Cost-effectiveness of oral bisphosphonates for osteopenia in Singapore: Implications for risk-based intervention thresholds

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Background, objective & methods

Why this analysis was needed

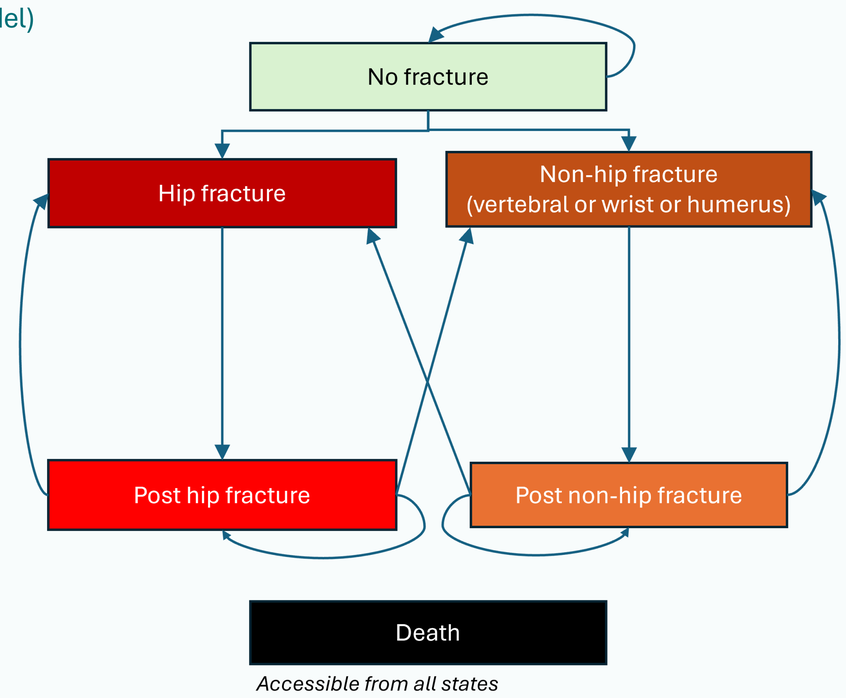
Singapore previously used US National Osteoporosis Foundation (NOF) thresholds to guide pharmacological treatment initiation for osteopenia: 10-year hip fracture (HF) risk ≥3% or major osteoporotic fracture (MOF) risk ≥20%. These were derived using US epidemiology and costs, so local applicability was uncertain.

Objective

Evaluate oral bisphosphonate therapy in adults with osteopenia using local data to inform risk-based intervention thresholds for ACE Clinical Guideline recommendations.

Economic model

(Markov model)



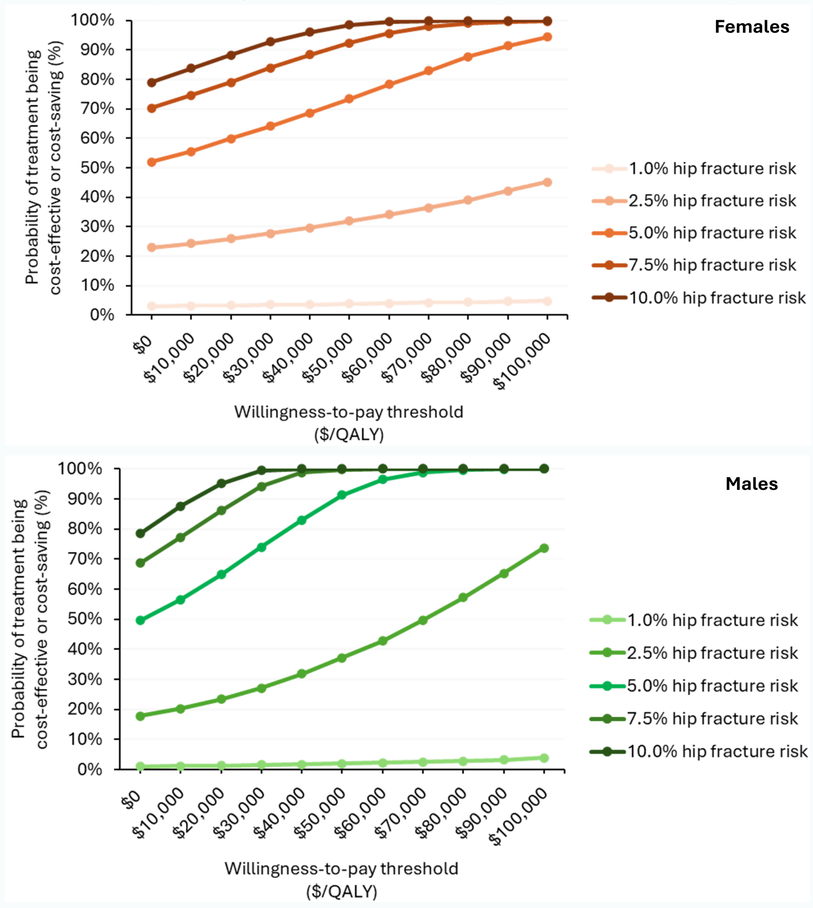
Accessible from all states

Population	Adults aged 50–84 years with osteopenia (BMD T-score -1.0 to -2.5), comparing treatment versus no treatment.
Perspective	Singapore healthcare system perspective; 10-year horizon; annual cycles; costs and QALYs discounted at 3%.
Inputs	MOH administrative data for fracture incidence, mortality, costs and resource use; published evidence for efficacy and utilities.
Analysis	Base-case: oral bisphosphonates (5 years treatment followed by 5 years drug holiday with waning effect); Probabilistic sensitivity analysis with 10,000 Monte Carlo simulations.
Treatment threshold	10-yeare fracture risk at which treatment is ≥50% likely to be cost-effective or cost-saving

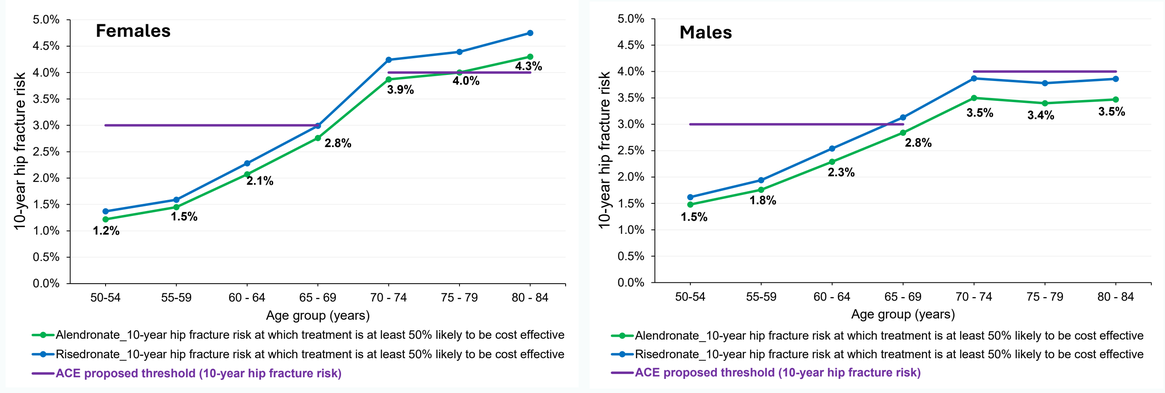
Results & interpretation

- Cost-effectiveness improved as fracture risk increased; higher-risk scenarios became cost-saving.
- Cost-effectiveness varied substantially by age and sex.

Cost-effectiveness acceptability curve (70-74 years presented as example)



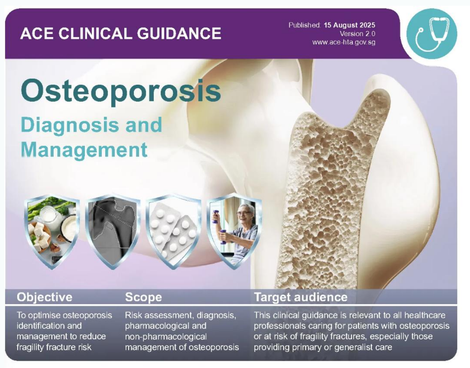
Cost-effective hip fracture intervention thresholds by age and sex



CE threshold = 10-year fracture risk at which bisphosphonate treatment was ≥50% likely to be cost-effective or cost-saving. ACE proposed threshold reflects Expert Group deliberation

Interpretation: Hip fracture risk was the main driver of model value. Age and sex-stratified thresholds were more locally appropriate than a single imported threshold.

Expert deliberation, guideline translation & implementation



Expert Group deliberation

- Retained 3% hip fracture threshold for younger adults to avoid prolonged exposure from early treatment.
- Selected 4% hip fracture threshold for adults ≥70 years to avoid undertreatment where hip fractures predominate.
- Adopted sex-stratified, age-independent MOF thresholds for implementability.
- Emphasised shared decision-making, patient context and benefit–harm assessment.

From model outputs to practical thresholds

Recommended intervention thresholds for osteopenia

Female 50–69	Female 70+	Male 50–69	Male 70+
HF ≥3% OR MOF ≥18%	HF ≥4% OR MOF ≥18%	HF ≥3% OR MOF ≥15%	HF ≥4% OR MOF ≥15%

Applies to BMD T-score -1.0 to -2.5. Thresholds are starting points for treatment discussion, and are not strict cut-offs.

Implementation

1. **Guideline dissemination** — Electronic direct mailers, social media, planned scientific publication
2. **Primary care-targeted webinar** — >400 attendees; 80% reported likely/very likely to make practice changes based on ACG
3. **Support point-of-care use** — Clinical decision support integration is being explored
4. **Preserve flexibility** — Tool-agnostic thresholds can support FRAX® or future calculators

Value-based prescribing, limitations & conclusion

Clinical implications for value-based prescribing

- **Contextualise value** — Singapore-specific thresholds reflect local fracture epidemiology and costs.
- **Balance benefit, harms and cost** — Thresholds inform value while preserving clinical judgement.
- **Reduce under- and over-treatment** — Age- and sex-specific thresholds target treatment more precisely.
- **Enable implementation** — Simple thresholds can be embedded into point-of-care prompts.

Study limitations

- Evidence for efficacy was mainly from female osteoporotic populations, with limited male and osteopenia-specific data.
- Utilities and efficacy parameters were based on published international literature, which may not fully represent local patient population.
- The healthcare-system perspective does not consider broader societal costs.
- The model may not fully capture the cumulative quality-of-life effects of multiple fractures.

Conclusion

Local cost-effectiveness modelling provided an economic basis for age- and sex-specific osteopenia treatment thresholds, translating value evidence into a practical national guideline recommendation while preserving individualised care.

Appendix

Selected references

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Contact / acknowledgements

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Resources

Please scan the QR code to read more about the published ACE Clinical Guideline on Osteoporosis and its supplement on the methodology used for the economic evaluation.

https://go.gov.sg/acg-osteoporosis

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