INNOVATIONS IN CLINICAL PRACTICE

A Captive Audience: A Pilot Study of Screening and Counseling Hospitalized Women for Fracture Risk

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BACKGROUND: Innovative methods are needed to improve screening for osteoporosis, especially in women with multiple comorbid conditions.

OBJECTIVES: Determine whether a fracture risk-screening program including a bedside calcaneal ultrasound is feasible in hospitalized women, and determine whether identification of fracture risks results in behavior change after discharge.

DESIGN: Prospective uncontrolled feasibility study.

SETTING: Five hundred twenty-eight bed academic hospital.

PARTICIPANTS: One hundred three hospitalized women age 60 years or older.

METHODS: A bedside calcaneal ultrasound was used to estimate bone mineral density. Clinical fracture risks were obtained via interview. The patient and primary care physician received personalized risk information and educational material.

RESULTS: Of 103 eligible women, 59 (57%) agreed to undergo bedside screening and counseling. Of these 59 women, 49 (83%) had at least one major clinical risk factor for fracture. The median T-score was -2.5. Among the 42 women available for phone follow-up 2 months after hospital discharge, 34 (81%) reported after at least 1 recommendation to diminish fracture risk.

CONCLUSION: A hospital-based osteoporosis screening program using calcaneal ultrasound is feasible and identifies women at risk of fracture. Feedback of low bone mineral density and fracture risk during hospitalization may promote behavior change to diminish fracture risk after discharge.

KEY WORDS: osteoporosis; screening; prevention; hospitalization; health behavior.

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INTRODUCTION

Screening by dual-energy x-ray absorptiometry (DXA) not only identifies women with low bone mineral density (BMD), but also prevents hip fracture.¹ However, screening for osteoporosis is underutilized, even in high-risk patients.² Patient and provider factors contribute to failure to participate in screening,³ and obtaining a DXA may be inconvenient if it requires a separate clinic appointment or a physician referral. This may be problematic for older women or women with multiple comorbidities, who are less likely to receive a DXA,^{3,4} suggesting that more innovative methods may be required to reach them.

The purpose of this study was to develop and pilot test a novel approach to screening high-risk women for osteoporosis. We hypothesized that hospitalized women would be a group that could be screened efficiently and because of comorbidities, would have a low prevalence of prior screening but would be at risk for fracture. We took advantage of the portability and accessibility of heel ultrasound in this pilot study to determine whether a hospital-based intervention to increase osteoporosis care was feasible. Our specific goal was to determine whether a fracture risk-screening program including a bedside calcaneal ultrasound in hospitalized women is feasible and whether identification of low bone mineral density results in behavior change after hospital discharge.

METHODS

Setting

Patients were located on medical and general surgery wards in a 528-bed urban academically affiliated community hospital. This study received approval from the Methodist Healthcare University Institutional Review Board.

Participants

This study used daily hospital census, reviewed 1-3 times weekly, for 12 months between 2005 and 2006 to identify a convenience sample of hospitalized women age >60 years. Excluded patients were: (1) located in an intensive care unit, a long-term care ward or rehabilitation ward; (2) receiving prescription osteoporosis medication; (3) admitted for acute

fracture; (4) admitted from a nursing home; (5) demented or unable to give informed consent; (6) weighed over 250 lbs, given limitations of the reliability of calcaneal ultrasound with higher body mass index⁵; (7) complaining of foot or leg pain; (8) diagnosed with acute deep venous thrombosis; or (9) admitted for an acute gastrointestinal bleed, to exclude those that might be harmed if a bisphosphonate were acutely started. Informed consent was obtained before conducting any study-related procedures or interviews.

Measurements

A study nurse and a pharmacy student were trained in the performance of calcaneal ultrasound (Hologic). Calcaneal ultrasound was used to estimate BMD and T-scores (BMD standardized to young adult mean by manufacturer's data). The coefficient of variation for the ultrasound used in healthy volunteers unplugged between each measurement was 3.2% for speed of sound (meters/second) measures.

Demographic data, weight, and current medications were extracted from the medical record. The study team performed a patient interview to collect information on fracture risks. Calcium obtained from dairy was determined by assigning 1 cup milk as 30 g/calcium, 1 ounce cheese as 200 mg, and 1 serving of yogurt as 400 mg.⁶ Baseline Osteoporosis Knowledge was determined with an abbreviated Osteoporosis Knowledge Assessment Tool⁷ reduced from 20 questions to 11, eliminating questions that were not directly applicable to this group of women. Three belief and concern questions⁸ were answered with a 5-point Likert scale. Scores were summed, with a maximum possible score of 11 for knowledge and 15 for osteoporosis beliefs.

Participants received fracture risk information and education material to address their personal risk factors. T-score was reported as follows: likely normal (T-score > +1); possibly low (+1 to -1), possibly osteoporosis, fracture risk approximately doubled (less than -1 to -2.5); likely osteoporosis, fracture risk quadrupled (at or below -2.5).⁹ This classification scheme was based upon studies demonstrating that ultrasound is not as sensitive as central DXA for the diagnosis of low bone mass.^{10,11} These limitations of calcaneal ultrasound were described, and the participants were encouraged to ask their doctor about definitive diagnosis with DXA, as well as treatment for osteoporosis if needed. The primary care doctor also received the patient's fracture risk information, as well as educational material and osteoporosis websites.

Evaluation of the effectiveness of the screening and patient education was assessed using a structured telephone interview 2 months after discharge. Estimates of program cost were \$20 per patient, not including the initial purchase of the ultrasound machine. This was calculated as the cost of education materials, mailings, and nurse time for intervention (identifying patients, performing ultrasound, collecting risk factors, providing feedback, and sending a letter to primary care physician).

Statistical Analysis

SAS statistical analysis software for Windows (version 9.1) was used for all analyses (SAS Institute, Inc., Cary, North Carolina). The association between baseline variables and the outcome, self-report of taking an action to reduce fracture risk,

was tested using *t* tests, chi-square statistics, and Fisher's exact tests where appropriate. Nonparametric statistics were used for associations between the outcome and score on the knowledge and belief questionnaire. All probability values were two-sided.

RESULTS

Baseline Characteristics

The figure shows study flow (Fig. 1). Very few participants (1.5%) were ineligible because of current use of a prescription osteoporosis medicine. Of the eligible women, 57.3% agreed to participate. The mean age was 71.4±8 years (range 60–97), and 61% were African American. Insurance was mainly Medicare (64.4%) or Medicare/Medicaid (25.4%). The majority of participants were hospitalized for cardiac or pulmonary causes (Table 1). Only 11 had received a DXA scan ever; only 7 had received a DXA in the previous 5 years. However, 83.1% had a major risk for fracture: body weight below 127 lbs, current smoking, maternal hip fracture, falls in the past 12 months, prior fracture after 45 years of age,¹² or current chronic corticosteroid use of greater than 7.5 mg/day. Most fractures after 45 years of age were from low-impact injuries (78.9%). The majority (90%) of participants reported intake under the Adequate Intake of calcium (1,200 mg/day).¹³

Fifty-six participants had a valid T-score by calcaneal ultrasound. Half (*n* = 28) had a T-score at or below -2.5. The median T-score was -2.5 (25–75% interquartile range -1.1 to -2.9).

Participants had little knowledge of and were not worried about osteoporosis. The median number of correct answers given on the knowledge test was 7 out of 11 (25%–75% interquartile range 5–9). The median score for the beliefs questionnaire was 8 (interquartile range 7–10) out of 15, with higher scores indicating greater concern.

Outcome of Pilot Intervention

Follow-up data was available for 42 participants (71.2%). Ten participants with a T-score < -2.5 were lost to or refused follow-up (35.7%), compared with 6 of those with higher BMD (20.7%). Surprisingly, 11 women contacted had not seen a

Figure 1. Study flow.

Table 1. Baseline Characteristics of Participants, N=59

Characteristics of Participants	Number of Participants (%)
Admission diagnosis*	
Cardiac	16 (27.1%)
Asthma/COPD/Pneumonia	13 (22.0%)
Surgery	7 (11.9%)
Gastrointestinal	6 (10.2%)
Fracture risk factors	
Weight < 127 lbs	11 (18.6%)
Current smoking	8 (13.6%)
Fracture after age 45 years	19 (32.2%)
Maternal hip fracture	11 (18.6%)
Current corticosteroids >7.5 mg/day	11 (18.6%)
Fall/12 months	30 (50.9%)
Behaviors	
Walk aid	31 (52.5%)
No lights in bathroom at night	9 (15.3%)
No home safety equipment	37 (62.7%)

physician since discharge from the hospital and were not included for analyses of changes that require an office visit.

Three participants received a DXA, and all reported that their physician had recommended it without the patients' request. Twenty-eight did not receive a DXA. Reasons for not asking their doctor for a DXA were: "forgot" ($n = 10$), "too many other health issues to worry about" ($n = 7$), "not worried about my bones" ($n = 2$), and "don't know" ($n = 9$). Seven patients were prescribed osteoporosis medication.

Thirty-four of 42 (81%) women with telephone follow-up reported that they made some change recommended by the study nurse: receipt of a DXA, making a home safety change (among those reporting no home safety equipment at baseline), increased use of walking aid, initiating a physical therapy or exercise program, increased dairy intake (among those reporting 0 to 1 daily serving of dairy at baseline), or new supplement use (in former nonusers of supplements). There was a trend for T-score below -2.5 to be associated with this self-reported outcome ($P = 0.11$). Among 18 women with an ultrasound showing a T-score ≤ -2.5 , 17 (94.4%) reported making at least 1 change. This was a DXA and receipt of a bisphosphonate prescription in 3. Of the 24 women with a T-score above -2.5 or invalid DXA, 17 (70.8%) reported a change, of which 4 were DXA scanning or medications. There was a trend toward an association between the outcome and baseline concern regarding osteoporosis above the median value ($P = 0.10$). Surprisingly, knowledge of osteoporosis above the median ($P = 0.52$) or presence of major osteoporosis risk factors or corticosteroid use ($P = 0.58$) were not associated with the outcome.

DISCUSSION

To our knowledge, this is the first study of a fracture risk-screening program among women hospitalized for reasons other than fracture. We used heel ultrasound because it can be easily administered at the bedside during a hospital stay and can provide an assessment of fracture risk. More than half of eligible women agreed to participate, with the majority of refusals secondary to not feeling well at the time screening was

offered. It is plausible that screening could be further increased if offered later in the hospital course.

Screening revealed a high prevalence of low BMD; half the participants had a T-score by calcaneal ultrasound at or below -2.5 . This is consistent with the known association between low bone mass and significant medical and cardiovascular conditions,¹⁴⁻¹⁶ and the increased risk of fracture after hospitalization.¹⁷

More than 80% of women who participated in the screening took at least 1 measure which could prevent fracture. Although the majority of these actions did not require input from a health care provider, several participants reported undergoing a DXA and/or receiving antiresorptive therapy. In our study, there was a trend towards more action taken among women with lower BMD. This is consistent with the findings that initiation of estrogen is highest among women with lowest bone density.^{18,19} We believe that the ultrasound with feedback of fracture risk was a critical part of this intervention, especially for individuals with lower BMD²⁰ because at baseline, there was low levels of concern and knowledge about osteoporosis. Low levels of understanding regarding osteoporosis has been shown previously.²¹ Prior work has demonstrated that greater belief about personal risk of osteoporosis was associated with taking actions to improve bone health.²²

Most prior work on reaching unscreened women has addressed 2 disparate groups of women: postfracture patients and healthy ambulatory women who accepted screening appointments.²³⁻²⁵ However, ambulatory programs may miss women in poor health. Women invited to, but not attending, a screening intervention, were older, had poorer health and a higher number of falls.²⁶ Hospital- and emergency department-based interventions after fracture overcome the bias of capturing only healthy women. Faxed reminders to physicians from the emergency department at the time of wrist fracture resulted in a 4-fold relative increase in DXA scan and initiation of prescription osteoporosis medication.²⁷ Gardner, et al. evaluated a printed script for the patient to ask their primary care doctor, including "When are you going to address my osteoporosis?" in hospitalized hip fracture patients. This increased osteoporosis care two-fold.²⁸ Finally, electronic reminders to physicians improved osteoporosis care after fracture in an outpatient HMO setting.²⁹

The hospital is an attractive setting to screen high-risk individuals and initiate interventions meant to improve health. Hospitalized older adults have a high risk for hip and other frailty fractures after discharge.¹⁷ This may be mediated by the association between low BMD with medical illness, as well as the high incidence of falling after hospital discharge. In the month after hospitalization, 8-20% of older adults fall, with the rate highest in the first 2 weeks and declining thereafter.³⁰ A substantial number of these falls led to injury and rehospitalization. Other authors have used the hospital to initiate mammography education,³¹ vaccination programs,³² and cervical cancer screening.³³ These programs successfully increased outpatient screening, identified undetected disease, or captured unvaccinated adults.

This study has limitations. First, we relied on self report for all study outcomes. While some prevention measures (e.g., home safety changes) would be difficult to validate, other measures, such as medication changes or receipt of DXA, could be checked using health care claims or medical record review. Second, we experienced more loss to follow-up—especially in women with low BMD—than reported by

others.^{27–29} This may reflect the socioeconomic status or comorbid conditions of our population, and may be addressed in future studies by more frequent follow-up. Third, the convenience of bedside screening with calcaneal ultrasound is offset by the decreased accuracy with which it estimates BMD. Ultrasound correlates with BMD measurements by DXA and predicts fractures,^{9,34–36} but because guidelines recommend central DXA screening,¹² we encouraged all women to ask for a confirmatory DXA. Finally, our intervention was performed at a single academic hospital, without controls.

Future directions should address how to better engage the physician in screening and prevention in underscreened high-risk women. This may include writing a prescription for a DXA at the time of interview, with results directed to the primary care doctor. We were surprised that more than 26% of women had no physician follow-up in the 2 months after hospitalization. This limited patient access to screening DXA as well as discussion with physician about behavior change and exercise.

CONCLUSION

Using heel ultrasound for bone density screening is feasible and acceptable to hospitalized women. Hospitalized older women have a high prevalence of low BMD and other risks for fracture. Providing a T-score may be an important motivator of behavior change after hospital discharge. Further studies are needed to determine whether such an approach could improve DXA scan utilization, medication initiation, and adherence and ultimately reduce fractures.

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Author Contributions: Dr. Ryder: study concept and design, statistical analysis and interpretation, manuscript preparation. Dr. Kessler: study design, manuscript preparation. Ms. Jones: data collection, manuscript preparation. Dr. Shorr: study concept and design, manuscript preparation.

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