Ibandronate in the Treatment of Postmenopausal Osteoporosis: A Cost-Effectiveness Analysis in the UK

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ABSTRACT

Objectives: To determine the cost-effectiveness of monthly ibandronate compared to weekly bisphosphonate (BP) treatments for UK women with postmenopausal osteoporosis.

Methods: A Markov model was developed to evaluate the lifetime cost-effectiveness of monthly ibandronate and weekly BPs. Vertebral, hip, and wrist fracture efficacy were assigned a bisphosphonate class effect as estimated by the literature. Persistence with weekly BPs was evaluated at rates reported from observational studies (57% at 6 months, 43% for years 1–5). An absolute improvement in persistence of approximately 10% (67% at 6 months, 53% for years 1–5) among women receiving ibandronate was assumed based on previous improvements in persistence with weekly BPs. Both fracture risk and mortality were allowed to increase as patients aged. Yearly drug costs were referenced to National Health Service acquisition costs for each BP. Direct health resource costs for fracture states were estimated from published literature and discounted 3.5% per annum. All costs were reported in 2004 UK sterling.

Results: More fractures were avoided (vs. no treatment) with monthly ibandronate (19.34 per 1,000 women) than with weekly BPs (16.54 per 1,000 women). This translates to additional quality-adjusted life years (QALYs) gained with ibandronate and weekly BPs of 23.0 and 19.7 per 1,000 patients, respectively, versus no treatment. Drug costs per patient per year increased from £283 with weekly BPs to £315 under conditions of assumed improved persistence with monthly ibandronate, but fracture management costs were slightly lower at £6,163 for ibandronate vs. £6,185 for weekly BPs. The incremental cost per QALY gained (vs. no treatment) was similar for monthly ibandronate (£2,318) compared to weekly BPs (£2,245). The incremental cost per QALY gained with monthly ibandronate (vs. weekly BPs) was £2,760, well within the accepted thresholds of cost-effectiveness.

Conclusion: Ibandronate is a cost-effective intervention for the treatment of postmenopausal osteoporosis. Incremental persistence with BP therapy improves the benefit realised by patients. These benefits include fewer fractures for patients without significant increases in net costs to payers.

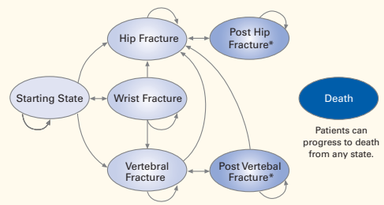
METHODS

A Markov model (Figure 1) was used to simulate a cohort of postmenopausal women aged ≥50 years with a history of previous fracture and a hip bone mineral density T-score of ≤–2.5. Model parameters and assumptions are as follows:

Parameters and Assumptions

- Patients transition between the health states annually for the remainder of their lifetime.
- Patient demographics were obtained from published literature. It was assumed that the postmenopausal population is represented by those aged ≥50 years (Table 1).
- Payer perspective was taken.
- Comparators included monthly ibandronate or weekly bisphosphonates versus no treatment.
- Transition probabilities were based on published literature, accounting for the impact of increasing age, prior fracture, and mortality (Stevenson et al., 2005; Klotzbeucher et al., 2000; Johnell et al., 2004).
- Fracture risk reduction efficacies for vertebrae (43%), hip (33%), and wrist (17%) were assigned a bisphosphonate class effect, as estimated in the literature (Kanis et al., 2002).
- Onset of efficacy was assumed to occur linearly from start of treatment until full fracture efficacy is achieved at 6 months.
- Maximum time on therapy was assumed to be 5 years.
- Waning fracture benefit following discontinuation of therapy was modeled as a 5-year linear decline (Kanis et al., 2002).
- Persistence with weekly bisphosphonates was evaluated at rates reported from observational studies (57% at 6 months; 43% at 12 months, with an assumed exponential decline in persistence from this point out to a 5-year maximum treatment).
- A 10% absolute improvement in persistence with monthly ibandronate was selected to approximately match the difference observed between weekly and daily bisphosphonate regimens (Cramer et al., 2004).
- Yearly drug costs, £252 for monthly ibandronate and £280 for weekly bisphosphonates (average between alendronate and risedronate), were obtained from the British National Formulary.
- Direct healthcare costs (Kanis et al., 2002; Dolan et al., 1998) and utilities (Brazier et al., 2002; Tosteson et al., 2001) for fracture states were estimated from published literature and were discounted at 3.5% per annum.
- A sensitivity analysis was performed around the expected improvement in persistence for monthly ibandronate.

Figure 1. Model Structure



* For simplification, we assume that once patients experience a hip fracture or vertebral fracture they can experience no further wrist fractures. Patients in the post-hip-fracture state can experience further vertebral fractures through a state prevalence estimate.

Table 1. Sources of Patient Demographics

Parameter	Source
Age distribution of women in the UK	Office of National Statistics, 2004
Average T-scores among osteoporatic women	Stevenson et al., 2005; Holt et al., 2002
Mean bone mineral density T-scores by age group	O'Neill et al., 1996
Prevalence of prior fractures among age groups	O'Neill et al., 1996; Kanis et al, 2002
Prevalence of osteoporosis (T-score ≤–2.5)	Kanis et al., 2000

RESULTS

Modeled results in terms of fractures avoided, per-patient costs, and cost-effectiveness are presented in Table 2 and Figure 2.

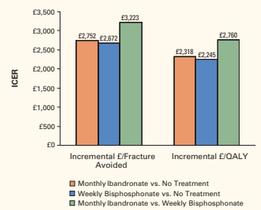
Table 2. Estimated Fractures Avoided per 1,000 Patients and Average Costs per Patient

Outcome	Monthly Ibandronate	Weekly Bisphosphonates
Number of fractures avoided per 1,000 patients		
Hip	7.22	6.05
Vertebral	2.29	2.00
Wrist	9.83	8.48
Total	19.34	16.54
Average costs per patient treated (UK £)		
Drug	£315	£283
Fracture care	£6,163	£6,185
Total	£6,478	£6,469

Note: With no treatment, 108 hip fractures, 69 vertebral fractures, and 48 wrist fractures are incurred per 1,000 patients.

- A 10% relative improvement in persistence yields approximately 17% more fractures avoided.
- Increased persistence does result in increased drug costs. However, fewer fractures with monthly ibandronate result in a reduction in fracture care costs compared to weekly bisphosphonates.
- Patients experience a gain of 23.0 QALYs per 1,000 patients with monthly ibandronate and 19.7 QALYs per 1,000 patients with weekly bisphosphonates.

Figure 2. Incremental Cost-Effectiveness Ratios for Selected Endpoints

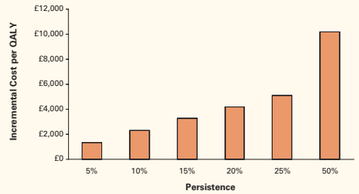


- With a 10% improvement in persistence, the incremental cost-effectiveness ratios (ICERs) are well within acceptable thresholds of cost-effectiveness.

Sensitivity Analysis

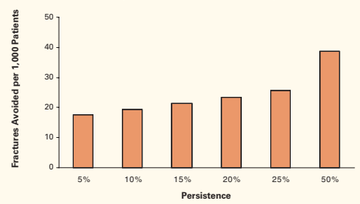
A sensitivity analysis was performed around the expected change in persistence due to the monthly formulation of ibandronate (Figures 3 and 4).

Figure 3. Sensitivity Analysis of Estimated Incremental Cost per QALY for Changes in Persistence with Monthly Ibandronate



- Even with improvement in persistence up to 50%, the ICERs are well within acceptable thresholds of cost-effectiveness.

Figure 4. Sensitivity Analysis of Estimated Fractures Avoided per 1,000 Patients for Changes in Persistence with Monthly Ibandronate



- Small improvements in persistence produce clinical benefits in terms of decreased number of fractures.

CONCLUSIONS

- Treating postmenopausal, osteoporotic women with monthly ibandronate is cost-effective.
- Model results consider direct costs only. The addition of societal costs is likely to further improve the cost-effectiveness of all bisphosphonate treatments.
- Greater fracture reduction is seen when persistence is improved.

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Presented at: European League Against Rheumatism (EULAR) Annual European Congress of Rheumatology

June 21–24, 2006, Amsterdam, Netherlands