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Rates of Osteoporosis Management and Secondary Preventative Treatment After Primary Fragility Fractures

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Background: Fragility fractures are often sentinel events in documenting new cases of osteoporosis. Numerous analyses have demonstrated low rates of adequate osteoporosis evaluation and treatment following primary fragility fractures. The purpose of this study was to quantify the incidence of primary fragility fractures in America and the rates of osteoporosis screening and management before and after fracture.

Methods: A retrospective review of the PearlDiver database was conducted using the International Classification of Diseases, Ninth Revision (ICD-9) and ICD, Tenth Revision (ICD-10) and Current Procedural Terminology codes. Patients who were 60 to 80 years of age and had primary fragility fractures of the hip, wrist, spine, pelvis, humerus, and other unspecified locations were included. The rates of dual x-ray absorptiometry (DXA) screening and osteoporosis pharmacotherapy were assessed for 2 years before and 2 years after the primary fracture.

Results: In this study, 48,668 patients with a primary fragility fracture were identified. Within this cohort, 25.8% (12,573 of 48,668) had received osteoporosis screening or treatment in the prior 2 years. In the 36,095 patients with no management before the fracture, 19% (6,799 patients) were diagnosed with osteoporosis and 18.4% (6,653 patients) received a DXA scan and/or filed claims for pharmacotherapy in the following 2 years. Patients with an osteoporosis diagnosis were more likely to receive both types of management (odds ratio [OR], 11.55 [95% confidence (CI), 10.31 to 12.95]), and male patients were less likely to receive both types of management (OR, 0.23 [95% CI, 0.17 to 0.27]). Secondary fragility fractures within the next 2 years were diagnosed in 8.4% (3,038 of 36,095) of patients at a mean of 221 days following the primary fracture.

Conclusions: The rates of appropriate osteoporosis evaluation, diagnosis, and management following primary fragility fractures remain unacceptably low. Less than one-third of patients with primary fragility fractures had been evaluated or treated for osteoporosis in the 2 years prior to fracture. Furthermore, among patients without pre-fracture management, <20% received osteoporosis screening or treatment within the next 2 years.

Level of Evidence: Prognostic Level IV. See Instructions for Authors for a complete description of levels of evidence.

Osteoporosis is the most prevalent chronic musculoskeletal condition, affecting >200 million individuals worldwide[1]. With 17.2 million more Americans projected to have osteoporosis by 2030, increasing awareness and preventive care is paramount[2]. Fragility fractures, fractures resulting from low-impact trauma such as a fall from a standing height or less, account for 2.8% of hospitalizations in patients >55 years of age and are often sentinel events for new osteoporosis diagnoses[3]. In the outpatient setting alone, there were >4 million reported outpatient visits for fragility fractures from 2010 to 2011[3,4], and the aggregate economic burden of osteoporosis in this patient population included $73.6 billion in medical expenditures and lost wages from 2012 to 2014[3].

Despite these striking figures, the true burden of osteoporosis is likely greater given high rates of underdiagnosis and undertreatment[5,6]. The National Osteoporosis Foundation's

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guidelines for diagnosing osteoporosis are based on measuring bone mineral density via dual x-ray absorptiometry (DXA) of the spine and hip, with a score of ≤−2.5 warranting an osteoporosis diagnosis[7]. Osteoporosis screening guidelines target women ≥65 years of age and men ≥70 years of age but may be recommended earlier in patients with certain risk factors or a previous fragility fracture after the age of 50 years[7,8]. However, these guidelines may neglect diagnoses in patients with higher DXA scores, patients with no recent fracture history, and younger patients[9,10]. To address these shortcomings, the National Committee for Quality Assurance (NCQA) established quality measures for compliance with accepted osteoporosis screening and management guidelines following fragility fractures[8]. Performance on these measures is reported through the Healthcare Effectiveness Data and Information Set (HEDIS), a performance improvement tool, and reported data are used to benchmark performance for accreditation for value-based-care programs from the U.S. Centers for Medicare & Medicaid Services (CMS)[8,11].

Unfortunately, previous analyses have reported rates of adequate osteoporosis evaluation and treatment following primary fragility fractures to be <30%[6,12-14]. In response, numerous recent initiatives have been implemented to improve upon the HEDIS measures. Fracture liaison services (FLSs), multidisciplinary initiatives aimed at addressing the osteoporosis treatment gap, have become more prevalent worldwide[15]. The American Orthopaedic Association (AOA) established the Own the Bone program in the United States in 2009. It contains nationwide deidentified fragility fracture data, educational materials, and best-practice management strategies to aid medical centers in establishing an FLS[16]. However, there is a paucity of contemporary, longitudinal analyses using nationwide U.S. data on the efficacy of such efforts in recent years.

The purpose of this study was to quantify the incidence of primary fragility fractures in America and to assess rates of osteoporosis screening and treatment prior to the fracture and, among patients without recent osteoporosis management, subsequent rates of osteoporosis management following the sentinel fracture. A secondary goal was to investigate the clinical and demographic variables associated with the likelihood of receiving osteoporosis management after the initial fracture and the risk of sustaining a secondary fracture.

Materials and Methods

Patient records were obtained from PearlDiver, a commercially available administrative claims database with deidentified inpatient and outpatient data. Eligible patients and outcomes were identified via Current Procedural Terminology (CPT) and International Classification of Diseases, Ninth and Tenth Revisions (ICD-9 and ICD-10) codes. The data set utilized contains the medical records of approximately 15 million patients across the United States from 2010 through the second quarter of 2018, which are collected by an independent data aggregator and include all payers. Institutional review board exemption was granted for this study as provided data were deidentified and were compliant with the U.S. Health Insurance Portability and Accountability Act (HIPAA).

A retrospective review was conducted to quantify the incidence of primary closed fragility fractures in the data set. In order to limit the potential transfer bias due to patients leaving or joining the data set during the collection period, only patients with continuous database enrollment during the entire study period were included. Patients who were 60 to 80 years of age and had fragility fractures of the hip, wrist, spine, pelvis, humerus, and other unspecified locations were included. Patients with a history of fragility or pathologic fractures, malignant neoplasms, and contraindications to first-line pharmacotherapy for osteoporosis (e.g., Roux-en-Y bypass for bisphosphonates) were excluded. Patients with various metabolic diseases that predispose to low bone density and autoimmune diseases requiring chronic corticosteroid therapy were excluded to limit confounding variables contributing to low bone density. Traumatic fracture etiologies were excluded to ensure the fragility-based etiology of the fractures. A complete list of codes used to define inclusion and exclusion criteria is available in Appendix Table A.1.

DXA scans were identified using CPT codes 77080 and 77081. Generic drug codes were used to identify prescription claims filed for the following medications: alendronate, risedronate, ibandronate, zoledronic acid, raloxifene, denosumab, teriparatide, abaloparatide, calcitriol, and various vitamin D and calcium supplements. These codes are cross-mapped to 11-digit National Drug Codes (NDCs) on patients' charging records. A full list of codes used to define each drug is provided in Appendix Table A.2.

For the analysis after the primary fracture, patients without a history of osteoporosis management within 2 years before the index fracture were divided into 4 cohorts based on the degree of osteoporosis-related management in the 2 years following the primary fragility fracture: (1) received a DXA scan only, (2) received pharmacotherapy only, (3) received both a DXA scan and pharmacotherapy, and (4) received neither DXA nor pharmacotherapy. The numbers of patients with diagnoses of osteoporosis or vitamin D deficiency were also queried. Additionally, rates of at least 1 subsequent fragility fracture at a different anatomic location from the index fracture during the next 2 years were assessed. The most common diagnosis codes for primary and secondary fragility fractures and the mean time between them were obtained. Demographic data including age, region, and sex were obtained for all included patients.

Statistical analyses were performed using R statistical software (R Foundation for Statistical Computing) integrated within the PearlDiver software, with an α level set to 0.05. Multivariable logistic regression adjusting for patient age, Charlson Comorbidity Index, diabetes, and history of tobacco use was used to calculate odds ratios (ORs) with corresponding 95% confidence intervals (CIs) to evaluate the likelihood of receiving some form of osteoporosis-related management based on the presence of an osteoporosis diagnosis, vitamin D deficiency diagnosis, or male sex. Cox proportional hazards regression was used to calculate hazard ratios (HRs) with corresponding 95% CIs to evaluate the impact of treatment exposure and various demographic and clinical variables on the risk of sustaining a secondary fragility fracture within 2 years following the first fracture.

Results

A total of 643,386 potential fragility fractures were identified. After applying exclusion criteria, 48,668 eligible patients were included (Fig. 1). Within this cohort, 25.8% (12,573 of 48,668) had filed a claim for osteoporosis screening or treatment in the prior 2 years. This left 36,095 unique patients with a primary fragility fracture and no history of osteoporosis-related management within the prior 2 years for analysis of subsequent rates of treatment and secondary fractures. Among these management-naïve patients, 88% (22,743 of 25,710) of women were ≥65 years of age and 68% (7,069 of 10,385) of men were ≥70 years of age at the time of the index fragility fracture.

Demographic data were obtained for the management-naïve cohort (Table I). In this sample, 71% of patients were female, 47% of patients were ≥75 years of age, and 41% of patients were located in the southern United States. Of the 36,095 patients, osteoporosis was diagnosed in 19% (6,799 patients) and vitamin D deficiency was diagnosed in 18% (6,611 patients). The 36,095 unique patients sustained a collective 36,295 fragility fractures during the sentinel event. By anatomic location (Table II), the most common fracture sites were the spine (39%), hip (26%), and wrist (13%). The highest-volume primary fracture locations by single ICD diagnosis code (Table III) were the femoral neck (ICD-9-8208), lumbar vertebrae (ICD-9-8054), and thoracic vertebrae (ICD-9-8052).

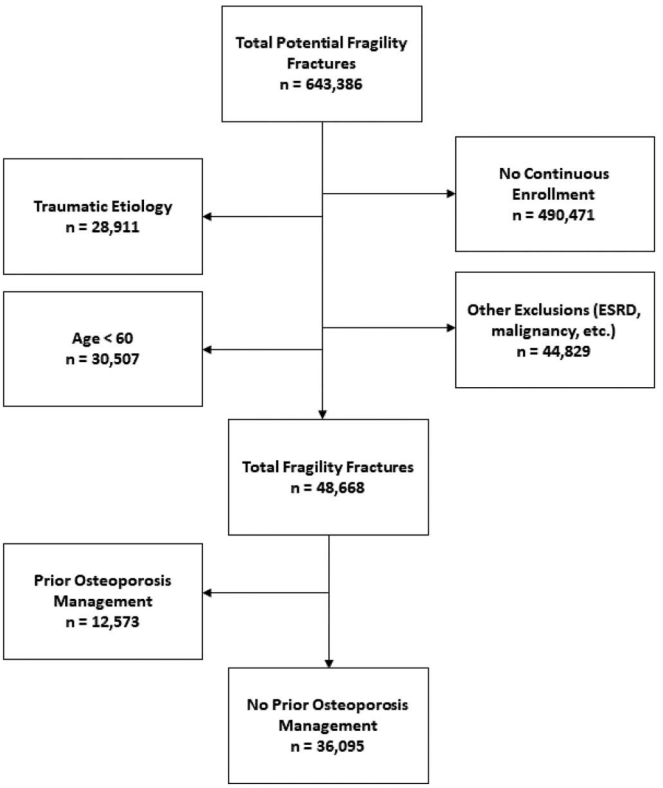

Fig. 1

Flowchart for the application of exclusion criteria showing how many patients were excluded by each exclusion criterion. Full exclusion criteria definitions are provided in Appendix Table A.1. ESRD = end-stage renal disease.

TABLE I Demographic Data for Unique Patients Sustaining Primary and Secondary Fragility Fractures

	Primary Fragility Fracture*	Secondary Fragility Fracture*†
Total	36,095 (100%)	3,038 (8.4%)
Sex		
Male	10,385 (29%)	685 (22%)
Female	25,710 (71%)	2,353 (78%)
Age		
60 to 64 years	4,607 (13%)	244 (8%)
65 to 69 years	4,908 (14%)	307 (10%)
70 to 74 years	9,495 (26%)	584 (19%)
75 to 80 years	17,085 (47%)	1,903 (63%)
Region		
Midwest	8,371 (23%)	690 (23%)
Northeast	7,496 (21%)	633 (21%)
South	14,783 (41%)	1,279 (42%)
West	5,380 (15%)	431 (14%)
Not available	65 (0.2%)	5 (0.2%)
Clinical diagnoses		
Osteoporosis	6,799 (19%)	927 (31%)
Vitamin D deficiency	6,611 (18%)	606 (20%)
Tobacco use	6,016 (17%)	555 (18%)
Diabetes mellitus	15,365 (43%)	1,313 (43%)

*The values are given as the number of patients, with the rates in parentheses. †This is the number of patients with another fragility fracture diagnosis code at a different anatomic location from the index fracture on a claim within 2 years of the index fracture.

TABLE II Total Primary Fragility Fractures by Anatomic Location

Primary Fracture Location	No. of Fractures* (N = 36,295)
Spine	14,209 (39%)
Hip	9,370 (26%)
Wrist	4,897 (13%)
Humerus	4,277 (12%)
Pelvis	2,943 (8%)
Other pathologic fracture	599 (2%)

*The values are given as the number of fractures, with the percentage in parentheses. The total fracture count adds up to more than the total patient count (36,095) because some patients had primary fragility fractures at multiple anatomic sites.

Among the 36,095 management-naïve patients, 6,653 patients (18.4%) underwent a workup for osteoporosis: 2,588 patients (7.2%) received only a DXA scan, 2,563 patients (7.1%) received only osteoporosis pharmacotherapy, and 1,502

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patients (4.2%) received both DXA and pharmacotherapy. Conversely, 29,442 patients (81.6%) received neither DXA evaluation nor pharmacotherapy during the following 2 years (Table IV). The most common medication on filed claims was alendronate (1,416 patients); medication utilization is detailed in Appendix Table B.1. Patients with an osteoporosis diagnosis were more likely to receive a DXA scan (OR, 1.77 [95% CI, 1.61 to 1.94]), pharmacotherapy (OR, 2.12 [95% CI, 1.94 to 2.31]), or both (OR, 11.55 [95% CI, 10.31 to 12.95]). Similarly, patients diagnosed with vitamin D deficiency were more likely to receive a DXA scan (OR, 1.59 [95% CI, 1.45 to 1.75]), pharmacotherapy (OR, 1.76 [95% CI, 1.61 to 1.93]), or both (OR, 2.85 [95% CI, 2.55 to 3.18]). Male patients were less likely to receive a DXA scan (OR, 0.47 [95% CI, 0.42 to 0.52]), pharmacotherapy (OR, 0.60 [95% CI, 0.54 to 0.66]), or both (OR, 0.23 [95% CI, 0.19 to 0.27]) relative to female patients.

Secondary fragility fractures were diagnosed in 3,038 patients (8.4%) at a mean time of 221 days following the index fracture (Table V). Stratifying by treatment exposure, this cohort included 190 patients (6.3%) with a DXA scan only, 261 patients (8.6%) with osteoporosis pharmacotherapy only, 128 patients (4.2%) who received both, and 2,459 patients (80.9%) with no

TABLE III The Most Common Primary and Secondary Fragility Fractures by ICD Diagnosis Code

Code	Description	No. of Patients*
Primary fragility fracture (n = 36,095)		
ICD-9-8208	Closed fracture, unspecified neck of femur	5,866 (16%)
ICD-9-8054	Closed fracture of lumbar vertebrae	4,267 (12%)
ICD-9-8052	Closed fracture of thoracic vertebrae	2,999 (8%)
Secondary fragility fracture†		
Overall (n = 3,038)‡		
ICD-9-8208	Closed fracture, unspecified neck of femur	415 (14%)
ICD-9-8088	Closed unspecified fracture of pelvis	199 (7%)
ICD-9-8054	Closed fracture of lumbar vertebrae	178 (6%)
Primary spine fracture (n = 815)		
ICD-9-8208	Closed fracture, unspecified neck of femur	188 (23%)
ICD-10-M8448XA	Pathologic fracture, other site, initial encounter	88 (11%)
ICD-9-8082	Closed fracture of pubis	51 (6%)
Primary hip fracture (n = 948)		
ICD-9-8088	Closed unspecified fracture of pelvis	122 (13%)
ICD-9-8082	Closed fracture of pubis	79 (8%)
ICD-9-8054	Closed fracture of lumbar vertebrae	75 (8%)
Primary humeral fracture (n = 413)		
ICD-9-8208	Closed fracture, unspecified neck of femur	44 (11%)
ICD-9-81301	Closed fracture, olecranon process of ulna	31 (8%)
ICD-9-81342	Other closed fractures of distal radius	29 (7%)
Primary wrist fracture (n = 372)		
ICD-9-8208	Closed fracture, unspecified neck of femur	30 (8%)
ICD-9-81240	Closed fracture, unspecified part of distal humerus	26 (7%)
ICD-9-73313	Pathologic fracture of vertebrae	24 (6%)
Primary pelvic fracture (n = 424)		
ICD-9-8208	Closed fracture, unspecified neck of femur	150 (35%)
ICD-9-8054	Closed fracture of lumbar vertebrae	61 (14%)
ICD-9-8052	Closed fracture of thoracic vertebrae	36 (8%)
Other primary pathologic fracture (n = 93)		
ICD-10-M8448XA	Pathologic fracture, other site, initial encounter	13 (14%)
ICD-10-M4854XA	Collapsed vertebrae, thoracic region, initial encounter	5§ (5%)
ICD-10-M4856XA	Collapsed vertebrae, lumbar region, initial encounter	5§ (5%)

*The values are given as the number of patients, with the percentage in parentheses. †These values only include patients with a secondary fragility fracture at a different anatomic site from the index fragility fracture. ‡The subgroup total (3,065) adds up to >3,038 because some patients with a secondary fracture within 2 years had index fragility fractures at >1 anatomic site. §The PearlDiver software only provides exact patient counts when the group total is ≥11. When patient counts are <11, −1 is reported by the software. For these fields, a value of 5 (median, 1 to 10) was assigned.

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TABLE IV Rates of Osteoporosis-Related Management Following Primary Fragility Fractures* (N = 36,095)

	Management			
	DXA Scan Only	Pharmacotherapy Only	Both Managements	No Management
No. of patients†	2,588 (7.2%)	2,563 (7.1%)	1,502 (4.2%)	29,442 (81.6%)
Time between fracture and claim‡ *(days)*	243.6	285.4	225.1	NA
OR for management§				
Osteoporosis	1.77 (1.61 to 1.94)	2.12 (1.94 to 2.31)	11.55 (10.31 to 12.95)	NA
Vitamin D deficiency	1.59 (1.45 to 1.75)	1.76 (1.61 to 1.93)	2.85 (2.55 to 3.18)	NA
Male sex	0.47 (0.42 to 0.52)	0.60 (0.54 to 0.66)	0.23 (0.19 to 0.27)	NA

*NA = not applicable. †The values are given as the number of patients, with the percentage in parentheses. ‡The values are given as the mean time between the index fragility fracture and a claim being filed for the associated screening or treatment. §The values are given as the OR, with the 95% CI in parentheses.

management before the secondary fracture. Additionally, 927 patients (30.5%) had an osteoporosis diagnosis and 606 patients (19.9%) had vitamin D deficiency. An osteoporosis diagnosis (HR, 1.91 [95% CI, 1.75 to 2.08]), tobacco use (HR, 1.19 [95% CI, 1.08 to 1.31]), and increasing Charlson Comorbidity Index score (HR, 1.03 [95% CI, 1.01 to 1.04]) were associated with a higher risk of secondary fragility fractures. Male patients (HR, 0.76 [95% CI, 0.70 to 0.83]), patients who underwent a DXA scan only (HR, 0.66 [95% CI, 0.59 to 0.74]), and patients who filed a claim for pharmacotherapy only (HR, 0.88 [95% CI, 0.79 to 0.98]) had a lower risk.

Discussion

The present study highlights the low percentage of patients screened prior to fragility fractures and the even lower number that are screened or treated after a sentinel event. In this study, of the 48,668 patients with primary fragility fractures identified, only 25.8% (12,573 patients) had received a DXA scan

TABLE V Incidence of Secondary Fragility Fractures and the Impact of Treatment Exposure, Demographic Variables, and Clinical Diagnoses*

	No. of Patients†	Time Between Fractures‡ *(days)*	Cox Regression§
Secondary fractures	3,038 (8.4%#)	221.4	NA
Treatment			
DXA scan only	190 (6.3%)	204.9	0.66 (0.59 to 0.74)
Pharmacotherapy only	261 (8.6%)	225.2	0.88 (0.79 to 0.98)
Both management	128 (4.2%)	177.1	1.20 (0.98 to 1.47)
No management	2,459 (80.9%)	224.5	NA
Demographic variables			
Male sex	685 (22.5%)	215.7	0.76 (0.70 to 0.83)
Age			
60 to 64 years	244 (8.0%)	154.6	0.97 (0.43 to 2.19)
65 to 69 years	307 (10.1%)	167.5	1.10 (0.49 to 2.46)
70 to 74 years	584 (19.2%)	148.1	1.43 (0.64 to 3.19)
75 to 80 years	1,903 (62.6%)	261.1	1.55 (0.69 to 3.44)
Tobacco use	555 (18.3%)	221.0	1.19 (1.08 to 1.31)
Clinical diagnoses			
Vitamin D deficiency	606 (19.9%)	204.7	1.04 (0.95 to 1.14)
Osteoporosis	927 (30.5%)	234.0	1.91 (1.75 to 2.08)
Diabetes	1,313 (43.2%)	223.3	1.02 (0.95 to 1.14)
Charlson Comorbidity Index	NA	NA	1.03 (1.01 to 1.04)

*NA = not applicable. †The values are given as the number of patients, with the percentage in parentheses. ‡The values are given as the mean. §The values are given as the HR, with the 95% CI in parentheses. #The proportion of patients with a fragility fracture who subsequently had another fragility fracture diagnosis code corresponding to a different anatomic location than the index fracture on a claim within 2 years of the index fracture(s).

and/or pharmacotherapy in the prior 2 years. Among the 36,095 management-naïve patients, 88% of women and 68% of men should have been screened for osteoporosis based on standard age-based screening guidelines. Subsequently, 7.2% (2,588 patients) received a DXA scan only, 7.1% (2,563 patients) filed a claim for osteoporosis-related pharmacotherapy only, and only 4.2% (1,502 patients) received both within 2 years after the sentinel fracture. Male patients were less likely to receive any osteoporosis screening or treatment. A substantial proportion (8.4%) of the management-naïve primary fragility fracture cohort sustained a secondary fragility fracture at a different anatomic location within 2 years.

Several limitations must be acknowledged. The complex nature of medical billing creates the potential for coding bias with the manual entry of billing codes. With regard to the secondary fracture rate, determining with absolute certainty if secondary fractures were sustained in a separate event or if they were undiagnosed during the initial encounter was difficult using claims data. Prior research has estimated that only 1 in 3 vertebral fractures are clinically identified[5]. Some secondary fractures also may have represented initially misdiagnosed fractures with later correction to more accurate diagnosis codes; however, by limiting secondary fracture diagnoses to different anatomic sites, this possibility was minimal and the reported secondary fracture rate may actually have been underestimated as secondary fractures at the same or the contralateral anatomic site were excluded. Although such errors are inherent to all analyses of administrative claims information, CMS has reported that such instances make up only 1.0% of payments[17]. By not requiring an osteoporosis diagnosis for inclusion in this study, and because bone density (i.e., T-score) information is not available in the database, some included patients may not have sustained true fragility fractures attributable to poor bone quality. However, factoring in exhaustive exclusion criteria and because fragility fractures are often sentinel events in diagnosing osteoporosis, this possibility was minimal. Additionally, as the PearlDiver database contains deidentified patient data, it was not possible to determine what proportion of included patients received medical care at a medical center enrolled in Own the Bone and/or with an established FLS. Thus, our conclusions should not be understood as a direct analysis of the efficacy of such programs but rather as a broader analysis of deficits in osteoporosis screening and management nationally. The 2-year follow-up used in the present study may have represented an inadequate treatment response period for some patients with prescription drug claims for osteoporosis pharmacotherapy prior to secondary fractures, as greater protective effects are associated with longer-term therapy[18]. As some included osteoporosis medications are available over the counter (i.e., calcium and vitamin D), it is possible that more patients were treated with pharmacotherapy. However, higher dosages may only be available via prescription and variable insurance coverage of vitamins (e.g., Medicare Part D) could be a financial barrier for some patients. Also, although researchers can quantify rates of prescription drug claims filed within the database, it is not possible to ascertain actual medication consumption by patients. Lastly, because the PearlDiver database only provides data on a particular group of patients during a specific time period, sampling bias is present.

Similar to prior analyses[6,12,19-23], the present study highlights low rates of osteoporosis evaluation and management nationwide: <20% of patients received any treatment following the index fragility fracture, including <5% who received both DXA screening and appropriate pharmacotherapy. Underdiagnosis, secondary to fracture location or a misleading T-score, likely plays a pivotal role[4,9,16,21,24-26]. This notion is supported by the present study, which found that patients with an osteoporosis diagnosis were >11 times more likely to receive both DXA screening and pharmacotherapy after the index fracture. Ambiguity in management responsibility and protocol is also apparent. Recent surveys have revealed that orthopaedic surgeons believe that osteoporosis follow-up and management are largely the responsibility of primary care providers[27,28], and, consequently, rates of familiarity with key management strategies are variable[28,29]. This ambiguity may lead to patients never receiving any follow-up[6]. Better outcomes have been reported when surgeons take a more active role in managing patients following fragility fractures, even if only initiating the evaluation process by ordering a DXA scan[30,31]. Patient compliance with medication must also be considered. Recent studies have demonstrated variable rates of osteoporosis medication adherence[32], with multidisciplinary management and poor osteoporosis education associated with lower compliance rates[33].

A prominent strategy to address this crisis has been the widespread adoption of FLS programs, which have proved effective in improving rates of osteoporosis management and reducing rates of secondary fragility fractures in certain studies[34-38]. However, such initiatives are not universally associated with improved outcomes[39,40]. Similarly, although not limited to data from medical centers with an established FLS, this analysis found that 8.4% of included patients were diagnosed with another fragility fracture at a different anatomic site within 2 years. In America, the Own the Bone program has grown steadily since its inception in 2009 and is a reliable, centralized source for data on patients with fragility fractures[16,24,41]. By January 2020, more than 260 institutions from all 50 states were participating in Own the Bone. Given our results and those from other recent analyses[6,19,20], although Own the Bone has increased awareness of the osteoporosis treatment gap in America, its success in actually closing that gap is unclear.

At the patient level, providers must increase patients' general understanding of osteoporosis as a disease, its relationship to fragility fractures, and standard management strategies[42,43]. At the institutional and provider levels, increasing awareness of this issue, education on appropriate management strategies, and communication between different specialties is paramount. Screening patients earlier allows for earlier identification of high-risk patients, and prophylactic treatment has been shown to improve outcomes[44]. Additionally, similar to prior studies[6,45], the current study found that male patients were significantly less likely to receive any osteoporosis management following a fragility fracture. Despite lower treatment rates, male patients were still less likely to sustain a secondary fracture. Increasing intervention efforts for male patients may prove particularly effective in preventing secondary fractures in this group specifically. There is an

opportunity for surgeons to take ownership of this issue and lead the charge in improving management of these patients.

In conclusion, despite increasing awareness, high rates of underdiagnosis and undermanagement in patients with primary fragility fractures have persisted. Of the 48,668 patients with primary fragility fractures, only 25.8% had received appropriate osteoporosis screening or management in the previous 2 years. Among patients with no recent history of management, <20% had been or were subsequently diagnosed with osteoporosis , either before or after the sentinel fracture; only 18.4% received a DXA scan and/or osteoporosis pharmacotherapy during the following 2 years; and 8.4% were diagnosed with a secondary fragility fracture at a different anatomic site in that time frame.

Appendix

eA Supporting material provided by the authors is posted with the online version of this article as a data supplement at jbjs.org (http://links.lww.com/JBJSOA/A282). ■

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