Osteoporosis Medication Use in Nursing Home Patients With Fractures in 1 US State

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Background: Little is known about osteoporosis medication use among high-risk patients in nursing homes (NHs). We studied the patterns and predictors of osteoporosis medication use in elderly patients who sustained a fracture and were admitted to an NH.

Methods: We linked pharmaceutical claims data from 2 state-run drug assistance programs for elderly patients to Medicare data for the years 1995 through 2004. We defined the rates of osteoporosis medication use among patients admitted to an NH following a hip, wrist, or humeral fracture for the 12-month period after the fracture. Predictors of using an osteoporosis medication were assessed in a multivariate Cox proportional hazards model adjusting for age and sex.

Results: Of the 4430 eligible postfracture patients, only 11.5% were prescribed an osteoporosis medication. There was a progressive increase in use from 1.6% in 1995 to 18.7% in 2001 but no increases in 2001 through 2004. Patient characteristics associated with osteoporosis medication use included a history of osteoporosis medication use in the prior 12 months (hazard ratio, 19.5; 95% confidence interval, 16.0-23.7) and female sex (hazard ratio, 1.57; 95% confidence interval, 1.13-2.21). A history of falls or fracture was not a significant factor. Calcitonin was the most commonly used osteoporosis medication (56%).

Conclusions: While the rate of osteoporosis medication use increased across the 10-year period, a low rate of osteoporosis medication use persists in the NH setting. More appropriate use of drug treatment of high-risk patients is needed in NHs.

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OSTEOPOROSIS HAS BEEN REPORTED IN 80% OF ALL NURSING HOME (NH) RESIDENTS.1 PROSPECTIVE COHORT STUDIES HAVE REPORTED RATES OF 3.7 TO 5.0 HIP FRACTURES PER 100 NH RESIDENTS PER YEAR, A RISK 2.5-TO 10-TIMES GREATER THAN IN COMMUNITY-DWELLING ELDERLY SUBJECTS.2,4 FRACTURES SIGNIFICANTLY INCREASE MORBIDITY5 AND HEALTH CARE UTILIZATION IN NH RESIDENTS.6 IN ONE STUDY OF 1427 FEMALE NH RESIDENTS, THOSE WHO HAD A FRACTURE WERE HOSPITALIZED 15 TIMES MORE OFTEN IN THE MONTH FOLLOWING THE FRACTURE COMPARED WITH THOSE WHO DID NOT HAVE A FRACTURE, AND THIS RISK PERSISTED 3 TO 12 MONTHS AFTER FRACTURE.6

Fracture prevention in the NH environment may focus on fall prevention, bone protection, and bone mineral density (BMD) enhancement. The role of low BMD in fracture risk has been acknowledged in NH patients.7 Many widely available pharmaceutical agents improve BMD, with the essential treatment goal of fracture reduction and ultimately reduced mortality.8-11 Alendronate sodium in particular has been proven to be efficacious in both community-dwelling elderly subjects and residents of long-term care facilities.12 Despite the wide availability of effective pharmacotherapy for osteoporosis, the use of these agents is uncommon among all patients with osteoporosis.13 Prior studies of osteoporosis medication use in NHs among various populations have found rates as low as 20%.13,15 Patients with a recent history of a fragility fracture are at high risk of future fractures.16 They warrant particular attention to secondary prevention of fractures, but the rate of use among this high-risk population is unclear.

The relatively controlled environment of the NH presents a unique opportunity for fracture prevention. These strategies include fall prevention, hip protectors, and pharmacotherapy including adequate vitamin D replacement. Fall reduction may lead to fracture reduction, however, randomized control data are lacking. The direct impact of hip protectors on fracture risk remains uncertain.17,18 Prescribing data for NH residents is widely available and makes it possible to assess an important aspect of fracture prevention. We conducted a retrospective analysis on pro-

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spectively collected data to describe the patterns of osteoporosis medication use in elderly NH patients with a recent fracture and then determined patient-level predictors of medication use in this population.

STUDY POPULATION AND DATA SOURCES

The study cohort was identified from all individuals enrolled in the New Jersey Medicaid and Pharmaceutical Assistance for the Aged and Disabled (PAAD) programs, with data linked to their corresponding clinical encounter and diagnosis data from the Medicare program. The study spanned medication use between January 1, 1995, and December 31, 2004. The PAAD program is a state-specific program for reimbursement of drug expenses for elderly and disabled citizens. The majority of patients in this program are older than 65 years. The New Jersey Medicaid program has no deductible with no maximum benefit and charges no copayment for prescription drugs. The PAAD also has no deductible and no maximum benefit, but there is a nominal $2 copayment with each prescription. There were no prescribing or reimbursement restrictions for osteoporosis medications during this study period. Available information from the database included demographic information, dates of enrollment and hospitalization, NH utilization data, and all recorded diagnosis, procedures, physician visits, and filled prescriptions.

From these patients, we identified those who sustained a hip, wrist, or humerus fracture and were then admitted to an NH within 30 days after discharge from an acute care facility (Figure 1). For those patients not admitted to an acute care facility for fracture treatment, we required NH admission to have occurred within 30 days from the date of the fracture. Patients may have been residents in the community or in an NH at the time of the index fracture. Fractures were defined using validated algorithms, which have high positive predictive value.28 Fractures were identified from International Classification of Diseases, Ninth Revision (ICD-9) diagnostic codes combined with procedure codes.

The New Jersey Medicaid and PAAD databases were then queried to identify osteoporosis medications prescribed in the 12-month period following NH admission. Nursing homes studied included all long-term care facilities, including skilled nursing facilities. Each individual was required to be a patient continuously for 30 days or more from the time of the index NH admission. Patients were excluded if they had not had any prescription filled for any condition during the first 30 days of NH admission. To reduce the possibility that patients were receiving their medication from another source, patients were also excluded if they did not have any prescriptions filled or did not have a Medicare claim in each of the two 6-month periods preceding the date of the index fracture. This ensured that each subject had a uniform period of eligibility during which medication coverage was in place and covariates could be assessed.

STUDY OUTCOME

The osteoporosis medications studied were bisphosphonates (both oral and intravenous), raloxifene hydrochloride, calcitonin, teriparatide acetate, and estrogen-containing hormone therapy. Because indications for medications were not identified, they could have been used for other purposes rather than secondary fracture prevention. However, in the setting of a recent fracture in an elderly population, this seemed less likely. Calcium and vitamin D supplementation and hip protectors were not studied because the available data could not identify these therapies.

PREDICTORS OF TREATMENT

Age and sex were identified from program enrollment information. All covariates were assessed in the 12 months preceding the index fracture. International Classification of Diseases, Ninth Revision diagnostic information was used to calculate a modified Charlson comorbidity index score.22 Specific codes were reviewed in conjunction with all filled prescriptions during the previous 12 months to create particular variables; this included a history of dementia, falls, osteoporosis, osteoporosis medication, or prior BMD examination. Covariates assessed were either those in the literature relevant to the pathogenesis of osteoporosis or those likely to influence prescription and relevant in an NH population.

STATISTICAL ANALYSIS

The overall rate of osteoporosis medication use was defined and then examined for each year of the study period. Use of individual categories of medication was also studied by year and collectively over the 10-year period. Initially, we studied the relationship of each variable to osteoporosis medication prescribing in an unadjusted Cox proportional hazard regression. We then entered these variables into a multivariate Cox proportional hazard model to determine the predictors of treatment. A similar analysis was conducted on patients with hip fractures to determine the influence of location of fracture in prescribing osteoporosis medications. Statistical analyses were performed with SAS version 9.1 software (SAS Institute Inc, Cary, North Carolina). P < .05 was considered statistically significant.

RESULTS

PATIENT CHARACTERISTICS

From January 1, 1995, to December 31, 2004, we identified 4430 patients who sustained a hip, wrist, or humeral fracture followed by admission to an NH within a 30-day period. Table 1 displays the characteristics of the population. Of the 4430 patients, 3677 (83.0%) were female. The mean age of the study population was 82.7 years. Most fractures were predominantly of the hip, and 75.5% of patients sustained the index fracture in an NH. The median
length of NH stay was 305 days, and 11.1% of our study cohort died within 12 months of the index fracture. More than 50% of the study cohort had a history of falls, and more than 80% had a history of a previous fracture.

MEDICATION USE

Of the 4430 patients studied, only 510 (11.5%) were prescribed an osteoporosis medication over a 10-year period. The rate of medication use increased from 1.6% in 1995 to 18.7% in 2001 (Figure 2), but between 2001 and 2004, there were no further increases. Calcitonin was the most commonly prescribed medication (56.1%), followed by bisphosphonates (35.1%), estrogen-containing hormone therapy (5.3%), and raloxifene (3.7%). No patients were prescribed teriparatide, which was available for use from 2002 onwards. The pattern of use changes over time (Figure 3). While calcitonin and bisphosphonates remained most common, the rate of use of bisphosphonates increased and calcitonin decreased during the study period.

PREDICTORS OF MEDICATION USE

The Cox proportional hazard model was adjusted for age and sex. Multiple variables were entered. Hazard ratios (HRs) were thus predictors of receiving medication (Table 2).

The most powerful predictor of receiving an osteoporosis medication was prior use of such medication in the 12 months preceding the fracture, with an HR of 19.46 (95% confidence interval [CI], 16.02-23.63). Female patients were also more likely to receive osteoporosis treatment. There were no other significant predictors of receiving medication. A similar analysis conducted on patients who had sustained hip fractures (n=4120) did not change the significant patient-level predictors of receiving osteoporosis medication (Table 3). Because a history of receiving an osteoporosis medication in the past year was such a significant predictor of future use, a separate analysis was conducted, removing these patients from the model to determine if other variables would gain significance.

This next analysis (Table 3) was performed on 3929 patients, among whom 195 patients received an osteoporosis medication, giving an overall prescription rate of 5.0%. The percentage of patients newly prescribed an osteoporosis medication without previous exposure increased from 1.2% in 1995 to 10.4% in 2001, after which time there were no further increases (Figure 1). Being female became an...
even stronger predictor of receiving medication, while the presence of gastroesophageal reflux or peptic ulcer disease also became a more prominent predictor.

### Table 3. Multivariate Cox Proportional Hazards Model Examining Predictors of Osteoporosis Medication Use

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total Study Population (N=4430)</th>
<th>Patients With No History of Osteoporosis Medication Use (n=3929)</th>
<th>Patients With Hip Fractures (n=4120)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>1.50 (1.13-2.25)</td>
<td>2.08 (1.31-3.31)</td>
<td>1.57 (1.10-2.24)</td>
</tr>
<tr>
<td>Prior falls</td>
<td>1.02 (0.84-1.24)</td>
<td>0.93 (0.69-1.24)</td>
<td>1.07 (0.88-1.31)</td>
</tr>
<tr>
<td>Prior fracture</td>
<td>1.29 (0.78-2.11)</td>
<td>1.37 (0.64-2.94)</td>
<td>1.47 (0.69-3.14)</td>
</tr>
<tr>
<td>Dementia</td>
<td>1.12 (0.96-1.41)</td>
<td>0.95 (0.71-1.27)</td>
<td>1.10 (0.91-1.34)</td>
</tr>
<tr>
<td>BMD examination</td>
<td>1.07 (0.70-1.63)</td>
<td>1.44 (0.35-5.84)</td>
<td>1.09 (0.72-1.67)</td>
</tr>
<tr>
<td>Diagnosis of osteoporosis</td>
<td>1.34 (0.85-2.11)</td>
<td>0.86 (0.09-4.73)</td>
<td>1.38 (0.86-2.23)</td>
</tr>
<tr>
<td>Gastroesophageal reflux/peptic ulcer disease</td>
<td>0.99 (0.81-1.29)</td>
<td>1.43 (1.03-1.99)</td>
<td>1.00 (0.81-1.23)</td>
</tr>
<tr>
<td>Osteoporosis medication use</td>
<td>19.54 (16.09-23.72)</td>
<td>19.18 (15.67-23.47)</td>
<td></td>
</tr>
<tr>
<td>Glucocorticoid</td>
<td>1.06 (0.80-1.40)</td>
<td>1.39 (0.86-2.25)</td>
<td>0.99 (0.74-1.34)</td>
</tr>
<tr>
<td>Modified Charlson comorbidity index</td>
<td>0.96 (0.92-1.00)</td>
<td>0.98 (0.95-1.02)</td>
<td>1.00 (0.96-1.04)</td>
</tr>
</tbody>
</table>

Abbreviations: BMD, bone mineral density; CI, confidence interval; HR, hazard ratio.

We conducted a retrospective study on prospectively collected data examining the patterns and predictors of use of osteoporosis medication in patients who had sustained fractures and were admitted to an NH. In this study of 4430 people over a 10-year period, we found that overall only 11.5% of patients who sustained fractures received any type of osteoporosis medication. From 1995 to 2001, this proportion increased, and after 2001 the rate was stable. Calcitonin was the most commonly used medication, followed by bisphosphonates. By 2004, bisphosphonates were the most commonly prescribed medication. The strongest predictor of receiving a medication was prior use of an osteoporosis medication and female sex.

The leveling out of osteoporosis medication use after 2001 may partly be explained by the reduced popularity of estrogen-containing hormone therapy after publication of the results of the Women’s Health Initiative in 2001.21 but it does not account for it completely. Undertreatment of geriatric patients has been documented for multiple medication classes.22-24 Prior studies among other NH populations have also found low rates of treatment of osteoporosis.14,15 In the NH setting, patient complexity has been patient characteristics such as a history of fracture, prior falls, and steroid use may contribute to future fracture risk.28,29 The absence of few significant patient predictors suggests a wide variation in physician practice. However, the role of prescriber-level and NH-level characteristics has not been fully investigated.

There were several limitations to our study. It was conducted using data from 1 US state. Prescribing patterns may vary according to local practices affecting the generalizability of this study to a broader population, although studies across the United States have reported similar results.14,17 We did not have medication use data on calcium and vitamin D supplementation or hip protectors, measures that all address fracture prevention and some aspect of bone protection. Other data lacking included functional status, particular ambulatory status. This patient characteristic may be an influence in the prescription of an osteoporosis medication even though there is increasing literature that fracture prevention is not an issue exclusively for ambulatory individuals: 35% of injuries falls occur in nonambulatory NH patients,30 and NH residents who are able to transfer independently are at increased risk of fracture.7 Increasing age and a history of a fall in the last consideration of pharmacological treatment, in addition to calcium and vitamin D supplementation, especially in those patients with previous fractures.26

Our study demonstrates that not only are few patients treated, but also patient characteristics are weak predictors of receiving osteoporosis medication. Underrecognition and undertreatment of osteoporosis among male patients is well known, and therefore it is not surprising that women are more likely to receive treatment.27 Prior osteoporosis medication use may give clinicians some confidence regarding tolerability of medication, leading to represcription of such medications, which may partially explain why the percentage of osteoporosis medication prescribing in patients with prior exposure may be as low as 5.0%. Prescription for an osteoporosis medication may also reflect more functionally able patients or family and/or patient preference. Similarly, the absence of a prescription may reflect careful consideration by the clinician regarding poor individual patient prognosis and limited longevity. Patient characteristics such as a history of fracture, prior falls, and steroid use may contribute to future fracture risk.28,29 The absence of few significant patient predictors suggests a wide variation in physician practice. However, the role of prescriber-level and NH-level characteristics has not been fully investigated.
6 months have both been found to be predictive of fracture among NH patients.31 In addition, our study was a retrospective analysis, which limited our ability to capture all points of interest such as BMD scans. The results of BMD scans may have provided a more complete representation of response of osteoporosis medication prescribing in response to an acute fracture event.

Finally, our study is based on administrative data, which did not provide indications for medications. It is possible that some of these prescriptions may be used for other purposes. Despite these limitations, valid inferences can be made regarding the low frequency of prescribing osteoporosis medication in the NH setting for patients who have recently sustained fractures. Osteoporosis pharmacotherapy remains low among these high-risk patients. All available treatment modalities must be used to prevent osteoporotic fragility fractures in this environment. There is considerable room for improvement in the use of osteoporosis pharmacotherapy in this high-risk NH population. Prospective randomized controlled trials are needed to confirm the efficacy and tolerability of osteoporosis medications in high-risk NH patients, after which the issue of cost-effectiveness must be addressed. Interventions aimed at enhancing osteoporosis treatment in NHs are vital.

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Author Contributions: Drs Parikh and Solomon had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Parikh and Solomon. Analysis and interpretation of data: Parikh, Mogun, Avorn, and Solomon. Drafting of the manuscript: Parikh, Mogun, Avorn, and Solomon. Critical revision of the manuscript for important intellectual content: Parikh, Avorn, and Solomon. Statistical analysis: Mogun. Obtained funding: Parikh. Study supervision: Avorn and Solomon.

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REFERENCES