment in this group is currently and that regional variation was likely, although it was noted that this population was included in a previous NICE quality statement. They also agreed that it was difficult to know whether the revised recommendation would increase or decrease resource use but agreed it would ensure resource use was most appropriately targeted.

Although not changed, the committee discussed the recommendation to consider risk assessment in women aged 65 years and over and men over 75 years. It was agreed that clinically this was appropriate due to age being the most important risk factor, but they discussed the potential for resource use implications for this group in particular because the committee highlighted that most women over 68 years would have risk over 10% even without any other risk factors and so would be eligible for BMD assessment with DXA under

the committee's new recommendations (discussed in Evidence report E). It was noted that the comprehensive geriatric assessment includes bone health and so in some older people risk assessment will be happening currently. It was also noted that current NICE Falls guideline recommends fracture risk assessment as part of a comprehensive falls assessment in some people. It was agreed that clinical judgement was required when deciding whether to undertake risk assessment and subsequent investigations such as DXA as it is only worthwhile if treatment would be considered and the results will inform management decisions (including as a baseline measurement for future assessment of treatment effect). The committee agreed that the consider recommendation allowed for clinical judgement regarding who needs risk assessment in this group.

Overall, the committee agreed the updated recommendation were unlikely to be associated with significant additional resource use compared to the prior NICE recommendations. However, the committee highlighted that risk assessment in people without a fragility fracture is currently limited, therefore despite the new recommendations being largely the same as the previous NICE recommendations, if rates of risk assessment increase there could still be a resource impact for the NHS. However, this would be associated with increases in treatment rates and associated reductions in fracture risk.

1.1.12 Other factors the committee took into account

Related NICE guidance identified and referred to within this review:

Chronic kidney disease: assessment and management (2021) NICE guideline NG203

Chronic obstructive pulmonary disease in over 16s: diagnosis and management (2018) NICE guideline NG115

Coeliac disease: recognition, assessment and management (2015) NICE guideline NG20

Crohn's disease: management (2019) NICE guideline NG129

Cystic fibrosis: diagnosis and management (2017) NICE guideline NG78

Eating disorders: recognition and treatment (2017, last updated 2020) NICE guideline NG69

Hyperparathyroidism (primary): diagnosis, assessment and initial management (2019) NICE guideline NG132

Pancreatitis (2018, last updated 2020) NICE guideline NG104

Spondyloarthritis in over 16s: diagnosis and management (2017) NICE guideline NG65

1.1.13 Recommendations supported by this evidence review

This evidence review supports recommendations 1.1.1-1.1.4 in the NICE guideline.

1.3 References

There are no references for this evidence review.

Appendices

Appendix A Review protocols

A.1 Clinical review protocol

The clinical review protocol was not updated, and information on the original review question can be found in Section C.1. of the original NICE guideline on osteoporosis (published 2012) in the Supporting Document G2.

A.2 Health economic review protocol

Review question	All questions – health economic evidence
Objectives	To identify health economic studies relevant to any of the review questions in the guideline update.
Search criteria	• Populations, interventions, and comparators must be as specified in the clinical review protocol above. • Studies must be of a relevant health economic study design (cost–utility analysis, cost-effectiveness analysis, cost–benefit analysis, cost–consequences analysis, comparative cost analysis). • Studies must not be a letter, editorial or commentary, or a review of health economic evaluations. (Recent reviews will be ordered although not reviewed. The bibliographies will be checked for relevant studies, which will then be ordered.) • Unpublished reports will not be considered unless submitted as part of a call for evidence. • Studies must be in English.
Search strategy	A global health economic study search will be undertaken for the guideline update using population-specific terms and a health economic study filter – see Appendix B below. Note that this guideline is being consulted on in two parts, but the health economic search covered the full guideline health economic review.
Review strategy	Studies not meeting any of the search criteria above will be excluded. Studies published before 2009 (including those included in the previous guideline), abstract-only studies and studies from non-OECD countries or the USA will also be excluded. Studies published 2009 onwards that were included in the previous guideline will be reassessed for inclusion and may be included or selectively excluded based on their relevance to the questions covered in this update and whether more applicable evidence is also identified. Each remaining study will be assessed for applicability and methodological limitations using the NICE economic evaluation checklist which can be found in appendix H of Developing NICE guidelines: the manual. **Inclusion and exclusion criteria** • If a study is rated as both 'Directly applicable' and with 'Minor limitations' then it will be included in the guideline. A health economic evidence table will be completed, and it will be included in the health economic evidence profile. • If a study is rated as either 'Not applicable' or with 'Very serious limitations' then it will usually be excluded from the guideline. If it is excluded, then a health economic

evidence table will not be completed, and it will not be included in the health economic evidence profile.

- If a study is rated as 'Partially applicable,' with 'Potentially serious limitations' or both then there is discretion over whether it should be included.

Where there is discretion

The health economist will make a decision based on the relative applicability and quality of the available evidence for that question, in discussion with the guideline committee if required. The ultimate aim is to include health economic studies that are helpful for decision-making in the context of the guideline and the current NHS setting. If several studies are considered of sufficiently high applicability and methodological quality that they could all be included, then the health economist, in discussion with the committee if required, may decide to include only the most applicable studies and to selectively exclude the remaining studies. All studies excluded on the basis of applicability or methodological limitations will be listed with explanation in the excluded health economic studies appendix below.

The health economist will be guided by the following hierarchies:

Setting:

- UK NHS (most applicable).
- OECD countries with predominantly public health insurance systems (for example, France, Germany, Sweden).
- OECD countries with predominantly private health insurance systems (for example, Switzerland).
- Studies set in non-OECD countries or in the USA will be excluded before being assessed for applicability and methodological limitations.

Health economic study type:

- Cost–utility analysis (most applicable).
- Other type of full economic evaluation (cost–benefit analysis, cost-effectiveness analysis, cost–consequences analysis).
- Comparative cost analysis.
- Non-comparative cost analyses including cost-of-illness studies will be excluded before being assessed for applicability and methodological limitations.

Year of analysis:

- The more recent the study, the more applicable it will be.
- Studies published in 2009 or later (including any such studies included in the previous guideline) but that depend on unit costs and resource data entirely or predominantly from before 2009 will be rated as 'Not applicable'.
- Studies published before 2009 (including any such studies included in the previous guideline) will be excluded before being assessed for applicability and methodological limitations.

Quality and relevance of effectiveness data used in the health economic analysis:

- The more closely the clinical effectiveness data used in the health economic analysis match with the outcomes of the studies included in the clinical review the more useful the analysis will be for decision-making in the guideline.

Appendix B Literature search strategies

The literature searches for this review are detailed below and complied with the methodology outlined in Developing NICE guidelines: the manual.(NICE2014) For more information, please see the Methodology review published as part of the accompanying documents for this guideline.

B.1 Clinical literature search strategy

The clinical literature search was not updated, and information on the original literature search can be found in Supporting document G2 NICE CG146 Osteoporosis Appendices.

B.2 Health economics literature search strategy

Health economic evidence was identified by conducting searches using terms for a population at risk of fragility fracture. The following databases were searched: NHS Economic Evaluation Database (NHS EED - this ceased to be updated after 31st March 2015), Health Technology Assessment database (HTA - this ceased to be updated from 31st March 2018) and The International Network of Agencies for Health Technology Assessment (INAHTA). Searches for recent evidence were run on Medline and Embase from 2014 onwards for health economics.

Table 2: Database parameters, filters and limits applied for population at risk of fragility fracture

Database	Dates searched	Search filters and limits applied
Medline (OVID)	Health Economics 1 January 2014 – 22 August 2025	Health economics studies Exclusions (animal studies, letters, comments, editorials, case studies/reports) English language
Embase (OVID)	Health Economics 1 January 2014 – 22 August 2025	Health economics studies Exclusions (animal studies, letters, comments, editorials, case studies/reports, conference abstracts) English language
NHS Economic Evaluation Database (NHS EED) (Centre for Research and Dissemination - CRD)	Inception –31st March 2015	

Database	Dates searched	Search filters and limits applied
Health Technology Assessment Database (HTA) (Centre for Research and Dissemination – CRD)	Inception – 31st March 2018	
The International Network of Agencies for Health Technology Assessment (INAHTA)	Inception - 22 August 2025	English language

Medline (Ovid) search terms

1	exp Osteoporosis/
2	(osteopor* or osteo-por* or osteop?eni* or osteo-p?eni*).tw,kf.
3	((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) adj4 bone* adj4 (los* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or demineral* or strength* or quality or quantit*)).tw.
4	((abnormal* or secondary or early or prematur*) adj4 bone* adj4 (los* or reduc* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*)).tw.
5	((low* or reduc* or decreas* or los*) adj4 bone* adj4 (mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*)).tw.
6	((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) adj4 BMD).tw.
7	((low* or los* or reduc* or decreas* or abnormal* or secondary) adj4 BMD).tw.
8	(bone* adj4 (deteriorat* or weak* or fragil* or decalc* or brittle* or atroph*)).tw.
9	((trabecula* or cancellous) adj4 (loss* or thin* or reduc* or decreas* or deteriorat* or low* or abnormal*)).tw.
10	((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) adj4 skeletal adj4 (los* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or demineral* or strength* or quality or quantit* or decalc* or atroph*)).tw.
11	((abnormal* or secondary or early or prematur*) adj4 skeletal* adj4 (los* or reduc* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit* or atroph*)).tw.
12	((low* or reduc* or decreas* or los*) adj4 skeletal adj4 (mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*)).tw.
13	Bone Diseases, Metabolic/

14	Osteoporotic Fractures/
15	(fragil* adj4 (fracture or fractures)).tw.
16	((low-impact* or low-energy or low-trauma* or insufficien*) adj4 fracture*).tw.
17	((risk* or frequen* or inciden* or suscept* or suspect* or predict* or prevent* or stop*) adj4 fracture*).tw.
18	((recurrent or recurring or repeat* or history or chronic or previous or prior or habitual) adj4 fracture*).tw.
19	refracture*.tw.
21	or/1-19
22	Economics/
23	Value of Life/
24	exp "Costs and Cost Analysis"/
25	exp Economics, Hospital/
26	exp Economics, Medical/
27	Economics, Nursing/
28	Economics, Pharmaceutical/
29	exp "Fees and Charges"/
30	exp Budgets/
31	budget*.ti,ab.
32	cost*.ti.
33	(economic* or pharmaco?economic*).ti.
34	(price* or pricing*).ti,ab.
35	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
36	(financ* or fee or fees).ti,ab.
37	(value adj2 (money or monetary)).ti,ab.
38	or/22-37
39	21 and 38
40	limit 39 to ed=20140101-20250822

1

Embase (Ovid) search terms

1	exp osteoporosis/
2	exp Osteopenia/
3	(osteopor* or osteo-por* or osteop?eni* or osteo-p?eni*).tw,kf.
4	((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) adj4 bone* adj4 (los* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or demineral* or strength* or quality or quantit*)).tw.
5	((abnormal* or secondary or early or prematur*) adj4 bone* adj4 (los* or reduc* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*)).tw.
6	((low* or reduc* or decreas* or los*) adj4 bone* adj4 (mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*)).tw.
7	((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) adj4 BMD).tw.
8	((low* or los* or reduc* or decreas* or abnormal* or secondary) adj4 BMD).tw.
9	(bone* adj4 (deteriorat* or weak* or fragil* or decalc* or brittle* or atroph*)).tw.
10	((trabecula* or cancellous) adj4 (loss* or thin* or reduc* or decreas* or deteriorat* or low* or abnormal*)).tw.
11	((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) adj4 skeletal* adj4 (los* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or demineral* or strength* or quality or quantit* or decalc* or atroph*)).tw.
12	((abnormal* or secondary or early or prematur*) adj4 skeletal* adj4 (los* or reduc* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit* or atroph*)).tw.
13	((low* or reduc* or decreas* or los*) adj4 skeletal* adj4 (mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*)).tw.
14	metabolic bone disease/ or exp bone demineralization/
15	fragility fracture/
16	(fragil* adj4 (fracture or fractures)).tw.
17	((low-impact* or low-energy or low-trauma* or insufficien*) adj4 fracture*).tw.
18	((risk* or frequen* or inciden* or suscept* or suspect* or predict* or prevent* or stop*) adj4 fracture*).tw.

19	((recurrent or recurring or repeat* or history or chronic or previous or prior or habitual) adj4 fracture*).tw.
20	refracture*.tw.
21	or/1-20
22	health economics/
23	exp economic evaluation/
24	exp health care cost/
25	exp fee/
26	budget/
27	funding/
28	budget*.ti,ab.
29	cost*.ti.
30	(economic* or pharmaco?economic*).ti.
31	(price* or pricing*).ti,ab.
32	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
33	(financ* or fee or fees).ti,ab.
34	(value adj2 (money or monetary)).ti,ab.
35	or/22-34
36	21 and 35
37	Limit 36 to dd=20140101-20250822
38	Limit 36 to dc=20140101-20250822
39	37 or 38

NHS EED and HTA (CRD) search terms

1	MeSH DESCRIPTOR osteoporosis EXPLODE ALL TREES
2	(((osteopor* or osteo-por* or osteopeni* or osteopaeni* or osteo-peni* or osteopaeni*)))
3	(((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) adj4 bone* adj4 (los* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or demineral* or strength* or quality or quantit*)))

4	(((abnormal* or secondary or early or prematur*) adj4 bone* adj4 (los* or reduc* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*)))
5	(((low* or reduc* or decreas* or los*) adj4 bone* adj4 (mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*)))
6	(((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) adj4 BMD))
7	(((low* or los* or reduc* or decreas* or abnormal* or secondary) adj4 BMD))
8	((bone* adj4 (deteriorat* or weak* or fragil* or decalc* or brittle* or atroph*)))
9	(((trabecula* or cancellous) adj4 (loss* or thin* or reduc* or decreas* or deteriorat* or low* or abnormal*)))
10	((((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) adj4 skeletal adj4 (los* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or demineral* or strength* or quality or quantit* or decalc* or atroph*))))
11	((((abnormal* or secondary or early or prematur*) adj4 skeletal* adj4 (los* or reduc* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit* or atroph*))))
12	((((low* or reduc* or decreas* or los*) adj4 skeletal adj4 (mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*))))
13	MeSH DESCRIPTOR Bone Diseases, Metabolic
14	MeSH DESCRIPTOR osteoporotic fractures
15	((fragil* adj4 (fracture or fractures)))
16	(((low-impact* or low-energy or low-trauma* or insufficien*) adj4 fracture*))
17	(((risk* or frequen* or inciden* or suscept* or suspect* or predict* or prevent* or stop*) adj4 fracture*))
18	(((recurrent or recurring or repeat* or history or chronic or previous or prior or habitual) adj4 fracture*))
19	(refracture*)
20	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19

INAHTA search terms

1	("Osteoporosis"[mhe])
2	(((osteopor* or osteopeni* or osteopaeni*))[Title] OR ((osteopor* or osteopeni* or osteopaeni*))[abs])
3	(((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) AND bone* AND (los* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or demineral* or strength* or quality or quantit*)))[Title] OR (((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) AND bone* AND (los* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or demineral* or strength* or quality or quantit*)))[abs]
4	(((abnormal* or secondary or early or prematur*) AND bone* AND (los* or reduc* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*)))[Title] OR (((abnormal* or secondary or early or prematur*) AND bone* AND (los* or reduc* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*)))[abs]
5	(((low* or reduc* or decreas* or los*) AND bone* AND (mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*))) OR (((low* or reduc* or decreas* or los*) AND bone* AND (mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*)))
6	(((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) AND BMD))[Title] OR (((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) AND BMD))[abs]
7	((low* or los* or reduc* or decreas* or abnormal* or secondary) AND BMD))[Title] OR (((low* or los* or reduc* or decreas* or abnormal* or secondary) AND BMD))[abs]
8	((bone* AND (deteriorat* or weak* or fragil* or decalc* or brittle* or atroph*)))[Title] OR ((bone* AND (deteriorat* or weak* or fragil* or decalc* or brittle* or atroph*)))[abs]
9	(((trabecula* or cancellous) AND (loss* or thin* or reduc* or decreas* or deteriorat* or low* or abnormal*)))[Title] OR (((trabecula* or cancellous) AND (loss* or thin* or reduc* or decreas* or deteriorat* or low* or abnormal*)))[abs]

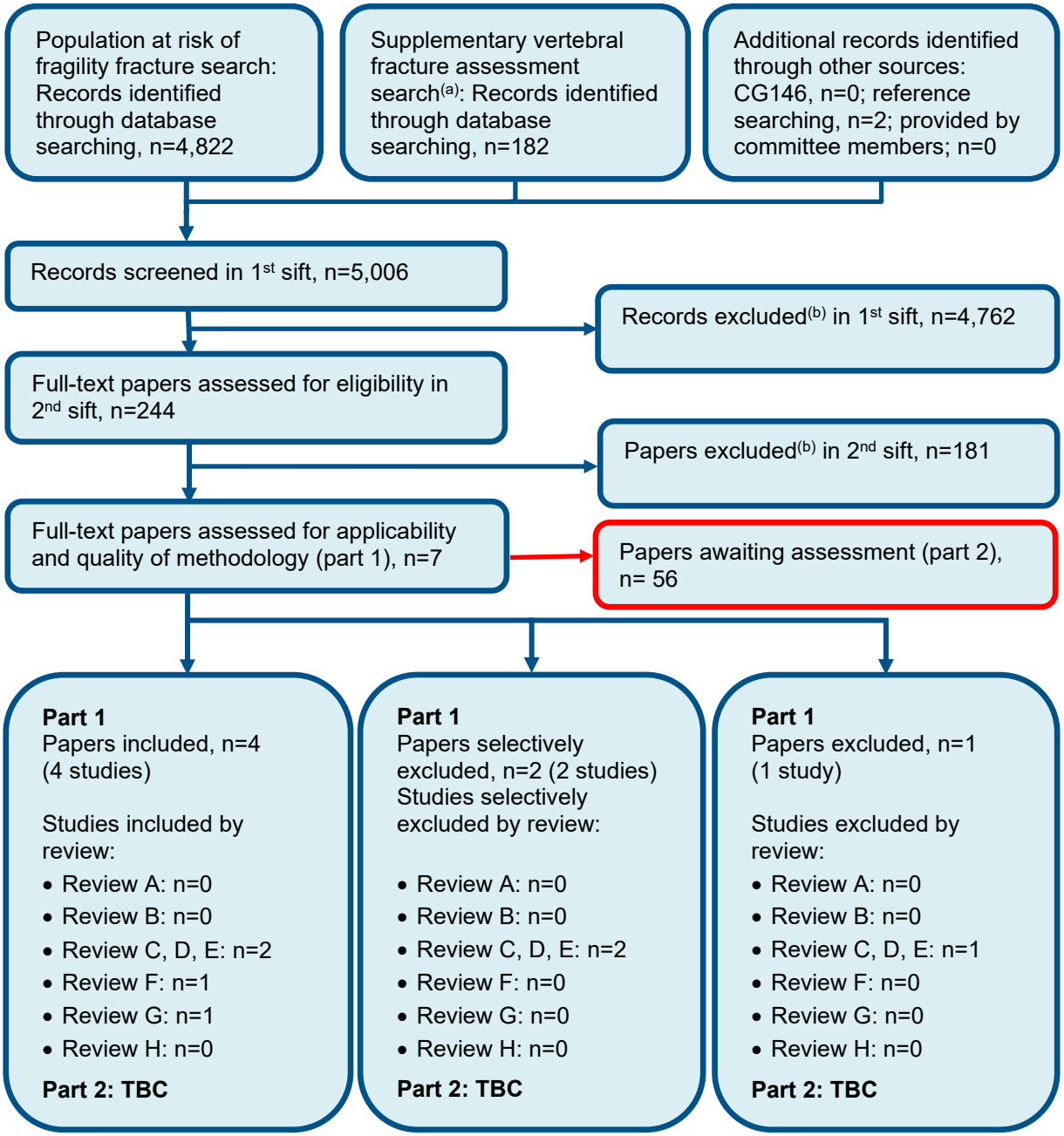
10	(((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) AND skeletal AND (los* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or demineral* or strength* or quality or quantit* or decalc* or atroph*)))[Title] OR (((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) AND skeletal AND (los* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or demineral* or strength* or quality or quantit* or decalc* or atroph*)))[abs]
11	(((abnormal* or secondary or early or prematur*) AND skeletal* AND (los* or reduc* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit* or atroph*)))[Title] OR (((abnormal* or secondary or early or prematur*) AND skeletal* AND (los* or reduc* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit* or atroph*)))[abs]
12	(((low* or reduc* or decreas* or los*) AND skeletal AND (mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*)))[Title] OR (((low* or reduc* or decreas* or los*) AND skeletal AND (mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*)))[abs]
13	"Bone Diseases, Metabolic"[mh]
14	"Osteoporotic Fractures"[mh]
15	(fragil* AND (fracture or fractures))
16	((low-impact* or low-energy or low-trauma* or insufficien*) AND fracture*)
17	((risk* or frequen* or inciden* or suscept* or suspect* or predict* or prevent* or stop*) AND fracture*)
18	((recurrent or recurring or repeat* or history or chronic or previous or prior or habitual) AND fracture*)
19	refracture*
20	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19

1

Appendix C Economic evidence study selection

Note that this guideline is being consulted on it two parts, but the health economic review search covered the full guideline. Only studies related to part 1 are included below. Studies that may be relevant to part 2 are noted but are not finalised.

Figure 1: Flow chart of health economic study selection



TBC= to be checked. These review questions will form the second instalment of this guideline update.

(a) Supplementary search for review questions F and G. Search methods in Appendix B of relevant evidence reports.
(b) Non-relevant population, intervention, comparison, design or setting; non-English language.

Appendix D Effectiveness evidence

No new clinical studies were included in this review as the clinical literature search was not updated. See Appendix D in the Supporting document G2 NICE guideline on osteoporosis (published 2012) for the original evidence identified.

Appendix E Forest plots

No forest plots were included in this review. Please see Appendix D in the Supporting document G2 NICE guideline on osteoporosis (published 2012).

Appendix F GRADE tables

No GRADE tables were included in this review.

Appendix G Economic evidence tables

No health economic studies were included in this review.

Appendix H Health economic model

New cost-effectiveness analysis was not conducted in this area.

Appendix I Excluded studies

I.1 Clinical studies

See Appendix G of the Supporting document G2 NICE guideline on osteoporosis (published 2012).

I.2 Health Economic studies

If any published health economic studies relevant to this question met the inclusion criteria (relevant population, comparators, economic study design, published 2009 or later and not from non-OECD country or USA) but were excluded following appraisal of applicability and methodological quality they are listed below with reasons. See the health economic protocol for more details.

None.