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Improving Osteoporosis Screening Rates in a Primary Care Practice

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Abstract

Osteoporosis is a prevalent condition that is often overlooked until a fragility fracture occurs. Screening for bone loss with dual-energy X-ray absorptiometry (DXA) scans is underutilized in the primary care setting. Direct communication with at-risk patients, offering self-referral for DXA screening, has been demonstrated to be the most effective intervention in increasing DXA screening rates. The goal of this DNP project was to improve bone density screening rates in a primary care practice by inviting patients at greatest risk of osteoporosis to schedule a DXA without a provider order. After a review of the electronic medical record, letters and educational brochures were mailed to 261 eligible patients, including women age 50 and over and men age 70 and over, with instructions to schedule a DXA scan. Sixty-seven (25.6%) patients completed a DXA scan within three months of receiving the letter. Patients whose DXA results revealed osteoporosis or osteopenia with a high risk of fracture were invited for in-person educational counseling and medication management. Number of correct items on an abbreviated version of the Osteoporosis Knowledge Assessment Tool (OKAT) tool improved from 5.55 (SD 3.3) before counseling to 10.18 (SD = 2.2) after counseling. Three months after the intervention, 475 (66.3%) of patients in the practice were appropriately screened for osteoporosis, compared with 398 (55.6%) three months prior to the intervention. The implication for nurse practitioners is the need to advocate for primary and secondary prevention of osteoporosis as well as educate themselves about screening guidelines, lifestyle recommendations and medication options for treating osteoporosis.

Keywords: osteoporosis, bone density, DXA, screening, self-referral, older adults

Improving Osteoporosis Screening Rates in a Primary Care Practice

Introduction

Low bone mass, a widespread condition mainly affecting older people, is asymptomatic until a fracture occurs. Worldwide, an estimated 10.2 million adults had osteoporosis and 43.4 million had osteopenia in 2010 (Wright et al., 2014). The only symptom of low bone density is fracture, which is a major cause of disability and deconditioning in older adults. Due to an aging population, the incidence of fractures is estimated to grow to more than three million per year by 2025 and will incur \$25.3 billion in costs by that year (Burge et al., 2007). The one-year mortality rate for elders after a hip fracture is 20%, and this rate has not decreased in the past 30 years despite surgical advances (Mundi, Pindiprolu, Simunovic, & Bhandari, 2014). If using the National Osteoporosis Foundation (NOF) guidelines, as many as 30% of women over 50 and 19% of men over 50 are at sufficient risk for fracture to justify osteoporosis medication (Dawson-Hughes et al., 2012). Failure to detect bone loss and lack of treatment prior to a fracture are missed opportunities; a meta-analysis of multiple drug trials confirms that several agents have demonstrated a reduced risk of fractures when compared to placebo in both men and women (MacLean et al., 2008; Nayak & Greenspan, 2017).

Background

Osteoporosis is a silent disease, and screening for bone loss can identify patients at increased risk of a fragility fracture, which is one that occurs with minimal trauma. Imaging with dual-energy X-ray absorptiometry (DXA) at the hip and lumbar spine is the gold standard for osteoporosis screening (Cosman et al., 2014; US Preventative Services Task Force [USPSTF], 2018). With the identification of bone loss, healthcare providers can make lifestyle recommendations and prescribe medication to halt or reverse bone loss and prevent a fracture. Since patients often underestimate their own fracture risk (Grover et al., 2014), it is important for

healthcare providers, especially in the primary care setting, to initiate the identification of patients at risk for fracture. A literature search was conducted to elucidate the best practices of bone density screening and strategies for adhering to these guidelines.

The rates of DXA screening in clinical practice remain suboptimal. In one study of women aged 50 and over with no prior diagnosis of bone loss, screening rates were calculated over a two-year period using claims data (Gillespie & Morin, 2017). For women aged 50 to 64, 21.1% were screened, 26.5% of women aged 65 to 79 were screened, and 12.8% of those aged 80 and above were screened (Gillespie & Morin, 2017). Amarnath, Franks, Robbins, Xing, and Fenton (2015) showed that rates of DXA screening in primary care reflected both underutilization and overutilization of bone density screening. Over a seven-year period, cumulative incidence of bone density screening was 58.8% among women aged 60 to 64 years with one or more risk factors, 57.8% for women aged 65 to 74 years, and 42.7% for women age 75 years and over. DXA screening was done for 45.5% among women aged 50 to 59 years without risk factors and 58.6% among women aged 60 to 64 years without risk factors (Amarnath et al., 2015). Bone density screening rates for men, which have been studied less frequently than for women, are even lower. In a sample of men aged 70-75, about 18% had a DXA in their lifetime (Alswat & Alder, 2012).

Problem Statement

Osteoporosis among adults over 50, a risk for fragility fracture without prior symptoms, is indicated by bone loss that results from normal aging and several secondary risk factors; currently adults at risk for bone loss are not optimally screened with DXA scans, preventing appropriate lifestyle and medication recommendations prior to a potential fracture. This quality improvement project seeks to identify primary care patients at risk for bone loss who are

candidates for osteoporosis screening and offer a DXA scan to these patients. The ultimate goal of the project is to provide intervention to patients at risk of fracture in order to prevent a fragility fracture.

Organizational “Gap” Analysis of Project Site

This project took place at an internal medicine practice located in eastern MA that is affiliated with a nearby community hospital. According to the hospital’s population health software analyzing the practice’s electronic medical record (EMR) data, the DXA screening rate at the practice is currently around 19%; this includes 1) women 65 and over, 2) men 70 and over and 3) adults with a history of fragility fracture over age 50 who have had DXA in the last two years (Hospital Electronic Medical Record, 2019). This is roughly on par with national screening rates of 12.8 to 26.5% for women (Gillespie & Morin, 2016) and 18% for men (Alswat & Adler, 2012). Presently, there is no systematic screening for secondary risk factors for osteoporosis, and osteoporosis is not a focus of the quality improvement efforts of the hospital’s population health team. In the health maintenance screen of the hospital’s EMR, there is a field in which a date can be entered for bone density tests, but this is only in the charts of females. There are no reminders in the EMR to complete a DXA.

Review of the Literature

In compiling evidence for the topic of osteoporosis screening and related interventions, the Cumulative Index to Nursing and Allied Health Literature (CINAHL) and PubMed databases were utilized. The search terms included “osteoporosis AND screening AND primary care,” “osteoporosis AND screening AND electronic AND record,” “bone density AND screening AND primary care,” “DXA AND screening AND primary care,” “DEXA AND screening AND primary care,” and “FRAX and United States.” The database search excluded articles prior to the

last 10 years and was limited to the English language. In both databases, the age range was limited to adults age 45 and over. The Johns Hopkins Nursing Evidence Based Practice (JHNEBP) evidence rating scales (Newhouse, Dearholt, Poe, Pugh, & White, 2005) were used for grading the quality and strength of the evidence.

The search yielded 637 articles, out of which 88 articles and ten clinical guidelines were chosen to review. Out of the 88 articles, 13 were selected citations of relevant studies, some more than 10 years old, located in the reference sections of articles located in the databases. Preference was given to studies from the United States in order to review healthcare utilization in context of the American healthcare system. Studies rated as Level I, II and III evidence were included, with an emphasis on meta-analyses and systematic reviews; these included high-quality studies with large sample sizes and well-defined methods. Papers demonstrating Level IV and V evidence were excluded. Other common reasons for exclusion included focus on special populations or secondary causes of osteoporosis, focus on imaging technology itself, and focus on treatment rather than screening. In preparing a synthesis of the literature, each of the papers was evaluated, using the Matrix Method (Garrard, 2017), in terms of description of the study sample, location of the study, design, intervention method, outcome, strengths, limitations, and level of evidence.

Of the 87 studies critiqued, 39 were included in the review. Of the 10 guidelines, seven were published in a peer-reviewed journal articles, which were reviewed and compared using the Appraisal of Guidelines for Research and Evaluation (AGREE) Instrument. This tool analyzes the six quality areas of a clinical guideline, including scope and purpose, stakeholder involvement, rigor of development, clarity of presentation, applicability, and editorial

independence (AGREE, n.d.). The guidelines with the three highest overall scores were used in determining the DXA screening criteria applied to this project.

Best Screening Practices

Unfortunately, making clinical decisions about which patients to screen for bone loss is not always straightforward. Several national and international guidelines for osteoporosis screening exist, but they make slightly different recommendations (see Appendix A). They mainly agree that all women aged 65 and over should be screened, as well as postmenopausal women age 50-64 with at least one risk factor for osteoporosis. The National Osteoporosis Foundation, the Endocrine Society, the American College of Preventative Medicine (ACPM) and the International Society for Clinical Densitometry (ISCD) all recommend screening men age 70 and over regardless of risk factors (Cosman et al., 2014; ISCD, n.d.; Lim et al., 2009; Watts et al., 2012). However, the USPSTF and American Academy of Family Physicians (AAFP) assert that there is insufficient evidence to support screening in men (AAFP, 2017; USPSTF, 2018). The American College of Physicians (Qaseem et al., 2008) recommends screening men only if risk factors are present. The American College of Gynecology (ACOG), the North American Menopause Society and the American Academy of Clinical Endocrinologists / American College of Endocrinology (AAACE / ACE) guidelines all address bone loss in women only (Camacho et al., 2016; Committee on Practice Bulletins - Gynecology, 2012; North American Menopause Society, 2010).

According to a comparison using the AGREE tool, the three guidelines that were developed with the most rigor were those of the Endocrine Society, AAACE/ACE and the USPSTF. The Endocrine Society and USPSTF guidelines contradict each other on whether

screening in men is indicated. Clearly more research needs to be conducted regarding bone loss in men in order to develop more definitive osteoporosis screening guidelines for men.

In men and women alike, assessing risk for fracture is rather complex. While there are references of dozens of risk factors for osteoporosis in the literature (Cosman et al., 2014), several key factors are identified by the World Health Organization's (WHO) Fracture Risk Assessment (FRAX) tool as the most important in predicting fracture risk. The FRAX tool was developed to calculate 10-year risk of major osteoporotic and hip fractures using femoral neck scores on DXA and the presence of several risk factors. These include previous fragility fracture, low body mass index (BMI), a parental history of hip fracture, current smoking, alcohol intake of three or greater drinks per day, lifetime exposure to oral steroids for three months or longer, a diagnosis of rheumatoid arthritis, and secondary causes of osteoporosis. Secondary causes identified are type I diabetes, osteogenesis imperfecta in adults, untreated long-standing hyperthyroidism, hypogonadism or premature menopause (age less than 45 years), chronic malnutrition, or malabsorption and chronic liver disease (Jiang et al., 2017).

Although FRAX is studied globally and is commonly used in clinical practice, it has lower sensitivity in predicting fracture than simpler risk assessment tools. Crandall et al. (2014) found that the sensitivity of the FRAX (without bone density measurements) for younger postmenopausal women was as low as 34%. For women over 65, the FRAX overestimates 10-year fracture risk (Hillier et al., 2011). Additionally, for men age 65 and over, the FRAX has either underestimated (Diem et al., 2012; Ensrud et al., 2014) or overestimated risk of fracture (Ettinger et al., 2013). A systematic review of fracture risk assessment instruments demonstrates that simpler instruments with less than five variables perform as well as those with greater than five variables (Nayak, Edwards, Saleh, & Greenspan, 2014). According to a meta-analysis by the

same group, Osteoporosis Self-Assessment Tool (OST), the Simple Calculated Osteoporosis Risk Estimation (SCORE) instrument, the Osteoporosis Risk Assessment Instrument (ORAI), and body weight criteria all have sensitivities near or exceeding 90% (Nayak, Edwards, Saleh, & Greenspan, 2015). However, the sensitivities are generally lower for younger than older participants (Nayak et al., 2015). Of note, the trade-off of these high-sensitivity instruments is low specificity.

The OST, validated in postmenopausal women (Geusens et al., 2002) and older men (Adler, Tran & Petkov, 2003), is the simplest of these validated risk assessment tools in that it accounts for only three variables: weight, sex and age. It is comparable or superior in sensitivity of other fracture risk assessment tools in postmenopausal women (Rud, Hilden, Hyldstrup, & Hróbjartsson, 2009). A systematic review by Liu et al. (2008) confirms that BMI 20-25 and age 70 and over are the most important risk factors for fracture in men. Using age and BMI is the most feasible for a population screening intervention, as opposed to a more complex tool with several variables. A study of an EMR database of over 50,000 postmenopausal women revealed that, except for age and BMI, FRAX risk factors were not reliably recorded in the EMR (LaFleur et al., 2011).

Interventions to Increase Bone Density Screening

History of fracture is a significant risk factor for future fractures (Kanis et al., 2004), and thus the period immediately following a fragility fracture is often used as an opportunity to intervene in order to prevent future fractures. A widely-studied intervention model is the fracture liaison service, a type of secondary fracture prevention. This model involves a dedicated clinician other than the primary care provider (PCP) receiving an alert of a fragility fracture during the period of acute fracture treatment, then assessing and treating patients for osteoporosis

as part of a comprehensive service. In a meta-analysis of fracture liaison service studies, Wu et al. (2018) showed an approximate 27% increase in the likelihood of bone density testing and up to a 21% increase in treatment initiation compared with usual care — a referral from the PCP.

Fewer studies examine interventions including adults who have never had a fracture, but the literature is growing. Lawrence et al. (2017) studied a comprehensive service similar to the fracture liaison service, but targeted toward those at risk who have never fractured. A Bone Health Team (BHT) coordinated screening, diagnosis, medication and lifestyle interventions, and follow-up of men aged 70 and older and women aged 65 and older in seven Veterans Affairs (VA) outpatient clinics. Fifty-one percent of those receiving care by the BHT had a DXA, compared to 1.9% in usual care.

In terms of simpler interventions aimed at primary prevention, the use of clinical decision support (CDS) for providers has been utilized in prompting clinicians to order DXA scans through electronic medical record (EMR) reminders. However, evidence does not convincingly show that EMR reminders are effective at increasing bone density screening rates. DeJesus et al. (2012) showed a modest improvement in DXA completion rates after a CDS tool was implemented; the rate increased from 80% to 84% completed. The large baseline percentage of 80% completion, however, seems to indicate that this sample may not be widely generalizable. El-Kareh et al. (2011) showed that an EMR reminder had low yield for successfully leading to a DXA order, even if there was a link to a computerized order entry screen. In a study of rheumatology providers, EMR reminders tailored to include patient risk factors did not improve screening rates (Rolnick, Jackson, & Amundson, 2009).

The literature suggests that contacting at-risk patients directly is more likely to improve screening rates than systematically reminding providers to order DXA scans. Zhang and Fish

(2012) demonstrated that patient reminder letters for preventative services, including DXA scans, improved completion rates from 45% to 66% after two reminder letters were sent. Loo et al. (2011) showed that EMR alerts alone made no significant difference in bone density screening rates (19.7% in EMR group vs. 17.7% of patients receiving usual care), while combining the EMR alert with a phone call or letter to the patient resulted in a screening rate of 30.5%. Another study showed that mailing a letter to women eligible for bone density screening resulted in 24% of the recipients scheduling DXA scans (Kesman, Rahman, Lin, Barnitt & Chaudhry, 2010). Of note, these women were appropriately screened; of those who had DXA scans for the first time, 41% had a new osteoporosis diagnosis and 41% had a new osteopenia diagnosis.

Studies also showed DXA screening rates improve if, once letters are mailed to eligible patients, these patients are free to call to schedule a test without an order from the PCP; self-referral or self-scheduling gives more control to the patient (Ayoub, Newman, Blosky, Stewart, & Wood, 2009; Denberg et al., 2009; Lafata et al., 2007; Warriner et al., 2012; Warriner et al., 2014). In a randomized control trial (RCT) studying 10,354 women age 65-89, Lafata et al. (2007) demonstrated an increase in screening rates from 10.8% to 24.1% after a mailed reminder. Screening rates increased slightly with an addition of a physician prompt (in the form of a letter one month later) to 28.9%, but the prompt did not significantly increase treatment rates compared with a mailed reminder only (Lafata et al., 2007).

Adding a phone reminder has also been shown to augment the effect of a letter. Denberg et al. (2009) showed that one large practice's screening rates increased from 60.9% to 78.7% after 564 eligible women age 65-79 were mailed a reminder letter to schedule a DXA scan; nearly 50% scheduled a DXA after one letter and up to three reminder calls over a seven-month

period. In a similar scale study, Ayoub et al. (2009) showed DXA rates of older women were 39.6% after a letter and follow-up call three weeks later, compared to 13.2% for usual care.

Warriner et al. (2012) performed a RCT studying 2997 women over 65 who had no DXA in at least four years; the intervention was a mailed letter with an educational brochure. The DXA completion rate for the intervention group was 17.3% compared to 5.2% in the usual care group. In an even larger RCT, Warriner et al. (2014) studied DXA rates in over 12,000 women over 65 who had not had a DXA in five years. After a letter with an invitation to self-refer for DXA, 24.1% of women in the self-refer group completed a DXA, compared to 5.9% in the usual care group. A meta-analysis of quality improvement strategies to improve osteoporosis care confirms that self-referral with patient education is the most effective approach to increase screening rates for those without prior fracture (Nayak & Greenspan, 2018).

Evidence Based Practice: Verification of Chosen Option

Bone density screening is an important component of preventative care that has been underutilized. Quality improvement efforts to improve DXA utilization have included reminders to clinicians and outreach efforts to eligible patients. It can be argued that the self-referral protocol has been feasible with mammography and this is a promising strategy for increasing the uptake of DXA screening. Decreasing administrative complexity and allowing patients to schedule DXA without an order from a healthcare provider is low-risk, low-cost and effective. Combining a patient letter with reminder call and patient education has been more effective than a letter alone.

Large-scale studies in improving bone density screening rates have included women over 65, the population that guidelines agree is eligible for a DXA. This population should be targeted in this quality improvement initiative by reaching out to those who have never had a DXA. As

guidelines suggest, women aged 50-64 should be screened for bone loss if risk factors are present. Women in the practice age 50-64 with a score on the OST less than 1.0, indicating moderate (-3 to 1) or high risk (-20 to -4), should also be invited for screening (Geusens et al., 2002). In postmenopausal women, the OST score less than 1 has a sensitivity of 89% and a specificity of 41%, while in older men the tool had a sensitivity of 89% and a specificity of 55% with a cutoff score of 3.0 (Nayak et al., 2015). Although guidelines are mixed about the inclusion of men in population screening for osteoporosis, a conservative approach is to include the oldest men at greatest risk. Men age 70 and over should be targeted for screening with an OST score less than 3. Lastly, adults with diagnosed bone loss need to be invited for screening if their last DXA scan was greater than five years ago. Although there are no consistent guidelines for DXA intervals in patients with diagnosed bone loss, Gourlay et al. (2012) showed that 10% of women (a statistically significant threshold) with moderate osteopenia developed osteoporosis within five years.

Theoretical Framework/Evidence Based Practice Model

The Stetler Model provides the theoretical underpinnings for this project (Appendix B). In 2001, the Stetler Model, a research utilization model, was updated within the context of evidence-based practice (Stetler, 2001). The newer model consists of five phases: preparation, validation, evaluation/decision making, translation/application and evaluation. In the preparation phase, one searches for, sorts, and selects sources of research evidence, while in the validation phase the research evidence is either deemed applicable or is rejected. The comparative evaluation/decision making phase occurs after synthesizing research evidence and involves determining feasibility and fit with one's current practice. This project has undergone these five phases. Evidence from the body of research has been gathered, included as supportive evidence

or excluded, and its applicability to a real-world practice has helped shape an idea for a formal application. Phase 4 entailed a tangible translation/application of the research findings, in the form of carrying out the intervention, and then an evaluation of the progress made (phase 5). In evaluating the outcomes, a decision can be made about how this intervention can become a part of routine practice.

Methods

Goals, Objectives and Expected Outcomes

The main goal of this quality improvement (QI) project was to increase DXA screening rates in the practice by 25% over the course of three months. It was expected that greater than 50% of the DXA scans completed would reveal a diagnosis of osteopenia or osteoporosis. For those who receive in-person counseling about bone loss, there would be a 100% improvement from pre-visit to post-visit scores on the Osteoporosis Knowledge Assessment Tool (OKAT) (Winzenberg, Oldenburg, Frendin, & Jones, 2003), reflecting increased knowledge of lifestyle changes in halting bone loss and preventing fractures. After patient counseling on the results of the scans, the aim was for >50% of applicable patients to begin osteoporosis medication treatment. While it was not a main outcome measure, increased numbers of osteoporosis medication prescriptions during the course of the project may reflect enhanced patient understanding of fracture risk. The ultimate objective of this project was to decrease fragility fractures, but this cannot be measured in the scope of this project.

Project Design

This QI project was a practice intervention in the form of a population screening. It used a one group, pre- and post-intervention design. The first phase of the intervention is a mailing of an invitation letter and education brochure, while the second phase is follow-up counseling for

patients who qualify for osteoporosis medication.

Project Site and Population

The project setting was an outpatient primary care office in eastern MA. The practice employs three physicians and one nurse practitioner, who is the DNP student conducting this quality improvement project. Other onsite staff included one licensed practical nurse, three medical assistants, two office coordinators and one office manager. The practice performs an average of 26 patient visits per day. There are 213 patients with diagnosed osteopenia, 45 with osteopenia and high risk of fracture and 143 with osteoporosis.

Although the office had a DXA scanner until 2017, its providers have since referred patients to its affiliated hospital, six miles away, for DXA screening. Alternatively, patients could have had DXA screening at either of two hospital-affiliated outpatient health centers; these are respectively 10 miles northwest and 14 miles southwest of the office.

Project Implementation and Data Collection Procedure

This QI project is divided into two phases that are referred to as Phase I, mailing of patient DXA invitation and education, and Phase II, patient medication and lifestyle counseling.

Phase I. The DNP student extracted EMR data to determine which patients were eligible for bone density screening. Patients were selected from patient lists provided by the hospital information technology (IT) department staff and population health team. The hospital IT department generated four lists using the IBM Watson tool with the filters: 1) females over 65 without a DXA scan in the last 5 years, 2) male patients over 70 without a DXA in the last 5 years, 3) all female patients age 50-64, and 4) male and female patients with a diagnosis of osteoporosis or osteopenia coded in the EMR. The IT department then provided lists of 1) all female patients age 50 and over (born on or before September 1, 1969) and 2) all male patients

age 70 and over (born on or before September 1, 1949). Age-based lists were needed to determine the ratio of appropriately screened patients compared with the total number who should have been screened. These lists were imported into a Microsoft Excel document and placed into tabs by eligibility criteria. Names were cross-referenced and duplicates removed. Also removed were patients who had left the practice, were deceased, lived in long-term care, or were receiving hospice care.

Prior to the mailing intervention, potential participants were classified as eligible or non-eligible. Eligible participants made up four groups: 1) Women age 65 and over with no history of DXA scan, 2) Postmenopausal women age 50-64 with OST score less than 1.0 and no DXA in the last five years, 3) Men age 70 and over with an OST score less than 3.0 and no DXA in the last five years, 4) Men and women age 50 and over with prior DXA with lumbar, total hip or femoral neck T-score of -1.0 or lower (indicating osteopenia or osteoporosis) and no DXA in the last five years. During the chart reviews, two additional eligibility criteria were added: 1) a history of fracture after age 50 and no DXA in the last five years and 2) evidence of osteopenia on an x-ray or CT scan and no DXA in the last five years. Exclusion criteria included: evidence of a DXA scan in the last five years, residence in long-term care facility, receiving hospice services, premenopausal or perimenopausal status, and inactive status in the practice (evidence that the patient left the practice or were not seen in greater than three years).

For each patient, weight in pounds, as close to the start date of the intervention as possible, was recorded in the database. The weight was converted into kilograms using a mathematical function in Excel. Age at the day of the start of the intervention was calculated using the formula $(10/15/19 - \text{date of birth})$. OST scores were calculated by another mathematical function: $0.2 \times (\text{weight in kilograms} - \text{age in years})$. Men over 70 with OST scores

greater than 3.0 were marked ineligible, as well as women 50-64 with an OST score greater than 1.0. Also marked ineligible were women whose chart showed evidence of perimenopausal or premenopausal status. All women age 65 and over without prior history of a DXA scan were considered eligible; their eligibility was not affected by OST scores.

For all patients with prior record of a DXA scan, dates of prior DXA scans, T-scores from these scans as well as history of treatment was ascertained from the EMR. This EMR review determined the baseline number of patients in the practice who were appropriately screened three months prior to the intervention.

Any patient with a DXA scan within the last 5 years was marked ineligible. However, for both eligible and ineligible patients, most recent DXA scan results were recorded in T-scores of the lumbar spine and hip, when available. For the purpose of verifying diagnoses, FRAX scores, which predict 10-year major fracture and hip fracture, were recorded. If not already recorded in the patient's chart, the scores were calculated using the FRAX tool (University of Sheffield, n.d.). Diagnosis of bone loss was verified on the patients' EMR problem lists and either added or corrected if needed. In order to find DXA scans of many of the newer patients in the practice, the DNP student gained permission to access a neighboring hospital's electronic medical record system.

Each of the practice's PCPs reviewed lists of their eligible patients to exclude any patients they did not wish to receive a letter. Some reasons cited were memory loss, history of medication noncompliance, poor renal function functioning, and advanced age. After the list of 284 eligible patients was finalized, the DNP student drafted and printed DXA orders from the EMR. An ICD-10 diagnosis code was as specific as possible to give support for insurance coverage of the DXA scan. If osteopenia, osteoporosis, osteopenia on x-ray, or fracture was not

on the problem list, then clinical diagnoses were chosen such as cigarette smoking, early menopause or rheumatoid arthritis as these are risk factors for bone loss. Otherwise, the diagnosis “screening for osteoporosis” was used. Four days prior to mailing the letters, the DNP student delivered orders for DXA scans for all eligible patients to the scheduling department.

Drafting and mailing invitation letters and educational brochures was done by the DNP student. Content of the mailing, including a form letter (Appendix C) and an educational brochure (Appendix D). The form letter was written by the DNP student with help of the DNP project mentor and edited by the marketing team. As requested by the marketing team, letters were printed on color hospital letterhead. The brochure was drafted using principles outlined by Edmonds et al. (2017), which examined the preferences of older adults in different types of osteoporosis educational brochures; the study showed that the participants preferred photographs as opposed to drawings, large print and plain language, avoiding medical jargon. Participants also preferred photos of people of diverse ages and race/ethnicity and limiting photos to one per page. The letter and brochure were approved by the DNP project mentor, director of radiology, and the hospital’s marketing department, who printed the brochures with a hospital logo.

Templates of the DXA invitation letter and the DXA results letter were uploaded to the EMR by a member of the information technology department. The DNP student printed the patient invitation letters, saving a copy in the electronic medical record as a document. A “care alert” note was placed in the EMR charts of eligible patients so that prompting by providers and staff members during office visits and phone calls was possible during the three-month period of the intervention. The reminder was set to expire January 11, 2020, three months after the letters were mailed. Through an e-mail and face-to-face conversations, providers and staff at the

primary care practice were apprised of the plan in anticipation of questions from patients receiving letters.

The scheduling department scheduled DXA scans at one of the three aforementioned sites through patient phone calls. After DXA scans were read by one of the hospital radiologists, results were routed to the DNP student through the EMR. Beginning four weeks after the letters were mailed, one reminder phone call was made if a DXA result was not apparent in the EMR. The DNP student and one of the practice's medical assistants made reminder phone calls to patients. Some of the patients were reminded in person during a visit prior to November 12, 2019 and did not receive a phone reminder. Patients who were scheduled for appointments during November 12-25, 2019 were reminded about the DXA invitation at their visits rather than over the phone. A portion of patients did not receive a phone reminder for other reasons, such as evidence they had moved out of the area or no longer came to the practice, had acute changes in health such as a new cancer diagnosis, or previously unseen DXA records were located or received.

Phase II. The second phase of the project began as patients receiving DXA scans were informed of results. The DNP student communicated DXA results in the form of a mailed letter, drafted in the style of a letter optimized by Edmonds et al. (2014), to those with normal bone density or a diagnosis of osteopenia with average risk of fracture (Appendix E). Edmonds et al. (2014) developed a letter based on the feedback from participants aged 50 and over. Participants preferred a letter that gives the date of the DXA scan, explanation of T-scores, diagnosis, FRAX score and a paragraph with lifestyle measures. The bar graph depicting fracture risk was also adopted from Edmonds et al. (2014) for this project.

Patients with a new diagnosis of osteopenia with a high risk of fracture or osteoporosis were identified as needing medication treatment. Osteopenia with high risk of fracture is defined by a T-score greater than -2.5 on DXA but a major risk of fracture greater than or equal to 20% and/or a risk of hip fracture 3% or greater on FRAX. Several guidelines (ACOG, 2012; Camacho et al., 2016; Cosman et al., 2014; Eastell et al., 2019; Lim et al., 2009) recommend treating osteopenia with high fracture risk with osteoporosis medication. All patients who required treatment counseling were called by the DNP student and offered an office visit to discuss treatment options; patients were given the choice of meeting with the DNP student or their primary care physician. Those who declined an appointment were given brief treatment counseling over the phone. The DNP student also updated the EMR problem list for all patients who had evidence of bone loss on DXA scan with diagnoses of osteopenia, osteopenia with high risk of fracture or osteoporosis.

Counseling for treatment options included face-to-face discussion and two handouts, and followed the ACP (Qaseem et al., 2017), Endocrine Society (Eastell et al., 2019), ACOG, NOF, and AACE/ACE treatment guidelines. Patient education material was gleaned from the above guidelines, which mainly agreed on general treatment measures. The counseling content included facts about the development of thinning bones, calcium supplementation recommendations, medication advice tailored to the patient's history and preferences, suggestions for weight-bearing exercise and/or balance improvement, and lifestyle changes applicable to the patient. The handouts, drafted by the DNP student, were entitled, "Important Facts About Bone Health" (Appendix F) and "Medication Options for Treating Osteoporosis" (Appendix G). Each handout included journal and online references.

The counseling topics also aimed to address all of the items on an abbreviated version of the Osteoporosis Knowledge Assessment Tool (OKAT) (Winzenberg, Oldenburg, Frendin, & Jones, 2003), which was used to measure the effectiveness of treatment counseling during the office visits. The tool was administered before and after the visit (Appendix H). Permission to use the OKAT in this project was gained from the principal investigator. The OKAT was developed in Australia, first validated in young white females and later tested in other populations around the world. The inventory presents 20 true or false statements, including, “Osteoporosis usually causes symptoms (e.g. pain) before fractures” and, “Calcium supplements alone can prevent bone loss.” The first 15 items of the inventory were used for this project. Only one change was made to the wording; for the item, “Ragi and broccoli are good sources of calcium for people who cannot take dairy products,” the term “ragi” was replaced with “sardines” to give an example of a food that is more familiar to American participants. Scores were calculated as the number of items correct and were compared before and after the counseling visit for each patient.

When patients arrived for their visit, the medical assistant gave the patient the abbreviated OKAT tool to complete. At the start of the visit, the patient was informed they would be quizzed again on their knowledge of bone health. After completing the OKAT, the medical assistant collected the OKAT tool and gave the patient the “Important Facts About Bone Health” handout, allowing them to read it before the DNP student entered the exam room. During the visit, the DNP student gave the patient the handout entitled, “Medication Options for Treating Osteoporosis,” highlighting potential side effects to help patients weigh risks and benefits of treatment. At the end of the visit, the patient was given another blank OKAT tool to complete. If the patient agreed to medication, a prescription for alendronate was sent to the

patient's pharmacy, or an investigation of insurance coverage of IV bisphosphonates was initiated.

Post-intervention. The number of DXA scans, results of DXA scans in T-scores, FRAX scores, OKAT pre- and post-test scores, and number of patients starting osteoporosis medication were recorded during the three-month intervention period.

Data Analysis

This quality improvement project adopts a one-group, pre-test/post-test study design. The main outcome measurement is the percentage of participants receiving a DXA scan as a result of the intervention; descriptive statistics compared the percentages of applicable patients receiving appropriate screening three months prior to the intervention compared with three months after the intervention. Descriptive statistics were also used to depict the results of completed DXA scans. Percentages of patients with normal bone density, osteopenia, osteopenia and high risk of fracture, and osteoporosis were compared. Additionally, numbers of patients receiving DXA who started medication treatment during the intervention period were calculated. Average scores on the OKAT before and after the treatment counseling sessions were compared using descriptive statistics due to the small number of patients in this group.

Cost-Benefit Analysis

The cost-benefit analysis takes into account that 284 patients were mailed letters and that 69 of the contacted patients followed through with a DXA scan during the 3-month intervention period. Costs include physical materials and personnel time (see Appendix I). Additionally, the expense of the DXA scan services was covered by patients' health insurance providers. Co-pays and agreed reimbursement rates between insurers and the hospital may vary and cannot be calculated for the purposes of this analysis. The estimated cost of the project is \$13,562. Since

the average cost of hospitalization following a hip fracture is between \$19,000 and 31,000, this project produces a cost savings, even if only one hospitalization is prevented (Burge et al., 2007).

Ethical Considerations/Protection of Human Subjects

The University of Massachusetts, Amherst (UMass) Internal Review Board (IRB) approval was obtained prior to initiating this project (see Appendix J). This project is a quality improvement study and the IRB did not classify the potential participants as human subjects; no consent forms were needed. However, since the project involved protected health information, all work involving patient data was done on an encrypted laptop provided by the primary care practice. A password-protected Excel file containing patient information was stored on the hospital intranet. Risks to participants included possible unnecessary testing, out-of-pocket expenses, and exposure to a minor amount of radiation from a DXA scanner. Potential benefits to participants included earlier treatment of bone loss, prevention of fracture and increased knowledge of bone health.

Results

This intervention took place at a hospital-affiliated suburban primary care practice with three PCPs. Participants were patients aged 50 and over who were eligible for osteoporosis screening; this included all women in the practice aged 50 and over, all men aged 70 and over, and men aged 50 and over with a prior diagnosis of bone loss.

Participants

A total of 979 patients were included in the sample. The vast majority (90.8%) of patients identified as Caucasian and non-Hispanic/Latinx, followed by 6.5% Asian, 0.6% Caucasian and Hispanic/Latinx, 0.6% African-American and 0.1% multiracial, while the rest of patients were of unknown race (1.3%). The sample was 74.4% female and 26.6% male.

After a list of 324 eligible patients was presented to the practice's PCPs, 38 patients were removed because the PCP thought the patient would not comply with screening, the patient should not receive osteoporosis medication or that screening was a low priority because of advanced age or medical issues. A total of 284 letters were sent, but after further review of records, 23 were removed from the denominator because the patient was either already up to date with DXA screening, had changed practices, was already receiving treatment, or was deceased. Of the 261 patients who correctly received letters, 67 (25.6%) had a DXA scan during the three months after the intervention. Two more patients who received letters also had a DXA, but they had a prior scan less than five years before the intervention and should not have been mailed a letter. Ten patients had a DXA scan ordered by their PCP within the three months before the intervention and did not receive letters.

Of patients who were sent an invitation letter, qualifying reasons for receiving a letter are depicted in Table 1. Nine of the patients who had DXAs were invited for screening only because they had osteopenia on prior imaging. Of these, five had osteopenia, two had osteopenia with high risk of fracture, one had osteoporosis and one had normal bone density.

Table 1

Numbers and Percentages of Patients Sent Letters by Qualifying Reason for Screening

Qualifying Reason for Invitation Letter	Sent Letters	
	(n)	(%)
Prior history of osteoporosis	17	6.5
Prior history of osteopenia with high fracture risk	2	0.8
Prior history of osteopenia	40	15.3
History of fracture and no DXA	18	6.9

Osteopenia on imaging and no DXA	34	13.0
Females 50-64 and OST < 1.0	38	14.6
Females aged >65	37	14.2
Males aged >70 with OST < 3.0	75	28.7
Total	261	100

For those who completed a DXA scan, reasons for receiving an invitation letter are shown in Table 2. Over a third (37.3%) of those who had a DXA as a result of the intervention were men over age 70 with an OST score less than 3.0. Men made up 28.7% of the recipients of the letters and were thus overrepresented in the group who completed DXA screening.

Table 2

Numbers and Percentages of Patients Who Had DXA by Qualifying Reason for Screening

Qualifying Reason for Invitation Letter	Completed DXA (n)	Completed DXA (%)
Prior history of osteoporosis	3	4.5
Prior history of osteopenia with high fracture risk	0	0
Prior history of osteopenia	9	13.4
History of fracture and no DXA	6	9.0
Osteopenia on imaging and no DXA	9	13.4
Females aged 50-64 and OST < 1.0	9	13.4
Females aged >65	6	9.0
Males aged > 70 with OST < 3.0	25	37.3
Total	67	100

As shown in Table 3, a majority (70.1%) of the 67 completed DXA scans showed a diagnosis of bone loss. Twenty of 67 (29.9%) scans showed normal bone density.

Table 3

Diagnoses Revealed by DXA Scans During the Intervention

Diagnosis	n (%)
Osteopenia	25 (37.3%)
Osteopenia with high risk of fracture	8 (11.9%)
Osteoporosis	14 (20.9%)
Normal bone density	20 (29.9%)
Total	67 (100%)

The eight patients whose DXA showed osteopenia and high risk of fracture and the 14 patients with osteoporosis were invited for visits; 11 of the patients had an office visit, while four had appointments with their PCP to discuss treatment options, and seven patients declined appointments and received counseling over the phone.

Sensitivity and Specificity of OST Scores

An OST score of less than 1.0 for women and less than 3.0 for men correctly predicted a T-score of -2.0 or less in 23 of 55 (41.8%) patients. OST scores of greater than or equal to 1.0 in women and greater than or equal to 3.0 in men correctly predicted T-scores of -2.0 or greater in 11 out of 12 (91.7%) patients. However, the OST score less than 1.0 for women and less than 3.0 for men correctly predicted any bone loss (T-score of -1.0 or less) for 40 out of 55 (72.7%) patients, while it ruled out bone loss in 4 out of 12 (33.3%) of patients.

DXA Screening Rate

Three months prior to the intervention, the practice had appropriately screened 398 of the 716 applicable patients, whereas three months after the intervention, the practice had screened 475 of the applicable patients. Ten of the 475 patients had DXA scans during the three months prior to the intervention, ordered by the practice's PCPs and independent of the intervention.

Table 4 shows the number and percentage of patients by age and is inclusive of those with prior diagnoses of bone loss. Table 4 also demonstrates the popularity of the intervention among men over 70, and that the greatest gains of the intervention were made in that demographic.

Table 4

Numbers and Percentages of Patients Screened Before vs. After Intervention, by Age Group

Age group	Three Months Before Intervention		Three Months After Intervention		Total (n)
	(n)	%	(n)	%	
Women aged 50-64	65	47.1	80	57.9	138
Women aged >65	263	70.3	286	76.5	374
Men aged 50-69	9	81.8	10	90.9	11
Men aged > 70	61	31.6	99	51.3	193
All groups	398	55.6	475	66.3	716

Note. Men aged 50-69 in the sample all have a prior diagnosis of bone loss.

Table 5 shows the difference between the screening rates three months before and three months after the intervention among patients with a prior diagnosis of bone loss, history of fracture or evidence of osteopenia incidentally noted on imaging. In this analysis, patients were coded as having osteoporosis if ever diagnosed with osteoporosis, even if subsequent DXA scans improved.

Table 5

Numbers and Percentages of Patients with Prior Evidence of Bone Loss Appropriately Screened Before and After the Intervention

Diagnosis	Three Months Before Intervention		Three Months After Intervention		Total (n)
	(n)	%	(n)	%	
Prior osteoporosis diagnosis	121	84.6	124	86.7	143
Prior osteopenia with high fracture risk diagnosis	41	91.1	42	93.3	45
Prior osteopenia diagnosis	164	77.0	177	83.1	213
Prior history of fracture without DXA	0	0	7	25.9	27
Osteopenia on imaging and no DXA	0	0	9	19.6	46
All diagnoses	326	68.8	359	75.7	474

In this group, the intervention was useful in getting patients with osteopenia to update their DXA scans, and also prompted several patients with a history of fracture to be screened, which was likely missed when the fracture initially occurred.

Impact of Reminder Calls

During the three-month intervention period, 111 of the 261 patients had appointments at the primary care practice. Providers reminded patients about the recommendation to schedule a DXA at 34 of these appointments. One month into the intervention, 149 reminder calls were placed. Of the 67 patients who had a DXA during the intervention period, four required prompting at an appointment, while 33 required a reminder call.

Medication Initiation

As a result of the intervention, four of the 11 patients who had office visits were started on an oral bisphosphonate (alendronate), while two agreed to start on an IV bisphosphonate (zoledronic acid). Of the 22 patients who were eligible for medication, seven agreed (one of whom was seen by her PCP), ten declined, four were undecided and one patient deferred discussion until a routine visit later in the year.

Three months prior to the intervention, 45 patients had a known diagnosis of osteopenia with high risk of fracture. Eight of them had a prior history of taking osteoporosis medication, 18 were currently under treatment and 19 were never treated. Within the three months prior to the intervention, one more patient had a DXA scan revealing osteopenia with risk of fracture and was treated. See Tables 6 and 7 for the comparison of treatment rates three months prior to the intervention with rates three months after.

Table 6

Numbers and Percentages of Treatment-Eligible Patients in Practice Taking Osteoporosis Medication, Three Months Before Intervention

Diagnosis	History of Past Treatment (n)	Under Current Treatment (n)	Total Treated		Total Treatment-Eligible Patients (n)
			(n)	%	
Osteopenia with high fracture risk	8	18	26	57.8	45
Osteoporosis	45	53	98	68.5	143
Total	53	71	124	65.9	188

As a result of the intervention, 8 additional patients were diagnosed with osteopenia with high fracture risk; however, one of them had a previous diagnosis of osteoporosis and is

therefore coded as having osteoporosis for this analysis. One of the 8 patients started treatment, three were undecided and four declined to start medication.

As shown in Table 6, a known 143 patients had a known history of osteoporosis three months prior to the intervention. Within the three months prior to the intervention, two patients had a new osteoporosis diagnosis and began treatment. During the intervention, fourteen of the patients had DXAs showing osteoporosis, twelve of which were new diagnoses. Six of these 14 patients agreed to treatment, 5 declined and 3 were undecided. The medication initiation rate was 7 out of 22 (31.8%).

Table 7

Numbers and Percentages of Treatment-Eligible Patients in Practice Taking Osteoporosis Medication, After Intervention

Diagnosis	Treated as of 1/15/20		Never Treated		Treatment-Eligible Patients as of 1/15/20
	(n)	%	(n)	%	(n)
Osteopenia with high fracture risk	28	52.8	25	47.2	53
Osteoporosis	105	67.7	50	32.3	155
Total	133	63.9	75	36.1	208

As seen in Table 7, the percentage of treatment eligible patients who had ever taken medication declined from 65.9% prior to the intervention to 63.9% after the intervention. The medication initiation rate of the patients having DXA scans during the intervention (31.8%) was lower than the rate of patients agreeing to medication in the practice in general prior to the intervention (65.9%).

Assessment of Improvement in Osteoporosis Knowledge

The average number of items answered correctly on the OKAT tool was 5.55 (SD = 3.3) prior to the counseling visit compared with 10.18 (SD = 2.2) items after the visit. Table 8 illustrates the number of patients who answered each item correctly in the pre-test OKAT and post-test OKAT.

Table 8

Percentage of Patients with Correct Answer on OKAT Tool Pre-test vs. Post-test, by Item

Item (Correct Answer)	Percent with Correct Answer Pre-test (%)	Percent with Correct Answer Post-test (%)	Change in Number of Correct Items (%)
1. Osteoporosis leads to an increased risk of bone fractures. (True)	100	100	0
2. Osteoporosis usually causes symptoms (e.g., pain) before fractures occur. (False)	36.3	81.8	45.5
3. Having a higher peak bone mass at the end of childhood gives no protection against the development of osteoporosis in later life. (True)	0	54.5	54.5
4. Osteoporosis is more common in men. (False)	54.5	100	45.5
5. Cigarette smoking can contribute to osteoporosis. (True)	45.5	100	54.6
6. White women are at highest risk of fracture when compared with other races. (True)	9.1	63.6	54.5
7. A fall is just as important as low bone strength in causing fractures. (True)	45.5	45.5	0
8. By age 80 years, a majority of women have osteoporosis. (True)	45.5	72.7	27.2

9. From age 50 years, most women can expect at least one fracture before they die. (True)	27.3	45.5	18.2
10. Any type of physical activity is beneficial for osteoporosis (False)	45.5	54.5	9.0
11. It is easy to tell whether I am at risk of osteoporosis by my clinical risk factors. (True)	45.5	72.7	27.2
12. Family history of osteoporosis strongly predisposes a person to osteoporosis. (True)	54.5	72.7	18.2
13. An adequate calcium intake can be achieved from two glasses of milk a day. (True)	18.1	54.5	36.4
14. Sardines and broccoli are good sources of calcium for people who cannot take dairy products. (True)	54.5	63.6	9.1
15. Calcium supplements alone can prevent bone loss. (False)	27.2	63.6	36.4

While the number of patients completing the OKAT tool was small (n=11), a few patterns emerged. Item 1 was universally answered correctly before and after the intervention, meaning that the item was likely too easy for this population and perhaps should not be included. The items related to calcium sources (items 13 and 15) showed improvement as this was a focus of the counseling. There was no improvement in knowledge about the importance of falls; it was not directly covered in the educational handouts. Of note, the instrument was set up with “I don’t know” as an answer, making it less likely for participants to make an educated guess.

Timeline

A summary of the project timeline can be found in Appendix K. After project approval on August 13, 2019, data from the EMR was examined to determine eligible participants for the

study. Eligibility lists were reviewed by the practice's PCPs the week of September 30, 2019. The scheduling department received DXA orders for eligible participants October 8, 2019. Letters were mailed at the end of the business day on Friday, October 11, 2019. As the following Monday was a national holiday, the intervention start date was Tuesday, October 15, 2019; this is the first business day that patients could call to schedule a DXA scan. Starting the week of November 11, 2019, patients without evidence of a DXA scan were reminded by phone. The reminder calls took three weeks. Over a period of three months, numbers of DXA scans, their results and treatment decisions were recorded. The last DXA scans included in the analysis took place on January 15, 2020.

Discussion

Phase I of this intervention, involving mailing patient letters inviting them to schedule DXA screening, was successful in encouraging 25.6% (n=67) of the patients to schedule a DXA scan within a three-month period. The practice's screening rate increased from 55.6% three months prior to the intervention to 66.3% three months after the intervention, which is an increase of 19.2%, short of the goal of 25%. However, even after the intervention period ended, DXA scans continued to be completed. Reminder calls were shown to be effective; about half of those who scheduled a scan did so after a phone call. As expected, the majority (70.1%) of the DXA scans showed bone loss, validating the procedure for selecting patients for a DXA invitation. Phase II involved 45 results letters and 11 counseling visits with the DNP student. During the counseling visits, patients demonstrated improvement in their osteoporosis knowledge as evidenced by an improvement in OKAT scores before and after the visits. The improvement from 5.55 (SD = 3.3) correct answers to 10.18 (SD = 2.2) demonstrated an 84.3% improvement, short of the goal of 100%. While some patients agreed to take medication, most

declined or were undecided. The medication initiation rate was 31.8%, below the 50% goal. The practice's medication initiation rates actually decreased from 3 months before to 3 months after the intervention.

In terms of this project's theoretical framework -- the Stetler model -- the fifth phase, evaluation, is a reflection of the application/evidence translation done by the intervention. While the intervention was mostly successful, there were aspects that could be done differently if such a population health effort were repeated. Additionally, reflecting on the interventions successes reveal lessons that can be used in everyday practice.

Successes of the Project

This was a simple intervention of low direct cost to the practice. Similar to quality improvement efforts involving reminder letters to patients to schedule mammograms or colonoscopies, this QI project could easily be replicated at a primary care practice. It was demonstrated that the effect of such a mailing would be bolstered by phone calls as well as prompting by providers. Patient compliance with the DXA recommendation does require that the patient be somewhat familiar with osteoporosis or bone density screening in the first place; this starts during preventative care visits.

Even if patients did not agree to a DXA scan or medication during the three-month intervention period, it opened up conversations between patients and providers about lifestyle recommendations, screening and medication options. Physicians in the practice demonstrated these conversations in their progress notes during the intervention period. Additionally, initial improvements in the screening rate have the potential to maintain higher screening rates moving forward. For those with a new diagnosis of bone loss, providers will likely recheck DXA scans on many of these patient in the next several years. Additionally, with an osteopenia or

osteoporosis diagnosis added to the problem list, providers will be reminded to address these diagnoses at preventative care visits.

This intervention was particularly popular with men over age 70. The level of improvement may reflect the practice's overall under-screening of bone loss in older men. Specifically, many of the men who had never been screened were willing to have a DXA but had never been advised to do so. In contrast, DXA screening in women is more common, so many of the women who received letters in this intervention may have represented a group less compliant with routine recommendations, and an invitation letter would have been relatively ineffective at creating a change in behavior.

The OST thresholds used in this project showed a sensitivity of 72.7% in detecting any bone loss (T score of -1.0 or less), though the OST sensitivities calculated in Nayak et al. (2015) assume a T-score of -2.0 or less. This project, though using a relatively small sample, supports the use of OST in clinical practice. It requires only age and weight to calculate the OST score, whereas other fracture risk tools require more data that may not be readily available in the EMR. Additionally, the OST may easily be added into an EMR function for clinical decision support. This practice's EMR already has a calculator tool for predicting an atherosclerotic cardiovascular disease (ASCVD) score based on several variables pulled from EMR data.

Counseling sessions used evidence-based practice to answer common questions but also well-tailored to individual patient concerns and medical histories. Patients expressed that they had learned useful information in the counseling session, even if they decided not to take medication. Some patients showed that they are more willing to take calcium supplements and were not aware that taking a calcium supplement with magnesium can help counteract

constipation. The medication and lifestyle education handouts continued to be used after the intervention period ended.

Lessons Learned

While the reminder calls were useful, they were very time consuming. The planned protocol was to remind patients over the phone to complete the scan one month after the letter was sent. This took one week longer than expected; the calls took place from November 12-25 and one of the practice's medical assistants was recruited to help call the patients. When the DNP student called, patients often had questions about screening or unrelated issues, taking up time on the phone. Calls were faster when done by the medical assistant, who was able to triage patient questions back to the DNP student or PCPs if needed.

Chart reviews revealed missed opportunities for treatment. Prior to the project, a new diagnosis of bone loss was often not added to the problem list in the patient's chart after a DXA scan was read. The items in a problem list serve as a prompt in creating an assessment and plan during a visit; without the item in the problem list, the diagnosis is more easily ignored. Additionally, prior to the intervention, result letters were often sent to these patients without proper follow up; a more proactive plan would be to communicate directly with the PCP to tell them that the patient is pending a decision about medication or that a letter/voicemail was sent. In this practice, an EMR flag can be scheduled ahead of time to send to the PCP just prior to their next appointment.

Chart reviews also came with an unexpected finding: some patients had a diagnosis on their problem list, "osteopenia determined by x-ray." This diagnosis was chosen if an x-ray or CT scan showed an incidental finding of an "osteopenic" appearance (as worded by the interpreting radiologist), but a DXA was not available for validation. As a result, all chart

reviews included an assessment of all available x-ray and CT records to find mention of osteopenia in the interpretation. For this project, “osteopenia on imaging” became its own eligibility criterion. Although x-ray is not used in the diagnosis of osteopenia or osteoporosis, McCullagh, McCoy, Crawford, and Taggart (2003) showed that of individuals with a spinal x-ray showing signs of osteopenia, 49.2% had osteopenia (T-score -1 to -2.5) on a DXA scan, while 38.1% had osteoporosis (T-score <-2.5) on DXA. In this intervention, nine of the patients who had DXAs based on osteopenia on prior imaging, and only one had normal bone density. In the future, one could consider screening patients if x-ray reports state “decreased mineralization” in the interpretation; such patients were not included in this intervention.

Widening the inclusion criteria to screen patients with a history of fracture for bone loss provided a form of secondary fracture prevention that was similar to work done by fracture liaison teams (Wu et al., 2018). Screening these patients may have opened up the conversation about osteoporosis treatment that was not discussed in the acute phase of fracture treatment or forgotten. However, the location of the previous fracture matters. Those with rib and ankle fractures in this sample of patients had DXA scans showing normal bone density, while patients with a history of femur and vertebral fractures had DXA scans showing osteoporosis. A retrospective cohort study showed that lower leg fractures, including foot, ankle, tibia and fibula fractures were the lowest predictor of future fracture, while hip and femur fracture were the most predictive of future fractures (Beaudoin et al., 2018). This knowledge helps the provider prioritize osteoporosis screening in patients with hip fractures. If this type of intervention were repeated, providers should focus their efforts in screening those with hip and femur fractures.

The decreased medication initiation rate was a surprising result. A possible reason for this was the nature of the medication counseling. In order to help patients to make informed decisions

about treatment, the counseling heavily focused on drawbacks and potential side effects, perhaps not fully illustrating the benefits of reduced fracture risk. Another reason was that patients in the practice who have previously tried osteoporosis medication were mostly counseled by their PCPs, with whom they had built a trusting relationship. Some of the patients who presented for counseling in this intervention had never met the DNP student before their visit. If this were the case, it may have given more legitimacy to the advice to state during the visit, “I showed these results to your PCP and they agree with the recommendation that you start medication.”

Project Facilitators and Barriers

Within this setting, the providers are very supportive of osteoporosis screening, which facilitated the intervention. The DNP student who ran the intervention has been working at the practice for seven years and has a good rapport with many of the patients; receiving a letter from a familiar person may have given credibility to the recommendation to have a DXA scan. Logistics were also made easier with the support of the practice and hospital staff. Specifically, permission from the hospital’s population health team has been granted to use a software tool called IBM Watson. This tool has already been programmed to search EMR data to generate lists of patients (women over 65 and men over 70) who have not had DXA scans in the last two years. The hospital’s marketing team was also supportive in proofreading the invitation letter and printing the educational brochures.

Barriers to this intervention was the relatively low patient prioritization of bone density screening as well as patients’ low perceived risk of fracture. A relatively low number of the practice’s patient interactions during the intervention period included a discussion about scheduling a DXA scan. There were many overlooked opportunities to remind patients during office visits to schedule a DXA; handling acute symptoms often took priority at sick visits.

Another possible barrier was the generic form letter that did not give patients any specific reason why they should be screened. More individual feedback about risk factors may have been more motivating for patients to schedule a DXA scan.

The goal of the patient education included with the letters is to raise awareness of fracture risk. Even for patients who are aware of fracture risk and agree to DXA screening, osteoporosis medications have received negative publicity due to rare adverse events, and this is a barrier to starting treatment for some patients. Fear about medication risks is one of the main reasons for the osteoporosis treatment gap in general. Compston (2020) also points out that the treatment gap for osteoporosis is fueled by 1) the fact that osteoporosis is treated by a variety of specialties, making it unclear who is “in charge” of the patient’s treatment and 2) the inconsistency between treatment guidelines is confusing and reduces their credibility.

Nursing Implications

The nurse practitioner, particularly in the areas of adult-gerontology, women’s health and endocrinology, has the challenge of addressing bone health in patients 50 and over, even when more pressing diagnoses take priority. One reason this is a challenge is the asymptomatic nature of bone loss. However, nurse practitioners can advocate for primary prevention of bone loss and fracture and secondary prevention with appropriate screening. Some nurse practitioners are already functioning as fracture liaison providers, but nurse practitioners at large are at the forefront of patient education; they should keep themselves educated about lifestyle recommendations for their patients over 50 as well as medication options for treating osteoporosis. Nurse practitioners also need to keep updated on screening guidelines, though national guidelines do not always agree.

Conclusion

DXA screening in older women and men is underutilized despite the advice of several national guidelines. This quality improvement project identified older adults at highest risk of fracture and increased osteoporosis screening rates in a primary care practice with a simple, low-cost intervention. The results of this project were consistent with the current evidence that interventions including letters inviting eligible patients to self-refer for DXA screening have been effective at increasing bone density screening, especially if paired with a reminder phone call. The intervention did show some improvement in osteoporosis knowledge in those who received counseling, but failed to improve medication initiation in this patient population. In order to maintain the successes of the project, the practice may need to place more importance on bone density screening and integrate it with other population health screening efforts, such as those for colonoscopies or mammograms. An effort to educate other providers about the OST's usefulness as a screening tool, as well as the utility of following up with a DXA if osteopenia is noted on imaging results, also may clarify who needs to be screened for osteoporosis. Such efforts must start with increased awareness of the providers in the practice and a willingness to treat bone density screening as a clinical priority.

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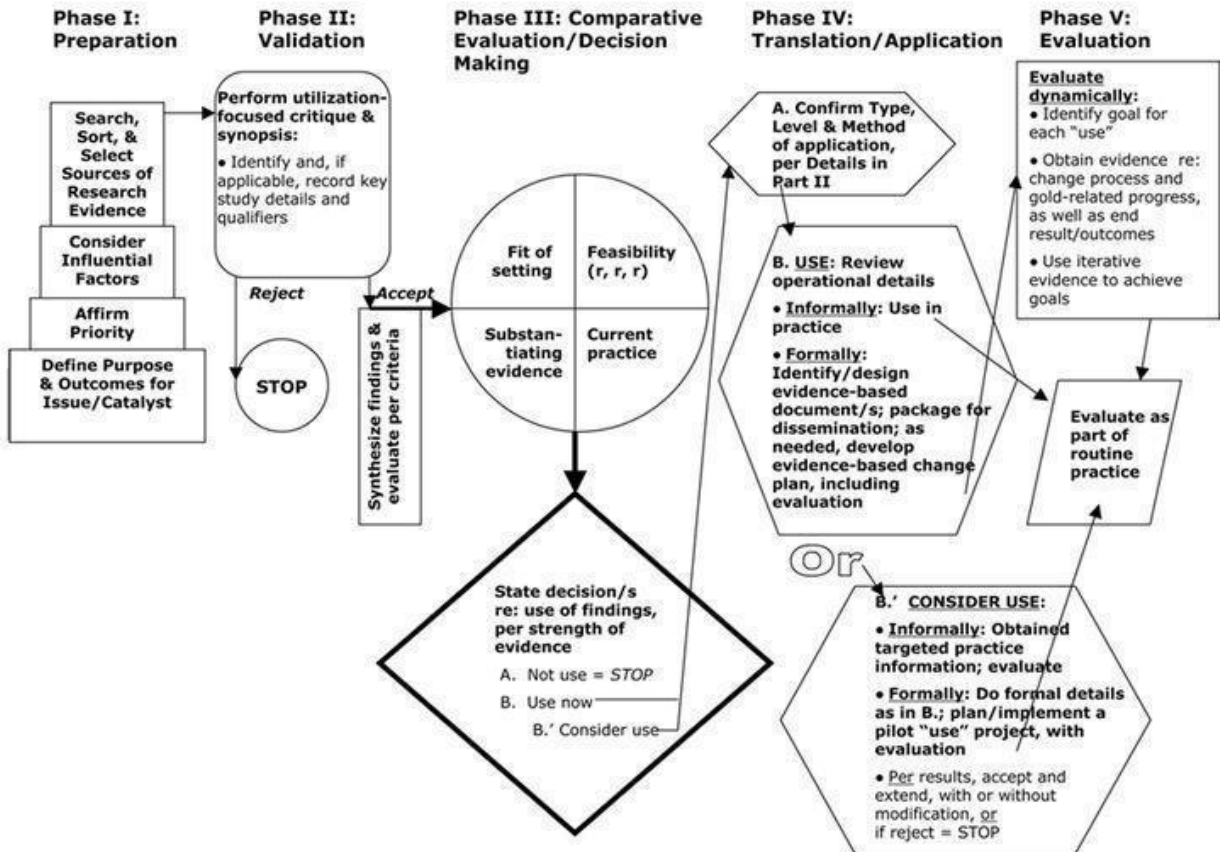
Appendix A

Summary of Osteoporosis Screening Guidelines

Guideline	Women ≥ age 65	Postmenopausal women with risk factors	Men ≥ age 70	Men age 50- 69 with risk factors
American Academy of Family Physicians (AAFP)	X	X	Insufficient evidence	Insufficient evidence
American College of Preventative Medicine (ACPM) (Lim et al., 2009)	X	X	X	X
American College of Obstetrics and Gynecology (ACOG)	X	X	N/A	N/A
Association of Clinical Endocrinologists (AAACE) / American College of Endocrinology (Camacho et al., 2016)	X	X	N/A	N/A
American College of Physicians (Qaseem et al., 2008)	N/A	N/A	Only with risk factors	X
The Endocrine Society (Watts et al., 2012)	N/A	N/A	X	X
International Society for Clinical Densitometry (ISCD) (ISCD, 2015)	X	X	X	X
National Osteoporosis Foundation (NOF) (Cosman et al., 2014)	X	X	X	X
North American Menopause Society (NAMS)	X	X	N/A	N/A
United States Preventive Services Task Force (USPSTF, 2018)	X	X	Insufficient evidence	Insufficient evidence

Appendix B

Stetler Model of Research Utilization to Facilitate EBP, Part I (Stetler, 2001)



Appendix C

Sample of Letter to Eligible Patients

Date

Patient Name

Patient Address Line 1

Patient Address Line 2

Dear Mr./Ms. _____,

At [name of our practice], we are working to improve care for patients who may be at risk for osteoporosis, which is a condition leading to thinning of the bones. This condition may result in debilitating fractures. Based on information from our electronic medical records, you have one or more risk factors for bone loss. Our recommendation is that you schedule a low-radiation scan called DXA.

We have enclosed a brochure with information on osteoporosis and DXA scans for your review. **You may call to schedule a DXA scan through Central Scheduling at [Name of Hospital] at [phone number].** The test is available at the main hospital and [names of two outpatient centers].

Sincerely,

Heidi Doreau NP

[Names of PCPs]

Appendix D

Educational Brochure Side 1



What to expect during a DXA scan

- Low-radiation Xrays will be taken of your hip and lumbar spine (low back)
- The scanner passes over you while you lie on a cushioned table
- You should wear clothes without metal such as zippers or hooks
- You may eat or drink prior to the scan

Please check with your insurance provider about coverage of the scan. Medicare generally covers DXA scans every 2 years.



How can I prevent breaking a bone?

Lifestyle measures may help stabilize bone loss and prevent fractures.

- Weight-bearing exercise, such as walking and light weight-lifting
- Minimizing caffeine and alcohol consumption
- Quitting smoking
- Taking calcium and vitamin D supplements

Preventing Falls

- Improve your balance with regular exercise and/or Tai chi classes
- Remove fall hazards from your home, such as area rugs
- Install grab bars or hand rails if needed
- Wear sensible shoes

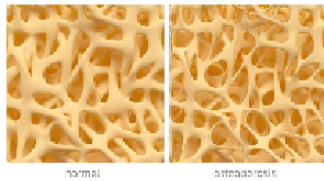


BONE DENSITY TESTING

Preventing fractures in adults 50 and over

Appendix D (Continued)

Educational Brochure Side 2



What is osteoporosis?

- Osteoporosis, meaning "porous bones," is a widespread medical condition in which bones become more brittle.
- There are no symptoms of the disease until a fracture occurs.

Who is at risk?

Up to 30% of women over 50 and 19% of men over 50 are at high risk of fracture due to bone loss.*

Risk factors for bone loss include:

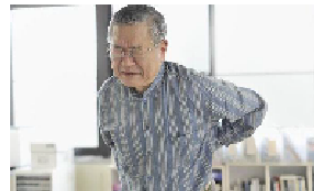
- Advanced age
- Low body weight
- Smoking
- Prolonged oral steroid use
- Rheumatoid arthritis
- Menopause before age 45
- Low testosterone

What is osteopenia?

- Osteopenia is level of bone loss that is more common and less severe than osteoporosis.
- Some cases of osteopenia progress to osteoporosis.
- Fractures occur in people with a diagnosis of osteopenia.

Regular screening with bone density scans helps you and your health care team decide if you need medication.

- Your health care team may order a dual-energy X-ray absorptiometry (DXA) scan after you turn 50.
- Most guidelines recommend DXA screening for women over 65 and other adults over age 50 who are at risk of bone loss.



Medication Options

Osteoporosis medication is recommended in those at high risk of fracture, including some with a diagnosis of osteopenia.

Osteoporosis medications may cut your risk of fracture in half.

- Oral medications include bisphosphonates: alendronate (Fosamax) and risendronate (Actonel). These are taken once a week.
- Your healthcare team may offer you injectable medications, such as zoledronic acid (Reclast) or denosumab (Prolia).

* Dawson-Hughes, B., Looker, A. C., Tosteson, A. N., Johansson, H., Kanis, J. A., & Melton, L. J. (2012). The potential impact of the National Osteoporosis Foundation guidance on treatment eligibility in the USA: an update in NHANES 2005-2008. *Osteoporosis International*, 23(3), 811-820.

Appendix E

Sample DXA Results Letter

Name
Address Line 1
Address Line 2

Date

Dear Mr./Ms. _____,

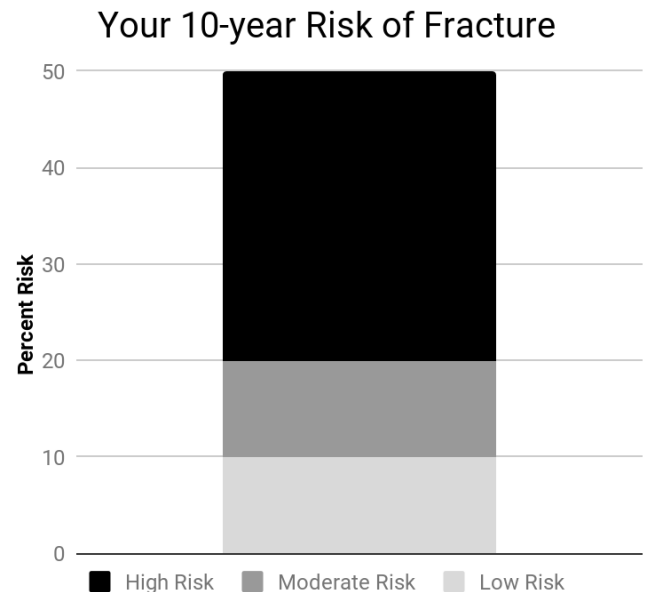
The following are the results of your bone density (DXA scan) done on [date]. DXA scanners report bone density as a T-score. This score is a comparison of your bones to those of young adults, when bones are strongest. Your T-score is _____, which means that your bone density [is normal / shows osteopenia]. According to the World Health Organization’s fracture risk assessment tool FRAX, your risk of a fracture in your spine, forearm, shoulder or hip in the next ten years is _____, while your risk of fracturing a hip is _____.

Your bone health can be [maintained/improved] with minimizing caffeine and maximizing weightbearing exercise. Also, you can supplement your diet with calcium citrate 1200mg and vitamin D3 1000 units per day. [If osteopenia: “We plan to recheck your bone density in 5 years.”] If you have questions about your results, please contact our office.

Sincerely,

Heidi Doreau NP

[Name of PCP]



Appendix F

Patient Diet and Lifestyle Education Handout (Page 1)

Important Facts about Bone Health

Osteoporosis is a common condition that leads to thinning of the bones and increased risk of fractures. Osteopenia is bone loss to a lesser degree than osteoporosis, but may lead to osteoporosis one day. Bone loss causes only one symptom: fracture, particularly with minimal trauma.

- Children and young adults who exercise achieve a higher peak bone mass than those who are sedentary. Additionally, exercise can help adults prevent bone loss. Such exercises include weight-bearing (walking, jogging, climbing stairs) and resistance exercises (exercise machines, weightlifting).

However: Those with severe osteoporosis should use caution with lifting heavy weights, bending at the trunk, and rotating the spine side to side as these movements may lead to compression fractures of the spine.

- By age 70, over half of women have bone loss requiring medication.¹ 1 in 3 postmenopausal women will have an osteoporotic fracture in her lifetime.²
- About 19% of men over 50 have bone loss requiring medication¹ and 1 in 5 men over 50 will have a fracture in his lifetime.²
- The majority of fractures occur in those with a diagnosis of osteopenia as this is a more common condition than osteoporosis.
- Vertebral fracture is the most common type of osteoporotic fracture.³

Risk factors for bone loss include:

- Being female, particularly after menopause
- Low testosterone in men
- Being Caucasian
- Cigarette smoking
- Drinking more than 3 alcoholic beverages daily
- Rheumatoid arthritis
- Family history of osteoporosis
- Taking certain medications, such as oral steroids

Prepared by Heidi Doreau NP

Appendix F (Continued)

Patient Diet and Lifestyle Education Handout (Page 2)

Diet Recommendations for Optimizing Bone Health

- Calcium supplements alone have a modest ability to reduce fractures: about 15%.⁴
- Your goal is to consume at least 1200mg of calcium per day,³ preferably from your diet. An 8 ounce glass of milk has 300mg.⁵ Nondairy source of calcium include sardines, broccoli, spinach, seeds, beans, and almonds.
- If you cannot get enough calcium in your diet, take calcium supplements. Pills with calcium citrate are best absorbed.
- Most calcium supplements come with vitamin D3, but you may need an additional vitamin D3 supplement to get the daily recommended 1000-2000 units. The daily upper limit of vitamin D3 is 4000 units.⁶
- Calcium can be constipating. Taking a calcium pill containing magnesium may help counteract constipation.
- Protein is also important for bone health: eggs, fish, chicken, beans, nuts, yogurt, cottage cheese.
- Caffeine intake recommended not to exceed 1-2 servings per day.⁴
- Soy supplements do not have a significant effect on bone density.⁶

References

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Appendix G

Patient Handout Summarizing Medication Options

Medication Options for Treating Osteoporosis

- Alendronate (Fosamax) - most effective of the oral bisphosphonates
 - Pill taken once a week
 - Alendronate reduces:
 - vertebral fractures by 44%
 - hip fracture by 40%
 - nonvertebral fractures by 17% (Eastell et al., 2019).
 - Usually given for 5 years but can be used for 10 years in severe cases
 - Common side effects include acid reflux and stomach discomfort
 - Rare side effects include osteonecrosis of the jaw (ONJ) and atypical femur fracture (AFF)
- Zoledronic acid (Reclast) is an IV bisphosphonate
 - Dose is 5 mg by intravenous infusion over at least 15 min once yearly
 - Usually given for 3 years (3 doses), but in severe cases up to 6 years
 - Over 3 years, zoledronic acid reduces:
 - vertebral fractures by 70% (with significant reduction at 1 year)
 - hip fractures by 41%
 - nonvertebral fractures by 25% (Cosman et al., 2014).
 - Potential side effects include muscular and joint pain; these mostly resolve within 3 days after treatment.
- Denosumab (Prolia) is a human monoclonal antibody - a “biologic agent”
 - Prolia reduces:
 - vertebral fractures by ~68%,
 - hip fractures by ~40%
 - nonvertebral fractures by ~20% over 3 years (Cosman et al., 2014).
 - Potential side effects include low calcium, cellulitis, rash, ONJ (rare), AFF (rare)
 - When discontinued, rapid bone loss results and should be immediately followed by a bisphosphonate

References

- Cosman, F. & de Beur, S. J., LeBoff, M. S., Lewiecki, E. M., Tanner, B., Randall, S., & Lindsay, R. (2014). Clinician’s guide to prevention and treatment of osteoporosis. *Osteoporosis International*, 25(10), 2359–2381. doi:10.1007/s00198-014-2794-2
- Eastell, R., Rosen, C. J., Black, D. M., Cheung, A. M., Murad, M. H., & Shoback, D. (2019). Pharmacological Management of Osteoporosis in Postmenopausal Women: An Endocrine Society Clinical Practice Guideline. *Journal of Clinical Endocrinology & Metabolism*, 104(5), 1595–1622. doi: 10.1210/jc.2019-002

Appendix H

The Osteoporosis Knowledge Assessment Tool (OKAT)

Please answer each of the following questions with True, False or Don't Know.

1. Osteoporosis leads to an increased risk of bone fractures.
2. Osteoporosis usually causes symptoms (e.g. pain) before fractures occur.
3. Having a higher peak bone mass at the end of childhood gives **no** protection against the development of osteoporosis in later life.
4. Osteoporosis is more common in men.
5. Cigarette smoking can contribute to osteoporosis.
6. White women are at highest risk of fracture as compared to other races.
7. A fall is just as important as low bone strength in causing fractures.
8. By age 80, the majority of women have osteoporosis.
9. From age 50, most women can expect at least one fracture before they die.
10. Any type of physical activity is beneficial for osteoporosis.
11. It is easy to tell whether I am at risk of osteoporosis by my clinical risk factors.
12. Family history of osteoporosis strongly predisposes a person to osteoporosis.
13. An adequate calcium intake can be achieved from two glasses of milk a day.
14. Sardines and broccoli are good sources of calcium for people who cannot take dairy products.
15. Calcium supplements alone can prevent bone loss.

Appendix I
Cost-benefit Analysis

Item	Cost
<i>Data Collection and Analysis</i>	
Laptop with access to EMR, IBM Watson and Excel software	Provided by the primary care practice
<i>Printed & Mailed Materials</i>	
Letterhead for letters to patients, envelopes	\$30 (provided by the primary care practice)
Educational brochures	\$140 (printing paid by hospital)
Postage	\$157 (paid by the primary care practice)
<i>Personnel</i>	
DNP student as program coordinator for 2 semesters (6 credits)	\$750 per credit = \$4,500 (not included in total costs for project)
Marketing staff (editing brochure) – 2 hours	\$30 per hour x 2 hours = \$60 (paid by the hospital)
Central Scheduling (processing orders) 285 orders over 16 hour period	\$25 per hour x 16 hours = \$400 (paid by the hospital)
Certified densitometry technologists 69 scans, totaling 18 hours	\$25 per hour x 18 hours = \$450 (paid by the hospital)
Medical assistant (phone reminders)	\$25 per hour x 4 hours = \$100
Radiologists interpreting DXA results 69 scans, totaling 18 hours	\$200 per hour x 18 hours = \$3600 (paid by the hospital)
<i>Billable services</i>	
DXA scans \$125 per scan x 69 scans	\$8625 (Paid by health insurance to the hospital)
Total estimated costs	\$13,562

Appendix J

Project Approval by UMass Human Research Protection Office

UMassAmherst

Human Research Protection Office

Mass Venture Center
100 Venture Way, Suite 116
Hadley, MA 01035
Telephone: 413-545-3428**Memorandum – Not Human Subjects Research Determination****Date:** August 13, 2019**To:** Heidi Doreau, College of Nursing**Project Title:** Improving Bone Density Screening at a Primary Care Practice**IRB Determination Number:** 19-126

The Human Research Protection Office (HRPO) has evaluated the above named project and has made the following determination based on the information provided to our office:

- The proposed project does not involve research that obtains information about living individuals [45 CFR 46.102(f)].
- The proposed project does not involve intervention or interaction with individuals OR does not use identifiable private information [45 CFR 46.102(f)(1),(2)].
- The proposed project does not meet the definition of human subject research under federal regulations [45 CFR 46.102(d)].

Submission of an Application to UMass Amherst IRB is not required.

Note: This determination applies only to the activities described in the submission. If there are changes to the activities described in this submission, please submit a new determination form to the HRPO prior to initiating any changes.

A project determined as “Not Human Subjects Research,” must still be conducted in accordance with the ethical principles outlined in the Belmont Report: respect for persons, beneficence, and justice. Researchers must also comply with all applicable federal, state and local regulations as well as UMass Amherst Policies and procedures which may include obtaining approval of your activities from other institutions or entities.

Please do not hesitate to call us at 413-545-3428 or email humansubjects@ora.umass.edu if you have any questions.



Iris L. Jenkins, Assistant Director
Human Research Protection Office

Appendix K

Project Timeline

Task	Aug 2019	Sept 2019	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020
Project approval	X								
Selection of eligible participants	X	X	X						
DXA orders sent to Central Scheduling			X						
Letters mailed to eligible participants			X						
DXA scans performed			X	X	X	X			
Reminder phone calls				X	X				
Outcome evaluation						X	X	X	X