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Osteoporosis

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Learning Objectives:

Upon completion of this lesson, the pharmacy technician will understand:

1. The prevalence and impact of osteoporosis on the Canadian population
2. The role of lifestyle changes and medication to prevent and manage the condition
3. Their role in supporting management of osteoporosis

Introduction

According to Osteoporosis Canada, osteoporosis affects 1.4 million Canadians. One in four women and at least one in eight men over 50 years of age has osteoporosis, but the illness can occur at any age.¹

Since this disease has its roots in childhood where bone size, strength and mineralization are at their peak, those people who had an inadequate intake of calcium and vitamin D in their formative years are clearly at a disadvantage. The prevalence of osteoporosis increases with age from 6% at age 50 to over 50% above year 80. Since a postmenopausal woman at age 50 has a remaining lifetime fracture risk for hip, spine or wrist of 40%, it is not surprising that the Society of Obstetricians and Gynecologists of Canada (SOGC) recommends that this segment of the population be assessed for the presence of risk factors for the disease.²

It has been estimated that the cost of treating osteoporosis and the fractures it causes (involving hospitalization and chronic care) amounts to over 1 billion dollars annually in Canada.^{1,3} In terms of quality of life, osteoporosis can cause disfigurement, loss of mobility, decreased independence and lowered self-esteem.¹ About 20% of women and 40% of men who sustain a hip fracture will die within one year of its occurrence.²

This lesson will discuss the risk factors for developing osteoporosis, lifestyle modifications to maintain bone health, current pharmacotherapy for prophylaxis and treatment of the disease, and the role a pharmacy technician can play in supporting patients to manage the condition.

What is osteoporosis?

Osteoporosis is a disease featuring low bone mass and, in general, deterioration of bone. Bone cells, known as osteoclasts, remove bone tissue in a process called bone resorption, and are instrumental in controlling the amount of bone tissue present in the body.⁴ In patients with osteoporosis, excess osteoclast activity can result in patients breaking bones, particularly of the hip, spine (vertebra) and wrist.^{1,4} People whose bones are severely weakened will experience breakage with a simple movement—bending over and picking up a bag of heavy groceries, or sneezing forcefully.³ Osteoporosis has been called the “silent thief” because bone loss develops over time without symptoms, until a fracture occurs. People sometimes confuse osteoporosis with osteoarthritis. Osteoarthritis is an illness of the joints (e.g., knee, hip) and surrounding tissue, not bone.¹

TABLE 1 – Risk factors: identifying patients who should be assessed for osteoporosis¹⁻³**Major risk factor/behaviour**

Age over 65
 History of spinal/fragility fracture after age 40
 Family history of osteoporosis
 Early onset menopause (before age 45)
 Malabsorption syndrome
 Oral glucocorticoid therapy for more than 3 months
 Primary hyperparathyroidism
 Tendency to falls
 Hypogonadism (low testosterone levels in men)
 Osteopenia (low bone mineral density)

Minor risk factor/behaviour

Low dietary calcium intake
 Drink more than 4 cups of coffee daily
 Have more than 2 alcoholic drinks daily
 Cigarette smoking
 Vitamin D deficiency
 Sedentary lifestyle
 Rheumatoid arthritis
 Chronic heparin therapy
 Chronic anticonvulsant therapy
 Small frame, weight less than 57 kg
 History of hyperthyroidism

TABLE 2 – Examples of foods high in calcium—daily goal 4 serving equivalents³

Food	Serving size	Serving equivalent
Milk	250 mL (1 cup)	1
Milk powder	45 mL (3 tablespoons)	1/2
Cheese slices/cubes	50 g (1.75 ounces)	1
Cheese, cottage	250 mL (1 cup)	1/2
Yoghurt	175 mL (3/4 cup)	1
Oatmeal, instant	1 packet	1/2
Salmon (include bones)	1 can	1
Sardines (include bones)	12	1
Beans, baked	250 mL (1 cup)	1/2
Beans, red kidney	250 mL (1 cup)	1/4
Broccoli	250 mL (1 cup)	1/3
Cabbage, Chinese	250 mL (1 cup)	1/2
Spinach (cooked)	125 mL (1/2 cup)	1/2
Orange	1 average size	1/4
Rhubarb, raw	250 mL (1 cup)	1
Figs, dried	10	1
Almonds	125 mL (1/2 cup)	1/2
Sesame seeds	125 mL (1/2 cup)	1/3
Sunflower seeds	125 mL (1/2 cup)	1/4
Tofu, raw	125 mL (1/2 cup)	1
Hummus	250 mL (1 cup)	1/2
Molasses	15 mL (1 tablespoon)	1/2

Who is at risk?

Osteoporosis guidelines published by the Society of Obstetricians and Gynaecologists of Canada (SOGC) recommend targeting individuals who probably are losing bone, and proactively taking steps to slow down the process that leads to osteoporosis. The first step in preventing a fracture is risk

assessment.² Although no single cause for the disease has been identified, certain situations and behaviours have a greater influence on the development of osteoporosis.¹⁻³ Some risk factors present a higher danger than others in bringing about the illness, but known factors are documented in Table 1.^{1-3,5}

Management

For patients who have been assessed as being at risk for the development of osteoporosis, the guidelines recommend several lifestyle modifications: limiting alcohol and coffee intake, detailed dietary changes, supplementation with calcium and vitamin D, and specific exercise routines. For patients who are at high risk for a fracture or have already had a break, physicians will start drug treatment.^{2,3}

Lifestyle modifications*Diet*

The SOGC guidelines emphasize the reduction in consumption of alcohol and coffee. They recommend a daily intake limit of less than two alcoholic drinks, and less than four cups of coffee.²

To maintain bone health, it is recommended that four serving equivalents of foods listed in Table 2 be eaten daily. In addition, a person can add milk powder to beef patties, oatmeal, mashed potatoes, or creamed soups to increase calcium content. Calcium-rich seeds (sesame, sunflower) or cheese cubes can be added to salads and molasses can be spread on toast, to enhance calcium content in the diet. If a person cannot eat the required calcium-rich foods, then they should take a calcium supplement to make up the difference.

Exercise

Increased activity of the resistance and weight-bearing type such as dancing, walking, hiking and tennis improve bone strength. To help reduce falls, people at risk should try exercises that improve balance, coordination and flexibility, such as tai chi, swimming and yoga.^{2,3} Patients who have been diagnosed with osteoporosis should do all in their power to prevent falls. Individuals prone to falls should be encouraged to wear comfortable shoes, which give firm support. They should watch for uneven ground, or faults in sidewalks. They must not hurry to catch a bus, answer the phone or doorbell as these situations are often the cause of falls.³

Pharmacotherapy

The World Health Organization has proposed four diagnostic categories for bone mineral density (BMD) in postmenopausal Caucasian women.² The most widely used and precise method of measuring BMD is

TABLE 1 – Nonhormonal Products used in the prevention and treatment of osteoporosis^{2,6-7}

Agent	Indication		Dose
	Prevention	Treatment	
Calcium/Vitamin D (various)	X		1500 mg/800 IU daily
Selective Estrogen Receptor Modulators			
Raloxifene Evista®	X	X	60 mg daily
Bisphosphonates			
Alendronate Fosamax®	X	X	5 mg daily 10 mg daily/70 mg weekly
Alendronate/Vitamin D3 Fosavance®		X	70 mg/2800 IU weekly 70 mg/5600 IU weekly
Etidronate Cyclic Didrocal®		X	As directed, 3-month kit
Risedronate Actonel®	X	X	5 mg daily/35 mg weekly 5 mg daily/35 mg weekly/75 mg on 2 consecutive days/month, 150 mg monthly
Risedronate/calcium Actonel plus Calcium carbonate	X	X	Risedronate 35 mg once weekly, then daily calcium carbonate 1250 mg
Zoledronic acid Aclasta™		X	5 mg intravenously once yearly
Calcitonin			
Salmon calcitonin Miacalcin™		X	200 IU daily, alternating nostrils daily
Anabolic Agents			
Teriparatide Forteo®		X	20 mcg daily subcutaneously
Strontium ranelate (under consideration for approval by Health Canada) Protelos®		X	2 g sachet daily at bedtime

dual energy x-ray absorptiometry (DXA). This test is non-invasive, and requires the patient to lie on a table where dual energy x-rays are focused on the spine and hip region. The absorption of these x-rays by the patient's bones are compared to absorption seen at peak bone mass (PBM) in controls matched for sex and race. The result is reported as a T-score with standard deviation (SD) from bone mass seen in a young adult in their prime.⁵ Once a patient is classified into a category, the physician can prescribe the most appropriate treatment as directed in the guidelines.²

1. Normal: BMD not more than 1 SD below PBM (T-score above -1)
2. Osteopenic: BMD between 1 and 2.5 SD below PBM (T-score between -1 and -2.5)
3. Osteoporosis: BMD 2.5 SD or more below PBM (T-score at or below -2.5)
4. Severe osteoporosis: BMD 2.5 SD or more below PBM (T-score at or below -2.5) PLUS the presence of one or more fragility fractures

Although BMD testing via DXA can be used for both assessment and follow-up, this marker should not be considered the only indicator for success in preventing or treating osteoporosis. In addition, physicians will follow height loss over the years, if they suspect bone deterioration. Bone turnover markers, determined by urinalysis, are a promising future way to assess prevention and treatment strategies.²

There have been several advances in the prevention and treatment of osteoporosis. The physician has a variety of pharmacological options including hormone replacement therapy, selective estrogen receptor modulators, bisphosphonates, calcitonin, anabolic agents and a monoclonal antibody.²

Calcium and Vitamin D Supplementation

Health Canada recommends 1000 mg to 1500 mg of calcium daily for individuals over the age of 50 to prevent bone loss. As people age, they are less able to absorb calcium. Vitamin D, either

naturally (sunlight) or through supplements (milk or tablet) assists in the absorption of calcium.³ Canadians are directed to have a vitamin D intake of 800 IU daily. Up to 10,000 IU of vitamin D once weekly may be taken, if the patient is unable to take a daily supplement. Doses of vitamin D 100,000 IU orally every four months have been shown to be effective in reducing the risk of osteoporotic fractures. For patients who have osteoporosis, calcium and vitamin D supplementation alone are insufficient to prevent fractures. Such patients must combine the supplements with pharmacological therapy.²

Hormone Replacement Therapy

The SOGC and the North American Menopause Society recommend the use of estrogen, in combination with progesterone for patients with an intact uterus, in postmenopausal women to prevent fractures of the spine and hip, as these hormones have a positive effect on BMD.² It has been reported that BMD rises in women who

begin estrogen therapy within five years after menopause. In clinical studies, patients used both oral and transdermal therapy, and it is thought that this strategy may prevent BMD loss even if low or ultra-low doses of estrogen in combination with calcium are used.^{2,6-7} To date, there are no trials using low or ultra-low dose estrogen therapy to prevent fractures. A low dose of oral conjugated estrogen (or estradiol equivalent) is considered to be 0.3 mg, while an ultra-low dose of estrogen would be half that amount.²

Selective Estrogen Receptor Modulators (SERMs)

This class of drugs modulates estrogen receptors and has demonstrated a benefit in preventing spinal fractures. In Canada, the only member of this group that is currently recommended in the guidelines is raloxifene. Patients receiving 60 mg or 120 mg daily of raloxifene for four years had about a 40% risk reduction in vertebral fracture.²

Bisphosphonates

Currently, three oral bisphosphonates are available on the Canadian market: etidronate, alendronate and risedronate.² All drugs in this group work similarly by binding permanently to mineralized bone surfaces. They prevent osteoclast activity, which is the cause of bone degradation during the remodeling cycle.⁶ The SOGC guidelines recommend that either alendronate or risedronate be considered in the treatment of osteoporosis, to decrease the incidence of spine, wrist or hip fractures. Evidence from studies indicates that etidronate may be useful only for decreasing spinal fractures.²

Health Canada has recently approved once-yearly intravenous injections of zoledronic acid, a bisphosphonate, for the treatment of postmenopausal osteoporosis. Zoledronic acid is the most potent agent in this group of drugs. The drug was approved on the strength of the HORIZON (Health Outcomes and Reduced Incidence with Zoledronic Acid Once Yearly) trial. Patients who had already sustained a low-force hip fracture saw their chance of having a spinal fracture within three years reduced by 70%, and the incidence of hip fractures reduced by 41%, when given zoledronic acid 5 mg intravenously as a single injection.²

Calcitonin

Calcitonin, a hormone produced in the thyroid gland, acts by inhibiting osteoclast

activity. Since it is poorly absorbed orally, the product is given by the subcutaneous or nasal route. The usual dosage for the treatment of osteoporosis is 200 IU daily as a nasal spray, via alternating nostrils. Studies have shown that salmon calcitonin nasal spray significantly reduces the incidence of spinal fracture, but not fractures of the hip or wrist. For patients who recently experienced a fracture of the spine, calcitonin is believed to have analgesic effects, and may be used to manage pain.²

Anabolic Agents

This new group of drugs improves the quantity and quality of bone, increasing its strength. Teriparatide increases cortical thickness, density and bone size. When patients were given the drug subcutaneously at a dose of 20 mcg daily for 21 months, they experienced a nine per cent increase in spinal BMD. Risks for spinal and non-spinal fractures were reduced by 65%, and 53% respectively. The drug is well tolerated, but some patients experience nausea, headaches and mild elevated blood calcium.²

Another drug from this class, strontium ranelate is currently in clinical trials. Strontium ranelate is incorporated into bone and accumulates in the skeleton because it is chemically and physically similar to calcium. The risk of non-spinal fracture was reduced by 16%, and hip fracture risk by 36% in patients receiving strontium ranelate 2 g orally daily over a one-year period. Side effects associated with this therapy include nausea and diarrhea, primarily during the first few months of treatment.⁶

Monoclonal Antibody

The human monoclonal antibody, denosumab, is currently in phase III clinical trials. It prevents osteoclast activation, thereby reducing bone degradation. The drug is given by subcutaneous injection twice yearly, and has been shown to reduce bone turnover and increase BMD in osteoporosis patients.²

Table 3 provides a summary of the drugs and supplements currently used to prevent and treat osteoporosis.

Role of the Pharmacy Technician

The pharmacy technician can play a vital role in helping patients who are at high risk of a fracture, or have already broken a bone and are being treated for osteoporosis.

They can have a positive impact on health and help raise awareness of osteoporosis by directing at-risk patients or those who have the disease to the Osteoporosis Canada website for information and support. The technician's role in reassuring the patient about the BMD test and what it entails can count heavily in successful attendance for the procedure. Technicians can also respond to inquiries about ways to modify lifestyle (e.g., diet, exercise), using the background information provided in this lesson.

Should the patient have questions about quitting smoking, the technician can direct them to the pharmacist for cessation therapy intervention. Dosing regimens are unique for some osteoporosis medications, such as once weekly, once monthly and once yearly, and some medications (e.g., bisphosphonates) have special instructions for oral administration. Technicians can play an important role in assisting the pharmacist in monitoring compliance. If the patient has concerns about the safety or efficacy of their medication, then the pharmacy technician can direct the patient to the pharmacist.

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► QUESTIONS

Please select the best answer for each question or answer online at www.pharmacygateway.ca for instant results.

1. Which of the following statements is TRUE:

- a) In people over 50 years of age, osteoporosis is about twice as common in women as men
- b) Osteoporosis affects bones, cartilage and muscle tissue
- c) Osteoporosis can cause disfigurement, but not death
- d) Diet in the formative years doesn't affect eventual development of osteoporosis

2. Risk factor/behaviour(s) associated with developing osteoporosis is/are:

- a) poor absorption of nutrients
- b) age beyond 65 years
- c) a and b
- d) large frame, weight above 57 kg

3. Features of the dual energy x-ray absorptiometry (DXA) test include:

- a) it is invasive and painful
- b) it requires the patient to lie on a table and have x-rays taken of the spine and hip
- c) it uses magnetic resonance, as in MRI scanning
- d) it is an absolute rather than a relative measure of bone mass

4. Which of the following patients, based on age and T-score is at high risk and should be treated for osteoporosis?

- a) 54 year old male, L 1-4 T-Score of -1.2
- b) 54 year old female, hip T-Score of -2.0
- c) 60 year old female, hip T-score of -2.4
- d) 80 year old male, hip T-score of -3.1

5. Beef, chicken, pork and lamb are considered excellent sources of calcium.

- a) True
- b) False

6. The recommended daily Vitamin D intake to prevent osteoporosis is:

- a) 800 IU per day
- b) 1000-1500 mg per day
- c) 50,000 IU per day
- d) none of these doses

7. Categories of drugs used to prevent and/or treat osteoporosis include:

- a) hormone replacement therapy
- b) bisphosphonates
- c) selective estrogen receptor modulators
- d) all of the above categories

8. Which of the following agent(s) have been approved for treatment of osteoporosis or prevention of osteoporotic fractures in Canada?

- a) Alendronate
- b) Teriparatide
- c) Risedronate
- d) Zoledronic acid
- e) All of the above agents are approved in Canada

9. Lifestyle habit(s) that increase the risk of developing osteoporosis include:

- a) prolonged sitting, watching television or working at a computer
- b) smoking a pack of cigarettes daily
- c) drinking six cups of coffee or more a day
- d) all of the above activities

10. How should zoledronic acid be administered for osteoporosis treatment?

- a) Orally once daily
- b) Subcutaneously once weekly
- c) Intravenously once yearly
- d) Nasal inhalation daily

11. Drugs which prevent or treat osteoporosis by inhibiting osteoclast activity include:

- a) alendronate
- b) oral conjugated estrogen with cyclic progesterone
- c) strontium ranelate
- d) raloxifene

12. Calcitonin may be taken orally to treat osteoporosis, as it is extremely well absorbed.

- a) True
- b) False

13. One of the following statements applies to the anabolic agents used to treat osteoporosis:

- a) anabolic agents such as teriparatide act by inhibiting osteoclast activity
- b) all anabolic agents must be given subcutaneously
- c) this group of agents is well tolerated, although some patients experience nausea
- d) currently, no drug from this group is commercially available in Canada

14. Ruth, a frail 75-year-old patient at your pharmacy, walks using a cane. Her arthritis is causing her great difficulty in moving about, so she tends to sit while waiting for her prescriptions. You notice her shoes are loose and give little support, as they are slip-ons. What concerns might you voice to the pharmacist on duty?

- a) Ruth is at risk for developing osteoporosis because she is frail and of advanced age.
- b) Ruth is at risk for a fall because she has difficulty moving about, uses a cane and wears shoes which give little support.
- c) Raise the concerns as stated in both a and b
- d) Ruth is not at risk for a chronic illness, she is just displaying characteristics seen in most elderly patients

15. Pharmacy technicians play an important role in everyday practice, when they:

- a) refer patients to Health Organization websites to raise awareness
- b) suggest patients speak to the pharmacist if they have questions about quitting smoking
- c) provide helpful information about non-drug therapy to cope with chronic illness
- d) all of the above statements

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