

# The Impact of Medication Adherence on the Cost of Osteoporosis Fractures in Germany: A Modelling Approach

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## INTRODUCTION

- Current osteoporosis therapies can reduce the risk of fractures and thus costs, but adherence to these medications is often poor
- Osteoporosis is a high prevalence and high cost bone disorder. Haussler et al. estimated that approximately 39% of German women over age 50 may have osteoporosis.<sup>1</sup> Their estimate compares to 41% for Denmark<sup>2</sup>
- Osteoporosis medications are effective but adherence is suboptimal. Rabenda et al. published a literature review in which they summarized adherence from about a dozen studies of bisphosphonate use in Europe and North America.<sup>3</sup> In terms of effective adherence (defined as % with medication possession ratio [MPR] > 50), the range of values from this literature review was from 22% to 69% effective adherence
- Understanding the value of improved adherence can provide policy makers with additional evidence for reimbursement decisions of newer therapies with improved adherence and proven efficacy

## OBJECTIVES

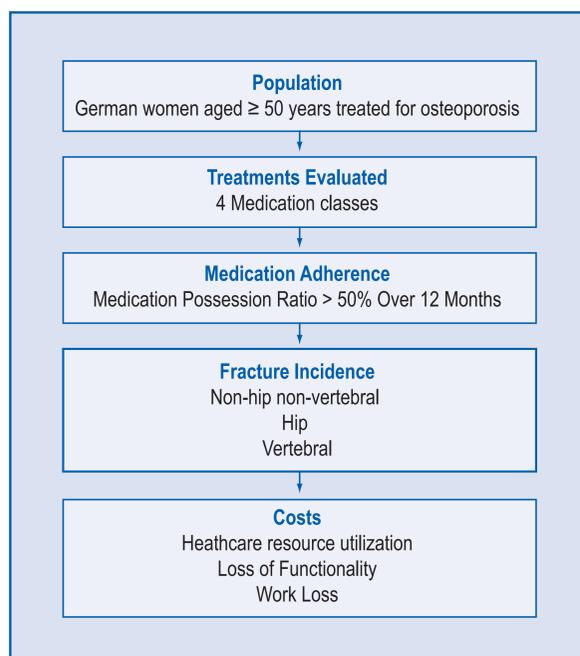
- **Primary Objective:** To estimate yearly potential savings in fracture-related costs from improved adherence to osteoporosis therapies in Germany from a societal perspective
- **Secondary Objective:** To create a flexible modelling tool to demonstrate the value of improved adherence to managers of health plans

## METHODS

### Structure

The model (Figure 1) was a deterministic cohort model developed in Microsoft Excel. Parameters can be changed to determine independent or combined effects on outcomes

Figure 1: Model Structure



### Base Inputs (see Table 1)

Demographic parameters were drawn from government databases, medication prescription share from industry databases (IMS), and fracture incidence (hip, clinical vertebral, and non-hip, non vertebral [NHNV]), medication adherence (MPR, 1-year intervals) and efficacy from published literature

- Population:
  - German female population aged ≥ 50 years in 2010 (n = 17,689,849)
  - Statistics for 2009 German population rolled forward to 2014<sup>4</sup>
- Treatment: Haussler et al. estimate of treatment included hormone replacement therapy (HRT).<sup>1</sup> Removing HRT reduced the proportion treated to 4.2%. This is similar to estimates reported for other countries<sup>2</sup>
- Medications: Based on industry estimates: oral bisphosphonates (94.6%), strontium (2.7%), raloxifene (2.6%), assumed equal for each age cohort. Medication costs were not considered
- Adherence:
  - MPR for 1-year periods. Effective adherence (MPR > 50%) estimated at 54% for each medication class based on the GRAND study,<sup>5</sup> adjusted for primary non-adherence (prescription written but not filled)
  - Estimate of % of cohort taking medication grouped into four adherence categories: 1) 0–50% (46%); 2) 51–70% (11%); 3) 71–80% (6%); 4) > 80% (37%). Estimates derived from the adherence distribution in Huybrechts et al<sup>6</sup>
- Medication Efficacy: The population in each 5-year age cohort taking each category of medication, at each level of adherence, was assigned a medication efficacy value for Hip, Vertebrae and NHNV based on clinical trial efficacy reported in the NICE Osteoporosis Evidence Review<sup>7</sup> adjusted for “real world efficacy” based on Siris et al<sup>8</sup>
- Fracture Incidence was based on German hospital discharge data, but these are only valid for hip fractures. The relative proportion of hip, vertebral, and NHNV fractures in Sweden<sup>9</sup> were used to estimate vertebral and NHNV fracture incidence from German hip fracture incidence data

## METHODS (continued)

### Base Inputs (continued)

- Costs for Health Care Resource Use (the direct costs of treating fractures, including hospitalizations, physical therapy, etc.); Work Loss (wages paid to workers for days of work missed due to fractures); and Lost Functionality (costs for nursing home care or home health care) were drawn from studies by Konnopka et al,<sup>10</sup> Borgstrom et al,<sup>11</sup> Haussler et al,<sup>1</sup> and Muelleret al,<sup>12</sup> and from reports published by the Health Reporting of the Federation: General Local Health Insurance Funds.<sup>13</sup> The Borgstrom et al<sup>11</sup> research was used to estimate the costs of vertebral fractures and was based on Swedish data, which is assumed to give a reasonable approximation of German costs

Table 1: Model Inputs

Population (2010 German Females > 50)			Medication Distribution			Untreated Fracture Rates	
	%	N	%	N		%	
50–54	17.0%	3,015,134	Oral BPs	94.6%	705,215	Hip	0.69%
55–59	15.5%	2,745,601	DABA	2.7%	20,347	Vertebral	0.39%
60–64	12.7%	2,249,320	SERMs	2.6%	19,751	NHNV	1.62%
65–69	14.4%	2,547,677	<b>Total Treated</b>	<b>100.0%</b>	<b>745,313</b>		
70–74	13.9%	2,453,672	Adherence (% patients with MPR > 50%)			Direct (HCRU) Costs Per Fracture	
75–79	10.3%	1,823,132	%	N	Hip	€ 7,752	
80–84	8.1%	1,440,433	Oral BPs	54.0%	380,816	Clinical vertebral	€ 2,832
85–89	5.4%	954,216	DABA	54.0%	10,987	NHNV	€ 1,459
90 +	2.6%	460,664	SERMs	54.0%	10,665	Loss of Functionality Costs Per Fracture	
<b>Total</b>	<b>100.0%</b>	<b>17,689,849</b>	Treated & Effectively Adherent*			Hip	€ 2,442
			%	N	Vertebral	€ 715	
			2.3%	402,469	NHNV	€ 338	
			Percentage Treated		Work Loss (Days) Per Fracture		
			%	N	Hip	71	
50–64	3.2%	256,322	50–64	3.2%	256,322	Vertebral	60
65–74	5.1%	255,069	65–74	5.1%	255,069	NHNV	46
75 +	5.0%	233,922	75 +	5.0%	233,922		
<b>Total</b>	<b>4.2%</b>	<b>745,313</b>	<b>Total</b>	<b>4.2%</b>	<b>745,313</b>		

\* Effectively adherent is defined as having an MPR greater than 50%  
BP, bisphosphonate; DABA, dual action bone agent (strontium ranelate);  
SERM, selective oestrogen-receptor modulator; MPR, medication possession ratio.

## RESULTS

### Fractures: Total and Avoided

- Total 2010 fractures were estimated at 478,886, with 25% hip, 15% vertebral and 60% NHNV. For the treated population, fractures were estimated at 20,696. Improving effective adherence in this population from 54% to a theoretical 100% resulted in 2,336 avoided fractures (874 hip, 672 vertebral, 790 NHNV), an 11.3% reduction in the fracture rate

### Cost: Total and Avoided, Overall and by Cost Type

- The model calculated total fracture-related costs for all patients in 2010 at €4.4 billion (with 69.6% for direct medical costs, 20.2% for long-term nursing care, and 10.2% for work loss) (cumulative: **Figure 2**)
- For the estimated 4.2% of treated patients, the model calculated total fracture-related costs at €184.9 million
- Fracture-related cost savings totalled €27.8 million for 2010 alone (cumulative: **Figure 3**)

### Cost: Total and Avoided by Fracture Type

- Increasing the % of patients with effective adherence from 54% to 100% decreased costs for hip (16.2%), vertebral (24.4%) and NHNV fractures (6.3%) (**Figure 3**)

Figure 2: Cumulative Fracture-Related Costs, by Cost Type, All Patients

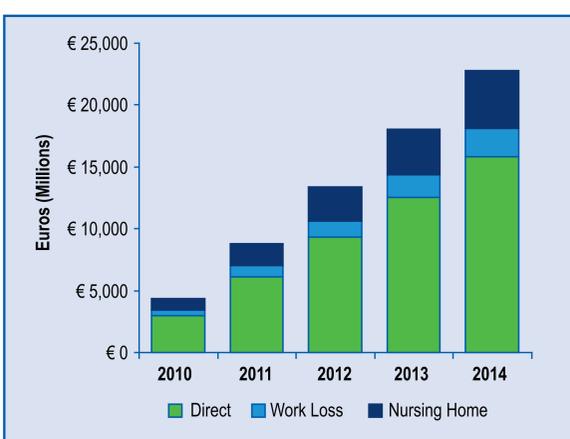
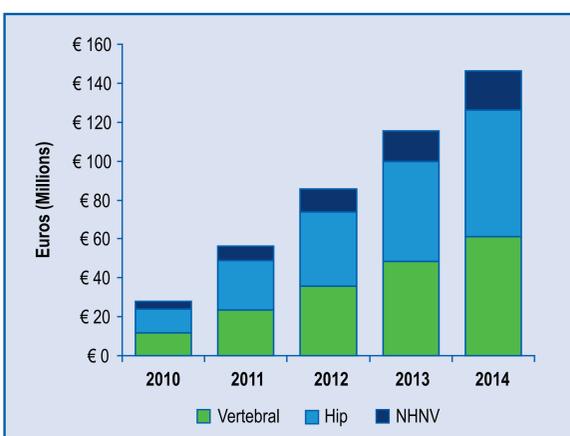


Figure 3: Cumulative Savings, by Fracture Type



### Analyses Performed

- Fracture Cost Savings Due to Improved Adherence: We estimated current costs with 54% effectively adherent and 100% effectively adherent, for the base year (2010) and for each year out to 2014. Savings due to improved adherence were calculated for each category of costs
- Sensitivity Analysis: Two one-way sensitivity analyses were conducted, one for total population and the second for treated population, over seven factors. The model was most sensitive to variations in direct costs per fracture. We also ran a two-way sensitivity analysis that looked at the interaction between increased % treated and improved adherence

## DISCUSSION

- Only this model allows users to manipulate all factors in the relationship between medication adherence and cost outcomes in real time
- Only a small portion of the population was treated. Greater adherence improved savings significantly but the total saved was small compared to total costs of osteoporotic fractures in the untreated population
- Although the model used up-to-date estimates, there was lack of consistency in the literature on definitions of adherence and costs of fractures. There will be uncertainty in estimated cost savings for treating osteoporosis until these problems are solved
- The model is limited by empirical estimates. In particular, precise data on treatment and adherence in older populations are lacking. The highest proportion of costly fractures occurred among elderly women and model accuracy would be vastly improved with more precise statistics. The variation in cost estimates was also unreasonably high. Better measurement of costs along with patient characteristics would improve the precision of osteoporosis cost estimates and the value of treatments for reducing fractures

## CONCLUSIONS

- Savings from improved adherence can be modelled in a flexible, transparent multivariate, real-world, real-time environment
- Applying the described model to the German population suggests that achieving full adherence to medication among women currently treated for osteoporosis in Germany would reduce fractures and cut down annual fracture-related costs by €27.8 million (15.1%)

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