

The impact of persistency on economic models for bisphosphonate therapy in osteoporosis

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ABSTRACT

Objectives: Economic models are important tools to assist decision-makers in examining the cost-effectiveness and budget impact of bisphosphonate therapy in osteoporotic patients. However, careful consideration of issues specific to bisphosphonate therapy is necessary to ensure results are generated appropriately. In this study we examine key factors upon which bisphosphonate-specific osteoporosis models should be built and the impact on model results.

Methods: A Markov model was created to estimate costs and outcomes associated with bisphosphonate-treated female osteoporotic (BMD ≤ -2.5) patients in the USA. A thorough review of economic and clinical literature and validation of model structure and treatment pathways was performed. To improve upon previously published models, key therapy-specific issues such as persistency, duration of therapy, and residual effect of therapy after discontinuation were either added for the first time or modified to more closely reflect clinical practice. Modelled patients were at least 50 years old and postmenopausal. The model considers hip, wrist and vertebral fractures and contains subsequent-year hip and vertebral fracture states. Treatment efficacy was taken from a published meta-analysis and persistency information was obtained from the IHCIS database. Resource use, costs and residual effect of therapy were estimated from published literature.

Results: Excluding or inappropriately modelling the key bisphosphonate-specific issues described above has a great impact on results. Failure to allow patient persistency to be less than 100% and failure to allow a duration of therapy shorter than the time horizon of the model both result in a higher incremental cost-effectiveness ratio (ICER) than appropriate due to overestimated bisphosphonate drug costs. Excluding the residual effect of therapy results in a higher ICER than appropriate, since patients do not enjoy the clinically-proven future benefits of having taken bisphosphonates.

Conclusions: Bisphosphonate-specific issues are important to consider in economic models assessing the cost-effectiveness and budget impact of bisphosphonates for osteoporotic patients. Otherwise, costs and outcomes will be inappropriately estimated.

INTRODUCTION

- An estimated 75 million people have osteoporosis in Europe, the USA and Japan.¹
- Annual costs of treating osteoporosis worldwide are expected to reach US\$131.5 billion by 2050.²
- Most models for cost-effectiveness with bisphosphonate therapy in osteoporosis have been developed using a Markov framework in which the fracture incidence-based approach is used (i.e. patients move between fracture/non-fracture health states).^{3,4}
- Previous models have included limited information on important therapy-specific issues such as persistency, duration of therapy, and residual effect of therapy.
- Patient persistency to bisphosphonate therapy is important to prevent fractures and chronic disability in patients with osteoporosis.
- Previous studies have shown that persistency with weekly bisphosphonates is better than that with daily dosing regimens but still >50% of patients on the weekly regimen do not persist on therapy at the end of 1 year.⁵
- The objective of this Markov model is to evaluate the impact of persistency and residual effect of bisphosphonate therapy on important clinical and economic outcomes.

METHODS

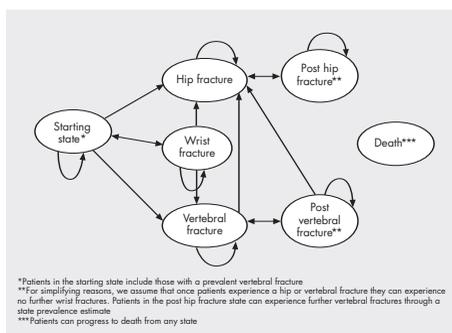


Figure 1. Model structure.

Table 1. Model scope.

Population	1,000 postmenopausal, osteoporotic women >50 years with a prevalent vertebral fracture and BMD T-score ≤ -2.5
Comparators	No treatment Bisphosphonate therapy
Subgroups	Age groups: 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, and 85+ (distribution based on 2000 US Census). Average age = ~66 years
Perspective	Payer
Time horizon	Lifetime
Discounting	Costs and benefits discounted 3% per annum
Outcomes	Number of fractures avoided Total costs (drug and medical care) per patient Incremental cost per QALY gained

Table 2. Sources for transition probabilities and model parameters.

Parameter	Source
Bisphosphonate efficacy	Kanis JA, et al. Health Technology Assessment 2002;6:29
Initial transition probabilities	Black DM, et al. J Bone Miner Res 1999;14:821–28 Kanis JA, et al. Osteoporos Int 2001;12:356–61
Fracture transition probabilities	Johnell O, et al. Osteoporos Int 2004;15:38–42 Johannell O, et al. Osteoporos Int 2004;15:175–9 Tosteson ANA, et al. Osteoporos Int 2001;12:1042–9
Mortality probabilities	US National Vital Statistics Reports, 2003 Johannell O, et al. Osteoporos Int 2004;15:38–42
Utilities	Brazier JE, et al. Osteoporos Int 2002;13:768–76 Tosteson ANA, et al. Osteoporos Int 2001;12:1042–9
Drug costs	AWP, 2004 Red Book
Medical care costs	Eddy DM, et al. Osteoporos Int 1998;(Suppl. 4) Costs adjusted to 2003 dollars using the Medical Consumer Price Index
Duration of therapy	Based on clinical trial data = 3 years

Assumptions of key factors modelled

- Persistency
 - time until reduced fracture risk = 12 months
 - baseline persistency rates: 100%, 58.1%, 44.2% for 0, 6, and 12 months, respectively⁵
 - persistency rates beyond 12 months fitted using exponential line.
- Residual effect
 - after discontinuing treatment, patients experience a 0.54% decrease in bone mineral density, translated to an increased risk of fracture.⁶

RESULTS

Persistence

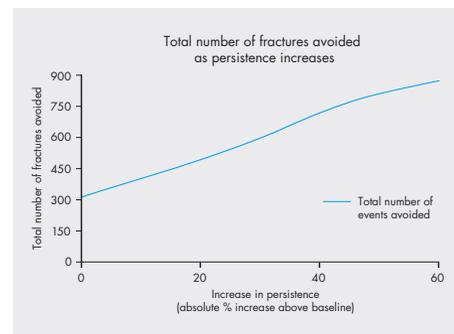


Figure 2. Persistence and total number of fractures avoided.

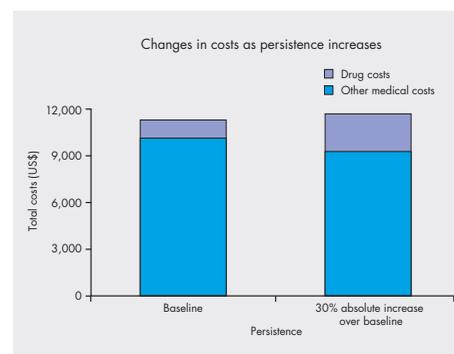


Figure 3. Persistence and total costs per patient.

Residual effect of therapy

Table 3. Residual effect of therapy.

	No residual effect	Residual effect
Number of hip fractures	266	260
Number of vertebral fractures	1,605	1,397
Total costs (US\$)	11,744,176	11,225,746
Incremental cost per QALY gained (US\$)	39,169	754

CONCLUSIONS

- An improvement in persistency with bisphosphonate therapy over current levels of persistency results in fewer fractures for patients (Figure 2).
- In addition, increased drug costs due to increased persistency are partially offset by reduced medical costs (Figure 3).
- Assuming a patient's fracture rate increases to that similar to no treatment once she discontinues therapy overestimates the incremental cost-effectiveness ratio (ICER) (Table 3). Thus, considering a residual effect of therapy after discontinuation is important when estimating the true cost-effectiveness.

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