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The Bone Health Team: A Team-Based Approach to Improving Osteoporosis Care for Primary Care Patients

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Abstract

Background: Significant improvements in secondary prevention of osteoporotic fractures have been noted with fracture liaison services. However, similar models for the primary prevention of such fractures have not been reported. **Objective:** To determine the impact of a Bone Health Team (BHT) on osteoporosis screening and treatment rates in U.S. veterans in primary care practices. **Design:** Historical cohort study of a primary care–based intervention of a BHT from February 2013 to February 2015. **Setting:** Community-based outpatient clinics of the Salt Lake City Veterans Affairs Health Care System. **Participants:** Men aged 70 years and older and women aged 65 years and older. **Intervention:** Enrollment in the BHT. **Measurements:** Rates of dual energy x-ray absorptiometry (DXA) completion, chart diagnosis of osteoporosis or osteopenia, completion of vitamin D measurement, and initiation of fracture reducing medication. **Results:** Our cohort consisted of 7644 individuals, 975 of whom were exposed to the BHT and 6669 of whom were not. Comparison of patients exposed to the BHT versus non-exposed subjects demonstrated a substantial increase in all outcome measures studied. Hazard ratios (HRs) from multivariable cox proportional hazard models were: measurement of vitamin D, HR = 1.619 ($P < .001$); chart diagnosis of osteopenia, HR = 37.00 ($P < .001$); chart diagnosis of osteoporosis, HR = 16.38 ($P < .001$); osteoporosis medication, HR = 17.03 ($P < .001$); and completion of DXA, HR = 139.9 ($P < .001$). **Conclusions and Relevance:** The implementation of a dedicated BHT produced significantly increased rates of intermediate osteoporosis outcome measures in US veterans in primary care practices. Additional research describing medication adherence rates and cost-effectiveness is forthcoming.

Keywords

osteoporosis, bisphosphonate, Bone Health Team, collaborative care, screening

Introduction

Affecting an estimated 53.6 million Americans aged 50 years and older, osteoporosis and osteopenia are common disorders responsible for an estimated 2 million fractures annually.[1] Significant improvements in the secondary prevention of osteoporotic fractures have been noted with the widespread use of fracture liaison services (FLS).[2,3] Other efforts to address secondary prevention have reported limited success.[4-8] With a projected 3 million fractures and an associated $25.3 billion in health care costs annually by 2025,[9] improved primary prevention is critical. Bone mineral density (BMD) screening and early intervention are obvious targets for improving prevention of first fracture. Despite this critical need, few models for the primary prevention of fragility fractures have been described,[10,11] and no team-based primary interventions reported.

Published reports continue to document low osteoporosis screening and treatment rates.[12,13] A systematic review of 51 articles found that less than a third of at-risk women

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received BMD testing.[15] Another study based on Medicare claims during 2002 to 2008 found that less than half of all elderly women had ever had a BMD test.[16] Among males, only about 7% of men received a diagnosis for osteoporosis following a fragility fracture, and even fewer received a BMD scan or received treatment within 1 year.[13-15,17,18] To date, no studies have examined reasons for low screening and treatment in the specific context of male osteoporosis, although data in women suggests that there is considerable uncertainty on the parts of clinicians about how to use BMD test results,[19,20] unfamiliarity with osteoporosis treatment guidelines,[21] and ambiguity about whose role it is to prescribe preventive therapies.[22]

To address this important issue, we partnered with primary care providers (PCPs) within the Salt Lake City Veterans Affairs Health Care System (SLCVAHCS) to develop a Bone Health Team (BHT) consisting of an endocrinologist, a pharmacist, and a nurse practitioner dedicated to the screening and management of patients at risk for osteoporotic fractures. The BHT manages the screening, diagnosis, treatment, and ongoing monitoring of osteoporosis, on behalf of PCPs, through a collaborative care agreement, using virtual and telephone clinics.

Methods

Patient Enrollment and Care Coordination

The Veterans Affairs Salt Lake City Health Care System Bone Health Team was established in January 2013 and includes an endocrinologist, a clinical pharmacist, and a nurse practitioner. A collaborative care agreement was established with the Chief of Community-Based Outpatient Clinics and allows for the BHT to enroll patients from any of the 7 community-based outpatient clinics (CBOCs).

Lists of patients treated by PCPs constitute "PCP panels." We generated PCP panels using data available from the Veterans Affairs corporate data warehouse. The BHT evaluated the PCP panels and identified patients with osteoporosis risk factors. The most common risk factor used by the BHT to justify bone density screening was patient age. The BHT offered screening to men aged 70 years and older and women aged 65 years and older. Younger patients (aged 50 years and older) with risk factors were eligible for enrollment in the BHT; however, in order to create a cohort that is readily comparable to non-BHT patients, this analysis describes only the patients that were enrolled based on age.

The BHT reviewed the entire PCP panel for an individual provider before proceeding to the next provider. So far, the BHT has completed screening the patient panels of 5 providers from one CBOC and has partially completed the screening of a sixth provider from a second CBOC.

Patients were contacted via telephone or letter, and all patient care activities were conducted using virtual and telephone clinics. The BHT managed the patient's entire osteoporosis care including screening, diagnosis, medication and nonmedication interventions, and ongoing follow-up. When providing patient care, BHT included the PCP as a cosigner to progress notes, thereby keeping the PCP informed and involved.

Bone Health Team Interventions

Screening: The BHT screened patients bone density using dual energy x-ray absorptiometry (DXA). Patients with osteopenia (*T*-score between −1 and −2.5) or osteoporosis (*T*-score −2.5 or worse) were evaluated for underlying causes. The BHT ordered serum chemistry; serum parathyroid hormone if any history of stage 3 or worse chronic kidney disease, or if a history of calcium or parathyroid hormone abnormalities; 25-hydroxy-vitamin D levels; and testosterone levels if not previously evaluated and patient had other symptoms consistent with possible hypogonadism. If abnormalities were identified during this evaluation, the corresponding potential underlying conditions were evaluated further.

In broad terms, the BHT generally used a bone active drug (oral or intravenous bisphosphonate, subcutaneous denosumab, or subcutaneous teriparatide) to treat patients. The rationale that the BHT used to help determine treatment threshold were: generally treat patients with osteoporosis; generally treat if fracture risk of 3% or more at the hip, or 20% or more major osteoporotic fracture risk based on FRAX risk assessment with BMD for patients with osteopenia,[14] include guidance from American College of Rheumatology clinical practice guidelines for patients on chronic glucocorticoids,[15] and include guidance from endocrine society clinical practice guidelines for men with hypogonadism and men receiving androgen deprivation therapy.[16]

In addition to pharmacotherapy, the BHT evaluated dietary and supplemental intake of calcium and vitamin D, as well as fall history, fall risk, and weightbearing activity history. The BHT discussed pertinent social history, including alcohol and tobacco use. Based on patient risk factors, BHT made appropriate recommendations, including supplementation of calcium and/or vitamin D if currently insufficient, referrals to physical therapy for core muscle strengthening and balance, referral to occupational therapy for a home safety evaluation, referral to smoking cessation, and encouraging weightbearing activities.

Study Design and Patients

This historical cohort analysis of the BHT described the outcomes of the SLC VA BHT for patients in the CBOCs of the SLCVAHCS from February 1, 2012 through February 1, 2015. Men aged 70 years and older and women aged 65 years and older were included in our cohort. Patients who were not assigned to VA SLC CBOC PCP panel, did not

have a PCP appointment in the preindex period, or who died during the preindex period, were excluded from the study. Covariates (summarized in Table 1) were defined in the 1-year preindex period of February 1, 2012 to February 1, 2013 (the year prior to the implementation of the BHT). This analysis was reviewed by the institutional review board of the SLCVAMC and determined to be a quality-of-care analysis and exempt from human subjects review.

Exposures and Outcomes

The primary exposure was enrollment in the BHT, as evidenced by a chart note titled endocrinology bone health e-consult. The outcomes in our analysis were (*a*) completion of DXA scan, (*b*) completion of a 25-hydroxy-vitamin D measurement, (*c*) chart diagnosis of osteopenia, (*d*) chart diagnosis of osteoporosis, and (*e*) initiation of a fracture reducing medication. DXA, vitamin D measurement, and fracture reducing medication outcomes reflect actual events during the observation period. Chart diagnosis of osteopenia and osteoporosis are chart diagnoses that may reflect new or prior observations.

Analysis

To measure the impact of BHT exposure on our outcomes, we constructed time-dependent, multivariable Cox proportional hazard models. In these models, patients were followed from the index date, February 1, 2013, until an event, or were censored on February 1, 2015. The BHT intervention began on February 1, 2013. All patients were unexposed and contributed person-time to the unexposed group unless and until they were exposed to BHT intervention, after which time they contributed person-time to the exposed group. The models adjusted for confounding on: age; sex; comorbidities, including alcohol abuse, smoking, diabetes mellitus, prior adulthood fracture, hyperparathyroidism, renal disease, and vitamin D deficiency; drug exposures, including anticonvulsants, aromatase inhibitors, androgen deprivation therapy, and testosterone; site of CBOC; and PCP discipline, including physician, physician assistant, or nurse practitioner. A separate regression model was constructed for each outcome.

Results

Our cohort consisted of 7644 individuals, 975 of whom were exposed to the BHT and 6669 of whom were not. Descriptive statistics for these individuals are presented in Table 1.

Unadjusted rates of each outcome are summarized in Table 2. BHT participants had substantially higher rates of each outcome. This observation was most evident in the DXA and osteopenia outcomes with rate ratios of 76.72 (95% CI = 69.70-84.44) and 26.70 (95% CI = 23.22-30.71), respectively.

To control for confounding we used Cox proportional hazard regressions. The hazard ratios (HRs) from univariate and multivariable Cox proportional hazards regressions are presented in Table 3. Exposure to the BHT was associated with an increased likelihood of having each outcome when controlling for numerous known clinical risk factors for fracture. The effect sizes ranged from HR 1.619 (95% CI = 1.448-1.810) in the case of the vitamin D lab outcome to HR 139.9 (95% CI = 112.4-174.2) for completion of bone density screening (DXA).

Discussion

In this historical cohort study involving patients meeting age-based criteria for osteoporosis screening, we demonstrated that a dedicated team significantly improved rates of osteoporosis screening, diagnosis, and treatment. To our knowledge, no similar team based model for primary evaluation of osteoporosis has been described.

Our table of baseline characteristics showed that BHT patients were younger, more likely to live in rural areas, and more likely to have a physician as their PCP. BHT providers repeatedly followed up with patients, and coordinated bone density testing in conjunction with other appointments, which may have contributed to the BHT being more successful at addressing the travel needs of rural patients for completing DXA.

BHT offered universal bone density screening for men as young as 70 years and women as young as 65 years, as advocated by the National Osteoporosis Foundation.[23] Without a concerted effort to perform evidenced-based population level screening, patient demand is the typical impetus for accessing health care services. Until first fragility fracture, osteoporosis is a silent disease. Frailty, falls, independence, and previous fragility fracture, which increase patient demand for bone density screening, are more prevalent concerns for older patients. This lack of urgency for primary prevention likely contributes to the age disparity between BHT and non-BHT patients as well as the low rates of osteoporosis screening in standard care.

Our analysis has the strengths of being conducted in a comprehensive health care system with an integrated electronic medical record that allowed us to follow our patients longitudinally. Limitations of our study include that it is primarily conducted among elderly men, which may limit generalizability to women, although we reasonably theorize that a BHT could also benefit health systems with a higher proportion of females. Another limitation is that our analysis did not have the ability to compare fracture rates between BHT and standard primary care because of the long follow-up period and large sample size needed to identify these rare events.

Consideration should be given to future studies exploring access to DXA for rural patients; gaps in the understanding of importance of osteoporosis screening among

Table 1. Patient Demographics for Patients Enrolled in the Bone Health Team (BHT) Versus Nonenrolled Patients (No BHT).

	BHT, N = 975		No BHT, N = 6669		
	n	%	n	%	*P*
Demographics					
Age (years)					
65-74	294	30.2	1590	23.8	.000
75-80	223	22.9	1716	25.7	
80-85	243	24.9	1740	26.1	
85+	215	22.1	1623	24.3	
Male	953	97.7	6534	98.0	.633
Rural zip code	827	84.8	4053	60.8	<.0001
Married	260	26.7	1842	27.6	.533
White	672	68.9	4185	62.8	.000
Non-VA insurance	958	98.3	6421	96.3	.002
Primary care provider type					
Physician	413	42.4	2099	31.5	<.0001
Physician's assistant	25	2.6	862	12.9	
Nurse practitioner	537	55.1	3708	55.6	
Weight (lbs)					
<150	78	8.0	435	6.5	.186
150-200	293	30.1	2180	32.7	
200-250	193	19.8	1242	18.6	
250+	53	5.4	316	4.7	
Not documented	358	36.7	2496	37.4	
Community-based outpatient clinic					
1	150	15.4	1841	27.6	<.0001
2	3	0.3	1191	17.9	
3	821	84.2	286	4.3	
4	0	0.0	1754	26.3	
5	0	0.0	111	1.7	
6	0	0.0	1099	16.5	
7	1	0.1	310	4.6	
8	0	0.0	77	1.2	
Medication use					
Testosterone	27	2.8	158	2.4	.448
Estrogen	0	0.0	5	0.1	.392
Corticosteroids	16	1.6	223	3.3	.004
Hormone deprivation therapy	11	1.1	45	0.7	.121
Phenytoin	2	0.2	31	0.5	.248
Comorbidities					
Alcoholism	0	0.0	9	0.1	.251
Smoking	60	6.2	489	7.3	.183
Rheumatoid arthritis	6	0.6	79	1.2	.113
Diabetes	43	4.4	167	2.5	.001
Renal disease	62	6.4	562	8.4	.028
Stroke	46	4.7	214	3.2	.015
Fall risk	20	2.1	137	2.1	.995
Vitamin D deficiency	52	5.3	671	10.1	<.0001
Hyperthyroidism	8	0.8	52	0.8	.893
Prior fracture	2	0.2	36	0.5	.165
Prior outcomes					
Dual-energy x-ray absorptiometry	5	0.5	59	0.9	.234
Osteopenia diagnosis	23	2.4	77	1.2	.002
Osteoporosis diagnosis	33	3.4	196	2.9	.446
Vitamin D lab	215	22.1	2671	40.1	<.0001
Osteoporosis medication	39	4.0	149	2.2	.001

Table 2. Surrogate Outcomes (Crude Rates) of Intermediate Outcome Measures of Primary Evaluation of Osteoporosis for Patients Enrolled in the Bone Health Team (BHT) Versus Patients Not Enrolled in the Bone Health Team (Non-BHT).

	BHT Patients, N = 975					Non-BHT patients, N = 6669					Rate Ratio		
	No. With Event	Person-Time (Days)	Rate (per 10000 Patient-Days)	95% CI, LL	95% CI,UL	No. with Event	Person-Time (Days)	Rate (per 10000 Patient-Days)	95% CI, LL	95% CI, UL	Rate Ratio	95% CI, LL	95% CI, UL
DXA	504	249,465	20.20	18.48	22.00	133	5,050,393	0.26	0.22	0.31	76.71	69.70	84.44
Osteopenia[a]	256	374,741	6.83	6.02	7.69	129	5,042,289	0.26	0.21	0.30	26.70	23.22	30.71
Osteoporosis[b]	147	410,552	3.58	3.03	4.18	239	4,989,201	0.48	0.42	0.54	7.47	6.28	8.90
Medication[c]	129	430,588	3.00	2.50	3.53	168	5,012,441	0.34	0.29	0.39	8.94	7.40	10.80
25(OH)D [d]	369	252,865	14.59	13.14	16.12	3,883	3,370,423	11.52	11.16	11.89	1.27	1.14	1.41

Abbreviations: DXA, dual-energy x-ray absorptiometry; CI, confidence interval; LL, lower limit; UL, upper limit; 25(OH)D, 25-hydroxy-vitamin D.
[a]Osteopenia—chart diagnosis of osteopenia.
[b]Osteoporosis—chart diagnosis of osteoporosis.
[c]Medication—medication order for bisphosphonate, denosumab, or teriparitide.
[d]Vitamin D—serum 25-hydroxy-vitamin D lab completion.

Table 3. Results From Univariate and Multivariate Cox Proportional Hazards Regression of Intermediate Outcome Measures of Primary Evaluation of Osteoporosis for Patients Enrolled in the Bone Health Team Versus Patients Not Enrolled in the Bone Health Team.

	Univariate Results				Multivariable Results			
		95% Confidence Interval				95% Confidence Interval		
Outcome	HR	Lower	Upper	*P*	HR	Lower	Upper	*P*
DXA	111.4	90.9	136.4	<.0001	139.9	112.4	174.2	<.0001
Vitamin D[a]	1.403	1.258	1.564	<.0001	1.619	1.448	1.810	<.0001
Medication[b]	13.78	10.76	17.64	<.0001	17.03	12.78	22.70	<.0001
Osteopenia[c]	36.34	29.01	45.52	<.0001	37.00	29.00	47.21	<.0001
Osteoporosis[d]	11.22	9.01	13.98	<.0001	16.38	12.77	21.01	<.0001

Abbreviations: DXA, dual-energy x-ray absorptiometry; HR, hazard ratio.
[a]Vitamin D—serum 25-hydroxy-vitamin D lab completion.
[b]Medication—medication order for bisphosphonate, denosumab, or teriparitide.
[c]Osteopenia—chart diagnosis of osteopenia.
[d]Osteoporosis—chart diagnosis of osteoporosis.

patients, particularly men; fracture risk reduction; and the economic viability of the BHT model.

Conclusions

Data from our historical cohort of primary care patients enrolled in the BHT showed significantly higher rates of osteoporosis screening with DXA and therapeutic intervention than current standard primary care practice, suggesting this phone-based, dedicated approach to osteoporosis screening and management may offer a viable method for the primary prevention of osteoporotic fractures.

Declaration of Conflicting Interests

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