

Chapter 10: Key Messages

- Individuals have a critical role to play in promoting their own bone health. All health care professionals, especially primary care providers, have the opportunity and responsibility to assist them in this task by promoting awareness of factors that influence bone health; identifying patients at risk of bone disease; and providing lifestyle and therapeutic interventions to prevent bone loss and fractures.
- Nurse practitioners, nurse midwives, and physician assistants can contribute significantly to the provision of bone health care. They can educate patients on nutrition and physical activity recommendations, ensure proper screening, and monitor compliance with treatment. Physical therapists, occupational therapists, pharmacists, and dietitians can play valuable roles in helping patients achieve maximal physical function and bone accrual.
- Childhood is an excellent time to initiate counseling aimed at encouraging appropriate nutrition and physical activities and discouraging the adoption of behaviors that negatively affect bone health.
- All young and middle-aged adults should be encouraged to adopt lifestyles that help prevent bone loss and promote overall health and the prevention of chronic disease. Young and middle-aged adult patients who have medical conditions or who are taking medications associated with bone loss should be considered for bone density testing and drug therapy.
- For older adults and the elderly, recommended levels of both calcium and vitamin D increase. Older adults should engage in regular physical activity, and many can follow the recommendations for younger adults. Weight-supporting activities may be more appropriate in older adults with compromised bone health, although with proper supervision and training they can safely engage in resistance exercises as well.
- Risk factors for bone loss and fracture should be assessed in all older women. In addition, all women aged 65 and older should undergo bone density testing as recommended by the U.S. Preventive Services Task Force and the National Osteoporosis Foundation. Bone density testing should be considered in men with fragility fractures; those on therapies that may cause bone loss, notably glucocorticoids or androgen deprivation; and men with multiple risk factors.
- Pharmacologic therapy should be considered in individuals who have osteoporosis. Individuals with low bone mass and multiple risk factors should also be considered for therapy. Selection of a therapeutic agent can be tailored to the severity of the patient's bone loss and other co-morbid conditions.
- Fall prevention strategies should also be discussed with every osteoporosis patient, and hip protectors should be considered for the frail elderly and patients at high risk for falling.
- A person of any age (especially an elderly individual) who represents a challenging clinical situation may benefit from a referral to an endocrinologist, rheumatologist, or other specialist in osteoporosis management.

Chapter 10

PUTTING IT ALL TOGETHER FOR THE BUSY HEALTH CARE PROFESSIONAL

As noted throughout this report, individuals have a critically important role to play in building and maintaining strong, healthy bones throughout life. All health care professionals, especially primary care providers, have the opportunity and responsibility to assist individuals in achieving this goal by promoting awareness of factors that influence bone health, identifying patients at risk of bone disease, and providing lifestyle and therapeutic interventions to prevent bone loss and fractures. Even though most osteoporotic fractures occur in older individuals, the risks of incurring such fractures are largely determined much earlier in life—both by the level of peak bone mass achieved during childhood and adolescence and by subsequent lifestyle choices and medical events of adulthood. As discussed earlier in this report, health care professionals could do a better job in preventing, identifying, and treating bone disease; osteoporosis remains underdiagnosed and undertreated. Since osteoporosis is a common disorder that can be diagnosed and treated in the primary care setting, much of the responsibility for promoting awareness, diagnosis, prevention, and treatment of osteoporosis falls on health care professionals who provide primary care. For example, pediatricians and other primary care providers for children and adolescents should

focus on maximizing bone accrual as discussed below in the section on infancy through adolescence. Primary care and other providers for adults can also help their patients maintain skeletal health by focusing on germane areas within their respective specialties. For example, obstetrics and gynecology providers should include recommendations for skeletal health in their discussions of nutrition and physical activity during family planning, lactation, pregnancy, and menopause, as discussed in the section on young and middle adulthood. Internists and specialists such as rheumatologists, gastroenterologists, oncologists, pulmonologists, dermatologists, and urologists should maximize lifestyle interventions and manage patients on pharmacotherapies, including oral glucocorticoids and gonadal hormone suppression therapies, that can cause bone loss, as discussed in the section on older adults and the elderly. Geriatricians, internists, emergency department physicians, and orthopedists have a unique opportunity to ensure that patients who present with fractures receive intensive interventions designed to maximize recovery and prevent future fractures. Certain health care professionals, such as nurse practitioners, nurse midwives, and physician assistants, can contribute significantly to the care

of many patients and can educate patients on nutrition and lifestyle recommendations, ensure proper screening, and monitor compliance with treatment. Other health care professionals such as physical therapists, occupational therapists, pharmacists, dentists, optometrists, and dietitians can play valuable roles in helping patients achieve maximal physical function and bone accrual. For example, pharmacists can advise patients concerning calcium and vitamin D supplementation, the best way to take medications, and any potential drug interactions. Optometrists can help by ensuring that the vision of older patients is adequately corrected, which should decrease the risk of potentially debilitating falls. For their part, dentists may be able to detect bone loss in the jaw, which could lead to further investigation of the potential for osteoporosis.

Fortunately, recommendations related to bone health also promote overall health and therefore fit in well with other preventive recommendations. This chapter is devoted to identifying ways that health care professionals can incorporate recommendations focused on bone health into the advice they are already providing patients, and to offering practical advice on how providers can assist patients in implementing these recommendations into their lives. These recommendations are based largely on the evidence related to the maintenance of bone health, the diagnosis of bone disease, and the prevention and treatment of fractures outlined in Chapters 6, 7, 8, and 9, and therefore references are not included in this chapter except in cases where material has not previously been referenced.

Children and Adolescents

The period from infancy through adolescence is critical for building bones and developing healthful bone habits that help an

individual to maintain a robust skeleton throughout life. As noted in Chapter 2, most individuals reach their “peak bone mass” during this time, which is determined by genetic factors and lifestyle choices (e.g., nutrition, physical activity) made by children with the influence of their parents during the first 18 years of life. The first 2 years of life and early adolescence are particularly important for future bone health, as they are characterized by rapid bone accumulation. Health care professionals who are involved in the health maintenance of infants, children, and adolescents have an opportunity to positively influence bone health for the rest of their patient’s lives. While bone disease is quite rare in children and adolescents, health care professionals also need to be aware of the warning signs of potential problems that could be caused by genetic factors, lifestyle choices, certain diseases, or use of certain medications.

Nutrition

Achieving recommended levels of intake for calcium, vitamin D, and other nutrients during infancy, childhood, and adolescence is critical to maintaining healthy bones throughout life. (See Table 10-1 for a listing of the dietary calcium and vitamin D requirements for infants, children, and adolescents.) What follows is a more detailed discussion of how health care professionals can assist their patients in achieving these levels.

Calcium

Adequate calcium intake is critical for infants, children, and adolescents, as discussed below.

Infants: Nutrition is important to bone health even before birth. The largest influx of calcium into the fetal skeleton occurs during the last trimester of human pregnancy. Most newborns will receive adequate levels of calcium from their mothers during full-term pregnancies, and from

breast milk, formula, and/or solid foods during the first year of life. Infants who are born prematurely “miss out” on some calcium before they are born and will likely have lower bone mass at birth than will a full-term infant. While breast feeding provides important advantages to premature infants, it may not provide for all of their needs. As a result, health care professionals should encourage parents of premature infants who are being breast fed to use supplements that provide added nutrients, particularly calcium,

vitamin D, phosphorus, and protein (Schanler 2001). Health care professionals should advise the parents of premature infants who are not being breast fed about the importance of using infant formulas that are designed to provide calcium and phosphorus intakes similar to those that occur in utero during the last trimester of normal human pregnancy. Even when premature infants use such formulas, it can take up to 5 years for their bone mass to catch up with that of full-term newborns.

Table 10–1. Summary Recommendations for Bone Health

	Calcium (mg/day)	Vitamin D (IU/day)	Physical Activity	Bone Density Testing	Patients at Increased Risk
Infants					Frequent fractures, anorexia, amenorrhea, chronic hepatic, renal, gastrointestinal, autoimmune disease. Medications in Table 10–2.
0–6 Months	210	200	Interactive play	As clinically indicated in high risk patients.	
6–12 Months	270				
Children and Adolescents					
1–3 years	500	200	Moderate to vigorous activity at least 60 minutes per day. Emphasize weight bearing activity.	As clinically indicated in high risk patients.	
4–8 years	800				
9–18 years	1300				
Adults					
18–50 years	1000	200	Moderate activity at least 30 minutes per day, on most, preferably all, days of the week.	As clinically indicated in high risk patients.	
51–70 years	1200	400	Emphasize weight bearing activity. Fall prevention programs, modified for the frail elderly and spine fracture patients.	Bone density testing by DXA in all women over age 65; consider in women under age 65 with risk factors. No consensus on men.	
>70 years	1200	600			Individuals with risk factors in Table 10–4.

Childhood: As shown in Table 10-1, children between 1 and 3 years old should get 500 mg per day of calcium, and those between 4 and 8 years old should consume 800 mg per day. Milk and foods derived from milk (e.g., cheese, yogurt) serve as the major food sources for calcium throughout childhood and adolescence. Any type of milk (whole, lowfat, or nonfat) provides the same level of calcium, but low-fat milk is the best choice for children over age 2. Additional sources include foodstuffs supplemented with calcium, such as fruit juices, fortified soy beverage, breads, and other breakfast foods, which can help to boost overall dietary calcium intake levels towards the recommended values. Since foods that contain calcium also have many other important nutrients, health care professionals should encourage parents and their children to strive for recommended levels of calcium intake through diet alone.

Adolescence: The second most rapid gains in bone mass occur with the onset of puberty, which also marks the time that calcium intake needs become greatest. As shown in Table 10-1, children 9 to 18 years old should consume 1,300 mg per day of calcium. Puberty is also the time that ethnic and gender differences in bone mass are first seen. As noted in Chapter 3, bone mass tends to be higher in African-Americans than in Caucasians, and higher in males than in females. Girls and boys experience their most rapid rate of bone growth during puberty, and by the end of puberty they have almost achieved peak mass. Hence the teenage years are especially critical to maximizing skeletal growth. Girls and, to a greater extent, boys also accumulate bone mass during and after puberty, with some additional mass being gained even in the third decade of life. Finally, it is worth noting that a delayed

onset of puberty is associated with a reduction in peak bone mass attainment.

Few adolescents consume recommended levels of dietary calcium shown in Table 10-1. As indicated in Figure 6-4 based on data from the National Health and Nutrition Examination Surveys (NHANES), children up to age 9 consume the recommended amount of calcium. Consumption begins to decline slightly just as the calcium requirement to sustain pubertal growth goes up. Health care professionals should inquire specifically about calcium intake during check-ups. It is useful to remember that while fluid milk consumption decreases as children progress to adolescents, both children and adolescents consume mixed foods such as pizza that contain considerable amounts of calcium through cheese. Calcium intake in children and adolescents can be enhanced by incorporating fruit-flavored yogurt, milk-based puddings and shakes, cheese (including low-fat cheese products), and fortified foods such as orange juice into family meals, snacks, and packed school lunches. It is important to recognize that even in the context of obesity and other chronic disease prevention, low-fat and nonfat, calcium-rich dairy foods can be emphasized as a way to promote bone health without having a negative impact on efforts to manage weight. Calcium supplements may be used for those individuals who would otherwise have a chronic, sub-optimal intake of calcium and are unable to meet the requirement for calcium through diet alone. Interactive nutrition, physical activity, and bone health information geared toward girls and adolescents can be found on two Centers for Disease Control and Prevention (CDC) Web sites related to the *Powerful Bones, Powerful Girls* campaign: <http://www.cdc.gov/powerfulbones/index2.html> and <http://www.cdc.gov/powerfulbones/parents>.

Vitamin D

As with calcium, adequate levels of vitamin D are critical to forming and maintaining healthy bones throughout infancy, childhood, and adolescence. Full-term infants who are fed human breast milk appear to mineralize the skeleton similarly to infants fed commercial formulas, including soy-based formulas for infants with an intolerance to cow's milk. However, infants who are exclusively breastfed and who have limited exposure to sunlight are at increased risk of developing vitamin D deficiency. Severe vitamin D deficiency can lead to rickets. The American Academy of Pediatrics has suggested that all infants who are exclusively breastfed receive 200 IU (international units) of vitamin D daily to lessen the likelihood of developing rickets.

Vitamin D requirements during childhood are 200 IU daily, which is the amount contained in two glasses of fortified milk or in most children's multi-vitamins. There are also rare cases of rickets in children who have congenital disorders of vitamin D or phosphorus metabolism and health care professionals should be alert to this possibility. (See Chapter 3 for more details.) These bone diseases may not respond to vitamin D but can be treated by other means.

Protein, Salt, and Phosphorus

There has been some concern that the high intakes of protein, salt, and phosphorus that occur in children and adolescents who eat high-calorie, low-nutrient foods and drink soda can impair bone growth and mineralization. This may be true if these intakes are at the expense of calcium-rich foods, but studies in adolescents have shown that intake of the recommended levels of calcium intake can compensate for high levels of protein, salt, and phosphorus (Fitzpatrick and Heaney 2003).

Physical Activity

Bone mass may be increased in childhood by impact-bearing exercise or physical activity. Thus, health care professionals should emphasize the importance of physical activity at every visit and should encourage healthy children to be active everyday. At a minimum, they should engage in at least 60 minutes of moderate to vigorous physical activity on most days, preferably daily. Unfortunately, many children and adolescents do not get enough physical activity. Health care professionals should inquire about physical activity at each visit and urge children and adolescents to engage in physical activity for at least an hour a day. Health care professionals can also help promote the importance of physical education in the schools by speaking out in the community.

Other Lifestyle Factors

Childhood is an excellent time to initiate counseling aimed at discouraging the adoption of behaviors that may negatively affect bone health, including smoking and alcohol consumption. Such counseling should be continued throughout adolescence, at which time the dangers of anabolic steroids (which can increase the risk of osteoporosis) should also be discussed.

Risk Factor Assessment, Bone Density Testing, and Specialty Referral

The vast majority of children and adolescents will have healthy bone development, and the health care professional's goal is to encourage and support these young individuals and their parents to make the proper lifestyle choices (adequate nutrition and physical activity) to promote both bone health and overall health status. However, health care professionals should be alert to medical conditions and medications that place children and adolescents at risk for poor bone health.

In young individuals, skeletal disorders may present as children who fail to maintain their natural growth curve. While this can be due to any of a variety of factors, metabolic bone disease should be considered as part of a full workup.

Eating disorders such as anorexia and bulimia are uncommon, but can be extremely debilitating. General practitioners may observe changes in weight and appearance, as well as a history of delayed onset or cessation of menstrual periods. Individuals suspected of having eating disorders such as anorexia or bulimia should immediately be referred to an appropriate specialist or an eating disorders clinic.

All young females should be queried about onset and regularity of their menstrual periods. Regular menses signal an intact gonadal axis and adequate estrogen exposure. If menses have stopped after menarche for any reason investigation is warranted. Prolonged periods of amenorrhea have very serious and long-term consequences on bone health. In fact, the cessation of periods in a young, healthy woman should serve as a red flag, as it can lead to a high risk of immediate stress fractures as well as an increased long-term risk of osteoporosis and osteoporotic fractures. Its most common cause in young healthy women is participation in a very strenuous athletic activity like cross-country running or activities that are both strenuous and emphasize low-body weight, such as gymnastics or ballet. The absence of menstrual periods might be the only sign that these individuals need attention. The first step is to increase nutritional intake with calorie-dense foods (e.g., nuts, cheese) as part of an otherwise balanced diet. If the periods do not return within a couple of months, these individuals should be encouraged to curtail their athletic activity. To ensure that the activities are

curtailed, health care professionals should make the adolescent, parents, and, if necessary, coaches and trainers aware of the short- and long-term consequences of amenorrhea to bone health.

Health care professionals should investigate the causes surrounding any fracture, including the level of trauma involved. Most fractures will be the result of common injuries (e.g., due to sports), but the potential for child abuse should also be considered. On the other hand, some of these children may have osteogenesis imperfecta, and it is also important to make this diagnosis and therefore avoid wrongful accusations of abuse. Health care professionals should also evaluate the potential for bone-related disorders, especially in children or adolescents who experience multiple fractures. Fractures are not uncommon during the early stage of puberty, which is a period (as discussed in Chapter 6) of rapid remodeling where the mineralization of newly formed bone lags behind the increase in the size of the bones. Nevertheless, any fractures in teenagers should be reported to their primary care providers, who should view it as a signal to further assess risk factors such as family and personal history to determine if additional steps are warranted. In some cases, especially fractures in infants, referral to a pediatric specialist who deals with metabolic bone disease (often an endocrinologist, nephrologist, or rheumatologist) will be necessary.

Children and adolescents taking certain medications or with certain diseases that are known to negatively affect bone health should also be carefully evaluated by a specialist. See Table 10-2 for a list of these diseases and medications. One group that is at particularly high risk of bone disease is the survivors of childhood cancer (Kaste 2004). In rare cases children may suffer from primary diseases that

affect the bone due to genetic anomalies or from metabolic disorders that affect the processes that regulate systemic mineral homeostasis for calcium or phosphorus (Table 10-2). Health care professionals who suspect these problems because of poor growth, skeletal deformities, or unexplained fractures should refer the child to a specialist in pediatric bone disorders.

Bone density testing is not appropriate for healthy children and must be interpreted with caution even in at-risk children, since it is an imperfect approach to assessing bone before peak bone mass is achieved. If dual x-ray absorptiometry (DXA) is used, bone density should be expressed in Z-scores rather than the T-scores used for adults. T-scores compare individuals to peak bone mass (which does not occur until the third decade of life), while Z-scores provide an age-matched comparison. Comparing children or adolescents to adult peak bone mass rather than age-specific bone mass will inappropriately underestimate their bone density. The measurement of bone density in children is further complicated by the lack of a large, uniform reference database for pediatric patients and by the fact that bone age and chronologic age may not match in children with chronic diseases. The bones of these children are more similar to those of younger children, and thus their bone density may be lower.

Adults

Nutrition

The recommended diet for optimal bone health is consistent with diets recommended for the prevention of other diseases. Therefore, health care providers have opportunities at many patient encounters to establish and reinforce nutritional recommendations that benefit bone and overall health. There are

Table 10–2. Representative Disorders of the Pediatric Skeleton: Developmental Disorders of Bone and Cartilage

Developmental Disorders of Bone and Cartilage
<ul style="list-style-type: none"> • Osteogenesis Imperfecta • Chondrodysplasia
Metabolic Bone Diseases [primary]
<ul style="list-style-type: none"> • Idiopathic Juvenile Osteoporosis • Fibrous Dysplasia • Hypophosphatasia(s)
Metabolic Bone Diseases [secondary]
<ul style="list-style-type: none"> • Hypophosphatemic Vitamin D Resistant Rickets • Vitamin D Dependent Rickets Type I or Type II • Anorexia Nervosa • Celiac Disease • Cystic Fibrosis • Gaucher’s Disease • Immobilization • Malignancy • Muscular Dystrophies • Organ (Bone Marrow, Renal) Transplantation
Medications That Can Cause Disorders
<ul style="list-style-type: none"> • Antiepileptic Medications • Oral Glucocorticoids • Gonadal Hormone Suppression After Puberty • Immunosuppressive Agents (Cancer Chemotherapy)

many very common conditions such as hypertension, diabetes, and weight management for which nutritional counseling is vital, providing health care professionals with an excellent opportunity to also incorporate recommendations for bone health.

Calcium

Calcium intake should be 1,000 mg per day during early and middle adulthood. A quick assessment of calcium intake can be made by estimating that a diet without dairy products contains approximately 250–300 mg per day of calcium (Weinberg et al. 2004). Calcium intake from dairy products, calcium-fortified foods, and supplements can be added to this baseline to obtain a rapid, reasonable estimate of the total daily intake. See Chapter 7 for a quick assessment tool that patients can use.

Common food sources of calcium have the added benefit of providing additional nutrients as well. Significant food sources of calcium include dairy products, calcium-set tofu, canned fishes with bones, and other calcium-fortified foods (see table 10-3). Some individuals with lactose intolerance can consume lactose-reduced milk, live culture yogurt, fortified soy beverage, tofu, and hard cheeses. For maximum calcium nutrition, health care professionals should encourage consumption of low-oxalate vegetables such as broccoli, kale, mustard greens, and turnip greens, as oxalates can impair calcium absorption. Vegetarians and vegans can consume tofu brands that are set with calcium (this type of tofu can be identified by checking the label), vegetables with calcium, almonds, and calcium-fortified foods and beverages, such as fortified orange juice and fortified soy beverage. Fortunately, the array of calcium-fortified foods is expanding, providing consumers with a wide variety of options for achieving adequate calcium intake. A table of calcium-containing foods, organized by calcium content per serving, can be found in Table 10-3.

To assist individuals in determining how much calcium they are getting from the food they consume, food labels express calcium content as a percentage of 1,000 mg—in other words, an item with 20 percent of the daily recommended

amount of calcium contains 200 mg of calcium. The calcium content of foods, including fresh fruits and vegetables, can be found on the USDA National Nutrient Database Web site at http://www.nal.usda.gov/fnic/cgi-bin/nut_search.pl.

Calcium supplements can be critical for those persons who cannot meet calcium requirements through food alone. In the absence of gastrointestinal disease, all major forms of calcium supplements are absorbed equally well when taken with meals. The citrated salts may be more readily absorbed in individuals with gastrointestinal disease or decreased stomach acid production. Since different types of supplements may contain different amounts of elemental calcium, it is important to check the label and to determine the exact amount of calcium in the supplement, in order to achieve the targeted level of calcium intake. Patients should be encouraged to check supplement labels to ensure that their calcium supplement meets United States Pharmacopoeia lead standards. Some calcium supplements may contain other nutrients such as vitamin D or vitamin K. This should be discussed with individuals on warfarin therapy who need calcium supplements, since their response to therapy may be altered by high vitamin K intake. Finally, calcium supplements should be ingested no less than 4 hours before or after taking iron or thyroid medications, since calcium may decrease the absorption of these other medications.

The efficiency of calcium absorption from supplements is greatest when calcium is taken in doses of 500 mg or less. In other words, calcium intake, be it through food and/or supplements, should be spread throughout the day, and the daily requirement should not be consumed at a single setting.

Finally, it is important to emphasize to patients that the upper tolerable level for calcium

Table 10–3. Calcium Containing Foods By Calcium Content Per Serving with 100 mg

Food	Serving size	Calcium, mg
>400 mg		
Tofu, regular with calcium sulfate	½ cup	434
Tofu, firm with calcium sulfate	½ cup	860
Fortified cereal	¾ cup	varies by brand
300–400 mg		
Whole milk	1 cup	291
Milkshake	8 oz.	300
Lowfat yogurt	8 oz.	300
Fortified orange juice	1 cup	300
Fortified soy milk	1 cup	300
Fortified rice milk	1 cup	300
Skim, 1%, or 2% milk	1 cup	321
Fortified cereal	¾ cup	varies by brand
Fortified oatmeal	1 pkt	350
200–300 mg		
Cheddar, monterey or provolone cheese	1 oz.	206
Soybeans, roasted	1 cup	237
Spinach (cooked)	1 cup	245
Mixed cheese dish	1 cup	250
Fortified energy bar	1	250
Soybeans (cooked)	1 cup	261
Swiss cheese	1 oz.	272
Plain yogurt	8 oz	274
100–200 mg		
Pizza	1 slice	100
Fortified waffles	2	100
Fortified butter or margarine	1 Tbsp.	100
Sherbet	1 cup	103
Mustard greens (cooked), Bok Choy	1 cup	104
Spaghetti, lasagna	1 cup	125
Cottage cheese	1 cup	138
Baked beans	1 cup	142
Dandelion greens or turnip greens (cooked)	1 cup	147
Ice cream	1 cup	151
Frozen yogurt or pudding	½ cup	152
American, Feta, or Mozzarella cheese	1 oz.	174
Soybeans, boiled	1 cup	175

Source: USDA 2002.

intake recommended by the Institute of Medicine is 2,500 mg per day. In some cases, this limit should be even lower, since some individuals who are susceptible can become hypercalciuric with calcium intakes as low as 1,500 mg per day. Health care professionals should ask their patients if they regularly take antacids, since many of them may not know that common antacids contain high levels of calcium. As a result, those individuals who take antacids regularly may be consuming calcium at the higher-than-recommended levels.

Vitamin D

The following recommendations for adequate intake do not take into account vitamin D that is absorbed from the sun, since it is difficult for an individual to determine how much vitamin D he or she gets from exposure to sunshine. Young and middle-aged adults should consume about 200 IU per day of vitamin D, although intakes of up to about 1,000 IU per day are generally considered safe. Much higher intakes can be toxic for healthy individuals, although physicians may prescribe higher dosages for individuals with a vitamin D deficiency. Primary food sources of vitamin D are limited to fortified milk (100 IU per cup), egg yolk (25 IU per yolk), fortified cereals, and fish oils. Sunlight exposure contributes variably to circulating and active vitamin D formation, depending on age, race, clothing, and latitude. Sunscreen with an SPF above eight will block the ultraviolet B radiation that stimulates vitamin D production; the extent to which this can lead to vitamin D deficiency is not well defined. However, particularly in northern climates and among older individuals, vitamin D deficiency is becoming recognized as very common. Health care professionals should educate individuals about recommended levels and sources of vitamin D and encourage adequate intake

through food sources, supplements, and appropriate amounts of sun exposure. Physicians should consider measuring the circulating form of vitamin D in the blood—25-hydroxy vitamin D—in individuals who have any of the following characteristics: low dietary intake of vitamin D, inadequate exposure to the sun, signs of poor absorption of vitamin D, or the presence of a gastrointestinal disorder that might decrease their vitamin D supply. Individuals found to be vitamin D deficient by a physician may be given pharmacologic doses of vitamin D to replenish stores and maximize bone mineralization (Pettifor 2003).

Protein

Adequate dietary protein is important for bone health. In short-term studies, low protein intakes have been shown to result in decreased calcium absorption, while protein supplementation after hip fracture has been shown to speed healing and decrease mortality. However, increasing protein intake also increases urine calcium excretion. The long-term effect of both high and low protein diets on skeletal health has yet to be determined. Following the current dietary guidelines for servings of protein-containing foods such as meat, poultry, beans, and dairy products does not present any problems for calcium and bone health. These guidelines can be achieved by consuming 2–3 servings of meat or beans and 2–3 servings of milk and cheese per day. Higher intakes may be necessary in individuals with a history of low protein intake and those who are recovering from fracture in order to bring protein levels back to normal (as long as they also are getting sufficient levels of calcium intake). Important sources of protein include low-fat dairy products, which also provide calcium, phosphorous, and other important nutrients. Most vegetables provide fiber and minerals in addition to small amounts of protein, while soy

protein sources such as tempeh, soybeans, and full-fat tofu provide isoflavones (plant compounds with estrogenic effects), which have been shown to increase bone density in some short-term clinical trials (long-term studies are ongoing). Nutritional supplements containing protein are available for those who cannot get enough protein from diet.

Other Nutrients

Sodium chloride intake increases urine calcium excretion, and excessive intake of salt may increase bone resorption in postmenopausal women, although this effect may be offset by adequate calcium intake. However, bone health is yet another reason to maximize the intake of fresh, unprocessed foods and achieve the Institute of Medicine recommendation for an intake of no more than 2,400 mg per day of sodium. Individuals can reduce their intake by avoiding canned, jarred, cured, and processed foods in home cooking. Individuals can reduce their intake of salt by carefully checking the labels of processed foods used in the home and choosing fresh fruits, vegetables, and meats without sauces and dressings when eating away from home. Caffeine consumption leads to a small decrease in calcium absorption; carbonated beverages do not appear to significantly affect calcium excretion independent of caffeine. As long as adequate levels of calcium intake are maintained, however, both carbonated and caffeinated beverages can be consumed in moderation.

Many other minerals such as phosphorus, magnesium, copper, and boron also contribute to bone health to varying degrees. Adequate amounts of these elements can generally be consumed by focusing on an overall healthful diet that includes an adequate intake of lean protein, abundant consumption of fruits and vegetables, and appropriate intake of calcium and vitamin D

along with moderate consumption of sodium and caffeine. (See Table 7-5 for more details.)

Physical Activity

Physical activity should be promoted throughout adulthood, as appropriate to the physical capabilities of the individual. Physical activity not only promotes bone health, but it also helps to optimize weight control, metabolic parameters, muscle strength, and cardiovascular fitness. Programs that have demonstrated skeletal benefits have all included impact activities or resistance-training exercises, including walking, jumping, jogging, running, soccer, racquet sports, weight lifting, dancing, hiking, and stair climbing. To promote bone and overall health, adult patients should be encouraged to accomplish at least 30 minutes per day of moderate intensity physical activity on most, preferably all, days of the week. Some strength or resistance training can be particularly beneficial to bone health. Engaging in longer periods of moderate activity and/or increasing the intensity of activity (i.e., at least 20 minutes of vigorous intensity activity) are the best ways to promote cardiovascular health.

Initiating and maintaining a program is a significant challenge for sedentary patients. Patients should be encouraged to engage in even small amounts of daily activity, since these activities may have some health benefits. Some individuals may find it easier to start with manageable goals that incorporate physical activity into their daily activities, such as parking farther from their destination or using the stairs instead of the elevator. Long-term compliance with physical activity routines may be enhanced by enlisting the support of family members or friends, advocating moderate intensity that is within the person's capabilities, devising programs that individuals can accomplish at home, offering flexibility in

activity choices, and providing feedback and incentives. Participating in a physical activity that the individual enjoys, such as gardening, a walk with a friend, or a community exercise or dance class, also helps maintain compliance. Individuals should be encouraged to find an activity they like enough to continue and to be ready to try a different program if they lose interest in the current one.

Patient education materials, including pamphlets and videos with specific exercises and instructions for moving safely and maintaining optimal posture, can be obtained from the National Institute on Aging at <http://www.niapublications.org> or from the National Osteoporosis Foundation at <http://www.nof.org>.

Other Lifestyle Measures

Excessive alcohol and tobacco use increases the risk for fracture. Thus, patients should be encouraged to quit smoking and to limit alcohol intake to moderate use, not only to optimize bone health, but also for their overall health and well-being. In addition, general safety measures to reduce the risk of trauma, such as consistent use of seatbelts, should be advised.

Pregnancy and Lactation

While the data are somewhat limited, it appears that there is a transient decrease in bone density during pregnancy and lactation, but the healthy mother's skeleton rapidly recovers after lactation is completed. Thus, there does not appear to be a long-term detrimental effect of pregnancy and lactation on bone health. Pregnant and lactating women should follow their obstetrician's recommendations for optimal nutrition and physical activity. The current recommended intakes during pregnancy and lactation are 1,000 mg per day of calcium and 200 IU per day for vitamin D. A higher intake of 1,300 mg per day of calcium is recommended for women under age 18.

Risk Factor Assessment and Bone Density Testing

All young and middle-aged adults should be encouraged to adopt lifestyles that help to prevent bone loss and to promote overall health and the prevention of chronic disease. Bone density testing of asymptomatic young and middle-aged adults without significant risk factors is not recommended. Although the radiation exposure of testing is very low, this exam should not be performed on women who may be pregnant.

Young and middle-aged adult patients with medical conditions associated with bone loss, such as hyperthyroidism, hyperparathyroidism, hypogonadism (either endogenous or medically induced), malabsorptive syndromes or eating disorders, significantly impaired mobility, or chronic renal or hepatic failure, warrant special attention. In addition to being strongly encouraged to adopt appropriate nutrition and lifestyle choices, they should also be considered for bone density testing and pharmacologic therapy. A bone density test should be performed on patients requiring medications that can result in bone loss, such as oral glucocorticoids, anticonvulsants, immuno-suppressants (cyclosporine A, tacrolimus, methotrexate), and heparin for more than a month. Since bone loss can occur rapidly after the initiation of glucocorticoid therapy, health care professionals should consider bone density testing prior to the start of such therapy; patients with low bone density should be considered for concurrent antiresorptive therapy.

In addition, younger patients with conditions that increase fracture risk should be encouraged to adhere to maximal nutrition and lifestyle measures aimed at preventing bone disease. Specific therapy such as antiresorptive drugs should also be considered in those with significantly low bone mass based on a bone density test.

Interpretation of bone density exams in this age group should focus on the T-score values, even though specific T-score thresholds for the diagnosis and treatment of osteoporosis have not been established for younger individuals. T-scores can be interpreted for patients by explaining that the T-score compares their bone density to the average maximum lifetime bone density (peak bone mass) in young adults. Patients should be advised that a positive T-score means that their bone density is above the average for a young adult around age 30, while a negative number means their bone density is below that of the average 30-year-old. The World Health Organization (WHO) has established definitions of normal (T-score above -1), low bone mass/osteopenia (T-score between -1 and -2.5), and osteoporosis (T-score less than -2.5) based on epidemiologic data. However, it should be remembered that the risk of bone fracture increases continuously as bone density decreases. In other words, there are no precipitous changes in fracture risk associated with these “break” points. The relationship between T-scores and fracture risk has been conducted primarily in postmenopausal women; data in younger individuals are limited. It should also be remembered that the WHO diagnostic definitions were derived from DXA data and therefore should not be applied to other bone density testing modalities.

Treatment and Monitoring Therapy

With the exception of glucocorticoid-induced osteoporosis, there have been few trials of osteoporosis medications in young and middle-aged adults. Therapy in this age group should focus on maximizing nutrition and lifestyle modifications and addressing any underlying medical conditions such as hypogonadism that can lead to low bone mass. Comorbid conditions that may affect bone should be treated; for example, care should be taken to ensure serum thyroid

stimulating hormone (TSH) remains in the normal range in individuals with hypothyroidism who are on L-thyroxine therapy. Young and middle-aged adults who have osteoporosis even after non-pharmacologic therapies have been employed should be considered for anti-resorptive therapy, options for which are discussed in Chapter 9.

For individuals who have received bone density testing prior to menopause, additional bone density exams should be conducted only if the results could prompt a change in therapeutic plan. Early postmenopausal women with normal or marginally low bone density do not need repeat bone density scanning for at least 3–5 years, unless an intervening medical condition that could accelerate bone loss develops. Individuals on anti-resorptive therapy may benefit from a follow-up DXA scan. However, due to the variability of densitometry measurements, at least 18 to 24 months should elapse between scans to ensure that any changes are large enough to be clearly detected. Since there is variability between DXA scans even with rigorous quality assurance and careful technique, care should be taken not to alter treatment regimens in response to small changes in bone density values. While they can be significant in research trials, changes in hip or spine bone density of 4 percent or less are at the detection limits of office-based densitometry and should be interpreted cautiously in the clinical setting. Osteoporotic patients who cannot readily see signs that therapy is working or failing often do not take their prescription drugs appropriately (i.e., adherence is poor) and/or they do not stick with their drug regimen over time (i.e., persistence is poor). A recent study of osteoporotic patients showed that monitoring by a nurse, with or without the use of a biochemical marker of bone resorption, could improve both adherence to and persis-

tence with therapy over time. Moreover, better adherence was found to be associated with better outcomes (Clowes et al. 2004).

Specialty Referrals

Specialists can assist primary care providers with additional expertise in those young and middle-aged adults who represent challenging situations, including individuals for whom the etiology of low bone mass is unknown, those who require an evaluation for secondary causes of bone loss, those being considered for long-term antiresorptive therapy, and those who either do not tolerate or do not respond to therapy. These patients may benefit from a referral to an endocrinologist, rheumatologist, or other specialist in osteoporosis management. Referrals to dietitians and physical therapists can also be helpful in implementing nutrition and physical activity programs, particularly for those individuals with significant dietary and mobility limitations.

A broad approach to assessing bone health, preventing bone disease, and managing osteoporosis in adults is illustrated in Figure 10-1.

Older Adults

Nutrition

The nutrition guidance outlined for young and middle-aged adults also applies to older individuals and the elderly. Specific additional recommendations pertinent to this age group are discussed below.

Calcium and Vitamin D

Calcium and vitamin D absorption decreases with aging, and older individuals with limited mobility tend to receive less sunlight, leading to rates of vitamin D deficiency (as measured by serologic testing) of up to 57 percent in this population (Thomas et al. 1998). As a result, recommended levels of both calcium and vitamin D

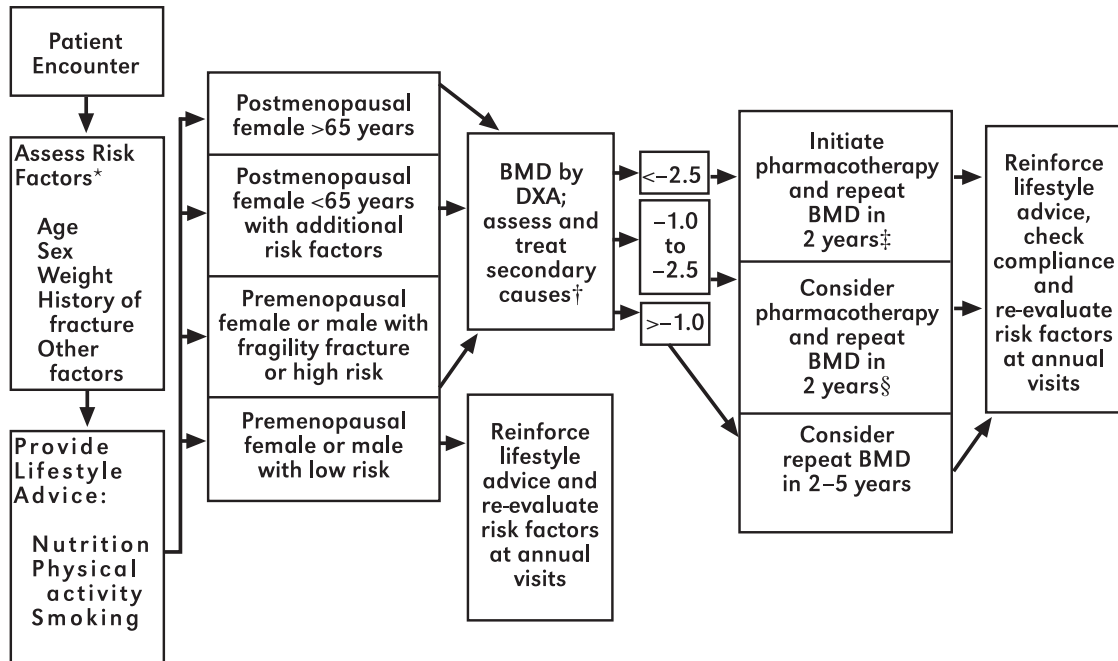
increase in this population. Total calcium intake should be 1,200 mg per day after age 50. Older individuals should be educated in how to read labels for calcium content, since calcium is expressed as a percent of 1,000 mg on labels (the recommended level for younger adults). Since the calcium intake goal for older adults is greater than 1000 mg per day, these individuals actually need to consume more than 100 percent of the level recommended on food labels. Since older persons may suffer constipation as a side effect of calcium supplements, health care professionals should emphasize food sources of calcium and also recommend increasing fluid and fiber intake. Inability to secrete acid in the stomach (achlorhydria) may limit the absorption of calcium carbonate salts; citrated salts may be absorbed better in these patients, but carbonate salts will still be absorbed if taken with meals.

Individuals between the ages of 51 and 70 should consume 400 IU per day of vitamin D, while those over age 70 should get 600 IU per day. Since it may be difficult for older individuals to achieve these levels of intake through food alone, many individuals will require multi-vitamins or specific vitamin D supplements. Individuals who have low vitamin D dietary intake and/or low sun exposure should have their vitamin D level measured. Persons found to have vitamin D deficiency should receive pharmacologic doses of vitamin D.

Other nutrients

Recommendations for other nutrients for older adults are the same as those for younger adults. In addition, protein supplementation has been shown to speed healing and reduce mortality in older individuals suffering hip fractures. These patients should have a nutritional evaluation during post-fracture rehabilitation.

Figure 10–1. Assessment of Bone Health and Management of Osteoporosis



Note: This flow chart outlines a broad approach to assessing bone health and preventing bone disease, determining who should have bone density measurements, and deciding on pharmacologic treatment for osteoporosis. More details on each of these topics can be found in Chapters 6, 7, 8, and 9. The flow chart does not include the use of biochemical markers of bone turnover, which, as discussed in Chapter 8, is a promising approach to assessing early response to or subsequent compliance with pharmacotherapy. This flow chart is based on the assumption that health care providers will see their patients annually, and will briefly evaluate risk factors, assess compliance to lifestyle and nutritional advice, and review medications at each visit. Because there are often no symptoms in individuals whose bone health is declining, this annual “bone check-up” by health care providers is essential.

Footnotes:

* There is no clear-cut definition of “high” and “low” risk at the present time, although the presence of multiple factors that contribute to bone loss (e.g., a family history of osteoporosis, low body weight, and endocrine, musculoskeletal, or nutritional disorders) should be considered an indication of high risk. The analysis of risk factors should include not only those that affect bone fragility, but also those that contribute to the risk of falling.

† If DXA of the spine and hip are not available, peripheral measurements may be used to assess risk, but the T-score cut-offs for treatment have not been established. It is important to evaluate possible secondary causes of bone loss as well as other skeletal disorders in all patients, but particularly in those who are being considered for pharmacotherapy. In most patients pharmacotherapy and treatment for secondary causes can be initiated at the same time.

‡ A generalized approach to pharmacotherapy is outlined in Chapter 9. But it is likely that the development of new drugs and the acquisition of new data on currently available drugs will lead to changes in treatment in the near future.

§ Individuals with low bone density or osteopenia (defined as BMDs between -1.0 and -2.5) are clearly at increased risk of fracture. The decision to recommend pharmacotherapy for these individuals will depend on many factors. Conservative therapy consisting of calcium, vitamin D, and exercise may be appropriate for young individuals with low BMD who have not had a fragility fracture.

Physical Activity

Older adults should maintain as high a functional status as possible and regularly engage in physical activity. Many older adults can follow the same recommendations for younger adults outlined above. Weight-supporting activities such as stationary bicycling, deep-water walking, and floor exercises may be more appropriate in older adults with compromised bone health although with proper supervision and training these individuals can safely engage in resistance exercises as well. Individualized programs devised by physical therapists or physiatrists can safely improve strength, mobility, and functional capacity in vulnerable older adults. Physical therapists can also train individuals in specific postural exercises to strengthen back extensor muscles, which may relieve pain and decrease development or progression of kyphosis.

Patients with spine fractures should avoid activities that flex the spine and increase pressure on compromised vertebral bodies. In addition, activities such as golf, bowling, tennis, and horseback riding place significant force on the spine and should be avoided in patients with compromised bone health. People with osteoporosis of the spine should avoid use of exercise machines that involve trunk rotation or forward bending, as these movements can cause a fracture in individuals with osteoporosis. Machines to avoid include abdominal exercisers, biceps, rowing, and cross-country ski machines, stationary bicycles with moving handlebars, or upper body ergometers.

Physical therapists play an important role in both fracture prevention and treatment. They can evaluate balance and the risks of falling and teach specific exercises and techniques to minimize that risk. Since nearly all hip fractures are associated with a fall, preventing falls in older individuals is fundamental to preventing frac-

tures. Occupational therapists can evaluate the home environment and make modifications that minimize the risks of falling, including eliminating loose rugs; installing hand rails, shower chairs, and hand-held nozzles in the bathroom; installing bedside lamps, nightlights in hallways and bathrooms, and strips of contrasting tape on stair treads; and recommending the use of canes and walkers as appropriate as well as the avoidance of certain types of clothing, including long garments and trailing hems.

Patient education materials, including pamphlets and videos with specific exercises and instructions for exercise, moving safely, and maintaining optimal posture, can be obtained from the National Institute on Aging at <http://www.niapublications.org/shopdisplayproducts.asp?id=17&cat=Exercise+for+Older+People> or from the National Institutes of Health Osteoporosis and Related Bone Diseases~National Resource Center (<http://www.osteoporosis.org>).

Risk Factor Assessment and Bone Density Testing

Risk factors for bone loss and fracture should be assessed in all women over 65. Commonly identified risk factors for fracture are listed in Table 10-4.

One of the best validated instruments to help identify patients at risk of low bone mineral density (BMD) (and thus in need of a DXA) is the three-item Osteoporosis Risk Assessment Instrument (ORAI). As shown in Table 10-5, ORAI uses age, weight, and current use of hormone therapy to identify women at risk for osteoporosis (Cadarette et al. 2000).

Another easy-to-use tool that many clinicians and their patients may find appealing is the Osteoporosis Self-Assessment Tool (OST). As shown in Figure 10-2, this tool combines age and weight in a simple nomogram. Assuming that

BMDs are performed on those with a score of less than two (the upper two sections of the chart), the OST tool identifies over 90 percent of women with osteoporosis—and 100 percent of those over age 65—as defined by WHO criteria (Cadarette et al. 2004). This finding not only helps to validate OST, but it also provides further evidence to support current guidelines recommending BMD testing in all women over age 65. However, as with other risk-assessment tools, OST has low specificity, as about 55 percent of the women identified by this tool as needing a BMD actually do not have osteoporosis (Cadarette et al. 2004). Since the OST index is easy to calculate, it may be the most useful available tool in clinical practice at this time.

As noted in Chapter 8, one risk factor that is not included in these screening instruments is height loss. Careful measurement of height can be useful both in assessing risk and in monitoring patients on therapy. A height loss of more than one inch should serve as a “red flag” for the potential of osteoporosis and/or spinal fractures.

Both the NOF and USPSTF recommend bone density testing for women age 65 and older. The USPSTF also recommends that bone density testing begin at age 60 for women who are at increased risk for osteoporotic fractures. Expert organizations differ, however, on when to conduct routine screening in women under age 60. The USPSTF has found evidence that screening women who are at lower risk for osteoporosis or fracture can identify additional individuals who may be eligible for treatment for osteoporosis. This evidence also suggests that such widespread screening would prevent a small number of fractures, since younger individuals with low BMD and no other risk factors are at low risk of fracture. The NOF guidelines recommend bone density testing in postmenopausal women under age 65 with risk factors for

Table 10–4. Risk Factors for Fracture

- Older age (>65 years)
- Fracture after age 45
- First-degree female relative with a fracture in adulthood
- Self report health as “fair” or “poor”
- Current tobacco use
- Weight less than 127 lbs.
- Menopause prior to age 45 years
- Amenorrhea
- Lifelong low calcium intake
- Excess alcohol consumption
- Poor vision despite correction
- Falls
- Minimal weight-bearing exercise
- Medical Conditions
 - ~ Hyperthyroidism
 - ~ Chronic lung disease
 - ~ Endometriosis
 - ~ Malignancy
 - ~ Chronic hepatic or renal disease
 - ~ Hyperparathyroidism
 - ~ Vitamin D deficiency
 - ~ Cushing’s disease
 - ~ Multiple sclerosis
 - ~ Sarcoidosis
 - ~ Hemachromotosis
- Medications:
 - ~ Oral glucocorticoids
 - ~ Excess thyroxine replacement
 - ~ Antiepileptic medications
 - ~ Gonadal hormone suppression
 - ~ Immunosuppressive agents

osteoporosis. It should also be noted that the majority of the evidence upon which these guidelines are based was obtained in White women. There is no consensus regarding screening in men; however, bone density testing should be considered in men with fragility fractures, those on therapies that may cause bone loss, notably glucocorticoids or androgen deprivation, and men with multiple risk factors.

Table 10–5. Scoring System for Osteoporosis Risk Assessment Instrument (ORAI)

Variable	Score
Age, yr	
≥ 75	15
65–74	9
55–64	5
45–54	0
Weight, kg	
<60	9
60–69	3
≥ 70	0
Current estrogen use	
No	2
Yes	0
Women with a total score of 9 or greater would be selected for bone densitometry.	

Note: The Osteoporosis Risk Assessment Instrument (ORAI) uses age, weight, and the use of estrogen as an aid to selecting postmenopausal patients for bone density testing. A score greater than 9 would indicate testing is warranted.

Source: Cadarette 2000. Development and validation of the Osteoporosis Risk Assessment Instrument to facilitate selection of women for bone densitometry —Reprinted from CMAJ 02–May–00: 162(9), Page(s) 1289–1294 by permission of the publisher. ©2000 Canadian Medical Association.

Measuring bone density at the hip by DXA is the best predictor of hip fracture. Some members of the original WHO working group recommended that the diagnosis of osteoporosis should be based only on the T-score obtained through DXA measurement at the hip (Kanis et al. 2000). These members indicated that while measurements at other sites and with other technologies may be useful for assessing risk of fracture, they should not be used for diagnosis of osteoporosis.

Bone density T-scores can be interpreted for older individuals in the same way they are for young and middle-aged adults. Although there are no data, many experts also evaluate the Z-scores in older individuals. The Z-score compares the patient's bone density to that expected for their age, rather than to peak bone mass. While this approach has not been validated, many experts will more strongly consider a laboratory evaluation of vitamin D levels and of potential secondary causes of osteoporosis in patients with Z-scores of –2 or less (meaning the patient's bone density is two standard deviations or more below that expected for their age). It is important to consider the possibility of secondary causes in all patients with osteoporosis, even those with Z-scores higher than –2. Laboratory evaluation for secondary causes should be guided by clinical judgment as well as findings from the patient's history and a physical examination. There are many different types of conditions and medications that can lead to secondary osteoporosis, as summarized in Tables 3-1 and 3-2 in Chapter 3.

Treatment and Monitoring Therapy

Pharmacologic therapy should be instituted in individuals who have osteoporosis, as defined by WHO criteria or the existence of fragility fractures. Individuals with low bone mass and multiple fracture risk factors should also be con-

Figure 10–2. Osteoporosis Self-Assessment Tool (OST) Chart

Body Weight lbs.	AGE (years)										Body Weight lbs.	
	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94		95–99
66–75	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	66–75
76–87	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	76–87
88–98	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	88–98
99–109	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	99–109
110–120	1	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	110–120
121–131	2	1	0	-1	-2	-3	-4	-5	-6	-7	-8	121–131
132–142	3	2	1	0	-1	-2	-3	-4	-5	-6	-7	132–142
143–153	4	3	2	1	0	-1	-2	-3	-4	-5	-6	143–153
154–164	5	4	3	2	1	0	-1	-2	-3	-4	-5	154–164
165–175	6	5	4	3	2	1	0	-1	-2	-3	-4	165–175
176–186	7	6	5	4	3	2	1	0	-1	-2	-3	176–186
187–197	8	7	6	5	4	3	2	1	0	-1	-2	187–197
198–208	9	8	7	6	5	4	3	2	1	0	-1	198–208
209–219	10	9	8	7	6	5	4	3	2	1	0	209–219
220–230	11	10	9	8	7	6	5	4	3	2	1	220–230

Note: The OST Chart uses age and weight as a decision assistance tool for postmenopausal women. The heavy lines divide high, medium, and low risk. Patients with a score of less than two (those with medium and high risk, in the unshaded area of the chart) would be recommended for bone density. This figure refers to postmenopausal White women. Cut points may be different for women of other races or for men.

Source: Cadarette 2004.

sidered for therapy (in addition to emphasizing appropriate lifestyle and nutritional intake). The FDA has approved several anti-resorptive therapies (bisphosphonates, selective estrogen receptor modulators, estrogen, and calcitonin) as well as a single anabolic agent, teriparatide (PTH), which is currently available only as a daily injection. Selection of therapeutic agent can be tailored to the severity of the patient's bone loss and other comorbid conditions. The risks and benefits of these agents, as determined by clinical trials, are discussed in Chapter 9. Finally, fall prevention strategies should be discussed with every osteoporosis patient, and hip protectors should be considered for the frail elderly and patients at high risk for falling.

Combinations of antiresorptive agents have been tested for their impact on bone density, and results suggest that this approach produces modestly greater increases in BMD than do single agents used alone. There are no data, however, on the efficacy of combination therapy in reducing the risk of fracture. In addition, using bisphosphonates in conjunction with teriparatide provides no added benefit over use of each agent individually.

As with younger individuals, follow-up bone density exams should be conducted only when the results could prompt a change in therapeutic plan. Older individuals with normal or minimally low bone density likely do not need to repeat bone density scanning for at least 3–5 years, unless an accelerated rate of bone loss is suspected that might lower their bone density to a level at which treatment would be considered. As with younger and middle-aged adults, individuals on anti-resorptive therapy may benefit from a follow up DXA scan at least 18 to 24 months after the initial scan.

The utility of markers of bone resorption in monitoring response to therapy shows promise but has not been firmly established. Some ex-

perts use marker measurements in the evaluation of patients with an apparent lack of response to antiresorptive therapy, but this approach has not been validated. Much work continues to determine the clinical utility of using markers of bone activity. A complete discussion can be found in Chapter 8.

Non-bone medication use should be evaluated as part of the treatment plan for elderly individuals with low bone density. Medications associated with dizziness, low blood pressure, falls in blood pressure upon standing (orthostasis), and sedation can increase the risk of falling, and their use should be minimized or avoided. In addition, alcohol use should be reviewed, as it may cause older individuals to become unsteady and susceptible to falls.

Follow-up for Fractures

There is significant morbidity and mortality following fractures in older individuals. In addition, these individuals are at very high risk for future fractures. Thus, health care providers should aggressively intervene to maximize bone health, minimize morbidity, and prevent future fractures in these patients. All nutrition and lifestyle modifications should be strongly encouraged, specific osteoporotic pharmacologic therapy should be instituted, and appropriate rehabilitation should be achieved. Identifying and intervening in patients with osteoporotic fractures presents an exceptional opportunity to dramatically reduce the consequences of this disease. Yet, as noted in Chapter 9, a significant number of fracture patients do not receive optimal long-term care focused on bone health. All health care providers involved in the care of fracture patients must dedicate themselves to ensuring not only adequate treatment for the acute fracture, but also aggressive implementation of all therapeutic and

rehabilitative measures to prevent further fractures. Specific post-fracture treatment recommendations are found in Chapter 9.

Specialty Referrals

Osteoporosis is often diagnosed and treated in the primary care setting. However, as with younger individuals, older persons and the elderly with particularly challenging clinical situations can benefit from a referral to an endocrinologist, rheumatologist, or other specialist in osteoporosis management. For example, such referrals may be appropriate in cases where secondary osteoporosis is suspected, therapy is not tolerated, bone density declines, or a fragility fracture occurs during treatment.

Physical therapists and occupational therapists provide vital assistance in the management of older patients with osteoporosis by working with them to increase strength, balance, and physical activity and to reduce the risk of falls. Referrals to physical and occupational therapists should be strongly considered for all osteoporotic individuals at risk for falls and/or with limited exercise capacity. Older individuals at risk for fracture should also be referred to an eye care professional, who should perform refraction, cataract removal, and/or glaucoma therapy as appropriate, as such treatments maximize visual acuity and minimize the risk of falls.

Elderly individuals with vertebral fractures, particularly those with persistent pain, may benefit from referral to an orthopedist and to a physical therapist, who can fit them for a back brace that helps to reduce kyphosis.

Strategies to Maximize Adherence

Long-term adherence, defined as the percentage of prescribed medication taken, and persistence, defined as the percentage of individuals who take a medication for the prescribed period of time, are poor with any therapy, with rates for both being around 50 percent (Clowes

et al. 2004). It is not known, moreover, whether certain strategies, such as feedback to patients on the results of repeat bone density testing or increased use of biochemical markers of bone turnover, can improve long-term compliance with osteoporosis therapies. In fact, while measurement of bone resorption markers has been advocated to improve compliance to therapy, monitoring by a nurse without such measurements has been found to be equally effective in improving compliance (Clowes et al. 2004). This study suggests that the key to maximizing adherence to any therapy is for health care professionals to follow up with patients to ensure that they are taking their medications appropriately.

Specific follow-up strategies that have been shown to improve adherence to other types of medical regimens should be utilized in patients with osteoporosis as well. These include counseling about the importance of the planned treatment regimen, enlisting the support of the patient's social network, sending reminders about follow-up appointments, recognizing adherence efforts, simplifying and organizing the treatment regimen, addressing patient concerns about side effects, and maintaining an encouraging provider-patient relationship. Many of these approaches are time and labor intensive; non-physician health care professionals can be invaluable resources in making the most of these strategies in a busy practice. Patient education materials on many aspects of osteoporosis are available free on-line from the National Institutes of Health Osteoporosis and Related Bone Diseases~National Resource Center (<http://www.osteoporosis.org>).

Key Questions for Future Research

Research questions related to the prevention, diagnosis, and treatment of bone disease are provided at the end of Chapters 6, 8, 9, and 11.

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