UW Integrative Medicine
Department of Family Medicine

University of Wisconsin
SCHOOL OF MEDICINE
AND PUBLIC HEALTH

An Integrative Approach to Healthy Bones: Osteoporosis, Osteopenia, and Fracture Prevention

What should I know about bone health?

Prevention is an important focus for every system of the body. The health of the skeleton is no exception. The spine, the femur (the long bone in the thigh), and other bones must handle a tremendous amount of force throughout a person's lifetime. Healthy bone requires a precise balance between bone formation and bone absorption. Bone cells called osteoclasts dissolve and absorb old bone tissue. Another type of bone cells, osteoblasts, help new bone form in the empty spaces. This process keeps bones strong.

Around age 30, bone density peaks (i.e., bones are at their strongest). After that, for most people, it steadily decreases with age. It is vital to pay attention to bone health throughout your life, especially *before* diagnoses such as osteopenia or osteoporosis are made. Future bone density is influenced by whether or not your mother had healthy calcium and vitamin D levels, and whether you were breast fed. Children and adolescents must maintain healthy calcium and vitamin D levels to keep bones strong. The first few years of menopause are a time of especially significant bone loss for women. During this time estrogen levels drop and osteoclasts are not held in balance as they were before.

Why does bone health matter?

Courtesy:NIAMS

The main concern regarding bone health is to minimize the risk of fractures. One and a half (1.5) million osteoporosis-related fractures occur in the U.S. each year. Three hundred thousand (300,000) of them are due to a fall to the hip. These are costly financially and also affect people's quality of life. Five to 20% of people with hip fractures die within one year. Sixty percent who have fractures will need assistance with their daily activities for the rest of their lives. For more information, see Washington University School of Medicine's handout entitled Bone and Mineral Diseases: Facts About Osteoporosis. (or enter this URL into your browser http://wuphysicians.wustl.edu/dept.aspx?pageID=4&ID=43).

Bone density can be easily measured and responds well to drug treatments. Therefore, it receives a great deal of attention when bone health is discussed. However, it is not the only consideration for a healthy skeleton. Even at ½ bone density, the human spine should be able to maintain five times the amount of weight it normally has to carry. Why then, do so many people get spine fractures? Fracture risk seems to be related not only to bone *quantity*, but also to bone *quality*. Fracture risk is greater when both bone density and overall bone quality are low. This handout suggests ways that you can safeguard the health of your bones.

How are bone problems diagnosed?

There are no symptoms in the early stages of osteoporosis. It is a good idea to pay attention to changes in your height and to tell your clinician about any bone pain you have (especially in the low back or neck). In the later stages of disease, the spine can curve abnormally causing a person to look hunchbacked.

- **Dual-energy x-ray absorptiometry (Dexa) scan.** The main medical test used in diagnosing bone density problems is the dual-energy x-ray absorptiometry scan. It is usually called a "dexa" scan. This test involves little radiation (much less than a CT scan). During the test, certain bones are exposed at the same time to two different X-ray beams with different energy levels. The differences in penetration provide information on bone density. To read more about this test, see Bone Density Scan at RadiologyInfo.org . (http://www.radiologyinfo.org/en/info.cfm?pg=dexa) Readings for the spine and the hip are most often used to diagnose low bone density.

  Results of dexa scans are given in T scores and Z scores.
  - **T scores** compare your bone density to that of a healthy 30-year-old of the same sex. The more negative the number, the less dense your bones are.
    - ***Osteopenia*** is diagnosed if the T score is between -1 and -2.5.
    - ***Osteoporosis*** is diagnosed if the score is less than -2.5.
    - ***Severe established osteoporosis* (SEO)** is diagnosed if the T score is less than -2.5 and if you have had a fracture.

    Test results vary based on what brand of dexa machine is used, so it is best if your follow-up tests are done using the same machine. Doctors usually recommend that you wait *at least* a year between tests if you are being treated for low bone density. This will allow enough time to pass for changes to occur with treatment. If you are not being treated, you can have this test done every 2-5 years.

  - **Z scores** compare your bone density to that of others of the same age, sex, and weight. This number is usually higher than the T score. It is not used to diagnose osteoporosis or osteopenia. Rather, it will let you and your clinician know how your bone strength compares to other people your age.

  The North American Menopause Society recommends that all women over age 65 have a dexa scan. It recommends scans for women younger than 65 if they have risk factors such as previous fractures, low weight, rheumatoid arthritis, or family members who have had hip fractures. It is a good idea for men who have risk factors to be tested beginning at age 70. A clinician may recommend a scan for a younger man who has several risk factors. Most clinicians will determine whether or not you need the test based on your overall risk for developing a bone density problem as well as your age. See the table on page 3 for causes of low bone density.

  Medicare covers initial dexa screenings. It pays for follow-ups a year or more later for people diagnosed with osteoporosis to see how treatment is working. It is important while treating bone loss to determine how bone density changes over time.

  Based on dexa measurements, 18 million Americans have osteopenia, and 10 million have osteoporosis. At least 1 in 5 women over age 50 have osteoporosis. By age 65, 50% of women and 20% of men have it. By age 75, 70% of men and women will have it. Half of all women over 50 will have a fracture of their hip, vertebra, or wrist at some point in their lives. For men, the lifetime risk for fracture is 13-25%, but they are more likely to die as a result of the fracture.

- **Quantitative ultrasound (QUS).** Some healthcare facilities offer QUS to screen for low bone density. This test usually looks at the bones of the foot. It can pick up low bone density so that additional evaluation by a dexa scan can be recommended. However, a normal test is not always a guarantee that bone density is normal.

- **Quantitative computerized axial tomography scan (CT scan)**. Quantitative CT scans can also show loss of density, but these are rarely used. X-rays are not accurate for diagnosing bone density changes.

- **Lab tests.** Some specialists suggest that lab tests be done to follow bone breakdown. Urine deoxypyridinoline and n-telopeptide (NTX) levels are used to measure rates of bone turnover. However, these tests may or may not be covered by health insurance. The importance of these tests in managing bone health is controversial.

***What would put me at more risk for poor bone health*?**

A number of risk factors influence bone density and bone health in general. Some of these can be changed; others cannot. This list cannot accurately predict whether you might have a fracture in the future. However, it does appear that at least 50% of hip fractures can be explained by risk factors that might have been reversible. See page 11 for a link to a risk calculator, which can help you gauge your likelihood of developing osteoporosis.

CAUSES OF LOW BONE DENSITY	
• Older age	• Limited sun exposure
• Being female	• Lack of exercise, not moving enough
• White or Asian ethnicity	• Taking a medication that can lower bone density
• First degree relative (such as your mother) with osteoporosis	• Some health conditions. These include: ○ Anorexia nervosa ○ Depression ○ Type 1 diabetes ○ Elevated parathyroid ○ Low testosterone ○ Elevated thyroid ○ Cushing's disease ○ Liver disease ○ Poor absorption of nutrients in the gut ○ Rheumatoid arthritis ○ History of a transplant ○ Turner's syndrome ○ Autoimmune diseases ○ Celiac disease
• Late start of menstruation (after 15 years old)	
• Early menopause	
• Prolonged time without having periods	
• Smoking	
• Drinking alcoholic beverages	
• Weight under 125 pounds	
• Weight loss of 12 pounds or more (The good things about this always outweigh the fracture risks.)	
• Previous fractures	
• Dietary issues (See section below on nutrition).	
• Increased inflammation in the body	

Some specialists think that genes may account for 25-45% of a person's weakened bones. A 25-year study of twins, however, did not find that fractures due to lower bone density were caused by inherited genes.

How can low bone density be prevented or treated?

Prevention is the most important step in keeping your bones healthy. Integrative care of the bones can be organized into 6 main categories: 1) nutrition, 2) dietary supplements, 3) lifestyle (e.g., physical activity and stopping smoking), 4) fall prevention and safety, 5) medications for bone density, and 6) other therapies (e.g., sun exposure, mind-body approaches). Once low bone density has occurred, treatment may also include pain management and surgery, such as kyphoplasty—a procedure to stop pain and stabilize bone by injecting cement-like material into the vertebra.

1. Nutrition

To form healthy bones, your body needs to absorb enough of Vitamins D, C, B, and K. Boron, chromium, copper, fluoride, iodine, iron, magnesium, manganese, selenium, silicon, and zinc are also important. Here are some suggestions for good nutrition based on current osteoporosis research.

- **Do NOT rely on dairy products alone. Eat other foods that help strengthen bones as well.** An analysis involving 37 studies revealed that eating dairy products did not strongly affect bone health unless foods fortified with Vitamin D were also eaten.

FOODS THAT ENHANCE BONE HEALTH		
Alliums (onion family)	Fennel	Parsley
Arugula	French beans	Pomegranate
Broccoli	Garlic	Prunes
Celeriac	Leeks	Red cabbage
Chinese cabbage	Lettuce	Turmeric
Cucumbers	Mushrooms (not shitake)	Wild garlic
Dill	Oranges (and other citrus fruit)	

- **Eat a few servings of soy.** One small study found that people who ate soy protein had better bone density than those who did not. Studies using soy supplements for osteoporosis have had mixed results. The bottom line – soy in foods may reduce your risk for fractures, so a few servings a day are reasonable. Taking soy supplements may not be worth it.

- **Calcium matters, but there is more to it than just taking calcium**. A high calcium diet may not be the only answer either. Your body needs to be able to absorb the right amounts of calcium. Many of the suggestions in this section of the handout work, in part, because they help the body absorb calcium. Vitamin D plays an especially important role. People who absorb Vitamin D adequately can obtain 600-800 mg of calcium from their diets.

- **Get enough Vitamin D.** Getting enough Vitamin D is not always easy to do with diet alone. The body is not able to absorb Vitamin D from dairy products very well. Spending time in the sun can help. But research indicates that even with time in the sun and adequate diet, many people still have low Vitamin D levels. These levels should be kept above 34 ng/dL to minimize fracture risk and maximize calcium absorption. (See page 7 for information on taking Vitamin D supplements).

- **Keep Vitamin A intake reasonable.** Many supplements have high levels of Vitamin A. Taking more than 3000 IU daily can increase your risk for a fracture.

- **Keep alcohol down**. Drinking 7 or more alcoholic beverages a week increases your risk for fractures.

- **Watch caffeine, but it is okay to drink tea**. Keeping caffeine under 300 mg daily (less than 4 cups of coffee), is better for the bones. Tea, even with caffeine, has NOT been found to have a negative effect on bone density. In fact, green, black, and oolong teas seem to have a protective effect against developing osteoporosis.

- **Avoid cola**. Drinking 5-6 servings of soft drinks per week (particularly colas) is a risk factor for developing osteoporosis, according to one study.

- **Eat to decrease inflammation in the body**. Studies are showing that low bone density is linked in part to chronic, low-grade inflammation. For more information, see our handout on the Anti-Inflammatory Diet .

- **Eat omega-3 fats.** Omega-3 fats are in cold water fish (salmon, herring, sardines), walnuts, ground flaxseed, and leafy green vegetables. Omega-3 fats help prevent osteoclasts from absorbing too much bone. Also by eating more omega-3 fats, you will help balance the amount of omega-6 fats in your body with the omega-3 fats. Too many omega-6's compared to omega-3 fats in the body can result in lower bone density. More research is needed in this area. In the meantime, eating more omega-3 fats is safe and is helpful for other health issues as well. For more information, see our handout on Omega 3 Fats.

- **Eat 8-10 servings of fruits and vegetables daily**. A serving is the amount that can fit in the palm of your hand. Eating a diet high in vegetables and low in animal protein (meat) seems to protect the body against bone loss.

- **Eat less animal proteins (meat).** Various studies have shown that women who eat over 75 grams (about 2.65 ounces) of protein daily probably have more acids in their bloodstreams. The body copes with these acids by taking calcium out of the bones to neutralize them. More research is needed to determine to what extent a diet to balance these acids (an alkaline diet) will promote health. Typically these diets encourage a low grain, low dairy, vegetarian diet, which certainly can have benefits for many different reasons.

  A good approach is to aim to eat 0.4 grams of protein per pound of your body weight each day. (For a 150 pound person this is 60 grams, about 2.12 ounces.) The type of protein seems to matter as well. People have lower bone density in places where most of the protein comes from animal, not plant, sources. For more information, see our handout Protein Alternatives to Meat.

- **Some specific diets seem to help**. The DASH and Mediterranean diets seem to help maintain healthy bones. Diets that restrict calories and help you lose weight may have a negative effect on bone health. The DASH (Dietary Approaches to Stop Hypertension) diet has been found to decrease bone turnover. It may be effective because it decreases the amount of sodium (salt) that a person eats. Find more information at the following links:
  - DASH Diet (http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/new_dash.pdf)
  - Mediterranean Diet (http://www.med.umich.edu/umim/food-pyramid/about.htm)

2. Supplements

For many people, taking supplements is important to maintain bone health. Many vitamins and minerals are involved in the formation of bones. They need to be taken in appropriate amounts and also must be properly absorbed. It is best to get vitamins and minerals by eating a healthy diet. But for many people, this is not enough. They need to get additional amounts through supplements.

- **Calcium.** People often think that if they take calcium supplements they will have healthy bones. The supplements do increase bone density. Surprisingly, however, they do not decrease the risk for fractures. They may even increase fracture risk. The results of a recent study add to the confusion. The findings suggest that calcium levels may be tied to a risk for heart attacks. The research, however, did not find an increase in the death rate for people who used calcium supplements. This may mean that the risk is not a strong one. Further research is needed.

  Recommendations from the Institute of Medicine for calcium are 1300 mg daily for females ages 9-18, 1000 mg a day for ages 19-50, and 1200 a day for ages 50 and up. The first 3-6 years after menopause are especially crucial. This is when many women have very high bone loss rates. Many authorities suggest that calcium will be much better absorbed if taken 3-4 times a day in amounts less than 500 mg each. If you take calcium supplements for two years and then stop, you will mostly lose their helpful benefits within two years.

  Please note that these recommendations are for elemental calcium, not the total amount of a calcium salt. Labels on the bottles may or may not give doses in terms of elemental calcium.

500 mg of elemental calcium is equal to
1250 mg of calcium carbonate
2350 mg of calcium citrate
1282 mg calcium phosphate
3846 mg of calcium lactate
5556 mg of calcium gluconate

  There is a lot of hype regarding which calcium products are best to take. In truth, no form of calcium is better than the others. Here are a few important facts about some of the more popular calcium supplements that are available:

- **Calcium carbonate**. This is better absorbed when taken with food. Some sources say that elderly people can only absorb about 5% of the calcium carbonate they take. Calcium carbonate decreases the acidity in the stomach, which may change digestion. You may notice more bloating or reflux when taking it.
- **Calcium citrate** is absorbed well even with low stomach acidity.
- **Bone meal** seems to be helpful. It contains a number of other minerals as well.

Bottom line for calcium supplements—aim to get your daily recommended calcium through a combination of food and supplements, as we wait for additional research to guide calcium use. If you take calcium supplements, also take Vitamin D because it may help to reduce the risk for a heart attack.

- **Vitamin D.** Vitamin D controls the absorption of calcium in the gut and how it is deposited into bone. It is found in fatty fish and cod-liver oil, liver, and sun-exposed mushrooms. Vitamin D has received a lot of attention recently, because it is showing promise in treating and preventing a number of health problems. A lack of Vitamin D is perhaps one of the main causes of osteoporosis and fractures. Vitamin D has been found to decrease the risk of fractures in the elderly. It can also reduce the risk for falls by about 22% in older adults who take it. A review of 29 studies found that Vitamin D in the form of D3 and calcium supplements decreased bone fracture risk by 24%.

  Both your diet and spending time in the sun will provide some Vitamin D. However, 50% of women receiving treatment for osteoporosis have levels that are too low. People are often advised to take Vitamin D3 because it is 3 times stronger than D2. Recent research has indicated that either form is effective. Specialists recommend that levels be kept in the upper half of the normal lab range, if possible, in the 40-80 ng/dL range.

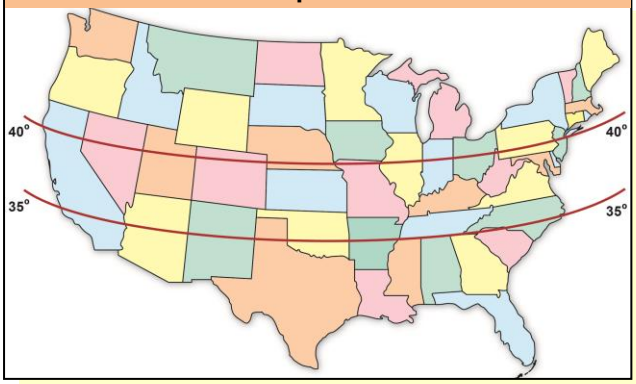
  Vitamin D supplements should be taken with meals. It is difficult to overdose on Vitamin D. There are only a few reports of it happening. People usually need to take 40,000 units a day over several months before this would occur. It can be helpful for your clinician to order a lab test to measure 25-hydroxy Vitamin D levels. This can help determine how much supplement to take. Calcium absorption is 65% higher for people with Vitamin D levels of 35 compared to those with levels below 20. Twenty minutes of full body sun exposure will give a young Caucasian person 20,000 IU of Vitamin D. You will not get too much Vitamin D by spending time in the sun, although you could get a sunburn!

  Dosing recommendations vary. Studies have found that 700-800 IU of D3 daily reduces the risk for fractures and decreases muscle-wasting. Many experts recommend 1000 IU daily for people over 65, since the skin is only 25% as efficient at making Vitamin D with sun exposure in older people. Some integrative providers are now recommending 2000 IU of D3 daily for all adults.

  Fat deposits under the skin can reduce the body's ability to absorb Vitamin D from the sun. Thus, obese individuals may be at high risk for Vitamin D deficiency, but they have less risk for osteoporosis.

How far you live from the equator is also important. In the northern hemisphere, people living north of 35-40 degrees latitude may require more Vitamin D.

Latitude Map for the U.S.A.



- **Vitamin K.** Vitamin K comes in 2 main forms:
  - **Vitamin K1** (phylloquinone) is found in green leafy vegetables.
  - **Vitamin K2** (menaquinone) is found in meats, cheeses, and fermented foods, such as fermented soy.

  A third form, Vitamin K3 has been linked to liver problems and is no longer used.

  The body needs Vitamin K to build bones. It works along with Vitamin D3. Clinicians have found that patients who have low bone mineral density and a fracture have lacked Vitamin K in their bodies. An analysis looking at the results of many studies found that taking a Vitamin K supplement reduced both bone loss and the number of fractures people had (up to 80% for hip fractures) . The doses used in studies have ranged from 1 mg – 10 mg of K1 and 45 mg of K2 each day.

  Caution--it is not a good idea to take Vitamin K if you are taking the medication warfarin to prevent blood clots. Vitamin K can reverse the drug's effects.

- **Magnesium.** Magnesium is important in bones. It helps keep bone flexible, and it increases bone mineral density in post-menopausal women. It has become popular to take for osteoporosis, but further research is needed to learn how useful it is. It may be reasonable to take a magnesium supplement because magnesium levels are too low for about 80% of Americans. A standard dose is 400-800 mg daily. Higher doses can lead to diarrhea. For more information on magnesium supplements, see the Dietary Supplement Fact Sheet: Magnesium by the National Institutes of Health Office of Dietary Supplements. (http://ods.od.nih.gov/factsheets/magnesium). You will find information on the magnesium content of various foods, recommended doses, and important drug interactions.

- **Strontium Ranelate (Protelos).** Strontium is an element in the body, but it is not an essential element. This means that the body does not require it for healthy growth. It is found only in bone. Strontium ranelate (also known as Protelos) works similarly to the drug alendronate to prevent fractures in the vertebrae of postmenopausal women who have had fractures in the past (a 40% risk reduction). However, some clinicians have

raised concern about strontium. It is much heavier than calcium and can replace calcium in bones. On x-rays, bones can then seem more dense than they really are.

Strontium ranelate is available by prescription in 70 countries, but not in the U.S. Most of the strontium supplements sold in the U.S. contain strontium citrate, which has not been studied as carefully. Some rare side effects have been reported, including blood clots and memory loss. Strontium seems to collect in the body and stay there a long time. Because of these issues, many clinicians want to see more research on strontium before they suggest taking it for bone health.

- **Herbal Remedies: Soy and Other Phytoestrogens.** Phytoestrogens are compounds contained in plants that act like estrogen in the body. Their effects depend on how much estrogen is in a woman's body. In premenopausal women, they compete with estrogen and will block the effect of estrogen. In postmenopausal women, where estrogen concentration is low, they add to the amount of estrogen circulating in the body.

  Eating soy food increases bone density, but findings related to soy supplements are mixed. Soy contains the isoflavones **daidzein** and **genistein**. Some studies have shown that taking a supplement increased bone density. For example, one well-designed study found that 54 mg of genistein was as effective as hormone replacement for preventing bone loss in postmenopausal women. Most studies have not found these supplements to be particularly helpful.

  Ipriflavone is a synthetic form of soy. When taken with 1000 mg of calcium, it helps to improve bone density. Notably, it also decreases back pain caused by compression fractures. The challenge is that it can also decrease a type of white blood cell in the body (lymphocyte) by nearly 30% after 6 or more months of use. (Lymphocytes prevent and fight infections in the body). This occurred in about 13% of study participants. Lymphocyte counts usually returned to normal after 12 months of taking ipriflavone. If you are planning to take ipriflavone, it is best to do so only under the guidance of your clinician who can keep an eye on your blood counts. The dose is 200 mg three times daily. This supplement can be purchased over-the-counter in many locations.

3. Lifestyle

- **Exercise** can help improve bone density. Walking, weight-bearing exercise, and resistance training are helpful. People of all ages benefit. Exercise is excellent for decreasing the risk for falling. It can also help increase the diameter of bones
throughout the lifespan. Vigorous, speedy walking (not just slow and gentle), makes a difference in maintaining bone mineral density. Walk at a rate of 3.8 miles/hour or more for the greatest benefit.

Courtesy: NIAMS

- **Tai chi** is a form of exercise that was developed in China. It was designed for relaxation and health. It reduces the risk of falling for elderly patients by improving balance. The effects of tai chi on bone mineral density need to be studied yet.

- **Smoking** increases the risk for fracturing a vertebra by 13% in women and 32% in men over their lifetimes. Hip fractures are increased by 31% for women and 40% for men. The more a person has smoked, the greater the risk.

4. Fall Prevention

Preventing falls is an important step in bone health. By preventing a fall, you will decrease your risk for a fracture and its complications. Please see the following publications for detailed guidelines on how to prevent falls in your home.

- Check for Safety: A Home Fall Prevention Checklist for Older Adults from the National Center for Injury Prevention and Control at the Centers for Disease Control (CDC). (http://www.cdc.gov/ncipc/pub-res/toolkit/checklistforsafety.htm)
- Patient Handout—Falls: General Information from the American Geriatrics Society (AGS) Foundation for Health in Aging. (http://www.healthinaging.org/public_education/tools/06_falls_general_information.pdf)

5. Medications for Bone Density

There are a number of drugs used to treat low bone density. Ask your clinician if medication is appropriate for your situation. Before starting a medication, ask what benefit you could expect from it and what harm it could cause.

6. Other Approaches

- **Mind-Body Approaches.** There are reports that people who are depressed may have lower bone mineral density. This has not yet been proven. However, you may want to try some ways to lower your stress level. Stress reduction techniques can help people with many different medical issues, and they tend to have few adverse effects. There are many ways to reduce stress. Deep-breathing, meditation, yoga, and walking in nature are just a few.

Courtesy: U.S. Nat'l Park Svc.

- **Sun Exposure.** A study of 250 patients who lived in institutions following strokes found that spending time in the sun regularly for a year increased their Vitamin D levels by four times and increased their bone mineral density an average of 3% compared to people who did not spend time in the sun.

- **Essential Oils.** In animals, essentials oils from thyme, rosemary, sage, and other plants, when added to food, seem to increase bone density by slowing down bone breakdown by osteoclasts. More research is needed on this for humans.

The information in this handout is for general education. It is not meant to be used by a patient alone. Please work with your health care practitioner to use this information in the best way possible to promote your health.

Where can I find more information?

ORGANIZATION	DESCRIPTION	URL
U.S. National Library of Medicine, National Institutes of Health (NIH)	1. Patient handout on osteoporosis. 2. Medline Plus information on osteoporosis. Includes links to an interactive tutorial and to information In Spanish.	1. http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001400/ 2. http://www.nlm.nih.gov/medlineplus/osteoporosis.html
National Osteoporosis Foundation	See the "About Osteoporosis" section for patient information.	http://www.nof.org/
Siteman Cancer Center Barnes-Jewish Hospital Washington University School of Medicine	Risk Calculator. Allows you to assess your risk for osteoporosis and other common health problems.	http://www.yourdiseaserisk.siteman.wustl.edu/
World Health Organization Collaborating Centre for Metabolic Bone Diseases, University of Sheffield, UK	FRAX® Fracture risk assessment tool. Allows you to assess your risk for fractures.	http://www.shef.ac.uk/FRAX/tool.jsp?locationValue=9

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References, if needed, can be found in the clinician version of this handout.

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Notes: