



RESEARCH ARTICLE

Learner Practice Gaps in Osteoporosis: Piloting a Metabolic Bone Disease Curriculum within a Fracture Liaison Service Framework

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ABSTRACT

Osteoporosis is a disease increasing in prevalence and a growing public health concern. However, health care gaps in the diagnosis and management of osteoporosis exist. One of the factors contributing to this observation may be that the disease does not receive significant attention particularly during internal medicine residency training. A curriculum was designed and implemented in a cohort of Loma Linda University internal medicine residents to address this issue. It consisted of a week-long rotation that allowed residents to enhance their knowledge of the recognition and management of osteoporosis through participating in an inpatient Fracture Liaison Service as well as attending osteoporosis conferences. A retrospective review of the osteoporosis management practices of residents who completed the curriculum was performed, with the objective of evaluating health care gaps among these residents and to inform educators about possible areas for curriculum improvement. Twenty-one internal medicine residents completed the MBD rotation during the designated period. Of those, 6, 9, and 6 were PGY 1, 2, and 3, respectively. 133 charts were reviewed for encounters occurring within 3 months of the MBD rotation completion. Residents who have completed the osteoporosis curriculum treated osteoporosis in 65.8% of patients who qualified, which is higher than the national average of 40% in the US, it less than an improvement than the authors expected. It is the opinion of the authors that internal medicine residents should emphasize osteoporosis care more given the prevalence, morbidity and mortality of the disease. There is work to be done to create an effective curriculum for this disease during postgraduate medical training.

Keywords: Population health, Quality improvement, Fracture liaison service, Osteoporosis, Medical education

Introduction and Background

Osteoporosis is the most common bone disease in humans. It is characterized by demineralization of bones that results in an increased risk of fragility fractures, which are defined as pathologic fractures that result from a fall that occurs from standing height or less¹. It is a major public health concern with a large, well-documented care gap². In fact, it is estimated that the population of individuals aged 50 or older with osteoporosis or low bone mineral density will increase from roughly 53 million in 2010 to 70.6 million in 2030³. However, despite the increasing prevalence and widespread impact, under-diagnosis and undertreatment have remained key issues.² Contributing factors to underdiagnosis have included Medicare reducing reimbursement for dual energy bone absorptiometry (DXA) in 2007⁴. There has been a 53% decline in prescriptions for oral bisphosphonates from 2008 to 2012 due in part to a decline in DXA scans being performed, but also to safety concerns related to atypical femoral fractures and osteonecrosis⁵.

The consequences have been profound. Researchers noted that from 2002 to 2012, the overall incidence of hip fractures in women aged ≥ 65 years declined at an annual per-centage rate of 1.8%. However, this rate plateaued as a decreasing number of DXA scans were ordered by outpatient providers, which likely contributed to an increase in the incidence of hip fractures by more than 11,000 nationwide from 2013-2015. The increase in hip fractures was substantially higher than what was projected had the decline in incidence continued as noted from 2002 to 2012⁶. The increase in hip fractures translates to a reduction in quality of life, increased healthcare spending, and even increased mortality. Individuals who sustain these fractures suffer significant loss of independence and functional impairment even up to 1 year after the initial fracture⁷. An increased risk of mortality is also demonstrated in women after an osteoporotic fracture compared to women without a fracture (3 vs 1.8 per 100 woman-years). In the same study, hip fractures were found to increase mortality 2.4-fold compared to other types of osteoporotic fractures⁸.

The burden of illness, however, extends far beyond those individuals who are directly affected. In fact, healthcare resource utilization (including number of hospitalizations and facility related hospital cost) from osteoporotic fractures far exceeds that of myocardial infarction, stroke, or breast cancer in US women 55 years and older⁹. Efforts have been made to advocate for appropriate management of osteoporosis including outlining quality of osteoporosis care measures by the National Committee for Quality Assurance (NCQA)¹⁰. These measures include performing a DXA scan or prescribing pharmacological therapy to treat osteoporosis in the six months after a fracture has occurred. Further recommendations included documentation of communication with the patient's primary care provider that a fracture has occurred, and that the patient would benefit from further workup or treatment of osteoporosis. Despite the availability of cost-effective and well-tolerated treatments to reduce fracture risk, less than one third of patients are treated with an osteoporosis medication within one year post fragility fracture¹¹.

The authors speculate that one of the likely contributing factors to the osteoporosis care gap is the discrepancy between the prevalence of the disease and the inadequate emphasis on osteoporosis education as part of postgraduate training. Internal medicine and family medicine providers are often the first line providers to identify and treat osteoporosis as part of their practice, and it is imperative that they are experienced and knowledgeable on the topic. However, the American Board of Internal Medicine (ABIM) 2020 board examination blueprint only requires that $<2\%$ of the exam include items related to disorders of calcium metabolism and metabolic bone diseases each, of which osteoporosis is only one. In comparison, hypertension, for example, is 5% of the tested material¹².

A Fracture Liaison Service (FLS) was established at our medical center in 2017 to address the osteoporosis care and knowledge gap. An FLS is a secondary osteoporosis prevention measure that facilitates identification of patients with fragility fractures being admitted to the hospital and transitions patients to outpatient care for osteoporosis management. Additionally, a metabolic bone disease (MBD) curriculum was designed within the framework of the FLS for Internal Medicine residents rotating through Rheumatology. Teaching occurred in formal lectures and bedside rounds, where patient cases were discussed with residents directly. Of note, prior to initiation of this curriculum, the residents had no formal exposure to osteoporosis teaching. The overall goal of this curriculum was to improve resident education ultimately leading to improvements in the care of patients with osteoporosis in the community. This study's objective is to evaluate osteoporosis practice care gaps among these residents, with the aim of informing educators about possible curriculum improvement areas in their training programs.

Methods

A retrospective review of osteoporosis management practices of residents who have rotated through Rheumatology and completed an MBD rotation from April 2018 to June 2020 was completed. The retrospective review of care provided by the residents spanned from May 2018 to September 2020.

Study Population

There are thirty to thirty-three internal medicine residents per year at our institution. The internal medicine residency is a three-year program and rheumatology may be taken as an elective in any of the years. Each year is described as either PGY-1, PGY-2, or PGY-3 depending on how many years have passed since graduation of medical school. There are typically no more than two residents rotating in rheumatology at any one time. There are some months where there is not an internal medicine resident rotating on rheumatology. During our study period, 26 residents took the rotation that included the MBD curriculum. Five residents opted to not allow review of their patient charts to practice improvement and quality checks on this curriculum. Twenty-one residents were included in the study. All year levels (PGY1-PGY3) were included. Residents who did not consent to chart review of their patients were not asked why they chose not to allow review of their clinical care.

Curriculum Components

During the one-week MBD rotation, residents received didactics in the form of lectures and comprehension checks on the following topics:

- Osteoporosis diagnosis
- Secondary causes work up
- Osteoporosis therapy
- DXA image interpretation
- Glucocorticoid Induced Osteoporosis
- Lifestyle interventions to improve outcomes in osteoporosis

Clinically, residents interviewed patients who were hospitalized for a fragility fracture and patients who presented to the outpatient osteoporosis clinic. With the supervising physician, the residents formulated a plan to diagnose any underlying contributing conditions and a plan for therapy.

Metrics Definition

Osteoporosis practice guidelines and nationally defined patient outcome measures were reviewed^{13,14}. To assess for measures of osteoporosis quality of care, the following metrics were identified as top priority:

- Osteoporosis diagnosis:
 - Appropriate ordering of DXA scans. Inclusion criteria:
 - Females >65 years
 - Males >70 years who had not had DXA scan ordered in the prior 2 years
 - Documentation of patient history of fragility fracture and recognition of that as a definition of osteoporosis. Fragility fractures are those which occur from a fall of standing height in a person equal to or greater than 50 years of age and do not include hands, feet or face¹.
- FRAX use for treatment decision:
 - Appropriate use of the Fracture Risk Assessment Tool (FRAX) calculation when necessary.
 - FRAX should be used when all the criteria below are met:
 - Patients with osteopenia
 - Female, postmenopausal
 - Never on treatment
 - Have not had a fragility fracture
 - If a patient meets the above criteria and has a risk of fracture greater than 3% at the hip and greater than 20% for a major osteoporotic fracture, then therapy should be initiated.
- Osteoporosis secondary causes
 - If a vitamin D level was checked this was noted. Repletion of vitamin D level was not documented as part of this study.
 - If patients were on long term systemic steroids this was documented (> 3 months)

Osteoporosis treatment with anti-osteoporotic medication: Electronic Health Record (EHR) Review

Patient encounters from resident continuity clinics were reviewed. Encounters were selected for patients who warrant osteoporosis screening - women aged > 65 and men > 70 years of age - seen for routine follow-up visits in resident continuity clinics from May 2018-September 2020 (within 3 months of the resident having completed the MBD curriculum). A visit diagnosis or a problem list including osteoporosis was not required. We reviewed whether attempts were made to include osteoporosis disease recognition and risk assessment as part of these routine follow-up visits. The following practices were examined:

- Osteoporosis diagnosis: Did residents document a history of fragility fracture (ie recognize the clinical diagnosis of osteoporosis) or order a DXA scan to diagnose osteoporosis?
- Osteoporosis risk factor assessment: Did residents use the Fracture Risk Assessment Tool (FRAX) calculation when necessary (see above) and screen for a history of parental fracture, prior patient use of corticosteroids, and vitamin D deficiency?
- Osteoporosis treatment: Did residents appropriately treat osteoporosis with anti-osteoporotic medication, or refer to specialist for treatment?

Descriptive statistics were utilized.

Results

Twenty-one internal medicine residents completed the MBD rotation during the designated period. Of those, 6, 9, and 6 were PGY 1, 2, and 3, respectively. 133 charts were reviewed for encounters occurring within 3 months of the MBD rotation completion. Regarding osteoporosis diagnosis and treatment, 18 (85.7%) residents ordered at least one DXA scan. Of 132 patients who met criteria for DXA screening, 99 (75%) were women >65 years and 33 (25%) were men >70 years. In total, only 81 (61.3%) of the 132 patients had a DXA ordered, of whom only 5/33 men (15.1%) had a DXA ordered. Only 51 (62.9%) of the 81 patients for whom a DXA was ordered completed the test. Twenty-five (25/51, 49%) patients were found to have osteoporosis on DXA. Appropriate osteoporosis treatment was either started or continued in 17/25 (68%). In total, 15 patient charts had documentation of a prior fragility fracture. Of those, 8 (53.3%) were started or continued treatment.

The total number of patients with osteoporosis diagnosed, regardless of method, was 40. Of those, only 25 (62.5%) were either started or continued treatment. Of the remaining 15 patients who were not on anti-osteoporotic medication, 2 did not warrant treatment (one being on a bisphosphonate break and the other was intolerant of all medication tried). For the remaining 13 there was no documentation of treatment being offered by the resident. There was no evidence that patients were offered treatment and declined it. Two patients were seen by an osteoporosis specialist. The most common medication used was alendronate. One patient was on zoledronic acid. Two were on denosumab. In evaluating

potential barriers to treatment initiation, 2 of 13 untreated cases demonstrated insurance-related issues or communication issues regarding co-managing a patient also being treated at an outside healthcare facility.

FRAX calculation was warranted in 60 of 133 charts. Of these 60 patients, 40 patients did not have a DXA on file and 20 had osteopenia. It was discovered that 1 of the 40 patients who did not have a DXA on file had a FRAX

calculated while none of the 20 patients who had osteopenia had a FRAX calculated.

Regarding osteoporosis risk factor assessment, only 32 of 133 (24%) patients had a vitamin D level checked. There was no documentation of inquiry into the history of parental fractures. A total of 13 of 133 (9.8%) patients had a history of long-term steroid use, with no documentation of it as a recognized risk factor for osteoporosis (see Figure 1).

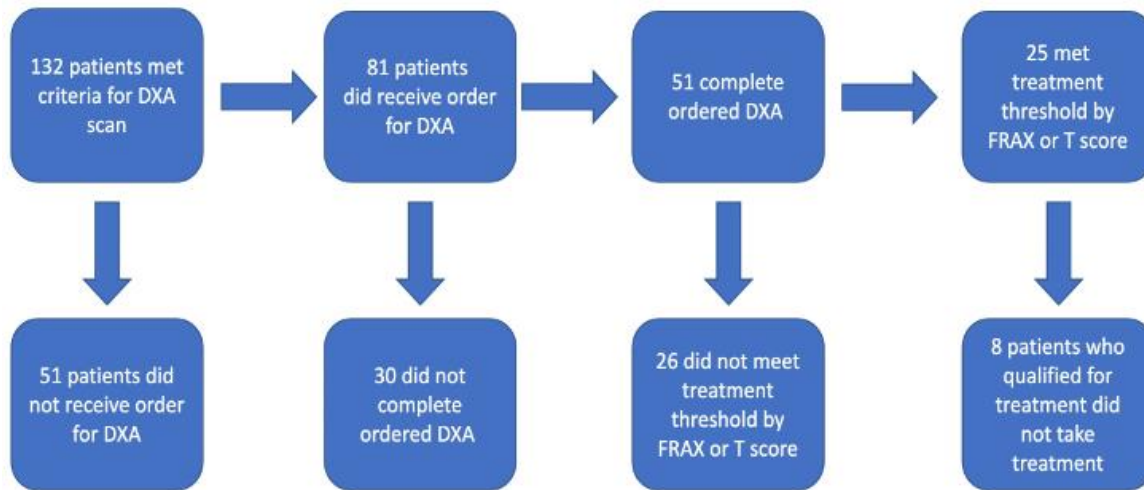


Figure 1. Results from chart review

Discussion

This review of osteoporosis practice management by Internal Medicine residents in continuity clinics who completed the MBD rotation reveals underutilization of diagnostic and risk assessment strategies, frequently missed patients with prior fragility fractures, and overall undertreatment of osteoporosis. This is evident by the findings that only 61.3% of patients who qualified for DXA had one ordered for them, only 61.6% of patients with fragility fractures started or continued osteoporosis treatment. Only 65.8% of confirmed osteoporosis patients who warranted treatment received it. While this well exceeds the 40% treatment rate found in a large US-population based study, we expected higher rates of treatment by residents who had just recently completed a curriculum focused on osteoporosis¹⁴.

The 38.4% of patients with a fragility fracture who were missed highlights the need to reinforce the concept that fragility fractures equate to a diagnosis of osteoporosis and require treatment. In addition, the fact that only 15.1% of men who warranted DXA had one ordered is likely explained by the fact that residents heavily rely on EHR reminders to screen for osteoporosis. The EHR utilized by residents was Epic, which automatically reminds providers to order DXA in women >65 years, but not in men >70 years. Finally, but certainly not least important, the significant underutilization of FRAX in the risk assessment of osteoporosis in the 60 patients for whom it was warranted demonstrates a knowledge gap that warrants correction.

Osteoporosis risk factor assessment performance of residents remained less than satisfactory, with only 24% of patients having Vitamin D levels checked and no

documentation of prior parental osteoporotic fractures or personal long-term steroid use in the risk assessment of patients.

The MBD curriculum consisted of a one-week rotation within the four-week rheumatology rotation with areas of emphasis on disease recognition and risk assessment. The residents completed FLS inpatient consults which required assessment of osteoporosis risk factors, determination of access to osteoporosis care, and management of referred patients in rheumatology outpatient osteoporosis clinics. Residents also attended osteoporosis conferences which included case discussions, DXA interpretation workshops, and review of treatment recommendations. Prior to this curriculum, the residents had no formal exposure to osteoporosis teaching integrated into the internal medicine residency program.

This lack of osteoporosis focus in medical education appears to be widespread. A review of online course results for Internal Medicine residents at Johns Hopkins regarding primary care topics including osteoporosis also showed that baseline knowledge among residents at university and community hospitals is poor¹⁵. This knowledge deficit carries throughout the medical education process and ultimately contributes to the wide osteoporosis care gap that can be seen in the community. Osteoporosis education should begin early in medical education (i.e. among students/residents) and be reinforced throughout their education. ACGME rheumatology fellowship requirements expect that a fellow must demonstrate competence in patient care and medical knowledge related to treating osteoporosis¹⁶, yet there is no such formal requirement for Internal Medicine residents, who are often one of the first points

of contact for those who require screening for this disease.

The MBD curriculum implemented in this study has its roots in the model of experiential learning, in which the learner gains knowledge and insights through practical application. This model of learning by doing is the foundation of medical school clerkships across the nation and extends through much of residency training. One of the benefits of integrating this model in medical training is that learners often “remember only a fraction of what they hear but a majority of what they actively do”¹⁷. In this model, learning is a continuous process that occurs through repeated exposure to and integration of knowledge in one’s field of practice.

While understanding and retrieval of knowledge form the basis of standardized tests in medical education, the real world of medicine often requires one to develop a level of comfort and proficiency in taking the next step of application to patient care. Implementing a curriculum is an intentional way of letting residents learn the importance of and the need for adequate screening and treatment of osteoporosis through actively engaging in FLS consults and assessments. The lessons learned were also reinforced by having residents attend osteoporosis conferences.

Ultimately, the goal of instituting a curriculum like the one described above is to effect change at the population level. Age-appropriate cancer screening has had a profound impact on reducing one’s mortality risk. For instance, instituting mammography as the gold-standard for breast cancer screening has been associated with up to 54% reduction in mortality¹⁸. For osteoporosis screening to have a beneficial effect on population health, it is important to incorporate changes to how and what residents are learning at all levels of training. One way of addressing the osteoporosis care gap is by instilling the understanding of the need for post-fracture care, as globally, it has been found that patients who receive anti-osteoporosis therapy after they have suffered a fragility fracture are more likely to adhere to medical therapy if they have gone through an FLS pathway than those who have not¹⁹.

The Kirkpatrick model of learning evaluation focuses on four key levels: reaction, learning, behavior, and results.²⁰ In examining the results of the MBD curriculum through the lens of this model, important insights may be gleaned. The first and second levels, reaction, and learning, were not evaluated in this study. In the future, it may be useful to assess a resident’s level of interest and perception of their experience with the MBD curriculum with an instrument such as a post-completion survey and their knowledge with a pre- and post-test. A study published in 2021 conducted a survey of 1,158 Graduate Medical Education programs in internal medicine, family medicine and obstetrics and gynecology in the United States found that most programs receive zero or one lecture about osteoporosis during the entirety of their education and that zero respondents felt well prepared to care for patients with osteoporosis.²¹ However, what is of particular interest in this study is the behavior that resulted from undergoing the MBD curriculum, not the learner perspective of their knowledge. Asking learners

to assess their competency in an area can fall victim to the Dunning-Kruger Effect, whereby individuals with limited knowledge or competence in a specific domain often lack the necessary self-awareness to accurately assess their own abilities leading to overconfidence in their skills.²²

As noted in the results above, diagnostic tools were underutilized, and patients were undertreated. In addition, there was insufficient documentation in the EHR by the residents regarding whether a patient’s osteoporosis risk factors were addressed during the clinic visit. It is possible that the residents did address those risk factors but failed to document them due to time constraints or forgetting to do so. Nevertheless, while the residents may have had knowledge from involvement in the MBD curriculum, that knowledge did not appear to adequately translate to a significant change in behavior. It is possible that these results may be linked to the fact that osteoporosis and metabolic bone diseases do not appear to be a significant focus of internal medicine residency training, particularly in the outpatient setting as noted in the 2021 study cited above.

Others have published results of osteoporosis educational interventions, however, there has not been another study to the authors’ knowledge that has taken the next step and translated the learning to actual patient care outcomes as this study has. For example, Nguyen et al have described a small group study of case-based osteoporosis education, however the authors did not take the next step to see if the intervention improved care of osteoporosis patients by residents.²³

Furthermore, it is likely that other diseases such as heart disease, diabetes, and hypertension appear to take precedence since they often produce tangible symptoms and the medications used to treat them are part of the bread and butter of medicine. In comparison, osteoporosis is a silent disease of the elderly that often manifests itself in the form of a fragility fracture. Given this information, it appears that osteoporosis is often a disease that is on the back burner of residents’ minds. As such, patients and medical providers alike may miss the window for primary prevention and not address the disease until the patient has already sustained a fracture. However, it doesn’t have to stay that way. One of the ways through which increased awareness and more appropriate osteoporosis screening may be developed may be to incorporate the MBD curriculum into each year of the internal medicine residency program. In addition, to ensure that all residents can participate in the curriculum, it could be instituted as a requirement during a resident’s elective months instead of only during a rheumatology rotation for which a resident is scheduled, as not all residents will be assigned to rotate through rheumatology.

Another way through which screening can occur in a timely, appropriate manner may be to establish clinical decision support for healthcare providers in the form of EHR-reminders. Thus, physicians can be alerted as to which patient needs a DXA scan in a timely manner.

This study is not without limitations. Due to the small number of residents who agreed to have their continuity

clinic records reviewed (21), we recognize that this is unlikely to represent the clinical practices of all Internal Medicine residents in the program. The authors allowed residents to opt out of undergoing practice review, however given the nature of the reviews and lack of any intervention aside from resident education, the option to not undergo practice review should likely not have been given to the residents. However, this small random sample provides sufficient insight to make improvements in the curriculum. Furthermore, the use of the EHR to review patient charts may not necessarily be reflective of true clinical practice but rather of documentation of clinical practice.^{24, 25, 26} In the future, it may be useful to examine possible interventions such as developing and utilizing EHR note templates on improving documentation accuracy to reflect clinical practice. In addition, patient barriers to screening and treatment may exist, as evidenced by the finding that a significant portion of patients for whom a DXA was ordered (30/81; 37%) did not complete the test. Possible barriers that may be further examined and addressed in future studies include patient access, health literacy, and insurance issues, all of which may play a role in helping patients achieve optimal bone health management.

Conclusion and Future Directions

Due to the unsatisfactory outcomes summarized above, it is apparent that the Loma Linda MBD curriculum needs to be modified. Areas for curricular improvement include reformatting the MBD rotation as a 2-week minimum

hands-on rotation providing multidisciplinary education including Orthopedic Surgery, Rheumatology and Endocrinology exposure. Increasing active learning components during the rotation and throughout the year in continuity clinics would help reinforce the material. In addition, it may also be helpful to include hard stops in clinic progress note templates that require providers to address a patient's osteoporosis risk factors, which may therefore lead to more appropriate screening and timely intervention. Outreach to continuity clinic supervising physicians for further resident guidance and education will also be paramount to improving patient osteoporosis outcomes. Those orthopedic residency programs with FLS programs are more likely to have dedicated osteoporosis education during training, therefore implementation of FLS programs at institutions with GME programs may be one way to increase OSP education in trainees.²⁷ We hope that this paper serves as a template for other medical education programs to examine their osteoporosis curricula and effect change that will improve osteoporosis outcomes in the United States.

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