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Economic Consequences and Potentially Preventable Costs Related to Osteoporosis in the Netherlands

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ABSTRACT

Background: Osteoporosis often does not involve symptoms, and so the actual number of patients with osteoporosis is higher than the number of diagnosed individuals. This underdiagnosis results in a treatment gap. **Objectives:** To estimate the total health care resource use and costs related to osteoporosis in the Netherlands, explicitly including fractures, and to estimate the proportion of fracture costs that are linked to the treatment gap and might therefore be potentially preventable; to also formulate, on the basis of these findings, strategies to optimize osteoporosis care and treatment and reduce its related costs. **Methods:** In this retrospective study, data of the Achmea Health Database representing 4.2 million Dutch inhabitants were used to investigate the economic consequence of osteoporosis in the Netherlands in 2010. Specific cohorts were created to identify osteoporosis-related fractures and their costs. Besides, costs of pharmaceutical treatment regarding osteoporosis were included. Using data from the literature, the treatment gap was estimated. Sensitivity analysis was performed on the base-case results. **Results:** A total of 108,013 individuals with a history of fractures were included in this study. In this population, 59,193 patients were using anti-osteoporotic medication and 86,776 patients were using preventive supplements. A total number of 3,039 osteoporosis-related fractures occurred. The estimated total costs were €465 million. On the basis of data presented in the literature, the treatment gap in our study population was estimated to vary from 60% to 72%. **Conclusions:** The estimated total costs corrected for treatment gap were €1.15 to €1.64 billion. These results indicate room for improvement in the health care policy against osteoporosis.

Keywords: costs analysis, the Netherlands, osteoporosis, osteoporotic fractures.

Introduction

Prevalence and Physical Health Burden

Osteoporosis is a skeletal disorder characterized by a decreased density of the bone mineral and alteration of the bone architecture [1,2]. The disease mostly occurs in postmenopausal women and elderly men. The total number of individuals older than 50 years diagnosed with osteoporosis in 2010 in the Netherlands was estimated at 148,200. This includes mostly female patients (133,000 female vs. 15,200 male patients) [1,3,4]. The most important consequence of osteoporosis is the increased risk of a bone fracture. Hip and spine fractures are the most critical fractures, often involving impairment, pain, or even death [1,2]. The number of osteoporosis-related fractures among people older than 50 years was estimated at 38,600 from a total estimated number of 120,000 fractures in 2010 [5]. Because of aging of the population, the prevalence of osteoporosis and its related consequences are expected to increase by 30% to 50% within 10 to 15 years on the basis of different scenarios [1,5].

Economic Burden

In addition to the physical health burden, the economic burden of osteoporosis is considerable. Although the costs of anti-osteoporotic medications are relatively low, the costs of osteoporosis-related complications are high. Osteoporosis-related fractures are the most important driver of costs for complications because these fractures are related to high resource use of inpatient care (hospitalizations) and often involve

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revalidation and long-term care and a considerable burden of indirect costs caused by, inter alia, sick leave [1].

Multiple estimates of the economic burden of osteoporosis are available in the literature. These estimates, however, vary widely [1,4,5]. In 2010, the total costs of osteoporosis in the Netherlands, with only medication, fractures, and long-term care taken into account, were estimated at €824 million [1]. The costs in the first year and the subsequent year amounted to €360 million and €434 million, respectively. Notably, the annual costs of pharmacological treatment of osteoporosis in the Netherlands were estimated at €29 million (3.5%) in 2010 [1]. Separately, health care costs for inpatient and outpatient hospital care related to osteoporosis were estimated at €190 million in the same year [5].

Treatment Gap

Osteoporosis itself does not usually involve any symptoms and therefore often remains unnoticed. Most hospitals in the Netherlands offer fracture liaison services (FLS) that involve postfracture screening in patients older than 50 years who had previously suffered from a fracture. Despite these services being offered, postfracture screening, let alone prefracture screening, for osteoporosis in the Netherlands is known to be suboptimal [6–10].

In the Netherlands, the actual number of patients with osteoporosis is estimated to be 2 to 5.5 times the number of diagnosed individuals [1,4]. The difference in these numbers indicates the existence of a treatment gap of 50% to 82% as a result of underdiagnosis. Nevertheless, estimates of the economic burden related to the treatment gap with regard to osteoporosis have not yet been published.

Aim

Because the health care reimbursement system in the Netherlands is fragmented into primary care (general practitioner), secondary care (hospital care), and tertiary care (long-term care) with strongly differing data availabilities, estimating the total burden of osteoporosis is complicated. The fact that the extent of the treatment gap is not yet clear further complicates such a task. In this study we present retrospective data regarding the burden of osteoporosis using the reimbursement data of one of the largest Dutch health care insurance companies. The aim of this study was to estimate the total health care resource use and costs related to osteoporosis, including fractures. In addition, we aim to estimate the proportion of fracture costs that are linked to the treatment gap and might therefore be potentially preventable. On the basis of these findings, we aim to formulate strategies to optimize osteoporosis care and treatment and reduce its related costs.

Methods

Study Design and Data Selection

The design of this cost evaluation study concerned a retrospective analysis. Claims data of the Achmea Health Database (AHD) were used to investigate the economic consequence of osteoporosis in the Netherlands in 2010 [11]. The AHD contains anonymized medical information of 4.2 million individuals of all ages in the Netherlands on reimbursed health care use and its costs. In particular, to estimate the costs of osteoporosis, claims data on inpatient care and pharmaceutical treatment were selected from the database. Selection criteria included 1) patients being older than 50 years and 2) who were receiving pharmaceutical treatment against osteoporosis in 2010 and/or were using vitamin D or calcium supplements in 2010 and/or had experienced one or more fractures in 2010.

The costs related to osteoporosis in the study population were calculated by adding the costs of claimed anti-osteoporotic medication, the costs of vitamin D and calcium supplements, and the costs of inpatient care for the treatment of osteoporosis-related fractures. Only those claims that were reimbursed between January 1, 2010, and December 31, 2010, were included in the analysis.

Costs

Anti-osteoporotic drugs

Claims data related to the use of anti-osteoporotic drugs were selected by using the Anatomical Therapeutic Chemical codes. These include bisphosphonates and strontiumranelate (M05B), selective estrogen receptor modulators (G03X), and parathyroid hormones and analogues (H05AA). Users of antineoplastic agents and medication against Paget disease (H05BA, M05BA05) were excluded from the analysis, because the fractures that were experienced by this group of users were likely not the result of osteoporosis but merely from these specified diseases.

Vitamin D and calcium supplements

Claims data on vitamin D and calcium supplements were also extracted from the database by using the Anatomical Therapeutic Chemical codes (A11, A12); these, however, are also available over the counter.

Osteoporosis-related fractures

To specifically link claims data on inpatient care to osteoporosis, a cohort method was designed for identifying the costs for the treatment of osteoporosis-related fractures. Notably, two cohorts were created in the selected claims database. An illustration of the created cohorts is shown in Figure 1.

Cohort 1 contained all patients having had at least one fracture in 2010. Fractures were classified according to Center et al. [12] as 1) hip fractures, 2) major fractures, and 3) minor fractures.

Hip fractures were defined as fractures of the proximal femur and acetabulum. Major fractures included fractures of the vertebra, pelvis, distal femur, proximal tibia, ribs, and proximal humerus. Minor fractures included all remaining fractures, fractures in fingers and toes excluded because their relation to osteoporosis is unlikely [12]. The estimated costs of fractures were based on the costs linked to Diagnose Behandel Combinatie (DBC) codes for specialist medical performances reimbursed by the insurance company.

Cohort 2 consisted of all patients older than 50 years who had received a prescription of an anti-osteoporotic medication, identified in the same way as described earlier.

Fractures were considered osteoporosis-related if the fracture occurred in a patient using anti-osteoporotic medication, therefore being part of both cohorts 1 and 2. Because Dutch patients with osteoporosis generally collect medications every 3 months, patients were considered to have experienced an osteoporosis-related fracture if medication was collected within 3 months before the fracture occurred (including the last 3 months of 2009). These selected fractures were labeled “assessed” osteoporosis-related fractures, which notably reflect an underestimation of the total osteoporosis-related fractures, given the aforementioned treatment gap.

Extrapolation

To estimate the total costs of osteoporosis in the Netherlands, total costs were extrapolated from the AHD population of 4.2 million individuals to the entire Dutch population of 16.6 million

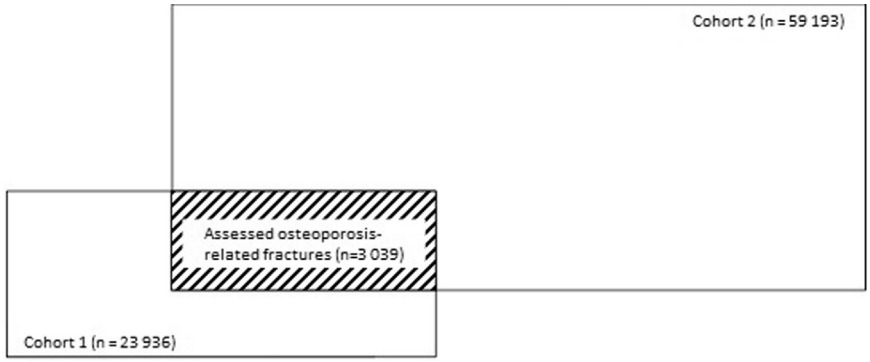

Fig. 1 – Overview of the patient selections. Cohort 1: All patients who experienced a fracture in 2010. Cohort 2: All patients using osteoporotic medication in 2010. Assessed osteoporosis-related fractures: Patients experiencing a fracture while being pharmaceutically treated for osteoporosis.

people by using data on fracture incidence in 2010 from the literature [3,5].

Treatment Gap

By combining data available from the literature with the results of our study, the treatment gap of our study population was estimated [6–9]. The percentages of FLS participants who were diagnosed with osteoporosis in four FLS studies (30–43%) were multiplied by the total number of fractures found in our study to calculate the theoretical number of osteoporosis-related fractures in our study population [6–9]. The difference between this theoretical number and the assessed number of osteoporosis-related fractures found in our study represents the treatment gap in our study population. The four FLS studies that were used are presented in Appendix Table S1 in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2017.02.006.

Sensitivity Analysis

By performing a sensitivity analysis, the total costs related to osteoporosis according to this study were corrected for the treatment gaps that were estimated using data from the four FLS studies. Therefore, the total estimated costs (in euros) corrected for the treatment gap were plotted against the treatment gap percentages calculated by using the data from the four FLS studies.

Results

Population Characteristics

In total, 108,013 patients were chosen from the AHD on the basis of the selection criteria: the patients suffered from one or more fractures (n = 23,056) and/or were using anti-osteoporotic medication (n = 59,193) and/or were using preventive supplements (n = 86,776) in 2010. Of this selection, 25,048 patients were male (23.1%) and 82,956 patients were female (76.9%). The mean age of all included patients was 71.5 ± 11.4 years. Figure 1 shows the cohorts that were formed in the study population so as to identify the osteoporosis-related fractures. Cohort 1 contained 23,936 patients and cohort 2 contained 59,193 patients. The overlap between the two cohorts indicated the occurrence of 3,039 osteoporosis-related fractures, which were actually assessed in this study.

In Table 1, more detail is provided on the number of patients, fractures, and users of anti-osteoporotic medication as well as vitamin D and calcium supplements. All numbers are shown for the age categories 50 to 59, 60 to 69, 70 to 79, 80 to 89, and older than 90 years as well as for all age groups together (i.e., all older than 50 years).

Costs

In Table 2, detailed information on the cost of medication and patient care is presented for the aforementioned age categories as well as for the total study population. From Table 2, it can be extracted that the total costs of anti-osteoporotic medication in the study population were €46.1 million. Furthermore, the total costs of vitamin D and calcium supplements were €36.0 million and those of osteoporosis-related fractures were €7.7 million. On the basis of these costs, the total costs related to osteoporosis in the study population were estimated to be €89.8 million.

Extrapolation

Through extrapolation by using data on fracture incidence from the literature, the total costs related to osteoporosis in the entire Dutch population in 2010 were estimated to be €464.9 million.

Figures 2A and 3B show the total and average costs, respectively, for all included patients per age category in 2010. The shares of costs caused by hospitalization and costs of anti-osteoporotic medication as well as vitamin D and calcium supplements are also presented. The average costs increased with the patients' age. The total costs also increased with the patients' age, except for the age categories 85 to 89 years and older than 90 years, in which a decrease in total costs was found. In patients older than 75 years, the share of costs caused by hospitalization in both total and average costs is relatively high.

Figure 2C shows the number of fractures and the average costs per class of fracture in 2010. The number of minor fractures was the highest among the selected classes, followed by major fractures and hip fractures. The average costs in hip fractures were the highest, followed by major and minor fractures.

Treatment Gap

Osteoporosis is diagnosed and anti-osteoporotic medication is initiated in about 30% to 43% of the individuals who participate in an FLS, according to the four studies presented in Appendix Table S1 in Supplemental Materials [6–9]. According to this information and the total number of fractures found in this study (n = 24,922), about 7,500 to 9,250 of the 23,936 individuals who experienced a fracture would be diagnosed with osteoporosis if they would all participate in an FLS. This indicates a treatment gap of 60% to 72%, because the number of patients who suffered from a fracture in 2010 and received treatment (before or after) was

Table 1 – Detailed characteristics of patients and fractures in the included population.

Characteristic	Age (y)					All 50+
	50–59	60–69	70–79	80–89	90+	
Study population, n (%)						
Male	5,616 (29)	6,357 (23)	6,894 (23)	5,411 (21)	770 (16)	25,048 (23)
Female	13,781 (71)	20,854 (77)	23,686 (77)	20,607 (79)	4,037 (84)	82,965 (77)
Total	19,397	27,211	30,580	26,018	4,807	108,013
Number of fractures, n (%)						
Hip	286 (5)	533 (8)	924 (17)	1,929 (36)	659 (43)	4,508 (18)
Major	1,437 (23)	1,658 (26)	1,625 (31)	1,687 (31)	502 (33)	6,960 (28)
Minor	4,444 (72)	4,278 (66)	2,777 (52)	1,797 (33)	384 (25)	13,454 (54)
Total	6,168	6,469	5,326	5,413	1,546	24,922
Patients using anti-osteoporotic medication						
Bisphosphonates	6,725	14,684	19,423	15,404	2,103	58,339 (98.6%)
SERM	47	151	158	116	20	492 (0.8%)
Parathyroid hormone/analogues	32	91	142	83	14	362 (0.6%)
Total						59,193
Patients using supplements (vitamin D and calcium)	13,802	21,064	25,561	22,389	3,960	86,776

SERM, selective estrogen receptor modulator.

3,039 according to the results. This treatment gap is in line with the treatment gaps described in the literature [1,13].

Sensitivity Analysis

In Figure 3, the outcome of the sensitivity analysis using other studies is shown in a plot. It shows osteoporosis-related costs corrected for underestimation due to a treatment gap. When no accounting for the treatment gap, total costs are equal to the costs found in this study (€464.9 million). Nevertheless, when a treatment gap of 60% to 72% was assumed, as suggested by the four FLS studies, osteoporosis-related costs increased to €1.15 to €1.64 billion.

Discussion

In 2010, 24,922 fractures were sustained in 23,056 individuals in the population at risk of osteoporosis in the AHD. Of these fractures, 3,039 were osteoporosis-related. The total costs related to osteoporosis in the AHD in 2010 were €90 million. Extrapolated to the entire Dutch population, the total costs of osteoporosis were €465 million. Corrected for treatment gaps as a result of underdiagnosis according to four scenarios based on information from the literature, these total costs were estimated to be €1.15 to €1.64 billion.

Other results of this study indicate that the average cost of fracture increases as the age of the patient increases. This increase is the result of a higher prevalence of the more expensive hip and pelvic fractures among elderly people.

Strengths of This Study

A major strength of our study is that we used data from the AHD, one of the largest health care insurers in the Netherlands. Moreover, because the provided data set contained reimbursement data from various insurance companies of the Achmea Insurance Group that aims its services toward various social groups in the Dutch society, we consider the data set as a valid representation of the general Dutch population. The number of fractures (24,922) found in the provided data set representing 4.2 million people is also consistent with other estimates on the number of fractures in the Netherlands in 2010 [5].

The fact that individuals could retrospectively be followed in various health care sectors in the data set over multiple years was also a great advantage. Detailed information in the medical specialist health care sector was ideal for calculating costs related to osteoporosis.

Study Limitations

There are some limitations in the provided data that caused some research opportunities to be missed. Long-term care costs related to fractures could not be included in this study because these costs were first linked to anonymized social security

Table 2 – Detailed characteristics of the costs of inpatient care and the use of anti-osteoporotic medication and supplements.

Costs (€, million)	Age (y)					
	50-59	60-69	70-79	80-89	90+	All 50+
Anti-osteoporotic medication	5.4	11.7	15.7	11.8	1.5	46.1
Vitamin D and calcium	4.9	8.1	10.5	10.3	2.1	36.0
All fractures	8.4	11.1	12.7	19.8	6.6	58.5
Assessed osteoporosis-related fractures	0.63	1.40	2.35	2.74	0.57	7.70

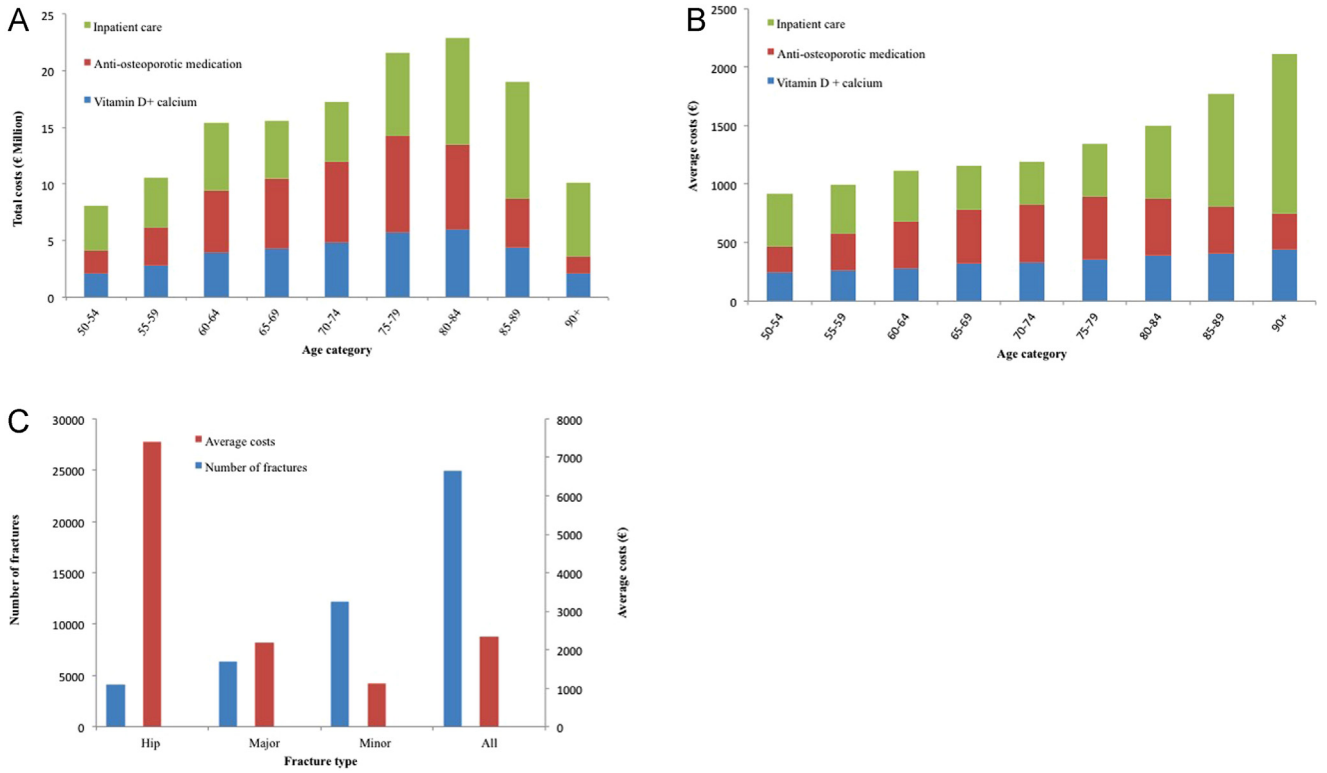

Fig. 2 – (A) Total costs per age category (all patients included in the analysis). (B) Average costs per age category (all patients included in the analysis). (C) The number of fractures and average costs per fracture.

numbers from the start of 2011. The patients who required long-term health care after a fracture in 2010 could therefore not be detected as it could not be determined whether they already relied on benefits in the same year. The costs concerning health care benefits are estimated to be higher than the costs in the first year after a fracture and represent more than half of the total costs of osteoporosis [1]. Besides, costs in health care sectors other than specialist medical care could not be included in this analysis because the information in the AHD was not detailed enough to be linked to osteoporosis with sufficient certainty.

Moreover, the provided data were not specific enough for determining the treatment gap by analyzing the number of patients in which anti-osteoporotic treatment was started after a fracture occurred. Other difficulties, such as the relatively low proportion of patients with osteoporosis-associated fractures who are examined for osteoporosis and the lack of sufficient detailed reimbursement data before the year 2010, made it

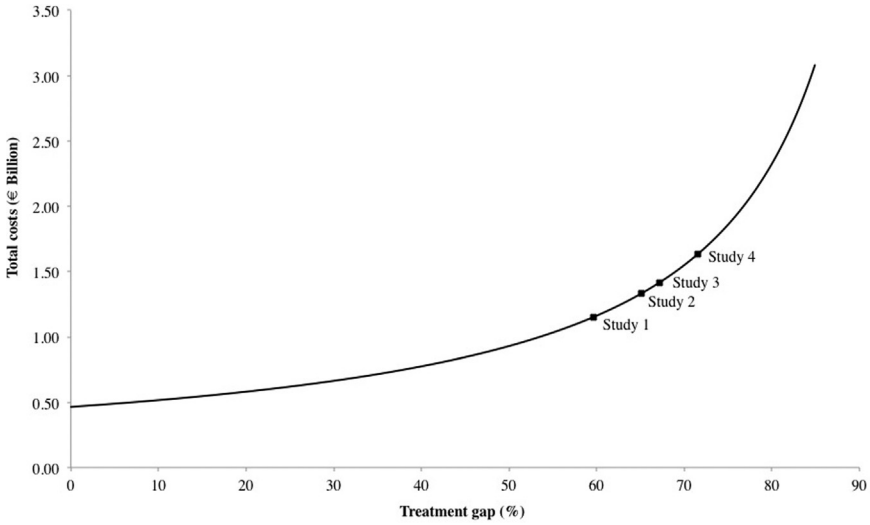

Fig. 3 – Total costs related to osteoporosis in the Netherlands, corrected for the treatment gaps calculated from data presented in several studies.

impossible to evaluate the treatment gap in a longitudinal way [10].

The definition that was used to identify osteoporosis-related fractures might have probably led to an overestimation, because not all fractures that occurred to individuals in cohort 2 were actually related to the poor bone mineral density (BMD) status of the concerned individuals. Nevertheless, this probable overestimation was likely minimized because fracture classification according to Center et al. [12] was used. Moreover, the effect of anti-osteoporotic treatment on BMD is evaluated for every 5 years in the Netherlands, indicating that most individuals in cohort 2 did indeed suffer from poor BMD status and were consequently at higher risk of fractures.

In the Netherlands, people older than 50 years are mostly prescribed vitamin D and supplements by a general practitioner, and so vitamins and supplements are mostly collected by these patients from the pharmacies. Therefore, the major use of vitamin D and supplements by persons older than 50 years is recorded in the reimbursement data of the AHD. The costs as a result of over-the-counter sales are relatively small and therefore not accounted for in this study. This might have led to a slight underestimation of the costs of vitamin D and supplements.

Implications

One FLS study that examined specifically the occurrence of a low-impact fracture did not find a notable difference in the number of diagnosed individuals compared with the other studies. Therefore, the average diagnosis percentages of all studies were used without further nuance. The fact that attendance to an FLS in the Netherlands in general is about 49% could be used for interpreting the outcome of the sensitivity analysis [10]. The cost outcome of this analysis would be approximately halved when the analysis was accounted for the attendance percentage.

The fact that health care expenses related to osteoporosis increase with the age of a patient emphasizes the importance of early detection and monitoring of osteoporosis in individuals older than 50 years. It should be kept in mind that even in the most favorable situation, treatment of osteoporosis does not lead to a full reduction in osteoporotic fractures [14,15]. Nevertheless, the costs of pharmaceutical treatment of osteoporosis do not outweigh the costs of osteoporosis-related fractures, especially when all aspects of the costs of this consequence are taken into account [1]. According to the results of this study and other data presented in the literature, pharmaceutical treatment of osteoporosis mostly consists of oral bisphosphonates and its costs do not exceed several hundreds of euros per year. The average first-year costs as a result of a fracture is, however, approximately €4500, let alone long-term disability costs and indirect costs of potential production losses [1]. This indicates the importance of early diagnosis and treatment.

Increasing focus on prevention and early detection of osteoporosis has been thoroughly discussed over the years. Screening for osteoporosis, for example, has been widely investigated. Some studies imply cost-effectiveness of screening/treatment procedures in osteoporosis. Factors such as age of initiation, repeat interval, type of screening test, and treatment threshold are determinants for the outcomes of these studies. If these factors are accounted for correctly, a screening strategy might be helpful to reduce the amount of potentially preventable costs related to osteoporosis [16,17]. The response rate regarding FLS in the Netherlands is also eligible for improvement, because this service is used by only 49% of individuals in the population at risk who suffered from a fracture [10].

Besides the aforementioned factors, emphasis has been given to the importance of adherence and persistence regarding the use of anti-osteoporotic medication as a determinant factor to the cost-effectiveness ratio of the screening/treatment strategies [16,17]. Oral bisphosphonates are known for relatively low compliance and persistence because of strict and patient-unfriendly intake directions [18,19]. Further research in alternatives for the first-choice medication might give new insights for a probable revision of the health care policy regarding osteoporosis.

Furthermore, positive results in studies concerning the connection of reimbursement funds to outcomes in health care might also suggest consideration of a total revision of the health care policy toward osteoporosis. A study concerning a system of integrated care in which a pay-for-performance model was used in Kinzigtal (Germany) resulted in positive outcomes with regard to fracture prevention compared with the usual fee-for-service reimbursement system [20]. Furthermore, several other studies in various countries concerning pay-for-performance systems have yielded positive results regarding costs and health outcomes [21,22]. The reduction of institutional fragmentation by the alternative reimbursement systems is argued to lead to better communication and cooperation between caregivers, resulting in health care more tailored to the patient and therefore in better outcomes for less money [21,22]. These results reflect the important role of the various kinds of caregivers involved in preventing and treating osteoporosis and the need for better cooperation between them.

The health care system in the Netherlands is also known for its institutional fragmentation. The strict border between first- and second-line care is often mentioned as a limiting factor in health care performance. The communication among community pharmacy, general practitioners, and hospitals and the follow-up of patients after hospitalization are known to be inadequate [21–23]. This leads to low persistence and compliance in patients in the short-term and to increased need for health care and higher expenses in the long run. Because osteoporosis is preeminently a disease that requires attention from both first- and second-line caregivers, the disappearance of the wall between the first- and second-line caregivers might lead to great developments in the treatment of the disease. This reflects the need for more awareness among caregivers with regard to the predicted increase in prevalence and costs related to osteoporosis and the role they can fulfill in preventing this prediction.

Future Research

Given the fact that not all costs have been accounted for in this research, the actual costs related to osteoporosis in the Netherlands are expected to be higher than estimated in this study. Furthermore, the prevalence—and related comorbidities and mortality—of osteoporosis is expected to increase rapidly in the near future because of aging of the population. A study including long-term health care costs, indirect costs, and costs related to osteoporosis in more health care sectors could lead to a better estimate of the total burden of osteoporosis and the potentially preventable costs. Furthermore, an alternative study design, a different data source, as well as a research model including demographic trends could be used for a more detailed investigation of the health care costs related to osteoporosis and a more accurate estimate of the treatment gap.

Conclusions

The total costs related to osteoporosis in the Netherlands in 2010, when only medication and hospitalization were taken into account, were €465 million. Corrected for treatment gap as a result of underdiagnosis, these costs were estimated to be €1.15 to €1.64 billion. These results indicate room for improvement in the health care policy against osteoporosis.

Because early detection and treatment of the patients representing the treatment gap might lead to prevention of many fractures, the costs related to the treatment gap are potentially preventable. A pay-for-performance reimbursement strategy might contribute to improve the approach of treating osteoporosis and reduce the treatment gap. Because the Dutch government already aims to introduce a pay-for-performance health care system in the Netherlands before 2020, it might be on its way to successfully reduce the potentially preventable costs related to osteoporosis.

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Supplemental Materials

Supplemental material accompanying this article can be found in the online version as a hyperlink at http://dx.doi.org/10.1016/j.jval.2017.02.006 or, if a hard copy of article, at www.valueinhealthjournal.com/issues (select volume, issue, and article).

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