Assessment of bone mineral density (BMD) by dual-energy x-ray absorptiometry (DXA) plays a vital role in the diagnosis of osteoporosis and in monitoring a patient's response to drug therapy. This commentary will discuss controversies surrounding the use of DXA for screening and monitoring of BMD in women.

The National Osteoporosis Foundation (NOF) has estimated that more than 43.6 million Americans have osteoporosis or osteopenia (low bone mass) [1]. In 2005, 2 million fractures were attributed to osteoporosis, with a direct cost of $17 billion; 71% of these fractures occurred in women [2]. By 2025, costs associated with fractures are projected to increase to $25.3 billion [2].

Bone mineral density (BMD) testing by dual-energy x-ray absorptiometry (DXA) is the recognized standard for the clinical assessment of skeletal health. DXA allows for the diagnosis of osteoporosis or low bone mass, strongly correlates with mechanical strength [3], is a good predictor of fracture risk [4], and affords excellent accuracy and precision [5] while minimizing patients’ exposure to ionizing radiation [6]. Moreover, drug therapy has been shown to be cost effective in postmenopausal women with osteoporosis [7]. Given that approximately 40% of white women older than 50 years will have an osteoporotic fracture in their lifetime [8], having clear recommendations for screening and monitoring using DXA are essential. Because of the absence of pertinent studies in men, this commentary will only address the evaluation of BMD in women.

DXA screening for low bone mass or osteoporosis is well accepted in women aged 65 years or older, regardless of risk factors, and in younger women with risk factors such as rheumatoid arthritis, glucocorticoid use, malabsorption syndromes, hyperthyroidism, hyperparathyroidism, or gastric bypass surgery. Screening of these individuals is recommended by NOF [1], the US Preventive Services Task Force (USPSTF) [9], the International Society for Clinical Densitometry (ISCD) [10], the American Association of Clinical Endocrinologists (AACE) [11], the American College of Radiology [12], and the North American Menopause Society (NAMS) [13]. Despite the fact that DXA testing has been added to the “Welcome to Medicare Exam,” only 14% of eligible women had a DXA study in 2010 [14]. Over the 7-year period from 2002 through 2008, 48% of older women did not have a DXA study [14].

Is DXA Testing Overused in Younger Women?

Potential misuse of DXA testing is a concern that has been raised by the Centers for Medicare & Medicaid Services (CMS) and the National Committee for Quality Assurance, which have together submitted for public comment a quality measure regarding “appropriate use of DXA scans in women under 65 years who do not meet the risk factor profile” [15]. The quality measure cites a small, retrospective study of 615 women [16], in which 41.3% of women younger than 65 years who had been sent for DXA screening were found to have been screened inappropriately, based on their lack of any of the recognized risk factors listed in the 2010 NAMS position statement.

However, a much larger study performed by Kale and colleagues [17] as part of the National Physicians Alliance Good Stewardship initiative found that DXA tests were ordered inappropriately in only 1.4% (95% confidence interval, 0.9%–2.2%) of all primary care visits by women aged 40–64 years. This study performed a cross-sectional analysis using 2009 data from the National Hospital Ambulatory Medical Care Survey and the National Ambulatory Medical Care Survey, which collect data on patient visits to primary care physicians in non–federally funded hospital outpatient departments and in non–federally funded, non–hospital-based offices, respectively; national estimates were then generated using weighted samples [17]. Given the large size and more rigorous methodology of this study, a critical analysis of the available data fails to support the claim that DXA testing is being misused in women younger than 65 years.

Indications for DXA Testing

What indications should be considered when determining the need for DXA testing? Table 1 provides a composite list of indications that have been proposed by AACE, ISCD, NAMS, and NOF. Table 2 lists the Medicare beneficiaries for whom CMS will cover DXA testing, based on the Balanced Budget Act of 1997 [18] and a 2006 revision of the relevant regulations [19]; although these guidelines are specific to...
the Medicare population, they are often adopted by private insurers as well. The 2011 updated guidelines from the USPSTF recommend DXA testing for any woman younger than 65 years if her fracture risk is equal to or greater than that of a 65-year-old white woman who has no additional risk factors [9]. This guideline effectively sets the testing threshold at a risk level of 9.3%, which is the 10-year risk of major osteoporotic fracture for a 65-year-old white woman with a body mass index of 21 kg/m² (found using the FRAX fracture risk assessment tool developed by the World Health Organization). To apply this guideline, FRAX is calculated without BMD, and if the 10-year risk for major osteoporotic fracture is at least 9.3%, then DXA testing would be appropriate based on the USPSTF recommendations. However, clinicians should be cautious in how rigorously they adhere to these recommendations, because clinical risk factors are a good predictor of fracture but only a fair predictor of BMD.

As the USPSTF points out in their guidelines, “clinicians should consider each patient’s values and preferences and use clinical judgment when discussing screening with women in this age group” (50–64 years) [9].

### Repeat DXA Testing

Repeat DXA testing is also controversial, both in older women and in those younger than 65 years, whether or not they are receiving drug therapy for low bone mass or osteoporosis. CMS allows for repeat DXA testing every 2 years [19], or more frequently if it is deemed to be medically necessary. Testing more frequently than every 2 years might be medically necessary when identification of rapid bone loss could alter treatment recommendations, such as when a patient has hyperparathyroidism or will be receiving glucocorticoids for 3 months or longer. However, insurers that oversee the administration of Medicare policies within specific states (commonly referred to as local Medicare carriers) have been allowed to define the conditions under which testing is medically necessary, and some have routinely allowed repeat testing at 12-month intervals in all postmenopausal women receiving drug therapy.

The literature is divided as to whether repeat DXA testing in untreated postmenopausal women enhances our ability to predict fracture risk. Two studies [21, 22] concluded that repeat DXA testing, which allows calculation of bone density loss, provides little value beyond that of the initial BMD assessment; however, one of these studies [21] looked at a younger cohort of patients in whom the fracture rate was significantly lower and the baseline BMD was much higher. In contrast, 2 other studies [23, 24] demonstrated that bone loss detected by DXA is a predictor of fracture risk independent of baseline BMD. Moreover, we know that individuals who experience rapid bone turnover are at increased risk of fracture independent of their baseline BMD. When a patient has a repeat DXA study performed on the same machine at the same institution (and the precision error is known and the least significant change has been calculated), then significant declines in BMD across several measured sites (spine and hip, or both hips) should influence decisions about drug therapy.

Controversy also surrounds the frequency of repeat testing in older women who are not being treated for low bone mass or osteoporosis. A 2012 study in The New England Journal of Medicine [26] examined DXA testing intervals in 4,957 untreated postmenopausal women aged 67 years or older who had had more than 1 DXA study and who had normal BMD or osteopenia at baseline. The primary outcome was the estimated time interval for 10% of participants to develop osteoporosis without experiencing a hip or clinical vertebral fracture or needing to start treatment for osteoporosis. Not unexpectedly, the authors found that a higher baseline BMD was associated with a longer time to develop osteoporosis and that women with normal bone density at age 67 years were unlikely to have subsequent rapid bone loss [26]. However, media reports failed to appreciate that this study excluded women in their early postmenopausal

| TABLE 1.  
<table>
<thead>
<tr>
<th>Women for Whom Dual-Energy X-ray Absorptiometry Testing Is Indicated*</th>
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<tr>
<td>All women 65 years of age or older, regardless of risk factors</td>
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<tr>
<td>Postmenopausal women with a history of fracture(s) without major trauma</td>
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<td>... after age 40–45 years (AACE [11])</td>
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<tr>
<td>... as an adult (NAMS [13])</td>
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<td>... after menopause (NAMS [13])</td>
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<tr>
<td>Postmenopausal women with osteopenia identified radiographically (AACE [11])</td>
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<tr>
<td>Postmenopausal women starting or taking long-term (≥3 months) systemic glucocorticoid therapy</td>
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<tr>
<td>Perimenopausal or postmenopausal women who have 1 or more of the following risk factors for osteoporosis and who are willing to consider pharmacologic interventions</td>
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<tr>
<td>Low body weight (&lt;127 lb) or low body mass index (&lt;20 kg/m²; AACE [11]; or &lt;21 kg/m², NAMS [13])</td>
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<tr>
<td>Ever use of long-term (≥3 months) systemic glucocorticoid therapy</td>
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<tr>
<td>Family history of osteoporotic fracture (AACE [11]; history of hip fracture in a parent (NAMS [13]))</td>
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<tr>
<td>Early menopause (AACE [11])</td>
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<tr>
<td>Current smoker</td>
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<tr>
<td>Excessive consumption of alcohol</td>
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<tr>
<td>Rheumatoid arthritis</td>
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<tr>
<td>Women with secondary osteoporosis, regardless of age</td>
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<tr>
<td>Women being considered for pharmacologic therapy, to monitor treatment effect</td>
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<tr>
<td>Women currently receiving pharmacologic therapy, to monitor treatment effect</td>
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</table>

*These recommendations are based on guidelines from the American Association of Clinical Endocrinologists (AACE), the National Osteoporosis Foundation (NOF), the International Society for Clinical Densitometry (ISCD), and the North American Menopause Society (NAMS).
years, when accelerated bone loss might require shorter testing intervals, and it also excluded women who had osteoporosis by DXA, those who had prior fractures, and those who were already receiving drug therapy. Additionally, this study did not assess for morphometric vertebral fractures, the presence of which would have established a clinical diagnosis of osteoporosis even if densitometric criteria were consistent with osteopenia.

While media reports have suggested that frequent DXA testing is a significant problem in clinical practice, the data suggest otherwise. King and Fiorentino demonstrated that during the 7-year span from 2002 through 2008, 25.4% of elderly fee-for-service Medicare beneficiaries had only 1 DXA study, 15.4% had 2 studies, 8.1% had 3 studies, 2% had 4 studies, and less than 1% had 5 or more DXA studies. Almost half (47.87%) of the individuals in this group did not have a DXA study [14].

Finally, some researchers have challenged the role of repeat DXA testing in postmenopausal women who are receiving drug therapy. A 2009 study by Bell and colleagues assessed 6,459 women with low BMD who were enrolled in the Fracture Intervention Trial (FIT) and were randomized to receive placebo or alendronate [27]. BMD was measured at baseline and at 1, 2, and 3 years after randomization. The authors concluded that monitoring BMD in the first 3 years after starting treatment “is unnecessary and may be misleading.” Performing a secondary analysis of pooled data from the 2 arms of FIT, they determined that more than 97% of treated patients demonstrated an increase in BMD. However, Watts and colleagues [28] pointed out several flaws in the Bell study. First, they noted that the purpose of monitoring is not to document an increase in BMD but to identify people who experience a significant decline in BMD, because these individuals experience a higher rate of fracture compared with individuals whose BMD is stable or increasing. In fact, patients in FIT were dropped from the trial if they had significant bone loss in the lumbar spine or total hip (8% or more over 1 year, 10% or more over 2 years, or 12% or more over 3 years) [29]. Moreover, patients in FIT faced a number of exclusion criteria, which set them apart from a real-world treatment group, and study participants also had significantly greater compliance with alendronate.

**Conclusion**

As we sort through these studies and recommendations, we should keep in mind that DXA is not the only tool for assessing fracture risk. The presence of a prior fragility fracture establishes a clinical diagnosis of osteoporosis and warrants drug therapy even if a DXA study shows only osteopenia. Vertebral body compression fractures may be detected by a plain radiograph or with Vertebral Fracture Assessment (VFA), a software addition to DXA that provides either a single-energy or a dual-energy x-ray image of the thoracic and lumbar vertebrae. Anywhere from 16% to 48% of older individuals with osteopenia on DXA have evidence of prevalent vertebral body compression fractures, most of which are low trauma [30-32]. The presence of such fractures changes the clinical diagnosis to osteoporosis and has a significant impact on treatment decisions. Moreover, fracture risk increases as vertebral fractures increase in number and severity [33].

FRAX provides 10-year fracture risk predictions using a number of clinical risk factors in addition to BMD, and NOF provides treatment thresholds specific to the United States for patients with osteopenia [1]. Using the concept of fracture risk thresholds rather than relying solely on BMD, AACE has proposed reasonable guidelines for frequency of DXA testing in patients who are not receiving treatment for osteoporosis or low bone mass (see Table 3) [11].

Despite being a chronic disease in which prevention has been shown to save money, osteoporosis remains underrecognized and undertreated. There is little evidence to support the claim that DXA testing is widely misused in.

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### TABLE 2.

**Medicare Beneficiaries for Whom Dual-Energy X-ray Absorptiometry Testing Is Covered**

- A woman who has been determined by the physician (or a qualified nonphysician practitioner) treating her to be estrogen-deficient and at clinical risk for osteoporosis, based on her medical history and other findings
- An individual with vertebral abnormalities as demonstrated by an x-ray to be indicative of osteoporosis, osteopenia, or vertebral fracture
- An individual receiving (or expecting to receive) glucocorticoid (steroid) therapy equivalent to an average of 5.0 mg of prednisone, or greater, per day for more than 3 months
- An individual with primary hyperparathyroidism
- An individual being monitored to assess the response to or efficacy of an FDA-approved osteoporosis drug therapy

*Note. FDA, US Food and Drug Administration.*

Source: Reproduced from an article in the Federal Register [19].

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### TABLE 3.

**American Association of Clinical Endocrinologists Guidelines for Frequency of Dual-Energy X-ray Absorptiometry Testing**

<table>
<thead>
<tr>
<th>Guidelines for testing in women who have not received osteoporosis treatment</th>
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<tbody>
<tr>
<td>The frequency of testing depends on the results of the initial test and the likelihood of clinically significant bone loss.</td>
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<tr>
<td>For patients approaching an intervention threshold, retesting every 1–2 years is often appropriate.</td>
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<tr>
<td>For those whose bone mineral density is borderline-low, retesting every 3–5 years is usually sufficient.</td>
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<tr>
<td>Patients who are comfortably above an intervention threshold may not need to undergo reassessment for 5 or 10 years, or ever, unless there is some new indication.</td>
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**Guidelines for testing in women who are undergoing treatment for osteoporosis**

Repeat testing every 1–2 years until bone density is stable, then reduce testing frequency.

*Source: Adapted from Watts et al [11].*
either younger women or in older women who are enrolled in Medicare. A number of studies, some of which have been inaccurately or incompletely covered in the lay press, have created confusion among health care providers and patients regarding the value of DXA testing. Compounding this confusion, there has been a 65% decline in Medicare reimbursement of DXA in the nonfacility setting, from $139 in 2006 to $49 in 2014; at this lower level, providers can no longer cover their operating costs. This has resulted in an 8.3% decline in testing rates in postmenopausal women from 2011 to 2012 (Christopher Hogan, PhD, written communication, July 2013; based on an analysis of data from the Medicare Physician/Supplier Procedure Summary Master Files, summarized from 5% Standard Analytical Files through 2012), and there has been an 8.1% decline in the number of DXA providers nationally between 2008 and 2011 (Christopher Hogan, PhD, written communication, July 2013; based on counts of unique provider identifiers on 5% sample, Limited Data Set, Standard Analytical Files, 2005-2011). Twenty-nine states lost more than 10% of their DXA providers, and 9 of those 29 states lost more than 20% of their DXA providers (Alison B. King, PhD, written communication, August 2013; based on counts of unique provider identifiers on 5% sample, Limited Data Set, Standard Analytical Files, 2005-2011).

DXA remains an important tool in the assessment of skeletal health. Critical analysis fails to support the assumption that DXA testing is overused in women less than 65 years of age. In women 65 years of age or older, the challenge is undertesting. Repeat DXA testing may be of clinical utility in untreated individuals who are approaching a fracture threshold and in treated patients to exclude significant bone loss from noncompliance, lack of efficacy, or a secondary cause of metabolic bone disease that was previously unidentified. NCMJ

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References


