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Own the Bone, a System-Based Intervention, Improves Osteoporosis Care After Fragility Fractures

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Background: The goal of this study was to evaluate the effectiveness of the American Orthopaedic Association's *Own the Bone* secondary fracture prevention program in the United States.

Methods: The objective of this quality improvement cohort study was dissemination of *Own the Bone* and implementation of secondary prevention (osteoporosis pharmacologic and bone mineral density [BMD] test recommendations). The main outcome measures were the number of sites implementing *Own the Bone* and implementation of secondary prevention, i.e., orders for BMD testing and/or pharmacologic treatment. The 177 sites participating in the program were academic and community hospitals, orthopaedic surgery groups, and a health system; data were obtained from the first 125 sites utilizing its registry, between January 1, 2010, and March 31, 2015. It included all patients, aged 50 years or older, presenting with fragility fractures (n = 23,132) who were enrolled in the *Own the Bone* web-based registry. The interventions were education, development of program elements, dissemination, implementation, and evaluation of the *Own the Bone* program at participating sites.

Results: A growing number of institutions implemented *Own the Bone* (14 sites in 2005-2006 to 177 sites in 2015). After consultation, 53% of patients had a BMD test ordered and/or pharmacologic therapy for osteoporosis.

continued

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Conclusions: The *Own the Bone* intervention has succeeded in improving the behaviors of medical professionals in the areas of osteoporosis treatment and counseling, BMD testing, initiation of pharmacotherapy, and coordination of care for patients who have experienced a fragility fracture.

The 2004 Surgeon General's report, *Bone Health and Osteoporosis*, clearly stated that the bone health status of Americans was in jeopardy, especially with the aging population¹. Each year an estimated 2 million individuals in the United States sustain an osteoporosis-related fracture at an estimated cost of at least \$19 billion to the Medicare system alone^{2,3}. In many countries, a fragility fracture, usually occurring after a fall from a standing, walking, or sitting position, seldom triggers osteoporosis treatment. In the United States, <20% of patients with a fragility fracture receive care for osteoporosis⁴. Without such treatment, patients with fractures often experience additional fractures, resulting in morbidity, disability, institutionalization, and increased mortality⁵⁻⁷.

Secondary prevention programs for osteoporosis are interventions conducted after the occurrence of disease-related complications (i.e., fractures). These interventions are highly effective, and in some organizations (e.g., managed care organizations or single-payer systems) they have had success improving osteoporosis treatment after fracture and reducing subsequent fracture rates⁸⁻¹¹. However, in nonmanaged care environments, implementation has been problematic¹². In the United States, this is likely related to a lack of alignment of financial interests in the health-care system and issues limiting interspecialty participation and care coordination. Insurance companies, instrumental in disseminating "Get with the Guidelines,"^{13,14} a secondary prevention program after cardiac hospitalizations, have been less forthcoming in their support of such a program for osteoporosis care after a fracture. Clinicians should realize that many patients who ultimately sustain a hip fracture have sustained prior fragility fractures. In 3 midwestern health-care systems, 45% of the patients who suffered 632 hip fractures reported a prior fragility fracture. Had such patients been treated for osteoporosis at the time of the initial fracture, there would have been 140 fewer hip fractures, with an estimated savings of \$3.4 million¹⁵. Thus, at a time of increasing fiscal constraint on health-care expenditures, addressing the prevention and treatment of a patient's osteoporosis after a fragility fracture, which helps to prevent future fractures, is a beneficial and highly cost-effective intervention¹⁶.

In 2005, the leadership of the American Orthopaedic Association (AOA) issued a position statement, "Leadership in Orthopaedics: Taking a Stand to *Own the Bone*," alerting the orthopaedic community to the need for improvement in the bone health of patients with fragility fractures². The *Own the Bone* pilot was conducted at 14 institutions from November 2005 to September 2006. The pilot design included recommendations for calcium and vitamin D supplementation, bone mineral density (BMD) testing, pharmacotherapy for osteoporosis, written communication with primary care physicians and patients, and lifestyle changes (e.g., exercise,

smoking cessation, and fall prevention) based on data presented in the Surgeon General's report. Over the course of the pilot project, an increase in most of the bone health recommendations was observed, leading to the creation of *Own the Bone* as a national quality improvement program in 2009^{3,17-20}. We hypothesized that *Own the Bone* would be adopted by a growing number of hospitals and clinics, with resultant improvement in BMD testing and treatment for osteoporosis. We also projected a growing awareness by the orthopaedic and medical communities of bone health issues in patients with fractures, which would improve the deficient national norms cited by the Surgeon General in 2004. Herein we present the results of the *Own the Bone* program from 2009 to 2015.

Materials and Methods

We developed a systematic approach to the design of *Own the Bone* as a quality improvement program, which resulted in a multifaceted intervention to prevent future fractures in patients with fragility fractures—all based on intervention mapping. This methodology is delineated in Figure 1²⁰.

Design

The design phase involved the development of an organizational structure and project elements:

1. Organization: creation of a steering committee and a multidisciplinary advisory board
2. Elements of project: development of
 - I. Clinical protocol: suggestions for a physician champion and a fracture liaison coordinator (nurse or other clinician) to facilitate bone health education; orders for calcium and vitamin D supplementation, BMD testing, and pharmacologic therapy; and a national web-based registry. In addition, structured case report forms for registry data collection, registry training, patient education materials for bone health maintenance consistent with evidence-based guidelines, and system-generated educational letters to patients and physicians were made available on the web site.
 - II. Program web site: Participating institutions accessed the secure web site and registry^{2,4}. Data entered into the registry included de-identified demographics, site of fracture, prior fractures, risk factors, comorbidities, prior BMD testing, follow-up visits, and testing and treatment for osteoporosis. The registry reported data periodically to each institution, thus allowing benchmarking within the institution and a comparison to national *Own the Bone* registry data.
 - III. Setting: *Own the Bone* recruited community and academic institutions (n = 177), including hospitals and orthopaedic surgery offices, between January 1, 2010, and March 31, 2015. The initial 125 sites provided data for this analysis. Patient consultation was conducted and follow-up was recommended. However, follow-up was not a mandatory part of the program.
 - IV. Patients: Men and women ≥50 years of age, with a low-trauma or fragility fracture were evaluated for inclusion. Patients with end-of-life care, severe dementia, metastatic cancer resulting in intravenous bisphosphonate therapy, or stage-5 chronic kidney disease were excluded.

Fig. 1

Systematic review process for development of the quality improvement project.

Education

1. Physician and nurse training: occurred at regional and national meetings and by webinars. Guidelines from the National Osteoporosis Foundation were used.

2. Patient education: Patients were given access to patient experience videos posted on the *Own the Bone* web site (www.ownthebone.org), online links to other osteoporosis resources, and educational material from multiple sources.

Implementation of Program

1. Collaboration with institutional Quality Improvement office

I. Clinicians were encouraged to establish a collaborative relationship with the institution's Quality Improvement Department to obtain institutional support for *Own the Bone* participation.

II. Clinicians pursued institutional approval for the program as part of a quality improvement project.

III. Quality measures: primary, recommendations for BMD testing and pharmacologic therapy; secondary, counseling on adequate calcium and vitamin D intake and lifestyle modifications.

IV. Registry data were reported to participating sites and the Steering Committee on a semiannual basis.

2. Mentoring in *Own the Bone*: Mentorship between early-adopter sites and newer sites was encouraged. Currently, site leaders and nurses contact the central AOA office with clinical inquiries, and members of the Steering Committee assist with evidence-based information.

Dissemination of Own the Bone

Dissemination occurred through peer-reviewed publications, presentations, and exhibitions at scientific meetings. Site recognition and program promotion also occurred through medical and lay journals, including *The Journal of Bone & Joint Surgery*, the *Journal of the American Academy of Orthopaedic Surgeons*, *Orthopedics Today*, and the *U.S. News & World Report* "Best Hospitals" guide. Numerous organizations have supported *Own the Bone*, including the National Osteoporosis Foundation, the Orthopaedic Trauma Association, the National Association of Orthopaedic Nurses, Physician Assistants in Orthopaedic Surgery, and the United States Bone and Joint Initiative, among others. Also, organizations such as the International Society for Clinical Densitometry, the International Geriatric Fracture Society, the

Fig. 2
Number of participating *Own the Bone* programs in the United States.

International Osteoporosis Foundation, and the Fragility Fracture Network have officially recognized *Own the Bone*.

Evaluation

Individual site evaluations were reported semiannually from registry data. De-identified aggregate data from all sites were also available, although sites were not individually identified or compared.

Comparison measures were obtained from the National Committee on Quality Assurance (NCQA). The Healthcare Effectiveness Data and Information Set (HEDIS) measure for osteoporosis recommends that women ≥ 67 years old receive a recommendation for BMD testing and/or treatment for osteoporosis within 6 months of an initial fracture. These HEDIS measures are made public, in contrast to the 2015 Centers for Medicare & Medicaid Services (CMS) Physician Quality Reporting System (PQRS) measures, which include osteoporosis management in men and women (50 to 85 years of age) with a fracture.

For this analysis, we collected case report data from the initial evaluations and benchmarking data from optional follow-up evaluations by either telephone or clinic visit, completed approximately 90 days after the fracture. Outcomes of interest included adoption by a growing number of hospitals and clinics as well as recommendations for osteoporosis therapy and/or BMD testing. The data were self-reported. One potential bias was that centers participating in *Own the Bone* needed to have Internet access.

Quality measures included the rate of compliance with current HEDIS measures for management of osteoporosis after fractures in women who used a preferred provider organization (PPO), ranging from 15% to 34%, with a 50th percentile of 19%²¹. A summary of the HEDIS measures for osteoporosis management in women who had a fracture can be found in the Appendix. This was reported by Medicare Health Maintenance Organizations (HMOs) and Medicare PPOs. Regarding osteoporosis management, PQRS measure 418 requires the reporting of women and men 50 to 85 years of age who suffered a fracture who either had a BMD test or osteoporosis therapy. The 2012 mean was 14%²², the 2013 mean was missing²³, the results in 2014 showed a mean of $40\% \pm 36\%$ ²⁴, and the results for 2015 were not

Fig. 3
Number of patients treated by *Own the Bone* programs from 2009 to 2015.

available²⁵. The considerable variability and discrepancy with managed-care data raise questions about accuracy that merit additional evaluation.

Statistical Analysis

Patient characteristics were summarized by mean and standard deviation (SD) for continuous variables and by frequency and percent for categorical variables. For each year from 2010 to 2015, the proportion of patients with treatment recommendations was tabulated for the *Own the Bone* cohort and compared with the proportion of individuals treated according to the HEDIS database utilizing 1-sample proportion tests. The proportions based on *Own the Bone* and the HEDIS database, along with a 95% confidence interval (CI), were plotted, and a p value of <0.05 indicated significance. SAS software (version 9.4; SAS Institute) was used for data analysis.

Results

Thousands of health-care providers have been informed about *Own the Bone*, resulting in the recruitment of 177 sites, representing 48 states, in the study period (Fig. 2).

Patient Characteristics

Some patients or families declined inclusion; those who declined were predominantly female (85%). A total of 23,132 patients were enrolled (Fig. 3; see Appendix). The mean age of patients (prior to *Own the Bone* becoming a clinical registry) was 67 ± 11 years. The number of women was 18,134 (78%). The ethnicities enrolled in the registry during the study period included white (n = 21,715, 94%), black (n = 770, 3%), Latino (n = 238, 1%), and Asian (n = 170, 0.7%). The number of patients treated in *Own the Bone* programs from 2009 to 2015 is depicted in Figure 3. Of these patients, 32% (n = 4,485) with a hip fracture had sustained a preceding fracture after reaching the age of 50 years. In 10% of cases, the hip fracture constituted the second hip fracture. Use of medications associated with bone loss, such as glucocorticoids, cancer therapy medications, and anticonvulsants, was noted in 5% of patients.

Fig. 4

Treatment rates for osteoporosis after a fragility fracture; *Own the Bone* and HEDIS rates from 2010 to 2015 are shown. *P < 0.05. **P < 0.001.

PPO = preferred provider organization, and HMO = health maintenance organization.

Outcomes

Dissemination of this program was successful; 177 institutions encompassing 48 states had implemented the *Own the Bone* program by March 2015, and the data for this analysis were obtained from the first 125 sites. The rate of BMD testing and/or osteoporosis pharmacotherapy after consultation was 53%, quite favorable when compared with the 90th percentile of similar measures in HMOs or PPOs in the United States per HEDIS data. At all time points, this rate of BMD testing and/or pharmacologic therapy in *Own the Bone* programs was higher than the 90th percentile of HEDIS measures from 2012 to 2015 ($p = 0.0001$) (Fig. 4). Educational and consultation letters were provided to 85% of patients and 84.3% of primary care physicians.

Discussion

The *Own the Bone* intervention program has succeeded in improving the behaviors of participating orthopaedic surgeons, medical specialists, and allied health personnel in the areas of counseling, coordination of care, BMD testing, and initiation of pharmacotherapy for patients who have experienced a fragility fracture. It is important to consider that HEDIS measures extend to 6 months after the fracture; thus, our rate of BMD testing and/or treatment may be higher than the measured 53% by 6 months. We have demonstrated that *Own the Bone* and its web-based registry, with its decision support tools, has provided a means to improve on the gap in medical care for osteoporosis following a fracture. Our results clearly demonstrate that the performance of *Own the Bone* participating clinicians regarding treatment for osteoporosis far exceeds that achieved in the United States with conventional care, whether with an HMO or PPO.

Own the Bone is the first system-based intervention that has demonstrated improved effectiveness nationally in addressing the bone health of patients with fragility fractures in a traditional non-managed-care medical system. In an attempt to transition to a so-called value-based reimbursement system, in 2010, CMS developed the PQRS with 4 measures for osteoporosis evaluation and treatment. Two of the current PQRS measures, numbers 24 and 418, apply to postfracture care and are covered through the *Own the Bone* program: communication with the physician or other clinician managing ongoing care postfracture for men and women 50 to 85 years old, and osteoporosis management in women between the ages of 50 and 85 years who have had a fracture. Reporting on some of the many PQRS measures is now mandatory, with penalties imposed on physician reimbursement for those who fail to comply with the designated quality measures. Substantial pressure is being placed on health-care delivery systems in the United States to improve patient care and outcomes while lowering costs in an environment of diminishing resources, and *Own the Bone* is one option for attaining that goal.

Clinicians must consider the social implications of fracture prevention because fracture-related deformity, disability, premature death, and institutionalization of elderly individuals can be prevented. Thus, in addition to reducing health-care costs, preventing fracture-related disability will improve quality of life for older adults and serve to maintain patients' physical independence and dignity with aging. Data from the measures

promulgated in the *Own the Bone* program support the idea that treatment for osteoporosis and secondary-fracture prevention are cost-effective objectives since it has been shown that treatment of osteoporosis after a fragility fracture will result in a reduction of future fractures and their associated risk of patient morbidity and mortality, consequently reducing health-care expenditures^{15,26}. Furthermore, current evidence suggests that bisphosphonate therapy reduces the risk of mortality not only in patients with hip fractures, but also in patients with osteoporosis who have not yet sustained a fracture. Therefore, we envision that the financial, cost-saving incentives recognized by insurance companies (and CMS), which contributed to the rapid program dissemination of the cardiac *Get with the Guidelines* program, could benefit greatly from the additional expansion of *Own the Bone*.

For sites that consider joining *Own the Bone*, there are multiple favorable elements. Training of site leaders and supporting professionals allows familiarization with program elements and processes. Education is an ongoing process, and recent-adopter sites are able to acquire a working knowledge of program elements. Regional seminars bring together regional leaders, allowing late-adopter site leaders the opportunity to network with leaders of early-adopter programs. The availability of a structured protocol allows sites to implement this program with a high level of fidelity; that is, implementation occurs in a similar fashion across different institutions. During the program implementation, there is ongoing support available by the AOA staff. Having collected frequently asked questions by numerous institutions, the staff is willing to provide answers when the need arises, as are members of the Steering Committee. Complex administrative or clinical questions are addressed by the corresponding Steering Committee member. In addition, stemming from the above-mentioned networking, site leaders can develop mentoring relationships with leaders of early-adopter programs. *Own the Bone's* "Bone Health Bulletin" keeps members updated in terms of bone-health topics. For the future, we would envision greater support from the insurance industry as occurred with the *Get with the Guidelines* program for cardiac care.

Some limitations of the *Own the Bone* intervention program must be acknowledged. The number of patients entered in the system is highly dependent on each program's coordinator or clinical nurse leader, thus adding to selection bias. Identifying participants with asymptomatic vertebral fractures is particularly challenging; therefore, the absence of a dedicated clinical nurse leader in this process makes both enrollment and follow-up more difficult. Second, the study does not address long-term adherence by postfracture patients to the primary care physician's recommendations. Although long-term follow-up is an option for *Own the Bone* participants, additional long-term follow-up programs would most likely improve such adherence. The HEDIS measure focuses on women ≥ 67 years of age and may not be completely comparable with our findings. The PQRS results for BMD testing and/or osteoporosis treatment after a fracture (14% for 2012, not reported in 2013 or 2015, and $40\% \pm 36\%$ for 2014) demonstrate considerable variability that merits

additional evaluation. Natural language processing could identify asymptomatic vertebral fractures from radiographic reports, although this is a new technology that is not yet widely disseminated in the United States. Adverse events such as osteonecrosis of the jaw or atypical femoral fractures, although rare, may have discouraged clinicians from continuing osteoporosis therapy for their patients. The risk per 100,000 person-years is 26 for osteonecrosis of the jaw, and it is 16 with 5 years of therapy and 113 with 10 years of therapy, respectively, for atypical femoral fractures²⁷. The risk of atypical femoral fractures at 10 years is considerably lower than the risk of being hit by a vehicle and requiring emergency care²⁷.

In conclusion, the success of *Own the Bone*, a quality-improvement program focusing on secondary fracture prevention and increased attention to appropriate osteoporosis process measures for patients with fragility fractures, demonstrates that collaboration between orthopaedic surgeons, medical specialists, and primary care physicians can improve the well-documented treatment gap in bone health care for patients with fragility fractures. The program's web-based registry and decision support tools encourage easy implementation of its multiple measures by community hospitals, academic institutions, and outpatient centers. Notably, our study resulted in marked improvement in BMD testing and/or osteoporosis therapy to 53% of patients postfracture. Therefore, *Own the Bone* is now well-positioned to be a national model for noteworthy quality improvement in the American health-care system regarding postfracture osteoporosis care in older adults. Its implementation serves to improve the quality of life for this subset of our aging population, while also decreasing national health-care costs.

Appendix

eA Tables showing the HEDIS measures for osteoporosis management in women who had a fracture and *Own the Bone* patient characteristics are available with the online version of the article at jbjs.org. ■

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