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ORIGINAL ARTICLE

Factors related to the use of bone densitometry: survey responses of 494 primary care physicians in New England

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Abstract Large population-based surveys have shown that approximately 30% of people over age 65 years have osteoporosis and that 17% of the population over 65 years will sustain a fracture during their lifetime. Many people with osteoporosis are never being evaluated even though effective treatments are available. We examined why primary care physicians order few bone mineral density scans. We conducted a cross-sectional survey of primary care physicians practicing in any of the six New England states. Target physician specialties included internal medicine, general practitioners/family physicians, and obstetrician-gynecologists who had a facsimile number listed with the American Medical Association. Demographics, practice characteristics, use of bone densitometry, and attitudes regarding osteoporosis, bone densitometry and health maintenance were assessed by questionnaire. Twelve percent ($n = 494$) of the physicians responded to the questionnaire. Respondents were similar to non-respondents with respect to years of practice, training and geographical state, though they were more likely to be female ($p \leq 0.05$). Respondents had a mean age of 51 years, and 51% were trained in internal medicine, 25% in general practice/family practice and 24% in obstetrics-gynecology. The mean number of self-reported bone densitometry referrals per month was 10 ± 11, and 25% of respondents reported that they referred fewer than 4 patients per month. In adjusted logistic models, factors significantly associated with referring fewer than 4 patients per month were: training in internal medicine (odds ratio (OR) 2.0, 95% confidence interval (CI) 1.0–3.9) or general practice/family practice (OR 2.6, 95% CI 1.3–5.2) versus obstetrics-gynecology; practicing in an urban setting (OR 2.5, 95% CI 1.3–4.9) or rural/small town setting (OR 2.2, 95% CI 1.2–4.1) versus a suburban setting; spending less than 50% of professional time in patient care (OR 4.0, 95% CI 1.7–9.5); seeing the lowest proportion of postmenopausal women (OR 2.5, 95% CI 1.2–5.3); the belief that calcium and vitamin D are adequate to treat osteoporosis (OR 2.1, 95% CI 1.0–4.5); and the belief that osteoporosis treatment should not be based on bone density results (OR 3.2, 95% CI 1.7–6.1). Potentially modifiable physician beliefs and a number of practice characteristics are associated with low referral rates for bone densitometry. Educational strategies aimed at improving the use of bone density testing should consider these factors.

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Introduction

Several prospective studies have reported that bone mineral density (BMD) is a major predictor of fracture risk in postmenopausal women [1]. In general, for every standard deviation that BMD is reduced, the risk of fragility fractures increases by 50–100% [2]. Randomized controlled trials have demonstrated that calcium and vitamin D, alendronate, risedronate, raloxifene, parathyroid hormone, and possibly calcitonin therapy, reduce the risk of fracture in people with osteoporosis, but not necessarily those with normal BMD [3, 4, 5, 6, 7, 8]. Moreover, measuring BMD increases the likelihood that women will start medication for osteoporosis and also improves compliance with osteoporosis therapies [9, 10, 11, 12]. Thus, BMD is an important tool in the diagnosis and management of patients with postmenopausal osteoporosis.

Surveys of clinical practice have found low utilization rates of bone densitometry and antiresorptive therapies. In one managed care organization serving the metropolitan Boston region, the median number of BMD tests ordered over 1 year by primary care doctors was 6 [13]. Several studies have shown low rates of both BMD testing and initiation of treatment of osteoporosis even after hip fractures [14, 15, 16], a finding that is particularly disturbing because these patients have a significantly increased risk of repeat fracture [17, 18]. Even though it is clear that BMD testing is often underutilized, the factors associated with use of BMD testing have not been determined. Thus, we designed a survey to assess what factors are associated with low utilization of BMD testing by primary care physicians.

Materials and methods

Physician sample

Primary care physicians from New England (Connecticut, Rhode Island, Massachusetts, New Hampshire, Vermont, Maine) with training in either internal medicine, family practice, general practice or obstetrics-gynecology were identified in the American Medical Association (AMA) Master File [19]. The AMA Master File contains the names of all doctors, not just AMA members. We sent a cover letter and questionnaire during the fall of 1999 to all doctors in these groups who had a facsimile number listed in the AMA Master File ($n=4{,}073$). The invitation letter came from a group of osteoporosis experts practicing at major academic institutions in New England. Only one attempt was made to contact doctors. Respondents who completed the questionnaire ($n=494$) were offered an honorarium of US$5 or a copy of the National Osteoporosis Foundation Guidelines for Management of Osteoporosis.

Data collection

The AMA Master File was used to determine physician characteristics and a 47-item questionnaire assessed respondents' attitudes and BMD testing patterns. The questionnaire was developed by a group of 20 practicing osteoporosis experts. Ten items of the questionnaire pertained to the doctor's practice, three items to their screening practices at annual examinations, five items asked for estimates of the monthly number of patients seen and screened with bone densitometry, and the remaining items asked respondents to rate their level of agreement with statements about osteoporosis and bone densitometry (questionnaire available upon request).

Outcomes

Because the goal of the study was to examine factors associated with low utilization of BMD testing, we asked physicians to estimate the number of scans they ordered each month. Responses ranged from 0 to 65, and doctors in the lowest quartile were considered low users of bone densitometry. We also defined a secondary endpoint that divided the self-reported monthly number of BMD scans by the self-reported volume of postmenopausal women seen each month. The bottom quartile of the adjusted rate of BMD use was similarly defined as the low users of bone densitometry.

Predictors

We assessed several types of potential predictor variables, including physician characteristics, practice features, and doctors' attitudes toward osteoporosis and bone densitometry. The number of years since graduation, gender, geographic state of the practice and type of training were all based on information from the AMA Master File. Years since medical school graduation was considered a continuous variable. Physicians' clinical practice features came from the physician survey. These included location (urban, suburban or small town/rural), organization (solo, group or hospital/managed care staff), hospital affiliation (teaching, community or none) and the physicians' estimates of the socioeconomic status of their patients, the predominant insurance coverage of their patients, the percent of time they spend in practice and the proportion of their patients who are postmenopausal women.

To assess physicians' attitudes toward osteoporosis and bone densitometry respondents were asked to rate their level of agreement with a series of statements. A 7-point Likert scale was used for all questions, with 1 defined as "very strongly disagree" and 7 as "very strongly agree."

Analysis

We compared the characteristics of physicians who responded to the questionnaire with those who did not using a chi-square test and Student's *t*-test. The attitudes of respondents were assessed by calculating the mean and standard deviation from the 7-point Likert scale. Then we examined the proportion of physicians who "agreed" (rated a 6 or 7 on the scale), "disagreed" (rated a 1 or 2 on the scale) or were "unsure" (rated a 3, 4 or 5 on the scale) for each statement on the questionnaire. The relationships between the primary endpoint (low use of bone densitometry, uncorrected for the number of postmenopausal women seen in a month) and potential predictors were analyzed using crude logistic equations. The results for the secondary endpoint were qualitatively identical to those of the primary endpoint and are not displayed. To ease the interpretation of our results, the doctors who were high users of bone densitometry were always selected as the reference group. All variables with odds ratios (ORs) ≥ 1.5 and p values < 0.2 were placed into the multivariable models. Years since medical school graduation and the proportion of women in the practice who were postmenopausal were also placed into the models. The area under the receiver operating characteristic curve, "C statistic", for each model was examined as a means of determining the predictive power of the adjusted analyses. The C statistic varies from 0.5 to 1.0, where a value of 0.5 suggests that the model is no better than a "coin-toss" and 1.0 is perfect ability to predict which doctors are

high users of bone densitometry. C statistics between 0.70 and 0.79 are considered adequate [20]. All statistical analyses were carried out in SAS Statistical Software [21]. A p value ≤ 0.05 was considered statistically significant.

Results

Respondents and non-respondents were similar in most respects (Table 1), including the number of years since graduation, type of medical training and the geographic state of practice. The only important difference between respondents and non-respondents was that respondents were more likely to be female (31% vs 23%; $p \leq 0.05$).

Most respondents were in a group practice rather than a solo or staff practice (Table 1). There was a near-equal distribution of physicians reporting that their practice was in an urban, suburban or rural/small town setting. The vast majority of the physicians (98%) were affiliated to a hospital: 55% with a community-based hospital and 43% with a teaching hospital. Most doctors responding to the questionnaire (74%) reported that they cared for patients for over 75% of the their time. The mean ($\pm$ SD) number of patients seen per month was 322 ± 179.

The distribution of self-reported use of bone density tests is displayed in Fig. 1. The number of bone density tests ordered each month ranged from 0 to 65 with a mean of 10 ± 11 and a median of 7. The top quartile of responses was greater than 15 tests per month, and the bottom quartile was fewer than 4. The percent of postmenopausal women receiving bone density tests was $17\% \pm 28\%$, with the top quartile of physicians ordering bone density tests on more than 20% and the bottom quartile on fewer than 4%.

The physicians' attitudes toward osteoporosis and bone densitometry are shown in Table 2. About one-third of the respondents were unsure or disagreed with the statements that bone densitometry is useful for predicting fractures and for monitoring osteoporosis treatment. Nearly half the respondents were unsure about or disagreed with the statement that bone densitometry is easy to understand, and 34% agreed that treatment recommendations on bone densitometry reports are useful. Over half the respondents were unsure about or disagreed with basing treatment decisions on the results of bone densitometry, and a similar proportion were confused about the best anatomic sites for measuring bone densitometry. Almost one-quarter of doctors agreed that insurance is a barrier to bone densitometry. Fifty-nine percent of respondents were unsure about or disagreed with the statement that osteoporosis can be prevented and 22% were unsure about or disagreed with the statement that treatment of severe osteoporosis is helpful.

We next examined the relationship between physicians' characteristics and attitudes and their use of bone densitometry. In a model adjusted for all significant variables (Table 3), physician factors that were significantly associated with ordering fewer bone density tests included: training in internal medicine or general practice/family practice versus obstetrics-gynecology;

Table 1 Characteristics of primary care physicians (Values represent column percentages unless otherwise noted. (–), information not available; *HMO*, health maintenance organization)

	Respondents ($n = 494$) %	Non-respondents ($n = 3{,}579$) %
Years since medical school graduation, mean $\pm$ SD	21	22
Gender, female	31	23*
Training:		
Internist	51	54
Obstetrics-gynecology	24	21
Family practitioner/general practitioner	25	25
State where practice located:		
Connecticut	27	29
Maine	14	8
Massachusetts	42	45
New HampshireNH	9	8
Rhode Island	4	7
Vermont	4	3
Practice type:		
Solo	25	–
Group	61	–
Staff of HMO or hospital	13	–
Practice location:		
Urban	26	–
Suburban	33	–
Rural or small town	41	–
Hospital affiliation:		
Teaching hospital	43	–
Community hospital	55	–
None	2	–
Patient care at least 75% of the time	74	–
Patients per month, mean $\pm$ SD	322 ± 179	–
Postmenopausal women as percentage of total, mean $\pm$ SD	28 ± 16	–

*$p < 0.05$

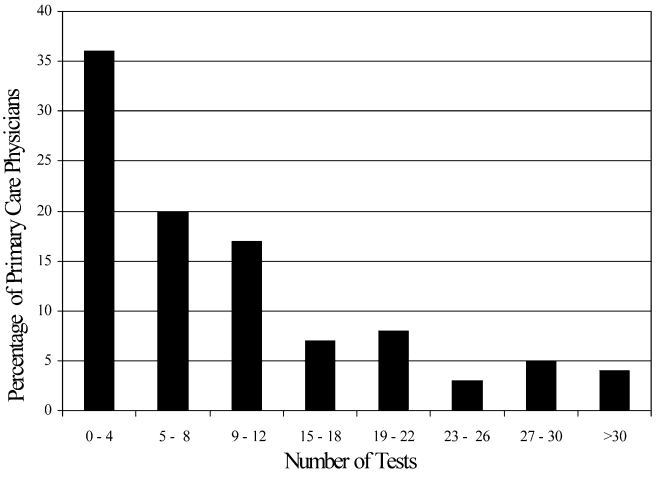

Fig. 1 Number of bone density tests ordered per month. The *horizontal axis* represents the number of tests reported per month and the *vertical axis* represents the percentage of primary care physicians reporting that volume. The percentages do not sum to 100% due to rounding. The mean number of bone density tests reported each month was 10, and the lowest quartile is <4 tests per month

practice in an urban or rural/small town location versus a suburban setting; spending less than 50% of professional time in patient care; and being in the lowest quartile for number of postmenopausal women seen per month. Several beliefs held by primary care doctors were related to low use of bone densitometry in adjusted models. These included the belief that calcium and vitamin D supplements are adequate treatment for most patients with osteoporosis and the belief that treatment decisions should not be based on results of bone densitometry. The fully adjusted model had a relatively strong ability to predict which doctors would be in the group reporting low monthly use of bone densitometry (model C statistic = 0.78).

Neither a physician's gender (crude OR = 1.4, 95% CI 0.8–1.4; $p = 0.1$) or years since medical school graduation (crude OR = 1.0, 95% CI 1.0–1.1; $p = 0.3$) were significantly associated with the use of bone densitometry.

Discussion

In this study, we identified several factors that were strong predictors of primary care physicians who were more likely to report low utilization rates of bone densitometry. Specifically, general internists and family physicians (versus obstetrician-gynecologists), physicians who practice in an urban or rural (versus a suburban) setting, physicians who spend less than 50% of their time in patient care and physicians who see a low proportion of postmenopausal women were more likely to report ordering fewer bone density tests. There were no relationships between physicians' gender or years since medical school graduation and their reported use of bone densitometry. In addition, physicians who believe that calcium and vitamin D alone are adequate treatment for osteoporosis and that osteoporosis treatment should not be based on bone density measurement also reported low rates of bone densitometry.

Rates of diagnosis and treatment of osteoporosis are low, particularly in an era when many effective therapies exist. Bone densitometry represents an important method for diagnosing osteoporosis prior to a fracture and also may act as a powerful tool for convincing women to use osteoporosis treatments. Numerous studies, including two randomized controlled trials, have shown that women found to have low BMD are more likely than those with normal BMD to take medications for osteoporosis and that women who underwent bone densitometry used medications for osteoporosis at

Table 2 Attitudes[a] of respondents regarding bone densitometry and osteoporosis (Not all rows add to 100% due to rounding)

Statement on questionnaire	Mean ± SD	Disagree (%)	Unsure (%)	Agree (%)
Bone densitometry is useful for diagnosing osteoporosis	6.3 ± 0.8	1	14	85
Bone densitometry is useful for predicting fractures	5.9 ± 1.1	1	28	70
Bone densitometry is useful for monitoring osteoporosis treatment	5.8 ± 1.2	2	30	68
Bone densitometry is easy to understand	5.2 ± 1.5	7	42	51
Treatment recommendations on the bone densitometry report are useful	4.4 ± 1.8	19	47	34
Would use bone densitometry more often if the results were easier to interpret	3.3 ± 1.7	40	45	14
Base treatment decisions on the results of bone densitometry	5.1 ± 1.4	6	48	45
Confused about best anatomic sites to use for bone densitometry	3.0 ± 1.7	48	40	11
Insurance is barrier to ordering bone densitometry	3.8 ± 1.9	30	46	23
Osteoporosis can lead to serious health consequences	6.6 ± 0.7	1	7	92
Most patients with osteoporosis have already been diagnosed	2.4 ± 1.1	60	38	1
Osteoporosis can be prevented in most patients	5.3 ± 1.1	1	58	43
Osteoporosis can be treated	6.2 ± 1.0	2	16	82
Most patients with osteoporosis are treated adequately	3.1 ± 1.2	31	66	3
Most patients with osteoporosis should be treated with prescription medications	5.4 ± 1.3	2	45	52
Treatment of osteoporosis is helpful even if the condition is severe	6.1 ± 1.0	1	21	78
Calcium and vitamin D alone are adequate treatments for most osteoporosis	2.5 ± 1.3	53	45	2
Patients with osteoporosis should be referred to a specialist	2.4 ± 1.4	61	35	4

[a]Based on a 7-point Likert scale where 1 = "very strongly disagree" and 7 = "very stronglyagree". Disagree" refers to the proportion of doctors responding with 1 or 2; Unsure to 3, 4 or 5; and Agree to 6 or 7

Table 3 Predictors of lowself-reported use of bone densitometry

Predictor	Crude relative risk OR (95% CI)	Adjusted relative risk OR (95% CI)
Physiciancharacteristics		
Gender, male	1.5 (1.0–2.3)	1.4 (0.8–2.6)
Years since medical school graduation, per year	1.0 (1.0–1.1)	1.0 (1.0–1.1)
Physician training		
Obstetrician-gynecologist	1.0	1.0
Internal medicine	1.5 (0.9–2.4)	2.0 (1.0–3.9)
Family practice/general practice	2.1 (1.2–3.6)	2.6 (1.3–5.2)
Practice location		
Suburban	1.0	1.0
Urban	3.4 (1.9–5.9)	2.5 (1.3–4.9)
Rural/small town	2.2 (1.3–3.7)	2.2 (1.2–4.1)
Hospital affiliation		
Community	1.0	1.0
Teaching	1.6 (1.1 2.4)	1.4 (0.8 2.5)
Patient care		
≥50%	1.0	1.0
< 50%	3.9 (2.0–7.7)	4.0 (1.7–9.5)
Percent of patients who are postmenopausal		
Highest quartile	1.0	1.0
Third quartile	1.6 (0.92–2.6)	1.1 (0.5–2.4)
Second quartile	2.1 (1.2–3.7)	1.8 (0.9–3.6)
Lowest quartile	2.6 (1.4–4.8)	2.5 (1.2–5.3)
Physicianattitudes[a]		
Osteoporosis cannot be prevented in most patients	1.6 (0.7–3.4)	1.2 (0.5–3.0)
Calcium and vitamin D alone are adequate treatments for most osteoporosis	3.1 (1.5–6.1)	2.5 (1.1–5.8)
Bone densitometry is not useful for diagnosing osteoporosis	3.8 (0.6–23.0)	3.0 (0.4–25.2)
Bone densitometry is not useful for predicting fractures	2.3 (0.9–6.1)	1.3 (0.4–3.8)
Bone densitometry is not useful for monitoring therapy	2.9 (1.2–7.0)	1.9 (0.7–5.3)
Bone densitometry is not easy to understand	2.2 (1.3–3.6)	1.3 (0.7–2.6)
Would use bone densitometry more often if the results were easier to interpret	1.6 (1.0–2.5)	1.5 (0.8–2.7)
Do not base treatment decisions on the results of bone densitometry	3.3 (2.0–5.7)	3.2 (1.7–6.1)
Confused about best anatomic sites to use for bone densitometry	2.5 (1.6–4.0)	1.7 (1.0–2.9)

[a]For ease of interpretation, these statements are configured so that all ORs reflect the risk of being a low user of bone density tests. All variables with relative risks equal to 1 are reference categories. Physician attitudes not noted on this table but shown in Table 2 had OR <1.5 or p value ≥ 0.2. The multivariable model was adjusted for all variables noted in the table. The multivariable model C statistic = 0.78

higher rates than the typical population [9, 10, 11, 12, 22, 23, 24, 25, 26, 27]. Several of these studies also suggest that bone densitometry enhances compliance with osteoporosis medication use [9, 10, 11, 12]. These findings highlight the value of bone densitometry in clinical practice.

If one believes that primary care physicians ought to be involved in the diagnosis and management of osteoporosis, the findings of this study suggest that it may be possible to increase the frequency of bone density testing through education. While untargeted continuing medical education may not be an effective means for improving the practice of medicine [28, 29], the use of carefully crafted messages in smaller educational settings has been an important means of changing physicians' testing practices [30]. Specifically, educating doctors about the relative efficacy of prescription medications for osteoporosis treatment versus calcium and vitamin D supplements alone and a rational strategy for use of bone density results to modify treatment may be two important areas to address in future continuing medical education programs. While this study did not directly address specific measures to improve the use of bone density testing, non-educational interventions that have been considered and include: financial incentives given to doctors to screen appropriately for osteoporosis; reminder mailings sent to patients; audits given to doctors about their practice; and the use of allied health professionals to invite patients for bone density measurements.

There were several potential limitations with the survey used in this study. First, the outcome of low use of bone density testing was based on self-report, and is at best an estimate of actual ordering patterns. This issue would have been a major problem if the goal of this study had been to determine actual bone densitometry utilization rates. Our goal, however, was to identify factors associated with low use of bone density testing by primary care physicians. By creating a dichotomous outcome (low use of bone densitometry) we attempted to limit the effect of inaccuracies in reporting. Second, the survey has not been validated in other populations. It was developed by clinicians with expertise in osteoporosis and bone density testing and thus has inherently strong face validity. The psychometric properties of the survey should be tested. Third, the response rate of 12%

raises the possibility that we may have a biased sample. When we compared respondents with non-respondents with respect to demographic characteristics, respondents were more likely to be female than non-respondents, but gender was not a significant predictor of BMD use in adjusted models. Finally, we may not have assessed all the potential factors that affect decision-making. Future surveys should test whether a doctor's financial interest in performing tests and/or a patient's insurance status might affect use of bone densitometry. Another factor that may have contributed to low use is some physicians' skepticism about the technology and the usefulness of typical bone densitometry reports.

These data do not address the appropriateness of bone density testing. Physicians who ordered fewer bone density tests may be testing patients appropriately; however, other data suggest that bone densitometry is substantially underused [16]. While these data are from self-report, the median number of monthly bone density tests ordered per respondent was 7, from which we can estimate that there is a median of 17 scans performed per 100 postmenopausal women seen each month. Even if one assumes that these patients are being seen several times per year, this rate appears low. Doctors in the lowest quartile reported ordering fewer than 4.2 scans per 100 postmenopausal women per month, a rate that seems extremely low. It is also interesting to note that approximately two-thirds of doctors reported agreement with the statement that bone densitometry is useful for monitoring treatment. Repeat testing does appear to improve compliance with medication use [9, 10, 11, 12].

This study was cross-sectional and so assigning causality is problematic, but on the basis of the physicians' attitudes associated with low use of bone density tests, one can assume that a knowledge deficit underlies low utilization of bone density testing. While a number of factors may be important contributors to physician's suboptimal management of osteoporosis, other data support the contention that doctors have a low level of knowledge with respect to osteoporosis but are responsive to education [31, 32]. Physicians may also be responsive to their patients' demands. Patient interest in diagnosis, prevention and treatment may pressure physicians to address osteoporosis more actively in practice. Physician- and patient-targeted strategies need to be explored as options to improve the management of osteoporosis. These findings should help provide a rational basis on which to design educational strategies aimed at doctors.

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