National Institute for Health and Care Excellence

Draft for consultation

Osteoporosis: risk assessment

[H] Fracture risk monitoring in non-treatment groups

NICE guideline <number>

Evidence reviews underpinning recommendations 1.8.1, 1.9.1-1.9.2 and 1.10.1 in the NICE guideline

January 2026

Draft for Consultation

This evidence review was developed by NICE

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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.

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ISBN:

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1. Fracture risk monitoring in non-treatment groups

1.1. Review question: What is the most clinically and cost-effective strategy for monitoring adults at risk of fragility fracture, who are not being treated pharmacologically, including repeating the risk prediction tools and bone assessment techniques?

1.1.1. Introduction

This review question was developed to determine monitoring timepoints for people at risk of fragility fracture but who are not being treated pharmacologically. The interventions included monitoring by risk prediction tools and/or bone assessment techniques compared to each other at different timepoints.

1.1.2. Summary of the protocol

For full details see the review protocol in Appendix A.

Table 1: PICO characteristics of review question

Population	• Adults who have previously had an assessment of fragility fracture risk and in whom pharmacological treatment has not been commenced
Intervention(s)	• Risk prediction tools validated in UK population: FRAX, QFracture, CFracture • Bone assessment techniques: Dual X-ray absorptiometry (DXA)
Comparison(s)	• Same intervention compared to itself at different timepoint
Outcomes	• Number or proportion of people meeting threshold for treatment • Number of people with fragility fracture • Health-related quality of life
Study design	• Randomised controlled trials • Systematic reviews of RCTs

1.1.3. Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual. Methods specific to this review question are described in the review protocol in Appendix A and the methods document.

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

1.1.4. Effectiveness evidence

1.1.4.1. Included studies

A search was conducted for randomised trials comparing the use of UK-validated risk prediction tools or dual X-ray absorptiometry (DXA) at one time point to themselves at another timepoint. No relevant clinical studies comparing any of these interventions to themselves at any timepoint were identified.

See also the study selection flow chart in Appendix C.

1.1.4.2. Excluded studies

See the excluded studies list in Appendix J.

1.1.5. Summary of studies included in the effectiveness evidence

No studies were identified.

1.1.6. Summary of the effectiveness evidence

No studies were identified.

1.1.7. Economic evidence

For methods, see the health economic review protocol in Appendix A.

1.1.7.1. Included studies

No health economic studies were included.

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

1.1.7.2. Excluded studies

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

1.1.8. Summary of included economic evidence

No health economic studies were included.

1.1.9. Economic model

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

1.1.10. Unit costs

The previous guideline included a comparison of the cost of undertaking DXA in all people compared to a strategy of risk assessment followed by selective DXA. An updated comparison is included below.

Table 2: Cost comparison from NICE CG146 2017 updated

Strategy	Cost breakdown	Units required	Cost per component	Total cost per person
	Initial contact	0-1	£0-£59	

Strategy	Cost breakdown	Units required	Cost per component	Total cost per person
BMD assessment for all	DXA scan	1	£84	£143 to £202[(a)]
	Post-DXA follow-up	1	£59	
Risk score + selective BMD assessment	Initial contact and risk assessment	1	£59	£59 to £202[(b)]
	DXA scan	0-1	£84	
	Post-DXA follow-up	0-1	£59	

Costings: Initial contact, initial contact & risk assessment, and post-DXA follow-up were all defined as a 15-minute GP consultation based on committee expert opinion (cost source= PSSRU 2023/24). The cost of a DXA scan was calculated by taking the average cost of DXA as reported in the NHS National Cost Collection 2023-24 (Currency code RD40Z).

(a) £143 if no initial contact appointment required; £202 including initial contact appointment.

(b) £59 if no DXA scan and £202 if DXA scan. The average cost per person will be between the two and dependant on the proportion of people that would require a DXA scan.

If an initial contact appointment is required with the individual prior to referral for BMD assessment, then costs for a risk score + selective BMD strategy will always be lower than for BMD for all.

However, if an initial contact appointment is not required prior to a BMD assessment, then risk score with selective BMD will be lower cost if the rate of BMD assessment is less than 71%.

1.2. The committee's discussion and interpretation of the evidence

1.2.1. The outcomes that matter most

The committee agreed that the number or proportion of people meeting the threshold for treatment (having previously not met the threshold), number of people who subsequently developed a fragility fracture and generic health-related quality of life measures were important outcomes for this review. All outcomes were considered equally important for decision making and therefore were all rated as critical.

No evidence was identified for any of the outcomes.

1.2.2. The quality of the evidence

No evidence was identified.

1.2.3. Benefits and harms

In the absence of any evidence the committee agreed, based on their experience and expertise, that it is important to make monitoring recommendations for adults at risk of fragility fracture who are not on pharmacological treatment to ensure they are reassessed and managed appropriately.

The committee discussed the different considerations for reassessment timing for people who had met the criteria for treatment but have declined or delayed treatment and those whose condition did not meet the criteria for treatment. The committee agreed that there should be separate recommendations made for monitoring these groups.

1.2.3.1. People who have declined or delayed treatment

The committee noted that some people, who are considered clinically appropriate for treatment at the initial baseline assessment, decline pharmacological treatment.

People may decline treatment for any of the following reasons:

- to try lifestyle changes before starting treatment
- focus on treatments for a different condition (dental or cancer treatment)
- fear of adverse effects of treatment
- personal reasons including caring responsibilities

As such, it is especially important to tell people when and how to access the service for reassessment. It is important to take into account if they have declined or delayed treatment as this will influence the discussion. It was noted that it is important to advise people to contact their GP if they change their mind or their clinical circumstances change (for example if they finish their dental treatment) to ensure that they are not lost within the system.

1.2.3.2. People whose condition did not meet the criteria for treatment

This includes people who had 10-year fracture risk below 10% at risk assessment and so did not progress to BMD assessment, and those eligible for BMD assessment but that following full clinical assessment taking account of risk, BMD (where feasible), clinical risk factors, patient history (including fracture history where relevant), were not eligible for treatment at this time. It is important that people who have not met the treatment threshold are monitored at appropriate timepoints so that they are offered pharmacological treatment if their condition progresses and reaches the threshold.

People with a 10-year fracture risk of major osteoporotic fracture of less than 10%

People whose condition has been assessed but not met the criteria for treatment are still likely to be at increased risk of fracture compared to the general population (although their condition did not meet the criteria), and this risk is likely to increase as they get older. The committee agreed that people with a 10-year risk of less than 10% should consider reassessment if there were any change in their clinical circumstances that would negatively impact bone health. Examples of changes in clinical circumstances that could impact risk included a fragility fracture or if they develop a new risk factor. This should be done with the same risk prediction tool used at baseline. Otherwise, if there are no changes in circumstances then they should be considered for reassessment after 5 years. The same criteria for DXA should be applied at reassessment as for the initial assessment.

This period of 5 years was agreed on the basis that the increase in age input into the risk prediction tools would likely mean some people reach the risk threshold of 10% without any new risk factors. The initial risk assessment tool should be used as different tools will likely give different scores to the same person on the same day let alone over time. The committee discussed the possibility of not being able to use the same tool but agreed that where possible this should be the gold standard.

People with a 10-year fracture risk of major osteoporotic fracture of 10% or more, or who had a DXA to assess their fragility fracture risk, but whose condition did not meet the criteria for treatment

The committee agreed that for people with a 10-year risk of 10% or more or who had a DXA to assess their fragility fracture, but whose condition did not meet the criteria for treatment, they should be considered for reassessment of their BMD by DXA at different timepoints. Reassessment of BMD by DXA should be considered when there is a change in their clinical circumstances (such as a fragility fracture or if they develop a new risk factor) unless this is

within 2 years of their most recent DXA scan. For most people repeating a DXA within 2 years would not show a clinically meaningful change in BMD as it is not likely to change more than the bone measurement error of the machine over 2 years. Reassessment should be considered at 5 years if there are no changes in their clinical circumstances that would negatively affect bone health (that is, they did not develop any new risk factors related to osteoporosis) but sooner, within 2 to 3 years, if their condition was close to being eligible for treatment, especially if they have a significant risk of accelerated bone loss (ABL). A shorter time period for reassessment for these people was recommended as they are likely to meet the threshold for treatment sooner. People at significant risk of ABL could include people on aromatase inhibitors, androgen deprivation therapy, non-surgical management of hyperparathyroidism, and high dose glucocorticoids.

The need for treatment should be considered without measuring BMD with a DXA scan again if their clinical circumstances change within 2 years of their most recent DXA scan.

Timing of follow up DXA scans

The committee agreed that the minimum time for reassessment by DXA scan should be two years unless there are exceptional circumstances. A minimum of two years was agreed as a repeat DXA before then is not long enough to show a clinically meaningful change in bone mineral density (BMD). Exceptional circumstances include having a high risk of accelerated bone loss, which can be present when using medicines known to cause a reduction in bone density such as systemic glucocorticoids. They thus made a recommendation to ensure that resources were not being used unnecessarily.

1.2.4. Cost effectiveness and resource use

No published economic evaluations were identified.

The committee drafted consensus recommendations with the aim of ensuring people are followed up appropriately to ensure timely treatment, but that unnecessary reassessment is avoided.

The committee agreed these recommendations are likely to be cost-neutral or cost-saving as they are not a substantial change in clinical practice but may reduce unnecessary reassessment in some geographical areas by clarifying minimum durations between reassessments.

1.2.5. Other factors the committee took into account

The committee discussed that people with learning disabilities and cognitive impairment may need support when expecting them to self-refer for ongoing management.

1.2.6. Recommendations supported by this evidence review

This evidence review supports recommendations 1.8.1, 1.9.1-1.9.2 and 1.10.1.

1.3. References

There are no references for this evidence review.

Appendices

Appendix A Review protocols

A.1 Review protocol for monitoring adults at risk of fragility fracture

Field	Content
Review title	What is the most clinically and cost-effective strategy for monitoring adults at risk of fragility fracture, who are not being treated pharmacologically, including repeating the risk prediction tools and bone assessment techniques?
Review question	What is the most clinically and cost-effective strategy for monitoring adults at risk of fragility fracture, who are not being treated pharmacologically, including repeating the risk prediction tools and bone assessment techniques?
Objective	Those initially screened for risk, but who were not found to be at high enough risk of fragility fracture to require intervention or in whom a decision was made not to precede with a pharmacological intervention may reach a level of risk requiring intervention at a later date. Risk changes in response to changes in BMD and change in other risk factors. It is therefore necessary to monitor those adults and repeat risk prediction tools and bone assessment techniques. This review investigates the best methods for carrying these assessments out on this population.
Searches	The following databases (from inception) will be searched: • Cochrane Central Register of Controlled Trials (CENTRAL) • Cochrane Database of Systematic Reviews (CDSR) • Embase • MEDLINE • Epistemonikos Searches will be restricted by:

	• English language studies • Human studies Other searches: The searches may be re-run 6 weeks before the final committee meeting and further studies retrieved for inclusion if relevant. The full search strategies will be published in the final review. Medline search strategy to be quality assured using the PRESS evidence-based checklist (see methods chapter for full details).
Condition or domain being studied	Those who were previously assessed for fragility fracture risk but did not go on to pharmacological treatment. Those assessed to not meet the threshold for treatment or those who chosen not to have treatment.
Population	Inclusion: • Adults >18 years and older) who have previously had an assessment of fragility fracture risk and in whom pharmacological treatment was not commenced (because not indicated or patient did not wish to begin treatment). Exclusion: • Children and young people less than 18 years. • Those on pharmacological treatment for their bone health • People on a treatment pause from bisphosphonates • Calcium and vitamin D alone Strata: • People with premature ovarian insufficiency (below 40 years) • Pregnancy-related osteoporosis
Intervention	Re-assessment using the following risk prediction tools at different time points: • FRAX

	• QFracture < 2 years, 2 to 5 years, 5 to 10 years, and 10 years and over Bone assessment techniques: • Dual X-ray absorptiometry (DXA) < 2 years, 2 to 5 years, 5 to 10 years, and 10 years and over The risk prediction tools (above) are those that are validated in a UK population. Studies carried out in non-UK populations will also be included provided they use a tool that has been validated on a UK population. CFracture is included because it is a modification of QFracture. Each iteration of risk prediction tool should be separate strata. Analyse older versions of FRAX separately. **Exclude:** Studies that do not include a UK-validated risk assessment tool (risk prediction tools only)
Comparator	• Same test to itself at different timepoints.
Types of study to be included	Randomised controlled trials (RCTs). Published NMAs and IPDs will be considered for inclusion. Systematic reviews of RCTs. For a systematic review (SR) to be included it must be conducted in line with the methodological processes described in the NICE manual. If sufficient details are provided, reviewers will either include the SR fully or use it as the basis for further analyses where possible. If sufficient details are not provided to include a relevant SR, the review will only be used for citation searching. **Exclusion:** Non-randomised studies
Other exclusion criteria	Non-English language studies. Conference abstracts will be excluded.
Context	Any setting

Primary outcomes (critical outcomes)	All outcomes are considered equally important for decision making and therefore have all been rated as critical:
	Primary outcome:
	• Number or proportion meeting the threshold for treatment
	Secondary outcomes:
	• Number with fragility fracture
	• Generic health-related quality of life (continuous outcomes will be prioritised [validated measures]). The hierarchy for extracting will be as follows, if measures higher on hierarchy are reported others will not be
	  ○ EQ-5D
	  ○ SF-6D
	  ○ SF-36
	  ○ SF-12
	  ○ Other utility measures (AQOL, HUI, 15D, QWB)

Data extraction (selection and coding)	All references identified by the searches and from other sources will be uploaded into EPPI R5 and de-duplicated. Titles and abstracts of the retrieved citations will be screened to identify studies that potentially meet the inclusion criteria outlined in the review protocol. Dual sifting will be performed on at least 10% of records; 90% agreement is required. Disagreements will be resolved via discussion between the two reviewers, and consultation with senior staff if necessary. Full versions of the selected studies will be obtained for assessment. Studies that fail to meet the inclusion criteria once the full version has been checked will be excluded at this stage. Each study excluded after checking the full version will be listed, along with the reason for its exclusion. A standardised form will be used to extract data from studies. The following data will be extracted: study details (reference, country where study was carried out, type and dates), participant characteristics, inclusion and exclusion criteria, details of the interventions if relevant, setting and follow-up, relevant outcome data, and source of funding. One reviewer will extract relevant data into a standardised form, and this will be quality assessed by a senior reviewer.

Risk of bias (quality) assessment	Risk of bias will be assessed using the appropriate checklist as described in Developing NICE guidelines: the manual. For Intervention reviews • Systematic reviews: Risk of Bias in Systematic Reviews (ROBIS) • Randomised Controlled Trial: Cochrane RoB (2.0)
Strategy for data synthesis	Pairwise meta-analyses will be performed using Cochrane Review Manager (RevMan5). Fixed-effects (Mantel-Haenszel) techniques will be used to calculate risk ratios for the binary outcomes where possible. Continuous outcomes will be analysed using an inverse variance method for pooling weighted mean differences. Heterogeneity between the studies in effect measures will be assessed using the I^2 statistic and visually inspected. An I^2 value greater than 50% will be considered indicative of substantial heterogeneity. Sensitivity analyses will be conducted based on pre-specified subgroups using stratified meta-analysis to explore the heterogeneity in effect estimates. If this does not explain the heterogeneity, the results will be presented pooled using random effects If sufficient data is available, meta-regression or NMA-meta-regression will be conducted. • GRADEpro will be used to assess the quality of evidence for each outcome, taking into account individual study quality and the meta-analysis results. The 4 main quality elements (risk of bias, indirectness, inconsistency, and imprecision) will be appraised for each outcome. Publication bias will be considered with the guideline committee, and if suspected will be tested for when there are more than 5 studies for that outcome. The risk of bias across all available evidence was evaluated for each outcome using an adaptation of the 'Grading of Recommendations Assessment, Development and Evaluation (GRADE) toolbox' developed by the international GRADE working group http://www.gradeworkinggroup.org/
Analysis of sub-groups	Subgroups that will be investigated if heterogeneity is present: • Those pre-menopausal at first assessment but post-menopausal at second assessment but not on HRT/on HRT • Pre- and post-menopausal, men above and below 50 years

Type and method of review	☒	Intervention	
	☐	Diagnostic	
	☐	Prognostic	
	☐	Qualitative	
	☐	Epidemiologic	
	☐	Service Delivery	
	☐	Other (please specify)	
Language	English		
Country	England		
Anticipated or actual start date	NA		
Anticipated completion date	November 2025		
Stage of review at time of this submission	Review stage	Started	Completed
	Preliminary searches	☑	☑
	Piloting of the study selection process	☑	☑
	Formal screening of search results against eligibility criteria	☑	☑
	Data extraction	☑	☑
	Risk of bias (quality) assessment	☑	☑
	Data analysis	☑	☑

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Review team members	From NICE: Carlos Sharpin [Guideline lead] Clare Jones [Senior technical analyst] Linyun Fou [Technical analyst] Kate Lovibond [Senior Health economist] Muksitur Rahman [Health economist] Sarah Glover [Information specialist]
Funding sources/sponsor	Development of this systematic review is being funded by NICE.
Conflicts of interest	All guideline committee members and anyone who has direct input into NICE guidelines (including the evidence review team and expert witnesses) must declare any potential conflicts of interest in line with NICE's code of practice for declaring and dealing with conflicts of interest. Any relevant interests, or changes to interests, will also be declared publicly at the start of each guideline committee meeting. Before each meeting, any potential conflicts of interest will be considered by the guideline committee Chair and a senior member of the development team. Any decisions to exclude a person from all or part of a meeting will be documented. Any changes to a member's declaration of interests will be recorded in the minutes of the meeting. Declarations of interests will be published with the final guideline.
Collaborators	Development of this systematic review will be overseen by an advisory committee who will use the review to inform the development of evidence-based recommendations in line with section 3 of Developing NICE guidelines: the manual. Members of the guideline committee are available on the NICE website: https://www.nice.org.uk/guidance/indevelopment/GID-NG10216

Other registration details	N/A	
Reference/URL for published protocol	N/A	
Dissemination plans	NICE may use a range of different methods to raise awareness of the guideline. These include standard approaches such as: • notifying registered stakeholders of publication • publicising the guideline through NICE's newsletter and alerts • issuing a press release or briefing as appropriate, posting news articles on the NICE website, using social media channels, and publicising the guideline within NICE.	
Keywords	N/A	
Details of existing review of same topic by same authors	N/A	
Current review status	☐	Ongoing
	☒	Completed but not published
	☐	Completed and published
	☐	Completed, published, and being updated
	☐	Discontinued
Additional information	N/A	
Details of final publication	www.nice.org.uk	

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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.

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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 search literature search strategy

Searches were constructed using a PICO framework where population (P) terms were combined with Intervention (I) and in some cases Comparison (C) terms. Outcomes (O) are rarely used in search strategies as these concepts may not be indexed or described in the title or abstract and are therefore difficult to retrieve. Search filters were applied to the search where appropriate.

What is the most clinically and cost-effective strategy for monitoring adults at risk of fragility fracture, who are not being treated pharmacologically, including repeating the risk prediction tools and bone assessment techniques?

Table 3: Database parameters, filters and limits applied

Database	Dates searched	Search filter used
Medline (OVID)	1946 – 15 November 2024	Randomised controlled trials Systematic review studies Exclusions (animal studies, letters, comments, editorials, case studies/reports) English language
Embase (OVID)	1974 – 15 November 2024	Randomised controlled trials Systematic review studies Exclusions (animal studies, letters, comments, editorials, case studies/reports) English language
The Cochrane Library (Wiley)	Cochrane Reviews to 202 Issue 11 of 12 CENTRAL to 2024 Issue 11 of 12	Exclusions (clinical trials, conference abstracts)
Epistemonikos (The Epistemonikos Foundation)	Inception to 15 November 2024	Systematic review studies Exclusions (Cochrane reviews) 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.

20	or/1-19
21	exp Densitometry/
22	(densitometr* or BMD-test* or BMD-tool* or densimetr*).tw.
23	(bone adj4 mineral adj4 dens* adj4 test*).tw.
24	(bone adj4 mineral adj4 dens* adj4 tool*).tw.
25	Absorptiometry, Photon/
26	(absorptiometr* adj4 (dpx* or dual-energ* or dual-photon* or photon*)).tw.
27	X-Rays/
28	(x-ray* or xray*).tw.
29	((grenz* or roentgen*) adj4 ray*).tw.
30	(x-radiation* or xradiation*).tw.
31	(DXA* or DEXA).tw.
32	(FRAX or FRAXTM or Qfracture* or Q-fracture* or Cfracture* or C-Fracture*).tw.
33	(fracture* adj2 risk adj2 assess* adj2 tool*).tw.
34	(QCT* or pQCT* or HR-pQCT* or HRpQCT* or PCD-CT* or PCDCT* or SR-MUCT* or SRMUCT* or HRclinCT* HRclin-CT* or HR-clin-CT* or HR-clinCT*).tw.
35	(QUS or PEUS or P-EU or P-EUS or PEQUS).tw.
36	or/21-35
37	Tomography, X-Ray Computed/
38	(cat scan* or ct scan* or cine ct or cine-ct or tomodensitomet*).tw.
39	((computed or computer assisted or computeriz* or computeris* or electron beam* or axial*) adj4 tomograph*).tw.
40	Four-Dimensional Computed Tomography/
41	(4d ct or 4dct or 4-dimensional CT or four dimensional CT).tw.
42	exp Tomography, Spiral Computed/
43	((helical or spiral) adj4 ct*).tw.
44	exp Ultrasonography/
45	(ultrasound* or ultra-sound* or ultrason* or sonograph* or echograph* or echotomograph*).tw.
46	(bindex* or echolight*).tw.
47	or/37-46

48	(quantitative* or asynchronous or high-res* or highres or photon-count* or photoncount* or pulse-echo* or pulseecho* or pulsecho*).tw.
49	47 and 48
50	36 or 49
51	20 and 50
52	randomized controlled trial.pt.
53	controlled clinical trial.pt.
54	randomi#ed.ti,ab.
55	placebo.ab.
56	randomly.ti,ab.
57	Clinical Trials as topic.sh.
58	trial.ti.
59	or/52-58
60	Meta-Analysis/
61	exp Meta-Analysis as Topic/
62	(meta analy* or metanaly* or metaanaly* or meta regression).ti,ab.
63	((systematic* or evidence*) adj3 (review* or overview*)).ti,ab.
64	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
65	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
66	(search* adj4 literature).ab.
67	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
68	cochrane.jw.
69	((multiple treatment* or indirect or mixed) adj2 comparison*).ti,ab.
70	or/60-69
71	51 and (59 or 70)
72	animals/ not humans/
73	71 not 72
74	limit 73 to (letter or historical article or comment or editorial or news or case reports)
75	73 not 74

76	limit 75 to english language

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	Bone densitometry/
23	(densitometr* or BMD-test* or densimetr*).tw.
24	(bone adj4 mineral adj4 dens* adj4 test*).tw.
25	(bone adj4 mineral adj4 dens* adj4 tool*).tw.
26	Photon absorptiometry/
27	(absorptiometr* adj4 (dpx* or dual-energ* or dual-photon* or photon*)).tw.
28	X ray/ or dual energy X ray absorptiometry/
29	(x-ray* or xray*).tw.
30	((grenz* or roentgen*) adj4 ray*).tw.
31	(x-radiation* or xradiation*).tw.
32	(DXA* or DEXA).tw.
33	FRAX tool/ or Qfracture/
34	(FRAX or FRAXTM or Qfracture* or Q-fracture* or Cfracture* or C-Fracture*).tw.
35	(fracture* adj2 risk adj2 assess* adj2 tool*).tw.
36	(QCT* or pQCT* or HR-pQCT* or HRpQCT* or PCD-CT* or PCDCT* or SR-MUCT* or SRMUCT* or HRclinCT* HRclin-CT* or HR-clin-CT* or HR-clinCT*).tw.
37	(QUS or PEUS or P-EU or P-EUS or PEQUS).tw.
38	or/22-37
39	X-ray computed tomography/
40	(cat scan* or ct scan* or cine ct or cine-ct or tomodensitomet*).tw.
41	((computed or computer assisted or computeriz* or computeris* or electron beam* or axial*) adj4 tomograph*).tw.
42	Four dimensional computed tomography/
43	(4d ct or 4dct or 4-dimensional CT or four dimensional CT).tw.
44	exp Tomography, Spiral Computed/
45	((helical or spiral) adj4 ct*).tw.

46	exp echography/
47	(ultrasound* or ultra-sound* or ultrason* or sonograph* or echograph* or echotomograph*).tw.
48	(bindex* or echolight*).tw.
49	or/39-48
50	(quantitative* or asynchronous or high-res* or highres or photon-count* or photoncount* or pulse-echo* or pulseecho* or pulsecho*).tw.
51	49 and 50
52	38 or 51
53	21 and 52
54	random*.ti,ab.
55	factorial*.ti,ab.
56	(crossover* or cross over*).ti,ab.
57	((doubl* or singl*) adj blind*).ti,ab.
58	(assign* or allocat* or volunteer* or placebo*).ti,ab.
59	crossover procedure/
60	single blind procedure/
61	randomized controlled trial/
62	double blind procedure/
63	or/54-62
64	systematic review/
65	meta-analysis/
66	(meta analy* or metanaly* or metaanaly* or meta regression).ti,ab.
67	((systematic* or evidence*) adj3 (review* or overview*)).ti,ab.
68	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
69	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
70	(search* adj4 literature).ab.
71	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
72	cochrane.jw.

73	((multiple treatment* or indirect or mixed) adj2 comparison*).ti,ab.
74	or/64-73
75	53 and (63 or 74)
76	(conference abstract* or conference review or conference paper or conference proceeding).db,pt,su.
77	75 not 76
78	nonhuman/ not human/
79	77 not 78
80	(letter or editorial).pt.
81	79 not 80
82	limit 81 to english language

Cochrane Library (Wiley) search terms

#1	MeSH descriptor: [Osteoporosis] explode all trees
#2	((osteopor* or osteo-por* or osteopeni* or osteo-peni* or osteopaeni* or osteo-paeni*)):ti,ab,kw
#3	(((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) near/4 bone* near/4 (los* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or demineral* or strength* or quality or quantit*))):ti,ab,kw
#4	(((abnormal* or secondary or early or prematur*) near/4 bone* near/4 (los* or reduc* or mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*))):ti,ab,kw
#5	(((low* or reduc* or decreas* or los*) near/4 bone* near/4 (mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*))):ti,ab,kw
#6	(((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) near/4 BMD)):ti,ab,kw
#7	(((low* or los* or reduc* or decreas* or abnormal* or secondary) near/4 BMD)):ti,ab,kw
#8	((bone* near/4 (deteriorat* or weak* or fragil* or decalc* or brittle* or atroph*))):ti,ab,kw
#9	(((trabecula* or cancellous) near/4 (loss* or thin* or reduc* or decreas* or deteriorat* or low* or abnormal*))):ti,ab,kw

#10	(((age-relat* or agerelat* or perimenopaus* or peri-menopaus* or postmenopaus* or post-menopaus* or menopaus* or pathologic*) near/4 skeletal near/4 (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*))):ti,ab,kw
#11	(((abnormal* or secondary or early or prematur*) near/4 skeletal* near/4 (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*))):ti,ab,kw
#12	(((low* or reduc* or decreas* or los*) near/4 skeletal near/4 (mass or architectur* or microarchitectur* or micro-architectur* or dens* or mineral* or content or strength* or quality or quantit*))):ti,ab,kw
#13	MeSH descriptor: [Bone Diseases, Metabolic] this term only
#14	MeSH descriptor: [Osteoporotic Fractures] this term only
#15	((fragil* near/4 (fracture or fractures))):ti,ab,kw
#16	(((low-impact* or low-energy or low-trauma* or insufficien*) near/4 fracture*)):ti,ab,kw
#17	(((risk* or frequen* or inciden* or suscept* or suspect* or predict* or prevent* or stop*) near/4 fracture*)):ti,ab,kw
#18	(((recurrent or recurring or repeat* or history or chronic or previous or prior or habitual) near/4 fracture*)):ti,ab,kw
#19	(refracture*):ti,ab,kw
#20	{or #1-#19}
#21	MeSH descriptor: [Densitometry] explode all trees
#22	((densitometr* or BMD-test* or densimetr*)):ti,ab,kw
#23	((bone near/4 mineral near/4 dens* near/4 test*)):ti,ab,kw
#24	((absorptiometr* near/4 (dpx* or dual-energ* or dual-photon* or photon*))):ti,ab,kw
#25	MeSH descriptor: [X-Rays] this term only
#26	((x-ray* or xray*)):ti,ab,kw
#27	(((grenz* or roentgen*) near/4 ray*)):ti,ab,kw
#28	((x-radiation* or xradiation*)):ti,ab,kw
#29	((DXA* or DEXA)):ti,ab,kw
#30	((FRAX or FRAXTM or Qfracture* or Q-fracture* or Cfracture* or C-Fracture*)):ti,ab,kw
#31	((fracture* near/2 risk near/2 assess* near/2 tool*)):ti,ab,kw
#32	(QCT* or pQCT* or HR-pQCT* or HRpQCT* or PCD-CT* or PCDCT* or SR-MUCT* or SRMUCT* or HRclinCT* HRclin-CT* or HR-clin-CT* or HR-clinCT*)

#33	(QUS or PEUS or P-EU or P-EUS or PEQUS)
#34	{or #21-#33}
#35	MeSH descriptor: [Tomography, X-Ray Computed] this term only
#36	((cat scan* or ct scan* or cine ct or cine-ct or tomodensitomet*)):ti,ab,kw
#37	(((computed or computer assisted or computeriz* or computeris* or electron beam* or axial*) near/4 tomograph*)):ti,ab,kw
#38	MeSH descriptor: [Four-Dimensional Computed Tomography] this term only
#39	(("4d ct" or 4dct or "4 dimensional CT" or "four dimensional CT")):ti,ab,kw
#40	MeSH descriptor: [Tomography, Spiral Computed] explode all trees
#41	(((helical or spiral) near/4 ct*)):ti,ab,kw
#42	MeSH descriptor: [Ultrasonography] explode all trees
#43	((ultrasound* or ultra-sound* or ultrason* or sonograph* or echograph* or echotomograph*)):ti,ab,kw
#44	((bindex* or echolight*)):ti,ab,kw
#45	{or #35-#44}
#46	((quantitative* or asynchronous or high-res* or highres or photon-count* or photoncount* or pulse-echo* or pulseecho* or pulsecho*)):ti,ab,kw
#47	#45 and #46
#48	#34 or #47
#49	#20 and #48
#50	((clinicaltrials or trialsearch* or trial-registry or trials-registry or clinicalstudies or trialsregister* or trialregister* or trial-number* or studyregister* or study-register* or controlled-trials-com or current-controlled-trial or AMCTR or ANZCTR or ChiCTR* or CRiS or CTIS or CTRI* or DRKS* or EU-CTR* or EUCTR* or EUDRACT* or ICTRP or IRCT* or JAPIC* or JMCTR* or JRCT or ISRCTN* or LBCTR* or NTR* or ReBec* or REPEC* or RPCEC* or SLCTR or TCTR* or UMIN*):so or (ctgov or ictrp)):an
#51	#49 not #50
#52	conference:pt
#53	#51 not #52

Epistemonikos search terms

1	(title:((osteopor* OR osteo-por* OR osteopaeni* OR osteo-paeni* OR osteopeni* OR osteo-peni*)) OR abstract:((osteopor* OR osteo-por* OR osteopaeni* OR osteo-paeni* OR osteopeni* OR osteo-peni*))) OR (title:((fragil* AND (fracture OR fractures))) OR abstract:((fragil* AND (fracture OR fractures)))) OR (title:(((low-impact* OR low-energy OR low-trauma* OR insufficien*) AND fracture*)) OR abstract:(((low-impact* OR low-energy OR low-trauma* OR insufficien*) AND fracture*)
2	(title:((densitometr* OR BMD-test* OR densimetr*)) OR abstract:((densitometr* OR BMD-test* OR densimetr*))) OR (title:((bone AND mineral AND dens* AND test*)) OR abstract:((bone AND mineral AND dens* AND test*))) OR (title:((QCT* OR pQCT* OR HR-pQCT* OR HRpQCT* OR PCD-CT* OR PCDCT* OR SR-MUCT* OR SRMUCT* OR HRclinCT* HRclin-CT* OR HR-clin-CT* OR HR-clinCT*)) OR abstract:((QCT* OR pQCT* OR HR-pQCT* OR HRpQCT* OR PCD-CT* OR PCDCT* OR SR-MUCT* OR SRMUCT* OR HRclinCT* HRclin-CT* OR HR-clin-CT* OR HR-clinCT*))) OR (title:((QUS OR PEUS OR P-EU OR P-EUS OR PEQUS)) OR abstract:((QUS OR PEUS OR P-EU OR P-EUS OR PEQUS))) OR (title:((asynchronous OR high-res* OR highres OR photon-count* OR photoncount* OR pulse-echo* OR pulseecho* OR pulsecho*)) OR abstract:((asynchronous OR high-res* OR highres OR photon-count* OR photoncount* OR pulse-echo* OR pulseecho* OR pulsecho* OR risk-predict*))))
3	1 and 2

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 4: 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	
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

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

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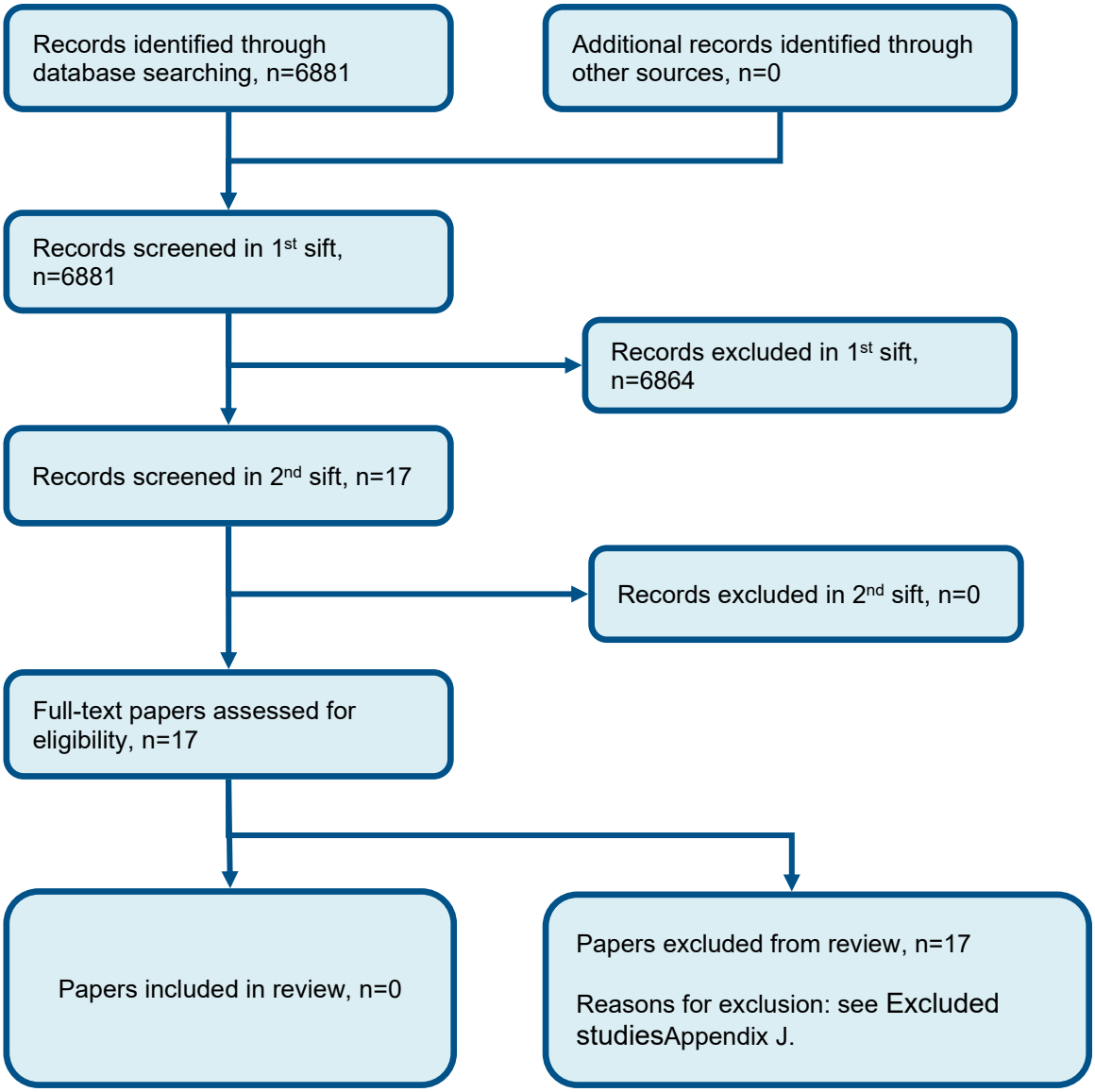
Appendix C Effectiveness evidence study selection

Figure 1: Flow chart of clinical study selection for the review of monitoring adults at risk of fragility fracture



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Appendix D Effectiveness evidence

No clinical studies were included in this review.

Appendix E Forest plots

No forest plots included in this review.

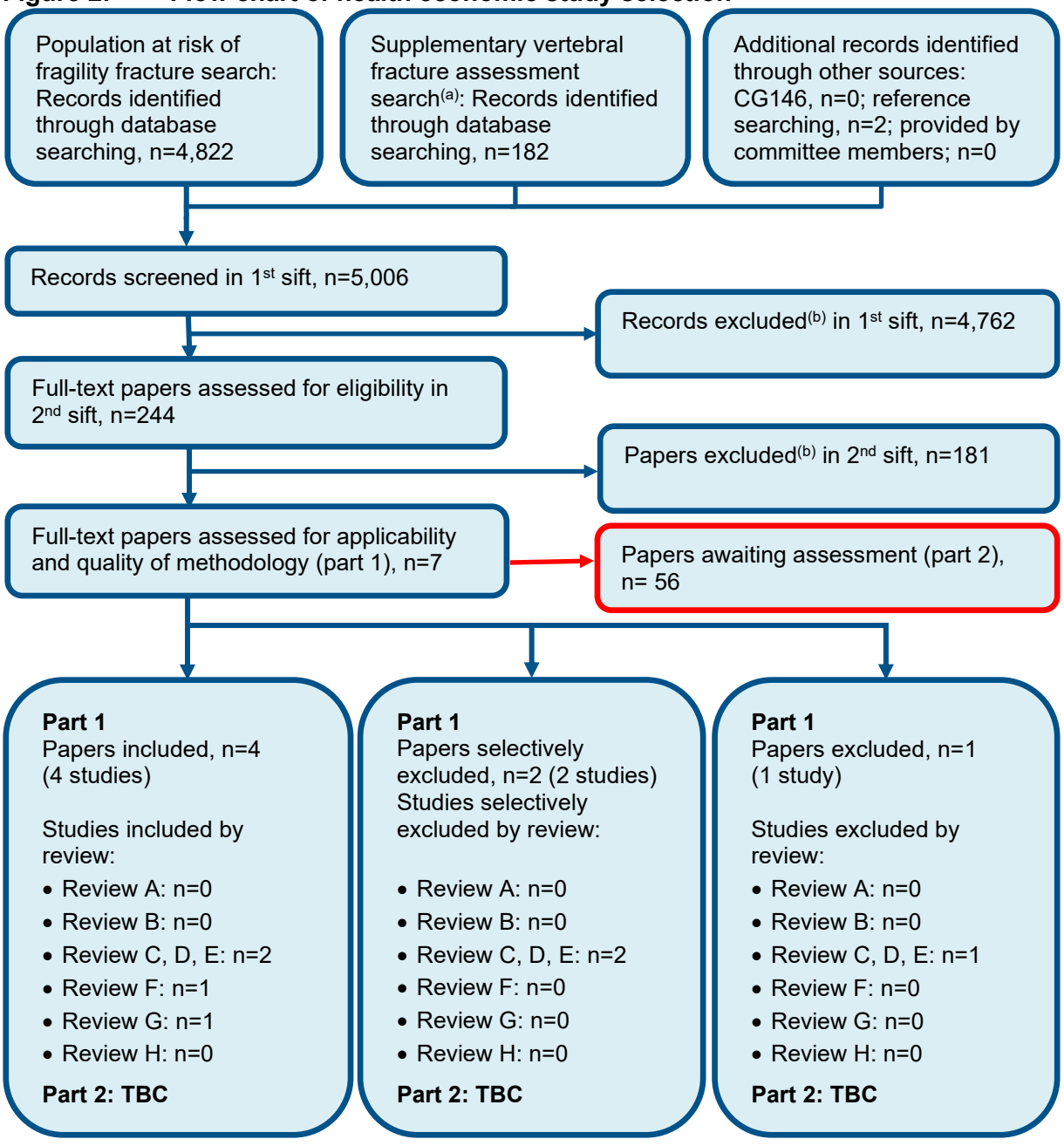
Appendix F Full GRADE tables

No GRADE tables included in this review.

Appendix G 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 2: 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 H Economic evidence tables

No health economic studies were included in this review.

Appendix I Health economic model

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

Appendix J Excluded studies

J.1 Clinical studies

Table 5: Studies excluded from the clinical review

Study	Exclusion Reason
Sharma, Ashish, Sinha, Rahul Janak, Singh, Vishwajeet et al. (2019) Implications of the Fracture Risk Assessment Algorithm for the assessment and improvement of bone health in patients with prostate cancer: A comprehensive review. Turkish journal of urology 45(4): 245-253	- Systematic review: No relevant articles identified
Shepstone, Lee, Lenaghan, Elizabeth, Cooper, Cyrus et al. (2018) Screening in the community to reduce fractures in older women (SCOOP): a randomised controlled trial. Lancet (London, England) 391(10122): 741-747	- Comparator in study does not match that specified in this review protocol
Sheu, A., Greenfield, J.R., White, C.P. et al. (2022) Assessment and treatment of osteoporosis and fractures in type 2 diabetes. Trends in Endocrinology and Metabolism 33(5): 333-344	- Review article but not a systematic review
Silverman, S.L.; Komm, B.S.; Mirkin, S. (2014) Use of FRAX-based fracture risk assessments to identify patients who will benefit from osteoporosis therapy. Maturitas 79(3): 241-247	- Review article but not a systematic review
Solomon, Daniel H, Polinski, Jennifer M, Stedman, Margaret et al. (2007) Improving care of patients at-risk for osteoporosis: a randomized controlled trial. Journal of general internal medicine 22(3): 362-7	- Population not relevant to this review protocol
Stevenson, Mary O and Tangpricha, Vin (2019) Osteoporosis and Bone Health in Transgender Persons. Endocrinology and metabolism clinics of North America 48(2): 421-427	- Review article but not a systematic review
Theriault, Guylene, Limburg, Heather, Klarenbach, Scott et al. (2023) Recommendations on screening for primary prevention of fragility fractures. CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne 195(18): e639-e649	- Systematic review: No relevant articles identified
Toussaint, Nigel D; Elder, Grahame J; Kerr, Peter G (2010) A rational guide to reducing fracture risk in dialysis patients. Seminars in dialysis 23(1): 43-54	- Review article but not a systematic review
Warriner, A.H., Outman, R.C., Saag, K.G. et al. (2009) Management of osteoporosis among	- Review article but not a systematic review

Study	Exclusion Reason
home health and long-term care patients with a prior fracture. Southern Medical Journal 102(4): 397-404	
Watts, N.B. (2013) Osteoporosis in men. Endocrine Practice 19(5): 834-838	- Review article but not a systematic review
West, S L; Patel, P; Jamal, S A (2015) How to predict and treat increased fracture risk in chronic kidney disease. Journal of internal medicine 278(1): 19-28	- Systematic review: No relevant articles identified - Review article but not a systematic review
Wu, C-H, Chen, C-H, Chen, P-H et al. (2018) Identifying characteristics of an effective fracture liaison service: systematic literature review. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 29(5): 1023-1047	- Systematic review: No relevant articles identified
Wu, Chih-Hsing, Tu, Shih-Te, Chang, Yin-Fan et al. (2018) Fracture liaison services improve outcomes of patients with osteoporosis-related fractures: A systematic literature review and meta-analysis. Bone 111: 92-100	- Systematic review: No relevant articles identified
Yadav, Anitha and Carey, Elizabeth J (2013) Osteoporosis in chronic liver disease. Nutrition in clinical practice : official publication of the American Society for Parenteral and Enteral Nutrition 28(1): 52-64	- Systematic review: No relevant articles identified
Ye, Carrie and Leslie, William D (2023) Fracture risk and assessment in adults with cancer. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 34(3): 449-466	- Review article but not a systematic review
Yong, E.-L. and Logan, S. (2021) Menopausal osteoporosis: Screening, prevention and treatment. Singapore Medical Journal 62(4): 159-166	- Review article but not a systematic review
Yu, N., Basnayake, C., Connell, W. et al. (2022) Interventions to Improve Adherence to Preventive Care in Inflammatory Bowel Disease: A Systematic Review. Inflammatory Bowel Diseases 28(8): 1177-1188	- Systematic review: No relevant articles identified

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J.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.