

Diagnosis and Management of Osteoporosis

MICHAEL P. JEREMIAH, MD; BRIAN K. UNWIN, MD; and MARK H. GREENAWALD, MD, *Virginia Tech Carilion School of Medicine, Roanoke, Virginia*

VINCENT E. CASIANO, MD, *Evans Army Community Hospital, Fort Carson, Colorado*

Osteoporosis-related fractures affect approximately one in two white women and one in five white men in their lifetime. The impact of fractures includes loss of function, significant costs, and increased mortality. The U.S. Preventive Services Task Force recommends using dual energy x-ray absorptiometry to screen all women 65 years and older, and younger women who have an increased fracture risk as determined by the World Health Organization's FRAX Fracture Risk Assessment Tool. Although guidelines are lacking for rescreening women who have normal bone mineral density on initial screening, intervals of at least four years appear safe. The U.S. Preventive Services Task Force found insufficient evidence to recommend screening for osteoporosis in men; other organizations recommend screening all men 70 years and older. In patients with newly diagnosed osteoporosis, suggested laboratory tests to identify secondary causes include serum 25-hydroxyvitamin D, calcium, creatinine, and thyroid-stimulating hormone. First-line treatment to prevent fractures consists of fall prevention, smoking cessation, moderation of alcohol intake, and bisphosphonate therapy. Clinicians should consider discontinuing bisphosphonate therapy after five years in women without a personal history of vertebral fractures. Raloxifene, teriparatide, and denosumab are alternative effective treatments for certain subsets of patients and for those who are unable to take or whose condition does not respond to bisphosphonates. The need for follow-up bone mineral density testing in patients receiving treatment for osteoporosis is uncertain. (*Am Fam Physician*. 2015;92(4):261-268. Copyright © 2015 American Academy of Family Physicians.)



More online
at <http://www.aafp.org/afp>.

CME This clinical content conforms to AAFP criteria for continuing medical education (CME). See CME Quiz Questions on page 252.

Author disclosure: No relevant financial affiliations.

More than 10 million Americans have osteoporosis, which is defined by the National Osteoporosis Foundation as a chronic, progressive disease characterized by low bone mass, microarchitecture deterioration of bone tissue, bone fragility, and a consequent increase in fracture risk.¹ Roughly 50% of white women and 20% of white men have a fracture related to osteoporosis in their lifetime; although black men and women are at lower risk of osteoporosis, those with osteoporosis have similar fracture risk.¹ Osteoporotic fractures are associated with increased risk of disability, nursing home placement, total health care costs, and mortality (*Table 1*).¹⁻³ Osteoporosis risk increases with age, and its impact will increase as the U.S. population ages.³ *Table 2* lists risk factors for osteoporosis.²

Diagnosis

Osteoporosis is diagnosed radiographically based on bone mineral density (BMD) determinations from dual energy x-ray absorptiometry (DEXA) assessment.⁴ Although quantitative calcaneal ultrasonography and peripheral DEXA can also predict fracture

risk, these modalities do not correlate well enough with central DEXA to be used diagnostically.^{1,5,6} The World Health Organization (WHO) established commonly accepted definitions of osteoporosis and osteopenia⁴ (*Table 3*).⁶

The WHO criteria should not be applied to men younger than 50 years, children, or premenopausal women. For these groups, the International Society for Clinical Densitometry recommends use of the z score (age and sex norms). Z scores of -2.0 or less are below the expected range for age. Osteoporosis in men younger than 50 years cannot be diagnosed based on BMD assessment alone.⁷

Screening

Published osteoporosis screening guidelines vary greatly (*eTable A*). The U.S. Preventive Services Task Force (USPSTF) recommends screening all women 65 years and older.⁵ DEXA of the hip and lumbar spine is the preferred assessment method. The USPSTF also advises screening women younger than 65 years whose 10-year fracture risk is greater than or equal to that of a 65-year-old white woman without additional risk factors.⁵ The FRAX WHO Fracture Risk Assessment

Table 1. Impact of Osteoporosis

Impact	Statistics
Disability (pain, disability, complications)	10 million Americans 50 years and older have osteoporosis of the hip 1.5 million Americans have osteoporotic fracture (40% of women and 10% of men will have a fracture of the hip, spine, or wrist) 40% regain prefracture independence
Mortality	10% to 20% increased mortality at one year after a fracture
Long-term nursing home care	20% of patients with a fracture
Annualized health care costs (2002)	500,000 hospitalizations 800,000 emergency department visits 2.5 million office visits 180,000 nursing home admissions Total costs projected to rise from \$18 billion in 2002 to \$25 billion by 2025

Information from references 1 through 3.

Table 2. Selected Risk Factors for Osteoporosis

Excessive alcohol intake (> 4 drinks per day for men; > 2 drinks per day for women), caffeine intake (> 2.5 units [e.g., cups of coffee] per day), and tobacco use (any smoking)
Family history of osteoporotic fracture
Gonadal hormone deficiency
Immobilization and inadequate activity
Increasing age
Low body weight (< 58 kg [128 lb])
Low calcium or vitamin D intake
Low level of physical activity
Personal history of fracture
Smoking
White or Asian race

Information from reference 2.

Table 3. Diagnostic Criteria for Osteoporosis and Osteopenia in Postmenopausal Women and Men Older Than 50 Years

Category	Bone mass (BMD derived from DEXA measurement)
Normal	Spinal or hip BMD within 1.0 SD below the young adult female reference mean (T-score ≥ -1.0)
Low bone mass (osteopenia)	Spinal or hip BMD between 1.0 and 2.5 SDs below the young adult female reference mean (T-score < -1.0 and > -2.5)
Osteoporosis	Spinal or hip BMD ≥ 2.5 SDs below the young adult female reference mean (T-score ≤ -2.5)
Severe/established osteoporosis	BMD ≥ 2.5 SDs below the young adult female reference mean and the presence of one or more fragility fractures

BMD = bone mineral density; DEXA = dual energy x-ray absorptiometry; SDs = standard deviations.

Information from reference 6.

this group has a similar osteoporotic fracture risk and treatment effectiveness as 65-year-old white women.¹

Evaluation for Secondary Osteoporosis

Primary osteoporosis is related to aging and loss of gonadal function. Secondary osteoporosis is caused by other health conditions (Table 4).² Up to 30% of osteoporosis cases in postmenopausal women are estimated to be from a secondary cause.¹⁰ The estimate climbs to greater than 50% in men, premenopausal women, and perimenopausal women if vitamin D deficiency is included as a secondary cause.¹¹⁻¹³ In addition to performing a history and physical examination, expert consensus suggests a basic laboratory evaluation for all newly diagnosed patients to determine if there are contraindications for certain osteoporosis medications and to identify the more common secondary causes. The most commonly recommended laboratory tests include serum 25-hydroxyvitamin D, calcium, creatinine, and thyroid-stimulating hormone levels.^{1,14}

Treatment

The National Osteoporosis Foundation recommends treatment of postmenopausal women and men with a personal history of hip or vertebral fracture, a T-score of -2.5 or less, or a combination of low bone mass (T-score between -1 and -2.5) and a 10-year probability of hip fracture of at least 3% or any major fracture of at least 20% as calculated by the FRAX WHO Fracture Risk Assessment Tool.¹ The WHO recommendations are less specific, stating that persons with or at risk of osteoporosis should be considered for treatment.¹⁵ Randomized controlled trials of treatment have shown reduction of

Tool (<http://www.shef.ac.uk/FRAX/>) was used by the USPSTF as a method of determining increased fracture risk for these women. Although guidelines for rescreening women with normal initial screening results are lacking, recent evidence suggests that intervals of at least four years appear safe.^{8,9}

The USPSTF found insufficient evidence to recommend routine screening for osteoporosis in men.⁵ Men with a minimal trauma fracture who are older than 50 years or those with secondary causes associated with bone loss could be considered for screening. The National Osteoporosis Foundation also recommends screening all men 70 years and older, based on the assumption that

Table 4. Common Causes of Secondary Osteoporosis**Medical conditions**

Central nervous system disorders (e.g., epilepsy, multiple sclerosis, Parkinson disease, spinal cord injury, stroke)

Chronic obstructive pulmonary disease

Endocrine/metabolic disorders (adrenal insufficiency, athletic amenorrhea, Cushing syndrome, hemochromatosis, homocystinuria, primary hyperparathyroidism, hyperprolactinemia, hyperthyroidism, primary or secondary hypogonadism, premature menopause, thyrotoxicosis, type 1 diabetes mellitus)

Gastrointestinal disorders (celiac disease, gastric bypass, inflammatory bowel disease, malabsorption, pancreatic insufficiency, primary biliary cirrhosis)

Hematologic disorders (hemophilia, leukemia and lymphomas, monoclonal gammopathies, multiple myeloma, sickle cell disease, thalassemia)

Human immunodeficiency virus infection or AIDS

Liver disease (severe)

Nutrition disorders (alcoholism, anorexia nervosa/bulimia, malnutrition, vitamin A excess, vitamin D deficiency)

Renal insufficiency or renal failure

Rheumatoid arthritis

Systemic lupus erythematosus

Medications

Anticonvulsants (e.g., phenobarbital, phenytoin [Dilantin])

Chemotherapeutics

Cyclosporine (Sandimmune)

Depo-medroxyprogesterone (Depo-Provera)

Glucocorticoids

Gonadotropin-releasing hormone agonists and antagonists

Heparin

Lithium

Methotrexate

Proton pump inhibitors

Selective serotonin reuptake inhibitors

Tacrolimus (Prograf)

Tamoxifen

Thiazolidinediones (e.g., pioglitazone [Actos])

Thyroid hormone excess

Adapted from U.S. Department of Health and Human Services. Bone Health and Osteoporosis: A Report of the Surgeon General. Rockville, Md.: U.S. Department of Health and Human Services, Office of the Surgeon General; 2004:47,51.

fractures for only two groups: those with a T-score of less than -2.5 and those who have already experienced a hip or vertebral fracture.¹⁶

NONPHARMACOLOGIC TREATMENT

Fall prevention is a priority for patients with osteoporosis because falls are more closely associated with fracture risk than is BMD.¹⁷ The USPSTF recommends exercise or physical therapy and vitamin D supplementation to prevent falls in community-dwelling adults 65 years or older who are at increased risk of falls.¹⁸ A multicomponent exercise program that consists of weight-bearing resistance and balance training should be recommended. Aerobic exercise programs that do not incorporate strength and balance training should be avoided because of the association with increased fracture risk.¹⁹ A thorough assessment of a patient's risks of falling and mitigation of those risk factors have strong evidence of effectiveness in fall prevention.²⁰ A Cochrane review suggested that hip protectors decrease fracture risk.²¹

Patients should be counseled to quit smoking because it has been shown to decrease BMD at all skeletal sites.²² Heavy alcohol consumption (defined as more than four drinks per day for men or more than two drinks per day for women) is a major risk factor for fracture and should be discouraged.²³

Dietary modifications may have a role in optimizing bone health. Consuming more than 2.5 units of caffeine daily (1 unit = one cup of coffee or two cups of tea) may increase fracture risk.²⁴ Diets with adequate protein intake are necessary for optimal bone health, but

the proper amount or source (plant vs. animal) remains controversial. A balanced diet consisting of vitamin D, calcium, protein, vegetables, and fruits is recommended; mononutrient dietary supplementation is unlikely to be helpful.²⁴ Table 5 shows a comparison of nonpharmacologic therapies.¹⁷⁻²⁵

PHARMACOLOGIC TREATMENT

Table 6 summarizes pharmacologic treatments for osteoporosis, including bisphosphonates, raloxifene (Evista), teriparatide (Forteo), and denosumab (Prolia).^{16,26-29}

Table 5. Nonpharmacologic Therapy to Reduce Fractures

<i>Intervention</i>	<i>Comments</i>
Alcohol moderation	≤ 4 drinks per day for men or ≤ 2 drinks per day for women
Decreased caffeine intake	≤ 2.5 cups of coffee or ≤ 5 cups of tea per day
Multicomponent exercise with strength and balance training	—
Multifactorial falls risk assessment	—
Smoking cessation	—
Sunlight/ultraviolet exposure	30 minutes per day, 5 days per week
Vitamin D supplementation	800 IU per day

Information from references 17 through 25.

Osteoporosis

Bisphosphonates. Oral bisphosphonates inhibit osteoclastic activity and are antiresorptive agents. They are considered first-line pharmacologic therapy. Randomized clinical trials demonstrate a reduction of vertebral and hip fractures with alendronate (Fosamax) and risedronate (Actonel).^{16,26} Alendronate and risedronate also decrease vertebral fractures in men^{30,31} and in patients with glucocorticoid-induced osteoporosis.^{32,33} Daily and intermittent use of ibandronate (Boniva) have demonstrated effectiveness in reducing fractures of the spine only.³⁴ Weekly and monthly dosing formulations improve adherence.³⁵ Oral bisphosphonates should be taken only with water and a wait of at least 30 minutes before reclining or ingesting other medication or food. This decreases upper gastrointestinal adverse effects and allows for appropriate absorption.

The intravenous bisphosphonates approved by the U.S. Food and Drug Administration for the treatment of postmenopausal osteoporosis are zoledronic acid (Reclast), 5 mg yearly (shown to decrease vertebral and hip fractures),^{16,26,36} and ibandronate, 3 mg every three months.³⁷ Although these medications are expensive, they are useful for high-risk patients who are unable to tolerate or adhere to oral therapy.

The optimal length of oral bisphosphonate therapy is unknown. One study found that women who take alendronate for five years followed by five years of placebo have no increased incidence of nonvertebral or hip fractures compared with women who take alendronate for 10 years. There is, however, an increase in vertebral fractures.³⁸ Osteonecrosis of the jaw and atypical femoral fractures are rare complications of bisphosphonate therapy that are associated with longer duration of use.^{39,40} Clinicians should consider discontinuing bisphosphonate therapy after five years in women without a personal history of vertebral fractures.

Raloxifene. Raloxifene, a selective estrogen receptor modulator, is approved for treating postmenopausal osteoporosis, and is effective at reducing vertebral fractures only.^{16,26} Raloxifene is commonly associated with increased vasomotor symptoms. It is associated with an increased risk of venous thromboembolism and a decreased risk of invasive breast cancer.¹⁶ The best candidates for raloxifene are postmenopausal women with osteoporosis who are unable to tolerate bisphosphonates, have no vasomotor symptoms or history of venous thromboembolism, and have a high breast cancer risk score.^{16,27} Bazedoxifene is a selective estrogen receptor modulator more recently approved for use in the United States for the prevention of osteoporosis as part of a combination therapy with conjugated estrogen (Duavee).

Table 6. Pharmacologic Therapies for Osteoporosis

<i>Class/medication</i>	<i>FDA indication</i>	<i>Fracture type</i>
Bisphosphonates		
Alendronate (Fosamax)	Prevention	Hip, vertebral, nonvertebral
	Treatment	Hip, vertebral, nonvertebral
Alendronate/cholecalciferol (Fosamax Plus D)	Treatment	Hip, vertebral, nonvertebral
Ibandronate (Boniva)	Prevention and treatment	Vertebral only
	Treatment	Vertebral only
Risedronate (Actonel)	Prevention and treatment	Hip, vertebral, nonvertebral
Risedronate, delayed release (Atelvia)	Treatment	Hip, vertebral, nonvertebral
Risedronate with calcium	Prevention and treatment	Hip, vertebral, nonvertebral
Zoledronic acid (Reclast)	Prevention	Hip, vertebral, nonvertebral
	Treatment	Hip, vertebral, nonvertebral
Raloxifene (Evista)	Prevention and treatment	Vertebral only
Teriparatide (Forteo)	Treatment (high risk*)	Vertebral, nonvertebral
Denosumab (Prolia)	Treatment (high risk*)	Hip, vertebral, nonvertebral

FDA = U.S. Food and Drug Administration; IV = intravenous; NNT = number needed to treat.

**—History of osteoporotic fracture, multiple fracture risk factors, or intolerant to other therapy.*

Information from references 16, and 26 through 29.

Typical dosage and monthly cost ^{27,28}	Adverse effects and contraindications	NNT (to prevent one fracture) ²⁹
Consider drug discontinuation after 5 years in low-risk patients	Small risk of atypical femoral shaft fractures; osteonecrosis of the jaw	
5 mg per day or 35 mg per week, oral \$53 10 mg per day or 70 mg per week, oral \$107	Mild upper gastrointestinal events, esophageal ulcerations, perforations, bleeding events, muscular and joint pains Contraindications: abnormalities of the esophagus; inability to stand or sit upright for at least 30 minutes; hypersensitivity to any product component; increased risk of aspiration or dysphagia	Hip: 91 (2 to 5 years)
70 mg plus 2,800 IU or 5,600 IU per week, oral \$140	Same as alendronate	—
150 mg monthly or 2.5 mg per day, oral \$153 3 mg every 3 months, IV \$159 (one dose = \$477)	Same as alendronate	Spine: 20 (3 years)
	Same as alendronate	—
5 mg per day or 35 mg per week or 75 mg in two consecutive days per month or 150 mg per month, oral \$199	Same as alendronate	Hip: 77 (3 years)
35 mg per week, oral \$168	Same as alendronate	—
35 mg per week (day 1) plus 1,250 mg calcium per day (days 2 to 7 each week), oral \$216	Same as alendronate	—
5 mg every 2 years, IV \$45 (one dose = \$1,083) 5 mg per year, IV \$90 (one dose = \$1,083)	Muscular and joint pains Contraindications: hypocalcemia creatinine clearance < 35 mL per minute per 1.73 m ² (0.58 mL per second per m ²) and acute renal impairment; hypersensitivity to zoledronic acid or any components of this product	Hip: 91 (3 years) Spine: 30 (2 years; from 1 study of men)
60 mg per day, oral \$198	Pulmonary embolism, thromboembolic events Contraindications: venous thromboembolism; pregnancy, women who may become pregnant, and breastfeeding mothers	Spine: 29 (3 years)
20 mcg per day for up to 2 years, subcutaneous \$1,545	Arthralgia, pain, nausea, transient orthostatic hypotension, hypercalcemia, hyperuricemia Contraindications: hypersensitivity to teriparatide or to any of its components; reactions have included angioedema and anaphylaxis	Spine: 11 (1.5 years)
60 mg every 6 months, subcutaneous \$146 (one dose = \$881)	Muscular and joint pains; small risk of osteonecrosis of the jaw (especially older women with poor dental hygiene or cancer) Contraindications: hypocalcemia; pregnancy	Spine: 21 (3 years)

SORT: KEY RECOMMENDATIONS FOR PRACTICE

<i>Clinical recommendation</i>	<i>Evidence rating</i>	<i>References</i>
All women 65 years and older should be screened for osteoporosis with dual energy x-ray absorptiometry of the hip and lumbar spine.	B	5
Women younger than 65 years should be screened for osteoporosis if the estimated 10-year fracture risk equals or exceeds that of a 65-year-old white woman with no risk factors.	B	1, 5
The U.S. Preventive Services Task Force concludes that the current evidence is insufficient to assess the balance of benefits and harms of screening for osteoporosis in men.	C	5
A fall risk assessment should be performed and a multicomponent exercise program and smoking cessation should be recommended to decrease fracture risk in individuals 65 years and older with osteoporosis or a history of vertebral fracture.	C	17, 20, 22
Bisphosphonates should be used as first-line pharmacologic treatment for osteoporosis.	A	16, 26
In patients who cannot tolerate or whose symptoms do not improve with bisphosphonate therapy, teriparatide (Forteo) and denosumab (Prolia) are effective alternative medications to prevent osteoporotic fractures.	A	16, 26, 44

A = consistent, good-quality patient-oriented evidence; B = inconsistent or limited-quality patient-oriented evidence; C = consensus, disease-oriented evidence, usual practice, expert opinion, or case series. For information about the SORT evidence rating system, go to <http://www.aafp.org/afpsort>.

Calcitonin. Calcitonin nasal spray is an antiresorptive agent approved for the treatment of postmenopausal osteoporosis. It has been shown to decrease the occurrence of vertebral compression fractures only.^{16,26} Although calcitonin has modest analgesic properties in the setting of acute and chronic vertebral compression fracture, it is not considered first-line treatment for osteoporosis because more effective medications are available.^{16,41} There have also been reports of increased cancer rates associated with use of calcitonin.⁴²

Teriparatide. Teriparatide is a recombinant human parathyroid hormone with bone anabolic activity. In a dosage of 20 mcg per day given subcutaneously for up to two years, teriparatide decreases vertebral and nonvertebral fractures.^{16,26} Teriparatide is approved for the treatment of postmenopausal women with severe bone loss, men with osteoporosis who have high risk of fracture, and individuals whose condition has not improved with bisphosphonate therapy. One study suggests that it is advisable to follow teriparatide therapy with bisphosphonate therapy to maintain BMD gains.⁴³

Denosumab. Denosumab is a human monoclonal antibody that inhibits the formation and activity of osteoclasts by blocking receptor activator of nuclear factor kappa B ligand. In a dose of 60 mg given subcutaneously every six months for three years, it significantly increased BMD in postmenopausal women compared with weekly dosing of alendronate.⁴⁴ Denosumab has been shown to decrease hip, vertebral, and nonvertebral fractures compared with low doses of calcium and vitamin D. It appears to be a reasonable alternative for persons whose condition does not improve with bisphosphonates. Renal insufficiency is a listed caution, but denosumab appears to be safe for patients with chronic kidney disease stages 1 to 3.⁴⁵

Hormone Therapy. The Women's Health Initiative study confirmed that estrogen, with or without progesterone, slightly reduced the risk of hip and vertebral fractures; however, this benefit did not outweigh the increased risk of stroke, venous thromboembolism, coronary heart disease, and breast cancer, even for women at high risk of fracture.⁴⁶ Lower doses of conjugated equine estrogens and estradiol have been shown to improve BMD, but a reduced risk of fracture has not been demonstrated and the safety is unknown.⁴⁷

Combination Therapy. There has been no demonstrated effectiveness of combination therapy in reducing fractures. Although research continues, there is currently a limited role for combination therapy beyond clinical trials.

BEST PRACTICES IN PREVENTIVE MEDICINE: RECOMMENDATIONS FROM THE CHOOSING WISELY CAMPAIGN

<i>Recommendation</i>	<i>Sponsoring organization</i>
Do not use dual energy x-ray absorptiometry (DEXA) to screen for osteoporosis in women younger than 65 years or in men younger than 70 years with no risk factors.*	American Academy of Family Physicians
Do not routinely repeat dual energy x-ray absorptiometry (DEXA) scans more often than once every two years.	American College of Rheumatology

*—Risk factors include, but are not limited to, fractures after 50 years of age, prolonged exposure to corticosteroids, diet deficient in calcium or vitamin D, cigarette smoking, alcoholism, and thin/small build.

Source: For more information on the Choosing Wisely Campaign, see <http://www.choosingwisely.org>. For supporting citations and to search Choosing Wisely recommendations relevant to primary care, see <http://www.aafp.org/afp/recommendations/search.htm>.

FOLLOW-UP

After initiation of treatment, the need for follow-up bone density testing is uncertain. A decrease in BMD could suggest treatment nonadherence, inadequate calcium or vitamin D intake, an unidentified secondary cause of osteoporosis, or treatment failure.⁴⁸ However, a single-institution study found that although follow-up DEXA scanning for patients with osteoporosis was performed often, this rarely led to changes in treatment, even in patients found to have decreased BMD.⁴⁹

Data Sources: We reviewed all cited references from the original 2009 review article, then performed a PubMed search using the following key words: osteoporosis, osteopenia, screening, diagnosis, treatment, prevention, secondary, and vitamin D. The search included meta-analyses, randomized controlled trials, clinical trials, and reviews. Additional searches included Essential Evidence Plus, the U.S. Preventive Services Task Force, the Institute for Clinical Systems Improvement, the National Guideline Clearinghouse, the Cochrane Database of Systematic Reviews, and the National Osteoporosis Foundation website. Search dates: April and July 2014, and May 2015.

The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of Defense, the U.S. Army Medical Corps, or the U.S. Army at large.

NOTE: This review updates a previous article on this topic by Sweet, Sweet, Jeremiah, and Galazka.²⁹

The Authors

MICHAEL P. JEREMIAH, MD, is an associate professor in the Department of Family and Community Medicine at the Virginia Tech Carilion School of Medicine in Roanoke.

BRIAN K. UNWIN, MD, is an associate professor in the Department of Family and Community Medicine at the Virginia Tech Carilion School of Medicine.

MARK H. GREENAWALD, MD, is a professor in the Department of Family and Community Medicine at the Virginia Tech Carilion School of Medicine.

VINCENT E. CASIANO, MD, is a member of the Department of Primary Care at Evans Army Community Hospital, Fort Carson, Colo. At the time the article was submitted, Dr. Casiano was command surgeon for the Multinational Force and Observers in Egypt.

Address correspondence to Michael P. Jeremiah, MD, Virginia Tech Carilion School of Medicine, 1 Riverside Cir., Ste. 102, Roanoke, VA 24016 (e-mail: mpjeremiah@carilionclinic.org). Reprints are not available from the authors.

REFERENCES

- National Osteoporosis Foundation. *Clinician's Guide to Prevention and Treatment of Osteoporosis*. Washington, DC: National Osteoporosis Foundation; 2014.
- U.S. Department of Health and Human Services. *Bone Health and Osteoporosis: A Report of the Surgeon General*. Rockville, Md.: U.S. Department of Health and Human Services, Office of the Surgeon General; 2004.
- National Osteoporosis Foundation. *America's Bone Health: The State of Osteoporosis and Low Bone Mass in Our Nation*. Washington, DC: National Osteoporosis Foundation; 2002.
- World Health Organization. WHO scientific group on the assessment of osteoporosis at the primary health care level: summary meeting report. Brussels, Belgium; May 5-7, 2004. Geneva, Switzerland: World Health Organization; 2007.
- U.S. Preventive Services Task Force. Screening for osteoporosis: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med*. 2011;154(5):356-364.
- Nayak S, Olkin I, Liu H, et al. Meta-analysis: accuracy of quantitative ultrasound for identifying patients with osteoporosis. *Ann Intern Med*. 2006;144(11):832-841.
- Schousboe JT, Shepherd JA, Bilezikian JP, Baim S. Executive summary of the 2013 International Society for Clinical Densitometry Position Development Conference on bone densitometry. *J Clin Densitom*. 2013; 16(4):455-466.
- Gourlay ML, Fine JP, Preisser JS, et al.; Study of Osteoporotic Fractures Research Group. Bone-density testing interval and transition to osteoporosis in older women. *N Engl J Med*. 2012;366(3):225-233.
- Berry SD, Samelson EJ, Pencina MJ, et al. Repeat bone mineral density screening and prediction of hip and major osteoporotic fracture. *JAMA*. 2013;310(12):1256-1262.
- Fitzpatrick LA. Secondary causes of osteoporosis. *Mayo Clin Proc*. 2002;77(5):453-468.
- Cohen A, Fleischer J, Freeby MJ, McMahon DJ, Irani D, Shane E. Clinical characteristics and medication use among premenopausal women with osteoporosis and low BMD: the experience of an osteoporosis referral center. *J Womens Health (Larchmt)*. 2009;18(1):79-84.
- Ebeling PR. Clinical practice. Osteoporosis in men. *N Engl J Med*. 2008; 358(14):1474-1482.
- Cerdá Gabaroi D, Peris P, Monegal A, et al. Search for hidden secondary causes in postmenopausal women with osteoporosis. *Menopause*. 2010;17(1):135-139.
- Management of osteoporosis in postmenopausal women: 2010 position statement of the North American Menopause Society. *Menopause*. 2010;17(1):25-54.
- World Health Organization. Prevention and management of osteoporosis: report of a WHO Scientific Group. Geneva, Switzerland; 2003. http://whqlibdoc.who.int/trs/WHO_TRS_921.pdf. Accessed September 6, 2014.
- Crandall CJ, Newberry SJ, Diamant A, et al. Comparative effectiveness of pharmacologic treatments to prevent fractures: an updated systematic review. *Ann Intern Med*. 2014;161(10):711-723.
- Karinkanta S, Piirtola M, Sievänen H, Uusi-Rasi K, Kannus P. Physical therapy approaches to reduce fall and fracture risk among older adults. *Nat Rev Endocrinol*. 2010;6(7):396-407.
- Moyer VA; U.S. Preventive Services Task Force. Prevention of falls in community-dwelling older adults: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med*. 2012;157(3):197-204.
- Giangregorio LM, Papaioannou A, Macintyre NJ, et al. Too fit to fracture: exercise recommendations for individuals with osteoporosis or osteoporotic vertebral fracture. *Osteoporos Int*. 2014;25(3):821-835.
- American Geriatrics Society. *AGS/BGS Clinical Practice Guideline for the Prevention of Falls in Older Persons*. New York, NY: American Geriatrics Society; 2010.
- Santesso N, Carrasco-Labra A, Brignardello-Peterson R. Hip protectors for preventing hip fractures in older people. *Cochrane Database Syst Rev*. 2014;(3):CD001255.
- Yoon V, Maalouf NM, Sakhaee K. The effects of smoking on bone metabolism. *Osteoporos Int*. 2012;23(8):2081-2092.
- Maurel DB, Boisseau N, Benhamou CL, Jaffre C. Alcohol and bone: review of dose effects and mechanisms. *Osteoporos Int*. 2012;23(1):1-16.
- Body JJ, Bergmann P, Boonen S, et al. Non-pharmacological management

Osteoporosis

- of osteoporosis: a consensus of the Belgian Bone Club. *Osteoporos Int*. 2011;22(11):2769-2788.
25. Sambrook PN, Cameron ID, Chen JS, et al. Does increased sunlight exposure work as a strategy to improve vitamin D status in the elderly: a cluster randomised controlled trial. *Osteoporos Int*. 2012;23(2):615-624.
 26. MacLean C, Newberry S, Maglione M, et al. Systematic review: comparative effectiveness of treatments to prevent fractures in men and women with low bone density or osteoporosis. *Ann Intern Med*. 2008;148(3):197-213.
 27. Drugs for postmenopausal osteoporosis. *Med Lett Drugs Ther*. 2014;56(1452):91-96.
 28. First Databank, Inc. AnalySource Monthly. <http://www.fdbhealth.com/policies/drug-pricing-policy>. Accessed September 5, 2014.
 29. Sweet MG, Sweet JM, Jeremiah MP, Galazka SS. Diagnosis and treatment of osteoporosis. *Am Fam Physician*. 2009;79(3):193-200.
 30. Ringe JD, Faber H, Farahmand P, Dorst A. Efficacy of risedronate in men with primary and secondary osteoporosis: results of a 1-year study. *Rheumatol Int*. 2006;26(5):427-431.
 31. Orwoll E, Ettinger M, Weiss S, et al. Alendronate for the treatment of osteoporosis in men. *N Engl J Med*. 2000;343(9):604-610.
 32. Adachi JD, Saag KG, Delmas PD, et al. Two-year effects of alendronate on bone mineral density and vertebral fracture in patients receiving glucocorticoids: a randomized, double-blind, placebo-controlled extension trial. *Arthritis Rheum*. 2001;44(1):202-211.
 33. Wallach S, Cohen S, Reid DM, et al. Effects of risedronate treatment on bone density and vertebral fracture in patients on corticosteroid therapy. *Calcif Tissue Int*. 2000;67(4):277-285.
 34. Chesnut CH III, Skag A, Christiansen C, et al.; Oral Ibandronate Osteoporosis Vertebral Fracture Trial in North America and Europe (BONE). Effects of oral ibandronate administered daily or intermittently on fracture risk in postmenopausal osteoporosis. *J Bone Miner Res*. 2004;19(8):1241-1249.
 35. Siris ES, Harris ST, Rosen CJ, et al. Adherence to bisphosphonate therapy and fracture rates in osteoporotic women: relationship to vertebral and nonvertebral fractures from 2 US claims databases. *Mayo Clin Proc*. 2006;81(8):1013-1022.
 36. Boonen S, Reginster JY, Kaufman JM, et al. Fracture risk and zoledronic acid therapy in men with osteoporosis. *N Engl J Med*. 2012;367(18):1714-1723.
 37. Delmas PD, Adami S, Strugala C, et al. Intravenous ibandronate injections in postmenopausal women with osteoporosis: one-year results from the dosing intravenous administration study. *Arthritis Rheum*. 2006;54(6):1838-1846.
 38. Black DM, Schwartz AV, Ensrud KE, et al.; FLEX Research Group. Effects of continuing or stopping alendronate after 5 years of treatment: the Fracture Intervention Trial Long-term Extension (FLEX): a randomized trial. *JAMA*. 2006;296(24):2927-2938.
 39. Woo SB, Hellstein JW, Kalmar JR. Narrative [corrected] review: bisphosphonates and osteonecrosis of the jaws [published correction appears in *Ann Intern Med*. 2006;145(3):235]. *Ann Intern Med*. 2006;144(10):753-761.
 40. Meier RP, Perneger TV, Stern R, Rizzoli R, Peter RE. Increasing occurrence of atypical femoral fractures associated with bisphosphonate use. *Arch Intern Med*. 2012;172(12):930-936.
 41. Silverman SL, Azria M. The analgesic role of calcitonin following osteoporotic fracture. *Osteoporos Int*. 2002;13(11):858-867.
 42. Overman RA, Borse M, Gourlay ML. Salmon calcitonin use and associated cancer risk. *Ann Pharmacother*. 2013;47(12):1675-1684.
 43. Black DM, Bilezikian JP, Ensrud KE, et al.; PaTH Study Investigators. One year of alendronate after one year of parathyroid hormone (1-84) for osteoporosis. *N Engl J Med*. 2005;353(6):555-565.
 44. Cummings SR, San Martin J, McClung MR, et al.; FREEDOM Trial. Denosumab for prevention of fractures in postmenopausal women with osteoporosis [published correction appears in *N Engl J Med*. 2009;361(19):1914]. *N Engl J Med*. 2009;361(8):756-765.
 45. Jamal SA, Ljunggren O, Stehman-Breen C, et al. Effects of denosumab on fracture and bone mineral density by level of kidney function. *J Bone Miner Res*. 2011;26(8):1829-1835.
 46. Cauley JA, Robbins J, Chen Z, et al.; Women's Health Initiative Investigators. Effects of estrogen plus progestin on risk of fracture and bone mineral density: the Women's Health Initiative randomized trial. *JAMA*. 2003;290(13):1729-1738.
 47. Lindsay R, Gallagher JC, Kleerekoper M, Pickar JH. Effect of lower doses of conjugated equine estrogens with and without medroxyprogesterone acetate on bone in early postmenopausal women. *JAMA*. 2002;287(20):2668-2676.
 48. Lewiecki EM. Bone density monitoring to monitor osteoporosis therapy in clinical practice. *Am Fam Physician*. 2010;82(7):749-754.
 49. Combs BP, Rappaport M, Caverly TJ, Matlock DD. "Due" for a scan: examining the utility of monitoring densitometry. *JAMA Intern Med*. 2013;173(21):2007-2009.

eTable A. Osteoporosis Screening Recommendations

<i>Organization</i>	<i>Recommendation</i>
American Association of Clinical Endocrinologists ^{A1} (2010)	<p>All women 65 years or older</p> <p>All postmenopausal women:</p> <ul style="list-style-type: none"> With a history of fracture(s) without major trauma after 40 to 45 years of age With osteopenia identified radiographically Starting or taking long-term systemic glucocorticoid therapy (≥ 3 months) Patients at increased risk of secondary osteoporosis (e.g., rheumatoid arthritis) <p>Other perimenopausal or postmenopausal women with risk factors for osteoporosis if willing to consider pharmacologic interventions:</p> <ul style="list-style-type: none"> Current smoker Early menopause Family history of osteoporotic fracture Excessive consumption of alcohol (> 2 drinks per day for women) Low body weight (< 58 kg [128 lb] or body mass index < 20 kg per m²) Any history of long-term systemic glucocorticoid therapy (≥ 3 months)
American College of Obstetricians and Gynecologists ^{A2} (2012)	<p>Bone density screening no more than once every two years beginning at 65 years of age, unless new health risks develop</p> <p>Selective screening in women younger than 65 years if they are postmenopausal and have other osteoporosis risk factors or fracture</p> <p>In the absence of new risk factors, DEXA monitoring of therapy should not be repeated after BMD is determined to be stable or improved</p>
National Osteoporosis Foundation ^{A3} (2014)*	<p>BMD testing should be performed:</p> <ul style="list-style-type: none"> In women 65 years and older and in men 70 years and older In postmenopausal women and men 50 to 69 years of age; recommended based on risk factor profile With vertebral imaging in those who have had a fracture to determine degree of disease severity At DEXA facilities using accepted quality assurance measures <p>Vertebral imaging should be performed:</p> <ul style="list-style-type: none"> In women 65 years and older and in men 70 years and older to diagnose vertebral fractures if T-score is ≤ -1.5 In women 70 years and older and in men 80 years and older to diagnose vertebral fractures, regardless of T-score In postmenopausal women and men 50 years and older with a low-trauma fracture In postmenopausal women and men 50 to 69 years of age to diagnose vertebral fractures if there is height loss ≥ 4 cm (1.5 in), or recent or ongoing long-term glucocorticoid therapy <p>To check for causes of secondary osteoporosis</p> <p>Monitoring should include:</p> <ul style="list-style-type: none"> BMD testing one to two years after initiating therapy to reduce fracture risk and every two years thereafter More frequent testing in certain clinical situations Longer interval between repeat BMD tests for patients without major risk factors and who have an initial T-score in the normal or upper low-bone mass range

continues

BMD = bone mineral density; DEXA = dual energy x-ray absorptiometry.

eTable A. Osteoporosis Screening Recommendations (continued)

Organization	Recommendation
Osteoporosis Canada ^{A4} (2010)*	<p>Younger adults (age < 50 years):</p> <p>Fragility fracture</p> <p>Risk factors: glucocorticoid use (> 3 months cumulative therapy in past year), high-risk medication use, hypogonadism or premature menopause (age < 45 years), malabsorption syndrome, hyperparathyroidism, other associated disorders</p> <p>Older adults (age > 50 years):</p> <p>Fragility fracture</p> <p>High alcohol intake</p> <p>Low body weight (< 60 kg [132 lb]) or weight loss (> 10% of weight at 25 years of age)</p> <p>Parental hip fracture</p> <p>Rheumatoid arthritis</p> <p>Smoking</p> <p>Vertebral fracture or osteopenia on radiography</p> <p>Men and women 65 years and older</p> <p>Repeat BMD testing in one to three years and reassess risk in moderate- and high-risk groups</p>
United Kingdom National Osteoporosis Guideline Group ^{A5} (2009)	<p>Population screening not recommended</p> <p>Case finding for BMD assessment is based on risk factor assessment and comparison of risk to age- and sex-specific fracture probabilities</p>
U.S. Preventive Services Task Force ^{A6} (2011)	<p>Screen for osteoporosis in women 65 years and older, and in younger women whose fracture risk is equal to or greater than that of a 65-year-old white woman who has no additional risk factors</p> <p>Current evidence is insufficient to assess the balance of benefits and harms of screening for osteoporosis in men</p>

BMD = bone mineral density; DEXA = dual energy x-ray absorptiometry.

*—Supported in part by pharmaceutical companies that produce medications for osteoporosis.

Information from:

A1. Watts NB, Bilezikian JP, Camacho PM, et al.; AACE Osteoporosis Task Force. American Association of Clinical Endocrinologists Medical Guidelines for Clinical Practice for the diagnosis and treatment of postmenopausal osteoporosis. *Endocr Pract.* 2010;(16 suppl 3):1-37.

A2. Osteoporosis. ACOG practice bulletin; no. 129. Washington, DC: American College of Obstetricians and Gynecologists (ACOG); 2012.

A3. National Osteoporosis Foundation. Clinician's Guide to Prevention and Treatment of Osteoporosis. Washington, DC: National Osteoporosis Foundation; 2014.

A4. Papaioannou A, Morin S, Cheung AM, et al.; Scientific Advisory Council of Osteoporosis Canada. 2010 clinical practice guidelines for the diagnosis and management of osteoporosis in Canada: summary. *CMAJ.* 2010;182(17):1864-1873.

A5. Compston J, Cooper A, Cooper C, et al.; National Osteoporosis Guideline Group (NOGG). Guidelines for the diagnosis and management of osteoporosis in postmenopausal women and men from the age of 50 years in the UK. *Maturitas.* 2009;62(2):105-108.

A6. U.S. Preventive Services Task Force. Screening for osteoporosis: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med.* 2011;154(5):356-364.