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Review Article

The Osteoporosis Value Paradox: Compare Cost of Care for Cardiovascular Disease Versus Osteoporosis, Dual-Energy X-Ray Absorptiometry (DXA), Fragility Fractures and Implications for Economics and Secondary Prevention

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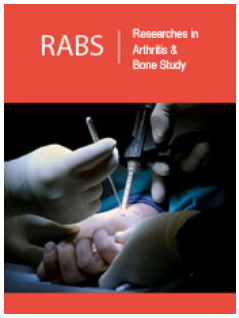

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Abstract

Background/Purpose: Cardiovascular Disease (CVD) and osteoporosis are leading contributors to morbidity, mortality, and healthcare expenditures. While CVD Has a much larger population and dominates total spending, osteoporosis-related fractures, especially hip fractures impose a larger substantial expense per-event and long-term costs. This study compares the economic burden, cost drivers, and prevention value of these conditions, with emphasis on gaps in osteoporosis care delivery.

Methods: A narrative economic analysis was conducted using published U.S. cost data, cost-effectiveness studies, and implementation metrics for CVD and osteoporosis. Outcomes included total annual costs, per-event costs, cost-effectiveness of preventive interventions, and real-world treatment rates following sentinel clinical events. The effects of the Women's Health Initiative (WHI) and the Dual-Energy X-Ray Absorptiometry (DXA) pricing were incorporated.

Using the 2015 to March 2020 National Health and Nutrition Examination Survey and 2015 to 2019 Medical Expenditure Panel Survey, this data indicates the estimated trends in prevalence for cardiovascular risk factors based on American Heart Association (AHA) adverse levels of Life's Essential 8 and clinical cardiovascular disease and stroke. It is projected for both contributors through 2050, overall and by age and race and ethnicity, accounting for changes in disease prevalence and demographics. The Cochrane Systemic Review also participated in some of the analyses.

Results: Government cutbacks on bone density readings include a professional component paying only $37 for non-facility bone density studies and the impact of the Women's Health Initiative had a detrimental effect on osteoporosis and fractures. Annual costs for CVD exceed $500 billion, compared with approximately $57 billion for osteoporosis-related fractures. However, per-event costs for hip fracture ($47,000-$71,000) equal or exceed those for myocardial infarction ($18,000-$29,000) and stroke ($15,000-$34,000). Hip fractures account for approximately 72% of osteoporosis-related costs despite representing a minority of fractures. Both diseases demonstrate high-value preventive interventions: statins and smoking cessation in CVD; DXA underpayment, anabolic and non-anabolic therapy and Fracture Liaison Services (FLS) in osteoporosis. Anabolic therapy, which is more effective but more expensive should also be included. Fracture Liaison Service (FLS) is cost-saving, with estimated savings of $418 per patient and $418 million per 1 million Medicare beneficiaries treated, preventing approximately 30,000 fractures. Despite this, implementation differs markedly: >90% of CVD patients receive secondary prevention after myocardial infarction, whereas <20% of patients receive osteoporosis treatment following hip fracture, but only ≈9% treated within 6 months.

Conclusion: Correcting underpayment and availability of bone DXA studies and understanding how incorrect interpretation of the WHI led to a higher risk of fractures. Although CVD carries a greater total economic burden, osteoporosis demonstrates comparable of greater cost intensity per clinical event and possible but not obtained highly favorable prevention economics. The persistent post-fracture treatment gap represents a major systems failure. FLS offers a scalable, cost-saving intervention that improves outcomes and reduces downstream costs. Aligning osteoporosis care with established CVD prevention frameworks represents a critical opportunity for value-based healthcare improvement.

Keywords: Osteoporosis; Fragility fracture; DXA; Cardiovascular disease; Cost-effectiveness; Fracture liaison service; Value-based care

Introduction

Cardiovascular Disease (CVD) and osteoporosis are major contributors to morbidity, mortality, and healthcare expenditures. While CVD, since it is a much larger proportion of the population, dominates total spending, fragility fractures impose substantial per-event costs, long-term disability, and mortality risk, yet remain underprioritized in prevention efforts [1-6]. Comparing the cost of care for cardiovascular disease versus the cost of care for osteoporosis and fractures, we find that Cardiovascular Disease (CVD) imposes a substantially larger economic burden than osteoporosis and fractures, with annual costs exceeding $500 billion versus approximately $57 billion for osteoporosis, yet both conditions demonstrate similar patterns of underinvestment in prevention relative to treatment costs and marked cost-effectiveness of targeted interventions when appropriately implemented. The comparison reveals critical differences in disease prevalence, acute care intensity, and prevention infrastructure that inform resource allocation decisions.

Comparative cost burden [1-6]

The CVD burden is approximately 9-fold larger in absolute dollars. However, this ratio obscures important clinical distinctions: CVD affects a larger population with an estimated 121.5 million adults (48% of U.S. adults ≥20 years), while osteoporosis affects 10.2 million adults ≥50 years with 2 million annual fractures [4-6]. On a per-patient or per-event basis, osteoporotic fractures demonstrate comparable or greater cost intensity (Tables 1 & 2).

Table 1: CVD Cardiovascular Vascular Disease includes a larger population than the osteoporosis population and more projected costs than osteoporotic fractures.

Condition	Annual Direct Medical Costs	Total Annual Costs (Direct+Indirect)	Projected Costs (2035)
Cardiovascular disease	$318 billion (2015) [1]	>$500 billion [2,3]	>$1 trillion [2,3]
Osteoporotic fractures	$48.8 billion (2018) [4,5]	$57 billion (societal, 2018) [6,7]	$95 billion (2040) [5,6]

Table 2: The individual cardiovascular events of a myocardial infarction or a cerebral vascular stroke cost per event is lower than hip fracture.

Event Type	Cost Per Event
Acute Myocardial Infarction (MI)	$18,300-$28,800 average cost per hospitalization [7]
Stroke	$15,000-$34,000 average cost per hospitalization [7]
Hip fracture	$71,058 incremental cost vs. matched controls [8]; $33,542 osteoporosis-related costs [8]
Hip fracture (all-cause costs, 12 months)	$47,163 means total costs [8]

Per-event cost comparison

The cost per hip fracture exceeds that of many acute cardiovascular events, and hip fractures account for 72% of osteoporosis costs despite representing only 14% of fractures [5-7]. Second fractures within three years incur incremental costs of $78,138 versus $44,467 for single fractures, demonstrating the compounding economic burden of inadequate secondary prevention [8].

Prevention Cost-Effectiveness Comparison

Both conditions demonstrate high-value preventive interventions, but implementation differs markedly:

Cardiovascular disease prevention

The preventive intervention for cardiovascular disease is prompter and more universal Life's Essential 8 [9-15] (Figure 1 & Table 3). The components of Life's Essential 8 include diet (updated), physical activity, nicotine exposure (updated), sleep health (new), body mass index, blood lipids (updated), blood glucose (updated), and blood pressure. This is provided by the American Heart Association [15].

Figure 1

Table 3:

Intervention	Cost-Effectiveness
Generic statins for high-risk primary prevention	Cost-saving when indirect costs included; $2,500-$10,990 per life-year gained [9,10]
Smoking cessation	Cost-saving [11]
Sodium reduction legislation	Cost-saving globally [12]
Aspirin for primary prevention (high-risk patients)	Cost-saving [13]
Life's Essential 8	American Heart Association [14,15]

Osteoporosis prevention

An FLS targeting patients post-hip fracture should result in cost savings and reduced fractures under most scenarios (Table 4) [16-21].

Table 4: The bone density test and osteoporosis prevention should be, but not enough, it is less likely to be initiated [21].

An FLS targeting patients post-hip fracture should result in cost savings and reduced fractures under most scenarios [16].

Intervention	Cost-Effectiveness
Fracture Liaison Services (FLS) for secondary prevention, bisphosphonates	Cost-saving for Medicare beneficiaries ($418 million savings per 1 million treated) [16-19]
but	Cost-saving at age ≥75 years; <$18,000 per QALY at younger ages [20]
Physical activity programs (primary prevention)	Cost-saving for women 40-64 years [18,19]
Under treatment of osteoporosis patients	Children of a lesser God [20]
DXA bone density (Dual-Energy X-ray Absorptiometry)	Identify Osteopenia and Osteoporosis and guide therapy ISCD [21]

WHI - Women's Health Initiative

Review the economic impact of the declining use of estrogen therapy on both cardiovascular and fracture outcomes since the WHI trials

The decline in estrogen therapy following the 2002 Women's Health Initiative (WHI) trials created a profound economic and clinical trade-off: reduced cardiovascular and breast cancer events in some populations, but a substantial increase in osteoporotic fractures and associated costs, with net economic effects varying dramatically by age and time since menopause [22-25].

The WHI scenario resulted in 4.3 million fewer Combined Hormone Therapy (cHT) users, 126,000 fewer breast cancer cases, 76,000 fewer cardiovascular disease cases, 263,000 more fractures, 145,000 more quality-adjusted life-years, and expenditure savings of $35.2 billion. The corresponding net economic return of the trial was $37.1 billion ($140 per dollar invested in the trial) at a willingness-to-pay level of $100,000 per quality-adjusted life-year [22]. The WHI E+P trial made high-value use of public funds with a substantial return on investment. These results can contribute to discussions about the role of public funding for large, prospective trials with high potential for public health effects [22].

Over 13 years, the decline in ET utilization was associated with $4.1 billion expenditure for excess chronic diseases (37,549 excess events) among women in their 50s, compared to savings of $1.5 billion and $4.4 billion for diseases averted by lower ET utilization among women in their 60s (13,495 fewer events) and 70s (40,792 fewer events), respectively [23,24].

WHI data reveal that both combined Conjugated Equine Estrogen-Medroxyprogesterone Acetate (CEE-MPA) and CEE-only therapy significantly reduce hip, vertebral, and total fracture risk, with further skeletal protection from calcium and vitamin D co-administration [6,25,26]. Cardiovascular outcomes are strongly influenced by timing: initiation before age 60 or within 10 years of menopause may confer benefit, while delayed initiation (≥65 years) increases risks of coronary events and stroke, supporting the "window of opportunity" hypothesis [27]. CEE-MPA therapy increases invasive breast cancer incidence (especially in prior users), while estrogen-only therapy is associated with a marginal nonsignificant reduction in breast cancer risk. Both regimens lowered colorectal cancer incidence during active treatment. Early Menopausal hormone therapy (MHT) initiation has no effect on cognitive function, whereas late initiation increases dementia risk [24]. The WHI termination of estrogen in 2002 precipitated a 57% decline in hormone therapy [27]. Hormone use continued to decline through 2009-2010 across all patients' demographic groups, with the current prevalence now at 4.7% (95% CI 3.3-6.1) overall, 2.7% (95% CI 1.9-3.4) for estrogen only, and 1.7% (95% CI 0.7-2.7) for estrogen plus progestin [28-30].

This decline was not accompanied by a proportional increase in alternative osteoporosis therapies-bisphosphonate prescribing continued its linear rise without acceleration, creating a treatment gap [26].

Economic impact by age: A heterogeneous picture

The economic consequences of reduced HT use diverged sharply by age group [30]. Decreased events were noted in older women ages 60 to 79 but increased in younger women ages 50 to 59 [25] (Table 5).

Table 5:

Age Group	Economic Impact (2003-2015)	Excess Events
50-59 years	$4.1 billion in excess costs	37,549 excess chronic disease events
60-69 years	$1.5 billion in savings	13,495 fewer events
70-79 years	$4.4 billion in savings	40,792 fewer events

For women in their 50s-those most likely to experience, symptoms and within the "window of opportunity" for cardiovascular benefit-reduced HT use generated substantial net harm and costs. For older women, the risk-benefit calculus favored reduced use [28].

Estrogen plus progestin and estrogen alone decreased risk for fractures but increased risk for stroke, thromboembolic events, gallbladder disease, and urinary incontinence. Estrogen plus progestin increased risk for breast cancer and probable dementia, whereas estrogen alone decreased risk for breast cancer [29].

Fracture-Specific Economic Burden

The WHI definitively established HT's antifracture efficacy: 44-56 fewer osteoporotic fractures per 10,000 woman-years [29,30].

More than 2 million incident fractures at a cost of $17 billion were predicted for 2005. Total costs including prevalent fractures are more than $19 billion. Men account for 29% of fractures and 25% of costs. Total incident fractures by skeletal site were vertebral (27%), wrist (19%), hip (14%), pelvic (7%), and other (33%). Total costs by fracture type were vertebral (6%), hip (72%), wrist (3%), pelvic (5%), and other (14%). By 2025, annual fractures and costs were projected to rise by almost 50%. The most rapid growth is estimated for people 65-74 years of age, with an increase>87%. An increase of nearly 175% is projected for Hispanic and other subpopulations [29].

This study shows some differences and predicts the burden of incident osteoporosis-related fractures and costs in the United States, by sex, age group, race/ethnicity, and fracture type, from 2005 to 2025. Total fractures were >2 million, costing nearly $17 billion in 2005. Men account for >25% of the burden. Rapid growth in the disease burden is projected among nonwhite populations [30]. Mean all-cause costs were greater in the fracture vs nonfracture cohort ($47 163.25 vs $16 034.61) overall and for men ($52 273.79 vs $17 352.68). The highest mean costs were for skilled nursing facility ($29 216), inpatient costs ($24 190.19), and hospice care ($20 996.83). The highest incremental costs versus the nonfracture cohort were for hips ($71 057.83 vs $16 807.74), spine ($37 543.87 vs $16 860.49), and radius/ulna ($24 505.27 vs $14 673.86). Total medical and pharmacy costs for patients who experienced a second fracture were higher compared with those who did not ($78 137.59 vs $44 467.47). Proportionally more patients in the fracture versus nonfracture cohort died (18% vs 9.3%), with higher death rates among men (20% vs 11%) [30].

Both studies predict increase in fractures.

Menopausal hormone therapy has a complex pattern of risks and benefits. Findings from the intervention and extended postintervention follow-up of the two WHI hormone therapy trials do not support use of this therapy for chronic disease prevention, although it is appropriate for symptom management in some women [29,30]. This outcome was because of the multiple other medical issues patients had and ignores the fact that women who stayed on hormone therapy had less fractures. This manuscript was published in 2013 by the same author as the following manuscript [30,31].

WHI findings indicate important differences in HT-related clinical outcomes by age and time since menopause. Systemic HT has an acceptable safety profile for menopause management when initiated among healthy women who are younger (or recently menopausal) and not at elevated risk for cardiovascular disease or breast cancer. Initiation of treatment in older women who are distant from menopause onset, however, should be avoided. Other HT formulations and routes of delivery warrant further study [32]. This manuscript was published in 2020 and she is the lead author. This is when the different age group outcomes became more germane.

Post-WHI, the 263,000 additional fractures projected through 2012 carried substantial costs [23]. Hip fractures alone-accounting for 72% of osteoporosis costs-imposed $47,000-$71,000 per events [8].

Medicaid data revealed 664% increase in osteoporosis medication spending from 1995 to 2004, shifting from HT to bisphosphonates without improving population-level fracture rates [27]. No complete data on anabolic therapy which uses more effective therapy but at a higher cost [26].

Cardiovascular economic effects

The cardiovascular impact from WHI remains contentious and age-dependent:

a) **Overall WHI population:** No reduction in CHD; but increased stroke and venous thromboembolism [31-33].

b) **Women 50-59 years or <10 years postmenopausal:** Trend toward reduced CHD risk (HR 0.76) and favorable all-cause mortality Earlier in the study it was reported that it increased cardiovascular events, but latter it was found that was not the cause [28,32].

c) **Economic modelling:** $35.2 billion in expenditure savings from reduced HT use, but $37.1 billion net increase return on WHI trial investment when QALYs valued at $100,000 [24].

The "timing hypothesis" suggests cardiovascular benefit when HT is initiated early, but economic analyses rarely incorporate this stratification, leading to aggregated estimates that obscure age-specific value [31].

There are a variety of issues regarding osteoporosis including anti resorptive and anabolic agents [33-36].

Alternative therapies: Cost implications

The shift to bisphosphonates and selective estrogen receptor modulators altered the cost structure while the anabolic teriparatide is more expensive (Table 6) [30-38]:

Table 6:

Therapy Class	Annual Cost (Generic)	Fracture Reduction	Notes
Oral bisphosphonates	$100-500	30-50%	Cost-saving at age ≥75, but older women fractures, evidence gaps of therapy Continued linear rise without acceleration [30,33-36]
Raloxifene	$1,500-3,000	30-50% vertebral; minimal nonvertebral	VTE risk, 4-10% of treated patients, remained relatively constant [37]
Teriparatide	$15,000-25,000	65% vertebral; 53% nonvertebral	High cost, limited duration [38]
HT (CEE+MPA) Hormone therapy, Conjugated equine estrogens and medroxyprogesterone acetate	$300-600	44-56% all fractur	Systemic risks increasing to 136/1,000 beneficiaries 57% decrease to 59/1,000 [22,23]

Although the data overall do not support the use of Menopausal Hormone Therapy (MHT) or selective estrogen receptor modulator for primary prevention of CVD, evidence is accumulating that careful use of MHT for perimenopausal symptoms may not carry CVD harm. Still MHT remained low and dropped [39].

Secondary fracture prevention intervention resulted in an average cost savings of $418 and an increase in QALYs of 0.0299 per patient over the lifetime; for 1 million patients who receive the intervention instead of usual care, expected cost savings for Medicare would be $418 million dollars. There was risk of cancer [40,41].

With loss of hormones bone density drops and women fracture. Women who discontinued postmenopausal HT had significantly increased risk of hip fracture and lower BMD compared with women who continued taking HT. The protective association of HT with hip fracture disappeared within 2 years of cessation of HT. [36].

Older women at high risk of fracture, 10 to 13 years of bisphosphonate use was associated with higher risk of any clinical fracture than 2 years of use. These results add to concerns about the benefit of very long-term bisphosphonate use [5,34].

Although the data overall do not support the use of Menopausal Hormone Therapy (MHT) or selective estrogen receptor modulator for primary prevention of CVD, evidence is accumulating that careful use of MHT for perimenopausal symptoms may not carry CVD harm. Still MHT remained low and dropped [39,42].

Data so far, favor transdermal estradiol over conventional-dose CEE with respect to CVD risk and oral estradiol over conventional-dose CEE with respect to stroke risk. Low-dose oral CEE may similarly have benefit over conventional-dose oral CEE for some CVD events. In addition, the transdermal route of delivery may avoid the excess risk of certain CVD events associated with MHT and lower doses of estrogen may have fewer adverse effects than the doses previously tested in WHI [32,39].

The absence of a low-cost, fracture-preventing alternative to HT for symptomatic women in their 50s represents a market failure with substantial economic consequences. However anabolic therapy is more effective but more expensive as noted [38].

Teriparatide recombinant human parathyroid hormone [1-33] received FDA approval on November 26, 2002-just months after the July 2002 publication of the WHI estrogen-plus-progestin trial results that caused hormone therapy prescriptions to decline 57% by mid-2004. This timing positioned teriparatide as the first anabolic bone agent available to fill the emerging treatment gap [38]. Other formulations of HT such as topical and other formulations have been suggested [32,39].

Current economic paradox

Despite 20 years of follow-up data supporting age-stratified HT use for symptomatic women [27,28], economic analyses and guidelines remain anchored to the 2002 aggregate findings. The USPSTF maintains Grade D recommendations against HT for chronic disease prevention, but without any help since there is omission of noting adequate differentiation by age or indication [28,29].

Key economic insights from extended follow-up:

a. CEE-alone: 22% reduction in breast cancer with long-term follow-up [40,41]

b. Younger women (50-59): 32% reduction in all-cause mortality but early WHI data evaluation did not recognize the benefit of CVD with estrogen-only therapy [32]

c. Removing CEE led to loss of symptom control which was very important for these women [22-24,29]

d. HT therapy is given by the physician after evaluation of the patient using the timing hypothesis [31,42]

e. One conclusion that fracture benefits persist after HT discontinuation ignores the straight-line utilization of bisphosphonates [35]. Older women paradoxically actually had more fractures [35] This conclusion ignores the effective use of hormones used in early -ages 50-59 or within 10 years of menopause on bone mineral density of which the WHI demonstrated. If hormone therapy is stopped there is rapid loss of bone that additional bone directed medications need to be used. Women who discontinued postmenopausal HT had significantly increased risk of hip fracture and lower BMD compared with women who continued taking HT [43,44]. But even the low circulating estrogen levels present in postmenopausal women have a significant impact on bone turnover. The proportion of hip fracture patients treated with osteoporosis drugs has increased, but remains low, with fewer

than one-third receiving pharmacotherapy. Of patients treated before and after hip fracture, 18% changed therapy post fracture. Significantly more patients changed therapy following fracture if a different physician prescribed treatment (26%) compared to those treated by the same physician pre- and post-fracture (13%; $p < 0.0001$) [34].

f. Teriparatide an anabolic was also used but had time limits but did not have enthusiasm and length of therapy then as we have now [38].

Policy and economic implications

A. Age-stratified coverage policies: Value based insurance design (VBID) should favor HT for women <50 years or <10 years postmenopausal, with reduced copayments aligned with cardiovascular and fracture prevention value [45].

B. Fracture Liaison Service (FLS) integration: Given HT's fracture prevention and the treatment gap post-WHI, FLS programs offer cost-saving secondary prevention [16].

C. Revised economic models: Current cost-effectiveness analyses should incorporate age-specific and time-since-menopause stratification rather than aggregate populations [22-24].

D. Formulation considerations: Transdermal estradiol and oral progesterone may offer favorable cardiovascular and breast cancer profiles compared with CEE+MPA, with economic implications requiring evaluation [32,39].

At elevated cardiovascular and breast cancer risk. The failure to implement age-stratified prescribing guidelines and economic models that capture heterogeneous effects perpetuates suboptimal resource allocation. Reframing HT as a time-sensitive intervention for appropriate candidates-rather than a uniformly harmful therapy-represents ignored finding a major opportunity for value-based care improvement [31].

a) The issues with the WHI were more apparent to some than others [46,47]. The influence on CVD was initially misread and the menopausal symptoms were ignored. The ignored findings were that HT initiated in the younger menopause group 50 to 59 Years or within 10 years of menopause helps CVD, the bones and the symptoms of menopause.

Where are We Now?

Given an approximate gender distribution of 55% women and 45% men among adults aged ≥50 years, this corresponds to roughly 41 million women and 34 million men. Based on lifetime risk estimates, approximately one in two women and one in five men over age 50 will experience an osteoporosis-related fracture, translating to ≈20 million women and ≈7 million men, or ≈27 million individuals overall [48,49].

Health outcomes: Approximately 20-30% of older adults who sustain a hip fracture die within one year, most often due to postoperative or medical complications, with higher mortality observed in men [48,49].

Many more survivors face chronic pain, reduced mobility, a hunched posture, and long-term nursing: Many survivors experience chronic pain, reduced mobility, kyphotic deformity, loss of independence, and a high likelihood of long-term institutional care. These downstream consequences drive substantial healthcare utilization, with direct costs exceeding $20 billion annually in the United States and projected to increase markedly with population aging. Osteoporotic fractures lead to chronic pain, disability, loss of independence, and long-term institutionalization. Hip fractures result in major functional decline, with many patients requiring nursing home placement and failing to regain baseline function [50].

Sources

Economic context

The cost imbalance in osteoporosis care remains stark: Solomon et al. (2014) noted that if payers required demonstration of adequate post fracture osteoporosis care, such as bone mineral density testing and appropriate medication prescribing, "local health care systems would likely improve their internal communication among providers, and potentially adopt collaborative care models" [16]. Nayak et al. [5] demonstrated that secondary fracture prevention interventions for Medicare beneficiaries were "highly likely to be cost-saving, both improving future health outcomes and reducing healthcare spending compared with usual care" [5].

What about "they only pay you $ 37" per DXA examination?

Prevention of osteoporosis includes diagnosis. As a physician we can develop signs on our history and physical, including family history of osteoporosis and of fractures, previous fractures, current smoking, long term glucocorticoid steroid use, associated rheumatoid arthritis, excess alcohol consumption and physical findings of osteoporosis including dermatoporosis as found on the dorsum of the hands a sign of thin skin of collagen fragility associated with osteoporosis [51]. Other findings include clinical signs of a previous fracture, kyphosis or stooped back kyphosis/thoracic deformity: Self-reported "humped back" or observed thoracic kyphosis increases suspicion for vertebral fractures; the wall-occiput distance >0 cm (LR+ 4.6) and rib-pelvis distance <2 fingerbreadths (LR+3.8) are associated with occult spinal fracture, vertebral tenderness suggesting a recent fracture, height loss suggested thresholds include >0.8 inches (2cm) over 1-3 years or >1.5 inches (4cm) from peak height at age 20 years, low body weight less than 112 lbs, Low body weight: Weight less than 51kg (112lb) carries the highest positive likelihood ratio (LR+7.3) for osteoporosis; low BMI (<20kg/m^2 or <127lb.) is a recognized clinical risk factor, low tooth count suggested less than 20 to reflecting alveolar mouth bone softness, Pain-related behavior: In patients with back pain, assessment of grimacing, sighing, difficulty turning prone, or need for assistance with positioning may help distinguish recent vertebral fracture from other causes of back pain [52].

Examination of the imaging findings by X-rays, DXA bone density (Dual-Energy X-ray Absorptiometry) (originally spelled

DEXA but now DXA) and can also be found on a CT scan (computed tomography) and MRI (Magnetic Resonance Imaging). A new study called the biomechanical CT (BCT) is an approved test by Medicare measures both bone mass and bone strength. It has just been approved this year and by October 5th, 2026, will be fully covered is a bone mass measurement with the CPT codes 055T-058T. Initially its availability may be limited But DXA measures bone mineral density but this more effectively measures bone mineral density and bone strength [53].

DXA scan can quantify the level of bone mineral density which is a measure of bone quantity and identify osteopenia and osteoporosis. Sometimes bone quality can be further identified by the Trabecular Bone Score which is advanced imaging software that analyzes the texture and pixel variations of a standard lumbar spine DXA scan unlike a bone mineral density which measures bone quantity. The trabecular bone scan provides an indirect estimate of bone quality and microarchitecture on how solid or porous the inner bone structure is. It is a costly separate examination program for the usual DXA unit. This can also be measured by visualization by the MRI but includes additional evaluation that is usually not available by the standard MRI unit. David Dempster PhD has shown on bone biopsies that the trabecular bone with osteoporosis has a less solid microarchitecture structure than the normal bone as is demonstrated in these figures [52,54].

Loss of Horizontal Crossties why the Osteoporosis Bone Shows a risk of Fracture (Figure 2)

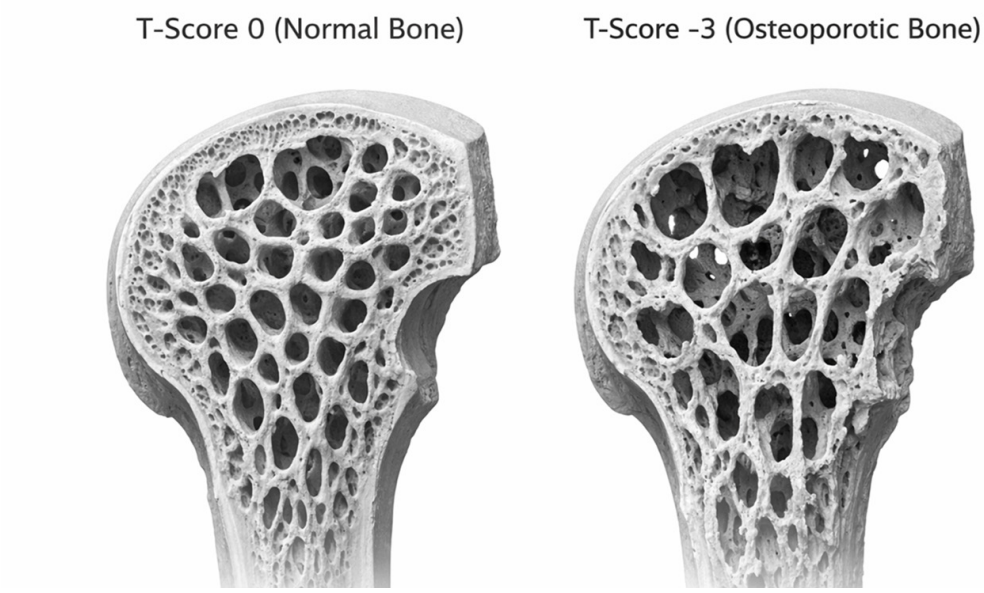

Figure 2

Normal Bone - thick connections

Osteoporosis Bone - loss of bone and connections

Model inspired by David Dempster [52].

Antiresorptive drugs maintain bone structure and primarily increase BMD by adding mineral to preexisting bone while anabolic drugs improve bone structure and primarily increase BMD by adding new, young bone to the skeleton

Dual - Energy X-ray Absorptiometry (DXA): The $37 government payment for the Professional component of a bone density test

The "$37 reimbursement" figure does not come from a single CMS rule document stated that way-it shows up in the medical literature describing the impact of Medicare payment cuts, particularly after the Deficit Reduction Act (DRA) of 2005 and subsequent Physician Fee Schedule changes [55-57].

The clearest place is explicitly stated:

A. A peer-reviewed review article in Journal of Clinical Endocrinology & Metabolism notes that Medicare reimbursement for office-based DXA fell to "approximately $37 per test" after the cuts beginning in 2007[55]. The article summarizes CMS policy effects, not issuing the rule itself [58].

B. This led to the loss of office-based non-facility DXA locations which lead to loss of easy access DXAs for our patients [50,56, 59-61].

C. The National coverage determination data is not clear [58].

What actually happened (policy-wise):

a. The Deficit Reduction Act of 2005 capped imaging reimbursement in physician offices starting in 2007 [57].

b. CMS then implemented this through the Medicare Physician Fee Schedule, which progressively reduced DXA payments [58].

c. Office-based DXA reimbursement dropped sharply (roughly from ≈$130-140 in 2006 → ≈$80 → ≈$70 → and in some analyses down to ≈$33-$37 effective payment levels depending on component/accounting) [50,56,59-61].

d. Office-based non-facility DXA reimbursement dropped substantially after 2007 and continued declining [50,56,59-61].

e. Overall bone densitometry reimbursement fell ≈70% from 2007-2019.

f. Policy discussions and advocacy pieces later describe typical reimbursement in the ≈$40 range, consistent with that ≈$37 figure.

g. In the United States, Medicare gradually reduced payments for Dual-Energy X-ray Absorptiometry (DXA) performed at physician offices (or other nonhospital settings, labeled non facility) from an average (professional and technical fees) of $139 in 2006 to about $82 in 2007 and 2008 and $72 in 2009. The reduction in DXA reimbursement was associated with a decrease in the number of DXAs performed in physician offices and fewer physician offices could not afford to provided DXA services [50,56,59-61].

Total DXA imaging -facility and non-facility (Table 7)

Table 7:

Year	Percentage (%)
2002	7.9
2003	8.2
2004	8.6
2005	9
2006	9.4
2007	9.8
2008	9.9
2009	10

The measured percentage of DXA imaging increased steadily from 7.9% in 2002 to 10.0% in 2009, with the rate of increase slowing and approaching a plateau after 2007.

From 2002 to 2009, the proportion of non-facility care remained relatively stable at approximately 68-70% before declining slightly to 66%, while facility-based care (especially hospital) increased modestly from about 30-31% to 34% over the same period as facility reimbursement increased.

Proportions of facility and non-facility central DXA by calendar year [50,56,59-61] (Table 8).

Table 8:

Year	% Non-Facility	% Facility
2002	69	31
2003	69	31
2004	70	30
2005	70	30
2006	69	31
2007	69	31
2008	68	32
2009	66	34

From 2002 to 2009, the proportion of non-facility care remained relatively stable at approximately 68-70% before declining slightly to 66%, while facility-based care increased modestly from about 30-31% to 34% over the same period.

From 2002 to 2004, there was a marked increase in practices initiating DXA services, reaching a peak in 2004, followed by a progressive decline; by 2007, the trend reversed, with discontinuations exceeding initiations and resulting in a sustained net loss of DXA-providing practices through 2009. This relates to our patients getting less DXAs

Net Change in DXA Practices (Table 9)

Table 9:

Year	Net Change (Initiating-Discontinuing Practices)
2002	Positive (increase)
2003	Positive (increase)
2004	≈ +950 (peak increase)
2005	Declining but still positive
2006	Near zero
2007	Negative (more discontinuing than initiating)
2008	Further negative decline
2009	Markedly negative

The difference between the numbers of physician office-based practices initiating and discontinuing DXA services by calendar year [50,56].

Between 1996 and 2002, the number of DXA scans performed on all Medicare patients increased by more than fourfold. In the same population, the percentage of scans performed by radiologists increased from less than one-third to almost one-half. Consequently, radiologists were steadily gaining market share of this procedure in the Medicare population [58,59]. The Medicare source did not give understandable specifics [58].

The DXA program is an important program to diagnose osteoporosis, but the government decided to decrease the payment to the point where the payment was beneath the cost it would take to do a DXA. When we look at this explanation below of the payment we see how DXA payment revolves [59-64] (Tables 10&11).

Table 10: Year-by-year Medicare reimbursement trends for CPT 77080 and 77081.

Year	CPT 77080 (DXA, Axial Skeleton)	CPT 77081 (DXA, Appendicular Skeleton)	Key Policy Events
1998	≈$120-$140 (estimated)	≈$80-$100 (estimated)	BMA 1997 establishes bone mass measurement, benefit [57]
2000-2005	≈$130-$150	≈$90-$110	Stable growth era; rapid expansion of office-based DXA [57]
2006	≈$139 (non-facility)	≈$95	Pre-DRA peak; last year of higher reimbursement [50,56,59-61]
2007	≈$82	≈$55	DXA implementation; TC cuts applied [50,56,59-61]
2008	≈$82	≈$55	Stabilization at reduced level [50,56,59-61]
2009	≈$72	≈$48	Continued downward adjustment [58]
2010-2015	≈$65-$75	≈$45-$55	Modest annual fluctuations; sequestration cuts (2013) [58]
2016-2019	≈$70-$80	≈$50-$60	Legislative stabilization attempts; site-of-service shift to hospital outpatient [52,61]
2020-2024	≈$75-$85	≈$55-$65	Slight recovery in nominal dollars; inflation-adjusted decline continues [56]

Notes on the table:

Values represent non-facility (physician office) national averages for total reimbursement (PC+TC)

Hospital outpatient payments remained substantially higher (≈$100-$120) throughout this period, driving the site shift [56,59-61].

The 70.5% inflation-adjusted decrease for bone densitometry between 2007-2019 was the largest of any imaging modality: Inflation-adjusted Medicare reimbursement for all imaging modalities decreased between 2007 and 2019. The greatest mean decrease in reimbursement rates was observed for MRI (-$52.08), and the largest decrease in total percentage change was seen for bone densitometry (-70.5%). Nuclear medicine demonstrated the smallest mean decreases in both annual change (-$0.32) and total percentage change (-4.28%) [60].

The loss of bone density around the world with its other correlations was associated with increased death [50].

Table 11: Critical distinctions in DXA coding.

Code	Description	Typical Use
77080	DXA, axial skeleton (hip, spine, or both)	Primary osteoporosis diagnosis/monitoring
77081	DXA, appendicular skeleton (peripheral)	Forearm, heel, finger-often for screening
77085	DXA, Vertebral Fracture Assessment (VFA)	Added to axial DXA
G0130	Single-Energy X-Ray Absorptiometry (SEXA)	Historically, largely replaced

Critical Impact of Reimbursement Collapse

The payment reduction triggered profound access consequences.

1) Office-based DXA discontinuations exceeded initiations starting in 2007; by 2009, 1,876 practices discontinued versus 1,394 that initiated.

2) Site-of-service shift: Hospital-based DXA rose from 31% to 34% of Medicare volume (2006-2009).

3) Screening rates plateaued: After 2006, annual growth in DXA utilization dropped from 0.4% to 0.1%

4) Undertreatment cascade: Reduced DXA access correlated with decreased osteoporosis diagnosis and bisphosphonate prescriptions, followed by plateauing hip fracture rates after 2012.

"Medicare's significant drop in payment rates for DXA from its high-water mark may have the appearance of a cost savings for that line item on CMS outlays, but it has generated MORE costs to the overall health system due to under diagnosing and under treating osteoporosis and the associated increase in fractures. The Increasing Access to Osteoporosis Testing for Medicare Beneficiaries Act of 2021 (S.1943) sought to restore DXA reimbursement to 70% of 2006 levels. The 2025 USPSTF systematic review confirmed screening reduces hip fractures (pooled RR 0.83) with 5-6 fewer fractures per 1,000 screened supporting the economic argument that upfront screening costs are offset by downstream fracture prevention [52,62].

Prevalence of osteoporosis

The most reliable U.S. estimates come from NHANES 2017-2018 and the National Osteoporosis Foundation (NOF) [63-65].

Corrected epidemiologic figures (Table 12)

Table 12:

Parameter	Verified Data	Source
Osteoporosis prevalence (age ≥50)	10.2 million adults aged ≥50 years; 12.6% age-adjusted prevalence CDC	NHANES 2017-2018
Osteoporosis in women ≥65	19.6% in 2017-2018 (up from 14.0% in 2007-2008) CDC	NHANES 2017-2018
Low bone mass/osteopenia (age ≥50)	43.1% have low bone mass; ≈43.3 million affected CDC	NHANES 2017-2018
Combined osteoporosis+low bone mass	≈54 million total affected	NOF estimates
Population at risk for fractures	≈54 million with low bone mass or osteoporosis; ≈2 million annual fractures	[6]

"Approximately 54 million Americans aged ≥50 years have low bone mass or osteoporosis-10.2 million with osteoporosis and 43.3 million with osteopenia. Osteoporosis-related fractures increase substantially after age 50, with ≈2 million incident fractures annually in the U.S." [63-65].

"Medicare's significant drop in payment rates for DXA from its high-water mark may have the appearance of a cost savings for that line item on CMS outlays, but it has generated MORE costs to the overall health system due to under diagnosing and treating osteoporosis and the associated increase in fractures need to be justified providing details on preventive screening guidelines (DXA scans) or lifestyle and medical treatments used to reduce fracture risks [66,67].

McAdam-Marx et al. [68] examined the effect of Medicare reimbursement reductions for imaging services on osteoporosis screening rates and found that while BMD screening rates did not substantially decline in the immediate 2 years after reimbursement cuts, the proportion of women whose first osteoporosis diagnosis occurred after a fracture increased-suggesting a shift toward diagnosis at the point of fracture rather than through preventive screening [68].

Miller et al. [55] explicitly identified "the decline in bone mineral density testing by dual-energy x-ray absorptiometry (DXA) in non-facility designated DXA sites (eg: private practices)" as one of three primary reasons for underdiagnosis and undertreatment of osteoporosis. The authors noted that Medicare reimbursement for DXA in non-facility settings had declined to approximately $37 per test by 2007, compared with $100 per test in facility settings, and that professional societies including the International Society for Clinical Densitometry supported legislation to establish "a flat and common floor for all DXA providers nationwide of $98/test" [55].

Tanner et al. [61] summarized that "patient access to DXA scans has been threatened by declining reimbursement and, therefore, access to diagnosis and fracture prevention," and noted that "successful efforts to reverse this trend" had been made but that "the future remains uncertain" [61].

McPhee et al. [62] stated that "due to CMS reimbursement cuts for DXA scans, the number of providers who can perform DXA scans has dwindled and machines are no longer common in provider offices," and explicitly endorsed the Increasing Access to Osteoporosis Testing for Medicare Beneficiaries Act of 2021 (S.1943), which aimed to restore reimbursement to 70% of 2006 levels [62].

Williams et al. (2021) documented that osteoporosis-related fractures in Medicare beneficiaries generated mean total all-cause healthcare costs more than 3-fold higher than matched nonfracture cohorts, with medical service costs 10-fold higher than pharmacy costs. They noted that "a decline in fracture rates between 2007 and 2013 followed by a subsequent rise in 2017... may be a result of changes in testing and treatment of osteoporosis during this time" [8].

Hsieh et al. [50] (cited in Lancet Rheumatology 2025) described associations between cuts in Medicare reimbursements for DXA and decreased provision of physician's office-based DXA services and prescriptions for FDA-approved osteoporosis therapies 2 years later, with age-adjusted hip fracture rates plateauing from 2012 to 2015 following a decade of steady decreases [50].

Prevention

Osteoporosis is a skeletal disorder characterized by compromised bone strength, which predisposes a person to increased risk of fracture. In the United States, 26% of women aged > or =65 years and >50% of women aged > or =85 years have osteoporosis. Over 1.5 million fractures per year are attributable to osteoporosis; these fractures result in 500,000 hospitalizations, 800,000 emergency room visits, 2.6 million physician visits, 180,000 nursing home placements, and 12 billion dollars to 18 billion dollars in direct healthcare costs each year. Fracture also results in loss of function and has a negative impact on psychological status. In recognition of the importance of bone health, the US Surgeon General has, for the first time, issued a comprehensive report on bone health and treatment. The report recommends a pyramidal approach to osteoporosis treatment that includes calcium and vitamin D supplementation, physical activity, and fall prevention as the first line in fracture prevention. The second level consists of treating secondary causes of osteoporosis; the third and top level consists of pharmacotherapy. Pharmacotherapeutic interventions (e.g., bisphosphonates, selective estrogen receptor modulators, calcitonin, and anabolic like teriparatide) in women with postmenopausal osteoporosis provide substantial reduction in fracture risk over and above risk reduction with calcium and vitamin D supplementation alone. Despite the effectiveness of therapy, most patients who receive treatment do not remain on treatment for >1 year. An important approach to reducing the rate of fractures is first to target our treatments to patients at high risk

for fractures and then to develop strategies to improve treatment continuation rates [69-71].

Participatory Learning for Action (PLA)

The Participatory Learning for Action (PLA) approach to CME planning is grounded in performance Improvement Continuing Medical Education (PI-CME) principles and Quality Improvement (QI) methodology, particularly the Plan-Do-Study-Act (PDSA) cycle [72]. The 2020 AAFP framework describes "Meta PI-CME" as continuous cycles of needs assessment, learning, implementation, and reassessment rather than "one and done" activities [72]. Greenspan et al. [73] demonstrated that a three-stage PI-CME initiative improved osteoporosis screening, fall-risk assessment, and treatment adherence through self-evaluation and goal setting [73]. Solomon et al. [74] showed that multifaceted interventions targeting primary care physicians and patients increased BMD testing and osteoporosis medication use, though absolute rates remained low [74]. The Asia Pacific Consortium on Osteoporosis (APCO) framework explicitly recommends "bottom-up" participatory approaches with healthcare providers conducting iterative benchmarking and quality improvement projects [75]. A 2026 ClinicalTrials.gov entry (NCT06682650) describes combining Normalization Process Theory (NPT) with PLA for implementation, using democratic techniques to identify barriers and prioritize action steps [75]. These sources support PLA-CME as an evidence-based strategy to translate osteoporosis knowledge into practice change.

Conclusion

Advocacy and attempted remediation

Professional societies {ISCD (International Society of Clinical Densitometry), ACR (American College of Rheumatology), ACCE, (American College of Clinical Endocrinologist) NOF (National Osteoporosis Foundation) CSRO (Coalition of State Rheumatology organizations)} have consistently advocated restoration to approximately $98 per test as a minimum viable reimbursement floor. (Still not enough to cover expenses) The "Increasing Access to Osteoporosis Testing for Medicare Beneficiaries Act" and similar legislation have been introduced repeatedly since 2010 to reverse DRA-mandated cuts, with partial success in stabilizing-but not restoring-payment levels [51,62,63].

We used to have many physician offices that were doing bone densities in Atlanta, but as you see this imploded. It still has not returned despite as noted many attempts. This is because the financial blockade has not been overridden [70].

The therapy for patients with osteoporosis now expresses the importance of an anabolic agent like teriparatide (Forteo), abaloparatide (Tymlos) and romosozumab (Evenity). (These are all injections) The scare of Osteonecrosis of the Jaw (ONJ) frightened patients from accepting bisphosphonate therapy like alendronate (Fosamax), risedronate Actonel,(These are all oral medication) ibandronate (Boniva) (available as oral or injection) zoledronate (Reclast) (Which is given by infusion), despite that ONJ is a very unusual episode in the course of therapy, much more in the high doses used for oncology and not the low doses used for osteoporosis. Patients did not want to take that chance of ONJ.

It appears that the episodes of government payment interference, Osteonecrosis of the Jaw (ONJ), misinformation spread by the Women's Health Initiative, the decrease in testing since physicians we're less likely to have a bone density unit in the office because of the cost of it, the cost of maintenance of it, the teaching of bone density technologists to facilitate performing the procedure. This has led to inappropriate concern. In some ways it was the government associated with the two-pronged attack whether they might have not known what that would do to our patients. We have now realized what the WHI and DXA reimbursement in the long run has cost our patients more.

The WHI E+P trial made high-value use of public funds with a substantial return on investment. These results can contribute to discussions about the role of public funding for large, prospective trials with high potential for public health effects [22].

We need to emphasize the importance and costs of osteoporosis and fractures and let people be aware of the need. The use of David Dempster models of the trabecular structure to assist in convicting people who don't want to take osteoporosis therapy is important. Unless they have personal experience, they are often reluctant to do any of the testing and Osteoporosis therapy.

Cardiologists are on top of treating the risks for cardiovascular disease, both before and then Importantly after the myocardial infarction, especially with anti-lipid and other therapy including imaging and echoing is an example of the idea of what we can use for bone protection and prevention.

What do we do as osteoporosis providers? We need to spread the word to our primary care and orthopaedic colleagues of the care of people with risks of osteoporosis and risks of fracture and our desire to advise and assist them. There are low rates of osteoporosis testing and treatment initiation and then continue the therapy which is decreased. There is a high secondary fracture rate (particularly among patients at very high risk) highlight the need for better management of patients after a fracture [71]. These shadow the implementation gap. The Medicare and insurance obstruction is limiting our ability to do this and we need change.

We are not allowed to trying to prevent osteoporosis and we should stop fractures at earlier ages! This needs to be done but there is the implementation gap! The gap is both in the patient being prescribed the medicine at the appropriate time, ideally before the fracture when osteoporosis is discovered but at least at the time of the fracture and then should continue to stay on the medicine which is low. Obstruction at trying to make an earlier diagnosis of osteoporosis is inappropriate for our health systems.

For osteoporosis and fractures, we should proceed by the example of cardiology.

1) We should be doing bone densities at an earlier age for women and men and if we find that there is risk then we should provide therapy. We should perform DXAs more often

2) We should be doing anti-osteoporosis therapy at an earlier age, the so-called preventive stage

3) We should stop the ridiculous under payment of the simple tests of a bone density to help identify women and men who were at risk. To this we should use age 40 for women and age 50 for men.

4) The federal mandate of underpaying has increased the risk of osteoporosis fractures, and it needs to stop. We should take this to our state legislators, our United States Congressional legislators and the American Medical Association.

5) The rheumatologists in our community were performing DXAs in their offices but they couldn't afford to continue it because the federal Medicare payment dropped as low as $37 a test for a test which costs over $100- $150 or more for purchase and maintenance of bone density units as well as education for the providers who perform the testing of the precision assessment.

6) We should develop this program immediately to help our patients prevent the risk of fracture, and to help control symptoms.

7) We need to confront the underpayment of our DXA exams from our offices as non-facility sites compared to the facility sites at the hospital. We don't have control over how they're done in the hospital and very often we find corrections. Also, in our office we have to do quality precision assessment to control examinations which unfortunately are not performed appropriately in most facility bone density exams

8) We are the champions of our patients, and we need to correct how the regulators are treating our patients and our physicians.

The moral of the story: Medicare's significant drop in payment rates for DXA from its highwater mark may have the appearance of a cost savings for that line item on CMS outlays, but it has generated MORE costs to the overall health system due to underdiagnosing and undertreating osteoporosis and the associated increase in fractures. Penny wise and pound foolish.

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