

Patient and Physician Predictors of Post-Fracture Osteoporosis Management

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BACKGROUND: Undertreatment of osteoporosis after hip or wrist fracture has been well documented, but the reasons for current patterns of care are poorly understood.

OBJECTIVE: We tested the role of physician and patient characteristics in predicting undertreatment when osteoporosis management was clearly indicated after a hip or wrist fracture in women over age 65.

METHODS: We assembled a cohort of 9,698 female Medicare beneficiaries aged ≥ 65 years who experienced hip or wrist fracture between 2000 and 2004 and their prescribing physicians.

MEASUREMENTS: The dominant prescriber was identified as the physician prescribing at least 50% of patient prescriptions in the year after the fracture. Multivariate logistic regression estimated the role of physician and patient characteristics on osteoporosis management after hip or wrist fracture.

RESULTS: Patients older than 90 and black patients were less likely to be treated for osteoporosis relative to patients aged 65–69 and white patients. Female providers were more likely to manage osteoporosis. Models including patient characteristics discriminated well between managed and unmanaged patients (C statistic 0.81), while adding physician predictors to the model provided no additional discriminatory ability (C statistic 0.81).

CONCLUSIONS: Our findings highlight that osteoporosis management rates are similar across providers, but vary considerably by patient types.

KEY WORDS: osteoporosis; fracture; physician characteristics; bisphosphonates; patient characteristics.

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INTRODUCTION

Fractures related to osteoporosis are common, causing morbidity or mortality in 2 million Americans and costing \$19 billion predicted for 2005.¹ Bone mineral density testing and/or pharmacologic osteoporosis treatment are indicated for all patients with an osteoporosis-associated fracture.¹ In spite of the availability of numerous post-fracture treatment options, osteoporosis management is suboptimal, with fewer than half of post-fracture patients receiving pharmacotherapy.² One study found that 21% of patients with hip fracture and 23% of patients with wrist fracture were prescribed pharmacologic treatment for osteoporosis and that the probability of treatment decreased with patient age.³ Moreover, the vast majority of those treated after fracture were on osteoporosis treatment before their fracture; the percentage of fractures that results in a patients starting on treatment for osteoporosis was much smaller.²

Little is known about whether post-fracture treatment is more a function of physician or patient characteristics. Outside of osteoporosis treatment, there is evidence that certain characteristics are correlated with appropriate prescribing for other conditions. For example, doctors who are more years from their training provide lower quality care on average than doctors with less experience.⁴ Physician specialty is another characteristic that can impact the likelihood of appropriate patient management. Mental health specialists are more likely to adequately treat depression than are general practitioners.⁵ Generally, board certification, frequency of procedures, and other physician characteristics have also been correlated with quality of care.^{6–8}

Patient characteristics such as age, race, and prior conditions were associated with management of osteoporosis.⁹ A recent study of 871 women aged 65 or more years from Ontario, Canada, found that after adjusting for the need for osteoporosis management (e.g., fracture history, steroid use, family history, and body size), age, health beliefs, higher education, higher income, use of preventive healthcare services, region of residence, and provider sex were associated with having had a bone mineral density test.^{10,11} However, this study had limited power to examine the relationship between patient and physician factors in a cohort of post-fracture patients. In order to help with the more accurate targeting of quality improvement efforts, we sought to identify patient and physicians predictors of osteoporosis management after hip or wrist fracture and to determine the relative importance of these predictors.

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METHODS

Setting and Design

We assembled a cohort of Medicare patients who experienced hip or wrist fracture between 1 January 2000 and 30 June 2004 by linking Medicare files to data from the Pennsylvania Pharmaceutical Assistance Contract for the Elderly (PACE) program. The PACE program provides prescription drug benefits to lower middle-income individuals age ≥ 65 whose annual earnings are above the threshold for Pennsylvania Medicaid. The PACE program requires a copayment of between \$5 and \$10 and does not have a formulary or restrict the medications that can be used by participants.

Cohort Definition

We included female patients who experienced a hip or wrist fracture during the study period and who were continuously enrolled in both Medicare and PACE for at least 1 year before and 1 year after the date of the fracture. The presence of hip or wrist fracture was indicated by either ICD-9 procedure codes (79. \times 5, 79.02, 79.12, 79.22, 79.32) or ICD-9 diagnostic codes (820. \times , 821. \times , 813. \times), indicating inpatient treatment of the fracture, or CPT codes indicating outpatient treatment of the fracture (27230–27248, 25600, 25605, 25611, 25620). Validation studies have demonstrated that these codes have a positive predictive value of 98% for hip fractures and 96% for radius/ulna (wrist) fractures.¹² We defined the fracture date as the date that the patient was treated for the fracture or had their first fracture-related code, and we excluded patients who died within 1 year of this date.

Osteoporosis Management

We defined osteoporosis management as pharmacologic treatment with osteoporosis medication or dual-energy X-ray absorption (DXA) testing within the 6 months after the fracture date. Osteoporosis medications included: bisphosphonates, hormone therapy (HT), raloxifene, and calcitonin. Treatment with teriparatide was considered, however, there were no instances of its use. We considered either treatment or diagnostic testing to be evidence of appropriate management under the assumption that pharmacologic therapy was not indicated for patients who did not receive treatment after DXA scanning.

Assignment of Dominant Prescriber

In order to identify the health provider most responsible for the management of osteoporosis in each patient in our cohort (i.e., both those that received osteoporosis management and those that did not), we evaluated all prescriptions filled by patients after their fracture. Consistent with the literature, we identified the “dominant prescriber” as the unique physician who prescribed $\geq 50\%$ of total prescriptions in the year after the fracture.¹³ If no dominant prescriber could be identified, patients were excluded from further analysis. To ensure our results were robust, we repeated our analysis using several alternative definitions for the dominant prescriber. First, if patients had seen a bone specialist (i.e., specialists in geriatrics, rheumatology, endocrinology, and orthopedic surgery) after hospital discharge for their index fracture, this

physician was considered to be the dominant prescriber. Second, patients were assigned a dominant prescriber in the following hierarchy: bone specialist, internal medicine, or family medicine specialists, and physicians prescribing more than 50% of all prescriptions in the year after the index fracture.

Patient and Physician Predictors

We identified patient comorbidities by searching Medicare claims for relevant diagnostic codes in the year prior to the fracture date. In this manner, we identified the following factors that may impact osteoporosis management after fracture: prior diagnosis of osteoporosis, corticosteroid use, breast cancer, endometrial hyperplasia, stroke, cardiac bypass surgery, congestive heart failure, chronic obstructive pulmonary disease, peripheral vascular disease, and gastrointestinal disease.¹⁴ We grouped these comorbidities into four main groups: cancer, coronary-vascular disease, glucocorticoid use, and gastrointestinal disease. We included treatment with a pneumonia vaccine as a predictor of the patient's preference for preventive care. We classified the PACE patients whose incomes are too high for Medicaid, but under \$14,000, into two socioeconomic groups: those with annual incomes less than \$10,000 per year and those with incomes greater than \$10,000 per year.¹⁵ We classified patients into three racial groups: white, black, and other.

We identified characteristics of each patient's dominant prescriber using the American Medical Association (AMA) Masterfile. Specifically, we determined physician gender, specialty, years of experience, and whether the physician's practice was rural or urban. Physicians were considered urban if the zip code from their practice address registered in the AMA file was located in counties classified as metropolitan areas by the United States Department of Agriculture and rural otherwise.¹⁶ Physicians were considered to have high experience if they graduated from medical school over 20 years before the date of the fracture. Specialties were divided into four mutually exclusive groups: (1) primary care, including family medicine and general practice; (2) bone-related specialties, including geriatrics, rheumatology, endocrinology, and orthopedic surgery; (3) internal medicine specialties, including nephrology and cardiology; (4) other specialties, including surgical specialties (e.g., neurosurgery), emergency medicine, and gynecology.

Statistical Analysis

We identified predictors of osteoporosis management (DXA and/or pharmacotherapy) within 6 months of the patient's fracture date. Factors of clinical relevance thought to impact osteoporosis management were incorporated into regression analysis including age, race, year of fracture, number of postoperative medications, income, cancer, coronary disease, prior osteoporosis diagnosis, corticosteroid use, and gastrointestinal disease. Odds ratios and 95% confidence intervals were estimated using logistic regression. Before running the adjusted model, we tested for collinearity between the covariates. In addition, models were run looking only at new users of osteoporosis medications.

We calculated a C statistic (area under the receiver operating curve), as a measure of how well the patient and physician

characteristics predicted osteoporosis treatment.¹⁷ A C statistic of 0.5 suggests that the a model does no better than a coin toss in predicting whether a patient does or does not receive treatment, whereas a C statistic of 1.0 suggests that the model is highly accurate at predicting treatment. In general, C statistics >0.8 are considered excellent, and C statistics between 0.70 and 0.79 are considered to have adequate predictive power.¹⁸

All analyses were run using STATA version 9.0 (StataCorp. 2005. College Station, TX)

RESULTS

We identified 13,446 hip and wrist fractures in females over age 65 during the study period. We excluded 2,859 patients because they died within 1 year of the fracture, leaving 10,607 fracture patients. Eight hundred and seventy-nine patients were excluded because no physician prescribed more than 50% of the total prescriptions or demographic information about their prescriber was missing. Therefore, our final cohort consisted of 9,698.

The mean age of the cohort was 83.7 years. Black patients made up 2% of the population, and patients of other races were <1% of the cohort. Most of the cohort had at least one comorbidity, including 47% with cardiovascular disease, 25% with a prior osteoporosis diagnosis, and 17% with gastrointestinal disease. (Table 1)

The mean time since graduation for physicians was 23.3 years, and the majority of physicians were male (87%), with most of the visits (78%) to physicians practicing in urban counties. The physicians were 88% family medicine or general practice, 3.6% bone-related specialties, such as geriatrics or orthopedics, 5.6% internal medicine specialties, such as gastroenterology or cardiology, and 2.9% from other specialties, such as emergency medicine or gynecology.

Osteoporosis Management Patterns

During the 6 months after hip or wrist fracture, 31.4% of patients received osteoporosis management. Patients who received osteoporosis treatment differed from untreated patients (Table 1). For example, in unadjusted analyses, 62% of patients who received osteoporosis management were receiving treatment before their fracture in comparison to only 11% of unmanaged patients. Female physicians who were the dominant prescriber for fracture patients treated 36.1% of their patients, while male physicians managed osteoporosis in 30.7% of their patients. Bone-related specialists were more likely than other physicians to manage their patients' osteoporosis (Fig. 1). Prescriber years since graduation did not influence osteoporosis treatment.

In multivariate analysis, osteoporosis management was predicted by patient age, with the eldest patients the least likely to receive osteoporosis medication or have a DXA (Table 2). For example, patients over 95 compared with patients aged 65–69 were less likely to be treated (OR=0.51; 95%CI, 0.33–0.80). Black patients were less likely to receive any osteoporosis management relative to white patients (OR=0.60; 95% CI, 0.39–0.91). Patients diagnosed with osteoporosis in the year before fracture were more likely to be managed in the 6 months following fracture (OR=2.39; 95% CI 2.13–2.69).

Table 1. Baseline Characteristics of Patients that Received (n=3,046) and Did Not Receive (n=6,652) Osteoporosis Management within 6 Months After their Fracture

Characteristic	Did not receive osteoporosis management (N=6,652)	Received osteoporosis management (N=3,046)
Patient characteristics		
Mean age (years)	84.1 years	82.8 years*
Income <\$10,000 per year %	59.8%	62.3%
Race		
White race %	96.9%	98.1%*
Black race %	2.3%	1.0%*
Other race %	0.8%	0.9%*
Patient comorbidities %		
Cancer	5.3%	5.4%
Coronary disease	67.2%	64.9%
Prior osteoporosis	24.3%	61.3%*
Glucocorticoid use	8.6%	12.7%*
Gastrointestinal disease	23.2%	25.5%
Other patient variables %		
Prior treatment	10.8%	61.9%*
Pneumonia vaccine	20.1%	24.3%*
Nursing home within 6 months	55.4%	50.0%*
Physician characteristics		
Urban %	78.3%	76.0%
Female %	12.1%	14.9%*
Family/general practice %	81.7%	81.5%*
Bone specialty %	3.4%	5.4%*
Medicine specialty %	7.9%	6.5%*
Surgery/other %	7.1%	6.6%*
Mean experience (years) ± SD	23.6 ± 9.7	22.9 ± 9.5*

*P<0.05

Patients who received any pharmacologic treatment for osteoporosis beforehand were far more likely (OR=9.41; 95% CI, 8.39–10.59) to be managed after the fracture. Adjusting for patient characteristics, female physicians were more likely to prescribe treatment for osteoporosis after fracture than male physicians (OR=1.18; 95% CI=1.01–1.38). There was no discernible difference between patients with dominant prescribers in internal medicine, bone-related specialties, medical specialties, or surgical specialties. The results were virtually identical when the dominant prescriber was redefined to include bone specialists or generalists.

Models including only patient characteristics had excellent discrimination between patients who did and did not have their osteoporosis managed (C statistic 0.81). Adding physician predictors to the model provided no additional discriminatory ability (C statistic 0.81).

COMMENT

The results of our large population-based study demonstrated that only 31.4% of patients were managed at all after fracture during the study period between 2000 and 2004. The variation in management patterns after osteoporosis-related fracture was explained primarily by patient characteristics; physician characteristics had almost no explanatory power. Patients over 90 years old, who were at the highest risk for future fracture, were the least likely to be managed consistently with other literature demonstrating the “treatment-risk” paradox.¹⁹ Black patients were also less likely to be managed after fracture,

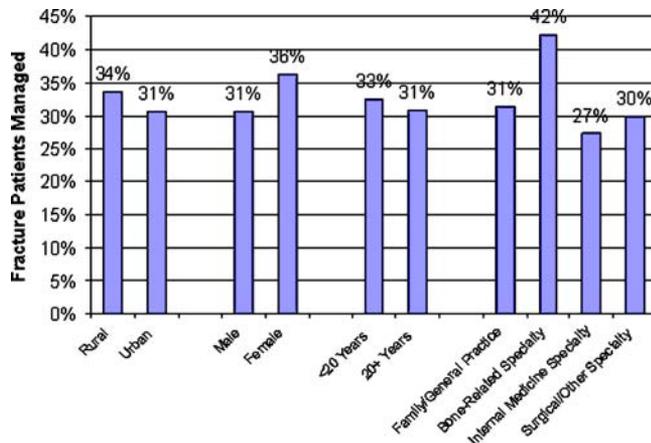


Figure 1. Unadjusted rates of osteoporosis management after hip/wrist fracture by physician characteristics.

consistent with the large amount of literature on racial and ethnic disparities.²⁰ In contrast, the only physician factor that predicted appropriate management was gender, yet this factor did not appreciably influence the predictive power of our models.

As such, our results highlight the need for quality improvements in the treatment of osteoporosis after fracture for all physicians and suggest that certain subgroups of patients should be the focus of particular attention. Unfortunately, interventions to improve osteoporosis management have had limited success. One intervention, supplying a system of reminders to physicians and phone calls to patients, led to a 45% relative improvement in osteoporosis management, but only a 4% absolute improvement in treatment, which did not translate into a statistically significant reduction in fractures.²¹ In another recently published study, an educational intervention delivered to patients with osteoporosis and/or their physicians had no impact on the appropriate osteoporosis treatment rates.²² Other interventions including treatment algorithms for physicians and follow-up letters for patients have also achieved modest results at best.²³ Accordingly, there is an urgent need to develop and evaluate interventions to help physicians effectively manage this increasingly important clinical condition.

The positive correlation between pneumonia vaccine use and osteoporosis treatment may indicate that patients with better preventative care are more likely to be treated after fracture. It is possible that the presence of a formalized relationship with a primary care physician, where it is understood by both parties that this physician is the coordinating point of contact for medical care, may predict osteoporosis management. One county-level analysis found a correlation between primary care physician presence and lower mortality rates, a correlation that did not hold for the supply of specialist physicians.^{24,25}

In contrast to existing literature, we found that physician specialty or physician experience did not predict the likelihood of osteoporosis management, which was found across specialties including cardiology,²⁶ mental health,⁵ and rheumatology.^{4,5,27}

Our study has several limitations. First, the physician responsible for osteoporosis treatment for each fracture was attributed exclusively to the dominant prescriber. It is possible that we mis-assigned patients to providers, which may have led to incorrect inferences about physician predictors of

osteoporosis management. Second, our study focused on drugs of proven efficacy, so we did not look at other preventive treatments, such as over-the-counter calcium or vitamin D supplements and hip protectors. Similarly, while we tried to control for contraindications such as gastrointestinal disease, coronary disease, and other comorbidities that may have reasonably impacted osteoporosis treatment, it is conceivable that other comorbidities not included in the model may have confounded the results.

Third, although this study is focused on physician prescribing, the data followed only filled prescriptions. It is possible that some groups were prescribed drugs, but did not fill their prescriptions. In particular, age may be correlated with the ability to actually fill prescriptions written by physicians, and thus our observation that older patients are particularly under-treated may be confounded by this fact. Finally, this study was limited to females over age 65 living in Pennsylvania.

Table 2. Predictors of Receiving Osteoporosis Management¹ within 6 Months After Hip or Wrist Fracture (n=9,698)

	Adjusted Odds Ratio (95% CI)
Patient predictors	
Age (years)	
65–69	1.00 (referent)
70–74	1.03 (0.73–1.46)
74–79	0.96 (0.70–1.33)
80–84	0.82 (0.60–1.13)
85–89	0.78 (0.57–1.07)
90–94	0.63 (0.45–0.88)*
95+	0.51 (0.33–0.80)*
Income	
<\$10,000	1.00 (referent)
\$10,000+	1.07 (0.96–1.19)
Race	
White	1.00 (referent)
Black	0.60 (0.39–0.91)*
Other	1.50 (0.87–2.58))
Patient comorbidities	
None	(referent)
Cancer	1.12 (0.90–1.41)
Coronary disease	0.94 (0.84–1.06)
Prior osteoporosis	2.39 (2.13–2.69)*
Glucocorticoid use	1.21 (1.01–1.46)*
Gastrointestinal disease	0.94 (0.83–1.07)
Number of prescriptions (0 is referent)	0.99(0.98–1.00)
Other patient characteristics	
Prior treatment	9.41 (8.36–10.59)*
Pneumonia vaccine	1.20 (1.06–1.35)*
Nursing home within 6 months	0.79 (0.71–0.89)*
Physician predictors	
Practice setting	
Rural	1.00 (referent)
Urban	0.93 (0.81–1.06)
Gender	
Male	1.00 (referent)
Female	1.18 (1.01–1.38)*
Specialty	
Family/general practice	1.00 (referent)
Bone specialist	1.12 (0.84–1.49)
Medical specialty	1.01 (0.84–1.22)
Surgical specialty/other	0.96 (0.78–1.18)
Experience	
<20 Years	1.00 (referent)
20+ Years	1.03 (0.92–1.16)

¹DXA and/or pharmacotherapy

*P<0.05

nia, and the predictors of osteoporosis prescriptions may not be generalizable to other states, the treatment of men, or younger women. Some patients prescribed medications by physicians may not have filled prescriptions, a rate that could vary across physicians. However, it is unlikely that variation in preferences in the cohort of strictly low-income Pennsylvania women over age 65 could explain the observed variation between patient groups. Other unobserved variables include education, communication, and health beliefs.

In conclusion, although fracture is the greatest single predictor of future fracture, only 31% of hip or wrist fracture patients had their osteoporosis managed. The treatment of osteoporosis is well predicted by patient characteristics, but physician characteristics do not predict treatment. In spite of hip or wrist fracture, a sentinel event indicating risk of future fracture, prior use of osteoporosis therapy, and patient characteristics best predict osteoporosis treatment.

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