CE 1.5 HOURS
Continuing Education

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Osteoporosis

Home healthcare clinicians are in a unique position to assess patients for risk of osteoporosis and fragility fractures. They are also key members of the interdisciplinary care team in the recovery of patients with fragility fractures. Home healthcare clinicians care for an aging patient population with diverse conditions and multiple medications that can increase their risk of osteoporosis. Bone mineral density in addition to an evaluation of clinical risk factors are necessary to diagnose osteoporosis; DEXA and FRAX are the tools available. Undertreatment of osteoporosis is common among community dwelling elderly adults. Lack of patient adherence and insufficient physician prescription of medications are common. There are a wide array of osteoporosis medications and patients need education about their use. With the growing number of older adults in the population, increasing numbers will be vulnerable to osteoporosis and fragility fracture. Home healthcare clinicians need to be proactive to assess the aging population and assist in their treatment of this common disorder.

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A CLINICAL UPDATE FOR HOME HEALTHCARE CLINICIANS

Approximately 10 million Americans have osteoporosis, which causes a progressive decrease in bone mass, bone fragility, and an increased risk of fractures. Osteoporosis contributes to more than 2 million fractures each year in the United States alone (Burge et al., 2007). The most common osteoporosis-induced fractures are hip and vertebral compression fractures. Osteoporotic fractures are associated with chronic pain and disability, loss of independence, placement in long-term care, and high mortality (Cosman et al., 2014). After sustaining hip fracture, 22% of women and 33% of men do not live a full year (Brauer et al., 2009) and approximately 44% of survivors suffer a second fracture within 5 years.

There is widespread undertreatment of osteoporosis in the older adult population (Miller, 2016). Studies show that even after an osteoporosis-related fracture, many patients do not receive appropriate osteoporosis treatment. According to Outman et al. (2012), only 22% of home healthcare patients with a fracture history receive osteoporosis prescription therapy. Home healthcare clinicians are in a unique position to assess risk factors, advocate for adequate treatment, and prompt physicians to prescribe necessary osteoporosis medications.

Pathophysiology

Bone is in a constant state of remodeling and regeneration. There is constant bone formation by osteoblasts and bone resorption by osteoclasts. Individuals in their mid-30s begin to have greater osteoclastic-induced bone breakdown compared with osteoblastic activity. As a result, bones become thinner and weaker in structure, which is particularly apparent in trabecular bone. Trabecular bone has a nonsolid, mesh-like architecture that commonly exhibits the effects of osteoporosis before solid bones (Rachner et al., 2011). Bone breakdown accelerates in women at the time of menopause when estrogen levels diminish. Women often suffer kyphosis with asymptomatic vertebral osteoporosis and compression fracture. Osteoporotic bone loss tends to affect men later in life than women. According to the Centers for Disease Control and Prevention (2017), 25% of women 65 years of age and over have osteoporosis of the femur neck or lumbar spine and 5% of men of the same age have similar findings.

Assessment of Bone Mineral Density

The neck of the femur and lumbar vertebrae are trabecular bones used to assess bone mineral density (BMD) with a dual-energy X-ray absorptiometry (DEXA) scan. This is the current standard measurement used to diagnose osteoporosis. Screening is recommended in all women over 65 years of age or in women aged 50 to 64 years with specific risk factors (O'Connor, 2016). Osteoporosis is diagnosed in anyone with a BMD less than or equal to 2.5 standard deviations below that of a healthy 30-year-old. The T-score is a measure of BMD in comparison to normal. A score of 0 means BMD is equal to the norm for a healthy young adult. Differences between BMD and that of the healthy young adult norm are measured in units called standard deviations. The more standard deviations below 0, indicated as negative numbers, the lower the BMD and the higher the risk of fracture (World Health Organization, 2007).

T-scores between +1 and -1 are considered normal. T-scores between -1 and -2.4 indicate low bone mass known as osteopenia. A T-score of -2.5 or lower indicates osteoporosis. BMD is a strong predictor of future fracture; however, many fractures occur in persons with BMD values that fall above the osteoporosis threshold (Burge et al., 2007). Thus, measuring BMD only partially identifies the population segment who are at risk of fracture.

Risk Factors for Osteoporosis

Risk factors for osteoporosis can be separated into modifiable and nonmodifiable categories (Table 1). Several clinical factors other than BMD are associated with a fracture risk. Age is a powerful independent risk factor that has not been considered in previous clinical guidelines.

In women with a T-score of -2.5, the probability of hip fracture is five times greater at the age of 80 years than it is at the age of 50 years (Kanis et al., 2008). Similarly, other clinical risk factors contribute independently to fracture risk (Table 2).

What Is the FRAX Score?

Osteoporosis diagnostic criteria developed by the National Bone Health Alliance (NBHA) are based on a more comprehensive evaluation of patient conditions. An algorithm, called World Health Organization's Fracture Risk Assessment Tool (FRAX) integrates risk factors with mortality data to estimate the 10-year absolute probability of hip and major osteoporotic fracture for adults aged 40 and over. Risk factors used in the algorithm include age, sex, femur neck BMD, body mass index, prior fragility fracture, parental history of hip fracture, glucocorticoid use, rheumatoid arthritis, current smoking, excess alcohol consumption, and secondary osteoporosis (Table 2). Using these criteria, the expanded definition increases the prevalence of osteoporosis and it may better identify those at elevated fracture risk. Based on the NBHA, 16% of men and 29.9% of women aged 50+ have osteoporosis (Wright et al., 2017). The FRAX assessment tool can be found at: https://www.sheffield.ac.uk/FRAX/tool.jsp.

Secondary osteoporosis is caused by disorders or treatments that interfere with bone metabolism and create bone loss (Tables 3 & 4). Abnormal hormone levels due to disorders or treatments such as hypercortisolemia of Cushing disease, hyper or hypothyroidism, deficiency of androgens or estrogen, and use of exogenous corticosteroids can cause bone loss (Antoniadou et al., 2017). Aromatase inhibitors used to treat breast cancer are particularly associated with rapid bone breakdown (Hong et al., 2017). Type 1 diabetes mellitus particularly increases risk of osteoporosis due to lack of the anabolic actions of insulin on bone. Also, the class of oral antidiabetic drugs known as glitazones can promote bone loss and osteoporotic fractures in postmenopausal women (Hamann et al., 2012). The

Table 1. Osteoporosis Risk Factors

Nonmodifiable Risk Factors	Modifiable Risk Factors
Age > 50	Smoking
Female gender	Excess alcohol consumption (>2 Units/day)
Family history	Low body mass index (<20 kg/m^2)
Previous fracture	Poor nutrition
Caucasian/Asian ethnicity	Vitamin D deficiency (poor sunlight exposure)
Menopause or total hysterectomy (with ovaries)	Eating disorder (anorexia or bulimia)
Rheumatoid arthritis	Sedentary lifestyle (lack of weight-bearing exercise)
Androgen deficiency in males	Frequent falls

Note. Based on information from "International Osteoporosis Foundation. Retrieved from https://www.iofbonehealth.org/whos-risk. Accessed October 18, 2017."

Table 2. Risk Factors on the FRAX Assessment Tool

Age	Between ages 40 and 90
Gender	Female
Race	Asian > Caucasian > African American
Weight/Height	Body mass index: weight in kg and height in cm for calculating body mass index (kg/m^2)
History of fragility fracture	Including radiographic evidence of vertebral compression fracture
Family history of osteoporosis	
History of hip fracture in mother or father	
Current smoking	
Corticosteroid use	Exposed to ≥5 mg/day of prednisolone for ≥3 mo (or equivalent doses of other glucocorticoids)
Rheumatoid arthritis	
Condition that is associated with secondary osteoporosis	Type 1 diabetes, osteogenesis imperfecta in adults, untreated long-standing hypothyroidism, hypogonadism, premature menopause, chronic malnutrition, malabsorption, and chronic liver disease
Alcohol use > 3 Units/day	A unit of alcohol is equivalent to a glass of beer (285 mL), an ounce (30 mL) of spirits, or a medium-sized glass of wine (120 mL)

Note. Based on information from "The assessment of fracture risk," by A. Unnanuntana, B. P. Gladnick, E. Connelly, and J. M. Lane, 2010, *American Journal of Bone and Joint Surgery, 92*, pp. 743-753.

Table 3. Disorders That Can Cause Secondary Osteoporosis

Endocrine Diseases	Gastrointestinal Diseases	Hematological Diseases	Pulmonary Diseases
Hypercortisolemia Thyroid disease (hypo- and hyperthyroidism) Primary hyperparathyroidism Diabetes mellitus Type 1 and 2 Hypogonadism Growth hormone deficiency	Celiac disease Inflammatory bowel disease Gastric bypass surgery Chronic liver disease Pancreatic disease Primary biliary cirrhosis	Leukemia Mastocytosis Thalassemia Multiple myeloma Hemophilia Monoclonal gammopathies Sickle cell disease	Chronic obstructive pulmonary disease
Kidney Diseases	**Connective Tissue Diseases/Autoimmune**	**Psychiatric Disorders**	**Neurological Diseases**
Renal tubular acidosis Chronic renal failure	Rheumatoid arthritis Ankylosing spondylitis Lupus Sarcoidosis	Depression Dementia	Spinal cord injury Multiple sclerosis Stroke Parkinson disease Muscular dystrophy

Note. Based on information from "Characteristics and diagnostic workup of the patient at risk to sustain fragility fracture," by E. Antoniadou, A. Kouzelis, G. Diamantakis, A. Bavelou, and E. Panagiotopoulos, 2017, *Injury, 48,* pp. S17–S23.

widely prescribed use of proton pump inhibitors and selective serotonin receptor inhibitors is also linked to osteoporosis and fragility fractures (Maes et al., 2017). Osteoporosis also commonly coexists with chronic kidney disease. Renal osteodystrophy (bone breakdown), hyperparathyroidism, imbalances in calcium, phosphate, and vitamin D are complications of chronic kidney disease (Miller, 2014). It is also important to remember that any disorder that subjects an individual to immobility diminishes bone strength.

Table 4. Drugs That Can Cause Osteoporosis

Glucocorticoids
Thyroid hormone
Hypogonadism-inducing agents/GnRH agonists
Aromatase inhibitors
Medroxyprogesterone acetate
Thiazolidinediones
Drugs acting on CNS/Antidepressants/Anticonvulsants
Drugs acting on the immune system
Antiretroviral therapy
Anticoagulants: heparin
Diuretics: loop diuretics
Drugs acting on the gastrointestinal tract/Proton pump inhibitors

Note. GnRH = gonadotropin-releasing hormone; CNS = central nervous system. Based on information from "Characteristics and diagnostic workup of the patient at risk to sustain fragility fracture," by E. Antoniadou, A. Kouzelis, G. Diamantakis, A. Bavelou, and E. Panagiotopoulos, 2017, *Injury, 48,* pp. S17–S23.

Treatment/Interventions

According to the 2008 National Osteoporosis Foundation recommendations, treatment of osteoporosis should be considered for:

(1) patients with a history of hip or vertebral fracture,
(2) patients with a T-score of -2.5 or lower at the femoral neck or spine,
(3) patients who have a T-score of between -1.0 and -2.5 at the femoral neck or spine and a 10-year hip fracture risk of ≥3% or a 10-year risk of a major osteoporosis-related fracture of ≥20% as assessed with the FRAX tool (Kanis et al., 2010).

Calcium

It is important to ensure the sufficient calcium intake through a balanced diet. It appears that an intake of more than 1,000 mg/day is sufficient for bone health (Moyer et al., 2013). However, the average daily dietary calcium intake in adults age 50 and older is 600 to 700 mg/day. Increasing dietary calcium is the first-line approach, but calcium supplements should be used when an adequate dietary intake cannot

be achieved. There is no evidence that calcium intake in excess of these amounts confers additional bone strength. Intakes in excess of 1,200 to 1,500 mg/day may increase the risk of developing kidney stones, cardiovascular disease, and stroke. However, a review of the literature indicates this is a controversial issue (Reid et al., 2015).

Vitamin D

Vitamin D plays an essential role in the maintenance of bone strength because it is necessary for intestinal absorption of calcium. Vitamin D is synthesized in skin during sun exposure as well as ingested as part of a balanced diet. Older individuals synthesize less vitamin D in skin (they also tend to expose their skin less than younger adults) and they frequently have nutritionally deficient diets. Thus, many older people may suffer from low vitamin D (Reid, 2017). A recommendation of daily vitamin D supplementation at a dose of 800 IU/day (20 µg/day) in older adults (>70 years) has been adopted by International Osteoporosis Foundation and the Institute of Medicine (Rizzoli et al., 2013).

Bisphosphonates

The most commonly prescribed medications used to treat osteoporosis are oral bisphosphonates. Bisphosphonates reduce osteoclast-mediated bone resorption by suppressing osteoclast activity. Adequate calcium and vitamin D supplements are necessary for optimal effect of bisphosphonate. Maximal reduction in bone resorption typically occurs within 3 months of initiating oral bisphosphonate therapy and remains approximately constant thereafter with bisphosphonate continuance. Suppression of resorption occurs even more rapidly after intravenous bisphosphonate therapy (Fazil et al., 2015). However, studies have reported that the majority of postmenopausal women discontinue bisphosphonate therapy within 1 year of initiation, indicating that adherence to long-term bisphosphonate treatment is often inadequate (Imaz et al., 2010). Patients should be advised to maintain an upright posture for 30 to 60 minutes after ingesting medication with a full glass of water. Nonspecific gastrointestinal symptoms, such as nausea, dyspepsia, and gastritis, are common reasons for oral bisphosphonate discontinuation. Severe musculoskeletal pain has been reported as well as ocular inflammation, esophageal cancer, osteonecrosis of the jaw, and subtrochanteric fractures of the femur (Kennel & Drake, 2009). Bisphosphonates include: Alendronate (Fosamax); Risedronate (Actonel); Etidronate (Didronel); and Ibandronate (Boniva) among others.

Raloxifene

Selective estrogen receptor modulators exhibit estrogen receptor agonist or antagonist activity based on the target tissue. Raloxifene (Evista) acts like an estrogen agonist at bone, preserving the integrity and strength without stimulating the breast or endometrial tissue. Raloxifene has been shown to reduce the risk of vertebral fractures by about 30% in patients with a prior vertebral fracture and by about 55% in patients without a prior vertebral fracture over 3 years (Ettinger et al., 1999). Raloxifene is also indicated for the reduction in risk of invasive breast cancer in postmenopausal women with osteoporosis. Adverse effects include increased risk of venous thromboembolism and hot flashes (Hadji, 2012).

Teriparatide

Teriparatide is a parathyroid hormone analog that stimulates osteoblastic activity in bone. Parathyroid hormone can cause bone resorption or bone synthesis depending on how it is used. Intermittent parathyroid hormone stimulation of bone, rather than prolonged receptor stimulation, enhances bone formation (Frolik et al., 2003). When used properly, teriparatide increases hip and spine BMD and reduces the risk of vertebral and nonvertebral fractures in postmenopausal osteoporotic women.

Combination therapy with antiresorptive medications and teriparatide simultaneously promotes bone synthesis. Studies have shown that the combination of teriparatide and denosumab increases bone density and estimated strength more than monotherapy and more than any currently available regimen. Teriparatide provides maximal benefit when its use is followed by or combined with an antiresorptive medication (Tsai et al., 2017). However, when individuals established on potent bisphosphonates are switched to teriparatide, hip BMD declines below baseline for at least the first 12 months after the

switch to teriparatide. This transient hip BMD loss is more prominent when the antiresorptive agent is denosumab. Hip BMD remains below baseline for almost a full 24 months (Cosman et al., 2017).

Calcitonin

Calcitonin is a bone resorption inhibitor derived from salmon and FDA-approved for the treatment of osteoporosis in women who are at least 5 years postmenopausal when alternative treatments are not suitable. Miacalcin nasal spray has not been shown to increase BMD in early postmenopausal women. However, calcitonin is known for its ability to relieve back pain due to vertebral compression fracture (Blau & Hoehns, 2003).

Antibody-Mediated Antiresorptive Therapy: Denosumab

Denosumab is a human monoclonal antibody that is genetically engineered to bind to cytokines that act as osteoclastic cell stimulants. The drug ultimately blocks osteoclastic activity and inhibits reabsorption of bone. Current data show that with up to 8 years of continued use, there is continued improvement in bone density with reduced fracture risk (Zaheer et al., 2015). To optimize treatment, denosumab should be used in combination with vitamin D and calcium. It has the potential to cause hypocalcemia and increased parathyroid hormone if used alone. Potential adverse effects include hypocalcemia, immunosuppression, osteonecrosis of the jaw, and possible increased fracture risk following discontinuation of the medication (Zanchetta et al., 2018). Based on current data, denosumab should not be stopped without continuing an alternative treatment in order to prevent rapid BMD loss.

How Long Should Osteoporosis Medications Be Used?

All nonbisphosphonate medications produce temporary effects that wane upon discontinuation. If these treatments are stopped, benefits rapidly disappear. In contrast, it may be possible to discontinue bisphosphonates and retain residual benefits against fracture at least for several years (Cosman et al., 2014). Evidence of efficacy beyond 5 years is limited, whereas rare safety concerns such as osteonecrosis of the jaw and atypical femur fractures become more common beyond 5 years.

Comprehensive home healthcare after a fragility fracture includes fall prevention, family and patient education, pharmacologic management, physical therapy, and occupational therapy as well as pain management and thromboprophylaxis.

Home Healthcare for Patients With Osteoporosis and/or Fragility Fracture

Home healthcare clinicians are in a key position to assess patients with a fracture history, initiate a care plan, inform physicians of patient risk status, coordinate multidisciplinary care, and provide patient and family education (Outman et al., 2012). Rehabilitation at home after a fragility fracture is preferred by the majority of older adults. However, approximately, 20% of persons who suffer hip fracture require long-term care (Salkeld et al., 2000). Comprehensive home healthcare after a fragility fracture includes fall prevention, family and patient education, pharmacologic management, physical therapy, and occupational therapy as well as pain management and thromboprophylaxis.

Postfracture Physical Rehabilitation

The goal of physical rehabilitation after a fragility fracture is to restore patients to their preinjury status, although 50% of older adults who sustain a hip fracture never regain prefall level of function and 40% never recover their prefracture walking ability (Haentjens et al., 2010). Many investigators question whether the current physical rehabilitation programs are sufficiently rigorous and prescribed for enough length of time. In general, a therapeutic exercise program needs to address flexibility, muscle strength, weight-bearing, core stability, cardiovascular fitness, and gait steadiness. Exercises that enhance the patient's proprioception and balance contribute to postural stability.

An algorithm called World Health Organization's Fracture Risk Assessment Tool (FRAX) integrates risk factors with mortality data to estimate the 10-year absolute probability of hip and major osteoporotic fracture for adults aged 40 and over.

Typically, home healthcare rehabilitation is provided 1 to 3 times per week for 3 to 6 weeks and one-half hour to 1 hour at a time. However, regular exercise for several days a week for 6 months to a year improves mobility, increases walking speed, and improves quadriceps strength (Turunen et al., 2017).

Fall Prevention

A home safety assessment, alcohol cessation, evaluation of vision, review of medications (specifically psychoactive medications), and orthostatic blood pressure assessment are important in mitigating patient falls. Studies of community dwellers have shown significant reduction of falls and fractures following exercise intervention, with the benefit increasing with escalating intensity of the exercise (Li et al., 2016). Foot problems and inappropriate footwear in older adults are associated with impaired balance and performance. Recommendations for use of appropriate shoes are indicated. Environmental hazards are any objects (throw rugs, furniture) or circumstances in the home environment that increase an individual's risk of falling, such as poor lighting, clutter, and lack of handrails in bathrooms.

Pain Management

Pain management in older adults can be complicated after a fragility fracture. According to Aubrun and Marmion (2007), given the likely comorbidities and increased sensitivities to opioids, the usage of multiple approaches to treating pain should be utilized. Acetaminophen, ibuprofen, and naproxen are commonly used for mild to moderate back pain due to compression fracture. Back bracing and back strengthening exercises are also recommended. For severe pain, opioids are used. Clinicians should use the World Health Organization (2007) pain ladder when treating pain in vertebral compression fracture. Opioids may induce sedation, cognitive impairment, delirium, and falls in older adults due to increased cerebral sensitivity to them. There is no difference in cognitive effects for fentanyl, morphine, or hydromorphone. If pain does not subside, studies show that calcitonin added to the regimen assists in pain relief (Blau & Hoehns, 2003). Kyphoplasty is also effective in relieving vertebral compression fracture pain.

Thromboprophylaxis

Pharmacologic prophylaxis for venous thromboembolism should be undertaken postoperatively for all patients with a hip fracture. Presently there is no consensus on the best agent to use. Studies have shown that fondaparinux or low-molecular weight heparin for 28 to 35 days after surgery are effective (Fisher et al., 2013). Warfarin is an alternative reasonable choice for therapy and is often used in patients who were taking warfarin prior to fracture. Direct thrombin inhibitors (dabigatran) and factor Xa inhibitors (rivaroxaban) are newer oral anticoagulants. However, there is no strong evidence with regard to their use in patients with fragility fractures around the hip. They do not require laboratory monitoring and can be administered in a fixed dose, but their disadvantage is that they do not have an antagonist to reverse their pharmacologic effect (Ktistakis et al., 2017). Pneumatic compression devices or foot impulse technology and thromboembolic stockings are recommended as mechanical means of thromboprophylaxis.

Conclusion

Home healthcare providers care for an aging patient population with diverse conditions and multiple medications that can increase their risk of osteoporosis. BMD in addition to an evaluation of clinical risk factors are necessary to diagnose osteoporosis; DEXA and FRAX are the tools available. Undertreatment of osteoporosis is common among community dwelling older adults. Lack of patient adherence and insufficient physician prescription of medications are common. There are a wide array of osteoporosis medications and patients need education about their use. With the

growing number of older adults in the population, increasing numbers will be vulnerable to osteoporosis and fragility fracture. Home healthcare providers need to be proactive to assess the aging population and assist in their treatment of this common disorder. Home healthcare clinicians are key members of the interdisciplinary care team in the recovery of patients with fragility fracture. ☗

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