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FOR TECHNICIANS**

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**Instructions**

1. After carefully reading this lesson, study each question and select the one answer you believe to be correct. Circle the appropriate letter on the attached reply card.
2. Complete the card and mail, or fax Mayra Ramos at (416) 764-3937.
3. Your reply card will be marked and you will be advised of your results in a letter from *Tech Talk*.
4. To pass this lesson, a grade of 70% (7 out of 10) is required. If you pass, you will receive 1 CEU.

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# Vitamins and the role of the pharmacy technician

By Dragana Skokovic-Sunjic, R.Ph., BScPhm.

**Statement of objectives**

Upon successful completion of this lesson, the technician should be able to:

1. Understand the recommended daily requirements and correct dosing of common vitamin supplements.
2. Understand the need to refer at-risk patients to the pharmacist.
3. Recognize the potential for overdosing if the patient is taking multiple vitamin products.

**Introduction**

While consumers typically perceive vitamins as natural and safe, in a few situations they can cause adverse effects or drug interactions. Vitamins have been promoted as able to cure cancer, relieve stress, increase athletic ability and reverse aging, to name a few claims. There is little conclusive scientific evidence for any of these claims. Although nutrition likely plays a role in disease, proving cause and effect is very difficult because there are many other factors involved and isolating the role of a single vitamin is very difficult.<sup>1</sup>

Retail pharmacies often have a huge section devoted to vitamins and related products. The majority of these products will contain multiple vitamin ingredients. In order for the pharmacy technician to make sense of these multivitamin products and to recognize situations where a patient might require referral to the pharmacist, it is necessary to first understand each individual vitamin. In this lesson we will review each vitamin and discuss some of its proven benefits and risks.

**Reading the labels**

Technicians will need to understand the following terms in order to read and understand vitamin labels.

Recommended doses of vitamins are expressed as either RNI or DRI. Recommended Nutrient Intake (RNI) is the level of dietary intake thought to be sufficient to meet the daily requirements in the majority of the population. Dietary Reference Intake (DRI) is based on scientific data and provides the range of daily intake values from optimal to maximum.<sup>2</sup> DRI standards are being developed to synchronize American and Canadian guidelines.

IU is the abbreviation for International Unit, the internationally accepted amount of certain substances, such as fat-soluble vitamins.

While microgram is sometimes written as "ug" or "µg," most of the commercially available vitamins have micrograms labelled as "mcg." One gram = 1,000 mg; 1 mg = 1,000 mcg.

**FAT-SOLUBLE VITAMINS**

Fat-soluble vitamins (A, D, E, K) are stored in the liver and fat tis-

sues for long periods, so overdose or chronic intake of high doses can cause potentially dangerous effects. Use of certain laxatives, mineral oil, cholestyramine and orlistat (Xenical) can reduce the absorption of fat-soluble vitamins.<sup>1,2,3</sup>

**Vitamin A and beta-carotene**

Vitamin A is essential for vision, immune function, integrity of skin and mucous membranes, growth and reproduction.<sup>3,4</sup> It is found in animal sources like eggs, milk, meat, liver and fish.<sup>2,5</sup> Plants contain molecules called carotenoids (e.g., beta-carotene) that can be converted to vitamin A. Beta-carotene, which is present in grains, oils, and green and yellow vegetables, usually provides about two-thirds of the vitamin A ingested in our daily diet.

Vitamin A deficiency can cause the inability to see in dim light (night blindness); in children, it can cause stunted growth. Deficiency is uncommon in developed countries, although vegetarian diets, extremely low-calorie diets and absorption disorders can increase the risk.<sup>1,2</sup>

**Dose:** (RNI) 2,700 to 3,300 IU per day for adults (1 retinol equivalent = 1 mcg of vitamin A = 3.33 IU of vitamin A).<sup>3,6</sup> Beta-carotene studies indicate that 6 mg per day should be adequate (five to six servings of fruits and vegetables per day).<sup>5,7</sup>

**Overdose:** Chronic ingestion of large doses of vitamin A (more than 10,000 IU per day) may cause loss of appetite, headaches, blurred vision, bone pain, hair loss, and enlarged spleen and liver. Doses of more than 10,000 IU per day should be avoided particularly by pregnant women and adults over the age of 70.<sup>4,6,8</sup>

**Note:** Unknown to many patients, halibut and cod liver oils contain significant amounts of vitamin A (5,000 IU and 1,250 IU, respectively), which must be included when calculating an individual's daily intake.<sup>5</sup>

Chronic alcohol consumption can increase the adverse effects of vitamin A and cause liver damage.<sup>8</sup> Large doses of beta-carotene (more than 25 mg per day) taken chronically can cause yellow-orange discoloration of the skin.

**Drug interactions:** High doses of vitamin A can increase the effects of warfarin.<sup>4</sup>

### Vitamin D

Vitamin D promotes the development and maintenance of strong bones and teeth. It is necessary for the absorption of calcium and phosphorus. Dietary sources of vitamin D are fatty fish, eggs, milk and butter.

Sunlight provides a major source of vitamin D, as it is synthesized when skin is exposed to the sun (80 to 90 per cent of the body's stores are provided this way).<sup>1,2</sup> Use of sunscreens will reduce vitamin D synthesis; however, exposure of the skin on the face and hands for five to 10 minutes two to three times per week will provide sufficient synthesis.<sup>5</sup> Elderly, obese or dark skinned people, people in northern climate, and people with gastrointestinal disease are not able to absorb sufficient vitamin D and normally require vitamin D supplements.<sup>4,7</sup>

**Dose:** (RNI) 400 to 800 IU per day to optimize calcium absorption and prevent osteoporosis. The Canadian Paediatric Society recommends that breast-fed infants receive 400 IU vitamin D daily, as breast milk does not contain vitamin D.<sup>3,4</sup>

**Note:** Many calcium supplements contain vitamin D. When considering the total daily intake of vitamin D, the amount present in calcium supplements, cod or halibut liver oil and multiple vitamin supplements must be included. Most of these supplements contain 400 IU of vitamin D.<sup>3,5</sup>

**Overdose:** High doses of vitamin D over an extended period can cause hypercalcemia (excessive calcium in the blood), with symptoms such as weakness, fatigue, loss of appetite and dry mouth. If untreated, this can lead to renal failure, seizures and vas-

cular calcifications.<sup>4,6</sup>

**Drug interactions:** Vitamin D should not be taken with digoxin because of the increased risk of arrhythmia (abnormal heart rhythm) due to vitamin D-induced hypercalcemia. Seizure medications (carbamazepine, phenytoin) can decrease the effectiveness of vitamin D.<sup>4,6</sup>

### Vitamin E (tocopherol)

Vitamin E protects tissues against oxidation damage and plays a role in the formation of red blood cells. It is found in vegetable oil, animal fats, eggs, grains, fruits and vegetables. Vitamin E deficiency is rare.

**Dose:** (RNI) 22 IU per day (d-alpha-tocopherol: 1 IU = 0.67 mg; d,l-alpha-tocopherol: 1 IU = 0.45 mg<sup>3,4</sup>).

**Overdose:** Vitamin E overdose might increase the risk of bleeding especially in patients with vitamin K deficiency.<sup>4,6</sup>

**Drug interactions:** Vitamin E supplements can increase the risk of bleeding in patients who are receiving anticoagulant or antiplatelet drugs. Vitamin E might reduce the effectiveness of some medications used in cancer chemotherapy.<sup>4,8</sup>

### WATER-SOLUBLE VITAMINS

Water-soluble vitamins (B-complex and vitamin C) are stored in various tissues and remain in the body for only a short time. If they are not replenished, symptoms of deficiency can occur within a few weeks. Unlike fat-soluble vitamins, water-soluble vitamins are considered relatively safe to

take as supplements because they do not accumulate in the body with repeat dosing.<sup>2,7</sup>

### B1 (Thiamine)

B1 helps release energy from carbohydrates and is needed for normal development of the brain and nervous system. It is found in milk, pork, whole grains, fish and legumes.

Dietary intake is usually sufficient to provide the recommended daily requirements, although increased requirements are common in several situations: pregnancy, very high carbohydrate intake, increased physical activity, hyperthyroidism, dialysis, liver disease and excessive use of alcohol.<sup>6,7</sup> Vitamin B1 deficiency is rare.

**Dose:** (RNI) 1 to 2 mg per day.

**Overdose:** Vitamin B1 overdose is mainly associated with parenteral administration (i.e., by injection).<sup>4,6</sup>

**Drug interactions:** Long-term use of furosemide in patients with congestive heart failure can increase thiamine excretion, causing thiamine deficiency that can lead to worsening heart failure.<sup>1</sup>

### B2 (riboflavin)

B2 is required for building and maintaining body tissues. It is found in milk, meat, eggs and green vegetables.

B2 deficiency is likely in patients with chronic diarrhea, alcoholism, and chronic use of tricyclic antidepressants, phenothiazines or oral contraceptives. Signs of deficiency include inflammation of the oral mucosa, magenta tongue, cracked lips, and burning, itching eyes.<sup>2,4,5</sup>

**Dose:** (RNI) 1 to 4 mg per day. The dose to treat deficiency is 5 to 30 mg per day.<sup>1,3</sup> Note: Even at the recommended dose, B2 will cause yellow-orange discoloration of the urine.<sup>1</sup>

**Overdose:** A dose of 400 mg per day, which is sometimes used in preventing migraines,

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can cause diarrhea and frequent urination.

### B3 (niacin and niacinamide)

Vitamin B3, which is also known as niacin (nicotinic acid) and niacinamide (nicotinamide), is involved in tissue respiration, lipid metabolism, normal functioning of the skin, nerves and digestive system. It is present in organ meats, fish, nuts, yeast, grains and green vegetables.<sup>1,4</sup> Chronic alcoholism, isoniazid therapy and some carcinoid tumors can cause niacin deficiency.<sup>1,4</sup>

*Dose:* (RNI) 10 to 20 mg per day. Niacin 1.5 to 6 g daily (in divided doses) is used orally as an adjunct to diet for the treatment of hyperlipidemia (high cholesterol levels).<sup>1,3,5</sup>

*Adverse effects:* Even low doses can cause flushing sensation, redness of the face and arms, dizziness, nausea and hypertension. Long-term overdoses can cause rash, hyperpigmentation and gout. Slow-release formulations taken at bedtime, pre-treatment with ASA or taking niacin with food may minimize flushing.<sup>1,4</sup> High doses should be taken only under medical supervision.

*Contraindications:* Large amounts of niacin increase the risk of irregular heartbeat. Niacin can cause hyperglycemia (high blood glucose), abnormal glucose tolerance and glucosuria (spillage of glucose into the urine). Patients with diabetes should not take it unless monitored by a physician. Patients with gout, gallbladder disease, liver or kidney disease, hypotension (low blood pressure) or allergies should use niacin with caution.<sup>1,4,6</sup>

*Drug interactions:* Concomitant use of a nicotine skin patch will increase flushing and dizziness. Use of statins with niacin increases the risk of myopathy (muscle disease associated with pain).<sup>4,6</sup>

### B6 (pyridoxine)

B6 plays an important role in the metabolism of protein and

amino acids, normal functioning of the brain and formation of red blood cells.<sup>4</sup> It is present in whole grains, dried legumes, nuts, meat and fish.

Both deficiency and excess can lead to the appearance of neurological symptoms, such as pain and tingling in the hands and feet, irritability, anxiety, anemia, dermatitis and convulsions.<sup>1,2</sup> Vegetarians, pregnant women, people over the age of 70, people on high-protein diets, or those consuming large amounts of alcohol are at increased risk of developing these problems.<sup>7</sup>

*Dose:* (RNI) Up to 2 mg per day as a dietary supplement. Higher doses are used for women taking oral contraceptives, for treatment of premenstrual syndrome and as a prescription medication in combination with doxylamine for nausea in pregnancy.<sup>1,4</sup>

*Overdose:* The safe upper limit is 200 mg per day; higher doses increase the risk of seizures, ataxia (jerky, uncontrolled movements) and peripheral neuropathy (alterations in sensory perceptions).<sup>1,6</sup>

*Drug interactions:* Vitamin B6 increases the metabolism of levodopa, reducing its efficacy for Parkinson's disease; the combination of levodopa/carbidopa does not seem to be affected. B6 is usually prescribed with isoniazid, since isoniazid may interfere with B6 metabolism and result in peripheral neuropathy. Estrogens or oral contraceptives also interfere with B6 metabolism and increase the need for B6 supplementation, especially in women with inadequate dietary intake of this vitamin.<sup>1,4</sup>

### B12 (cyanocobalamin)

Vitamin B12 plays an important role in the formation of red blood cells and in the nervous system.<sup>3,7</sup> Animal products such as organ meats, eggs and dairy products are the only dietary sources of B12.

Due to the large body stores of this vitamin, deficiency

can take months to years to become symptomatic. Deficiency can be caused by inadequate dietary intake or problems with absorption. Vegetarians and people over 50 are at high risk of developing deficiency.<sup>4</sup>

*Dose:* (RNI) Up to 2.4 mcg daily, higher for pregnant (2.6 mcg/day) and lactating (2.8 mcg/day) women. In the elderly, 25 to 100 mcg daily is required to maintain B12 levels. For the treatment of deficiency, intramuscular or subcutaneous preparations of vitamin B12 are given in the dose of 100 to 200 mcg every month, or alternatively oral doses of 1,000 mcg daily.<sup>1,4</sup>

*Overdose:* Even high doses of B12 do not cause adverse effects. However, it should be used with caution in people with Leber's disease (optic nerve atrophy), megaloblastic anemia and polycythemia vera (a blood disorder).<sup>1,6</sup>

*Drug interactions:* Because large amounts of vitamin C can destroy B12, the two vitamins should be taken at least an hour apart. Medications that reduce the production of stomach acid (H2 blockers and proton pump inhibitors) can decrease absorption of B12. Metformin inhibits B12 receptors in the small intestine and reduces B12 absorption.<sup>4,6</sup>

### Folic acid

Folates (available in food) and folic acid (available in supplements and fortified foods) play a role in the maturation of red blood cells, functioning of the nervous system and preventing damage to DNA. Folic acid is easier to absorb and utilize than folates from food. Foods naturally rich in folates are green vegetables, legumes, mushrooms, liver, bananas, and orange and tomato juice.<sup>1,5</sup>

Folates are particularly important during pregnancy, as maternal deficiency can cause neural tube defects (e.g., spina bifida) in the baby.

Deficiency can also cause megaloblastic anemia, fatigue, gastrointestinal symptoms, and increased homocysteine levels, which have been associated with the increased risk of stroke and heart attack.<sup>1,4</sup>

*Dose:* (RNI) 400 mcg (0.4 mg) per day.<sup>4,5</sup>

*Drug interactions:* Folic acid may reduce seizure control when combined with phenobarbital and phenytoin. Ulcer medications (H2 blockers and proton pump inhibitors) can decrease the absorption of folic acid, while oral contraceptives increase its metabolism (possibly leading to deficiency).<sup>1</sup>

High doses of folic acid can mask the symptoms of pernicious anemia in individuals with undiagnosed anemia; lack of treatment could lead to neurological damage.<sup>1</sup>

### Vitamin C (ascorbic acid)

Vitamin C plays a role in the synthesis of collagen (the principal protein in the skin), is essential for healthy gums and capillaries, and aids iron absorption, wound healing and cartilage and bone formation. Vitamin C is found in citrus fruits, tomatoes, strawberries, green peppers and broccoli. The amount of vitamin C in food can significantly decrease with cooking or prolonged storage.<sup>3,7</sup>

There is a lot of controversy about the effectiveness of vitamin C for prevention of the common cold. The majority of evidence, however, shows that vitamin C supplementation does not decrease the risk of developing a cold.<sup>1,8</sup>

Vitamin C deficiency can lead to fatigue, personality changes, loss of appetite, low resistance to infection, poor wound healing and scurvy (characterized by bleeding gums, loosening teeth, petechial hemorrhage).<sup>4,6</sup>

*Dose:* (RNI) 90 mg daily for men and 75 mg daily for women. Smokers require an additional 35 mg daily. For treatment of scurvy, the

required dose is 100 to 250 mg once or twice daily for up to three weeks.<sup>1,4</sup> Vitamin C requirements are increased during pregnancy, and lactation, in the elderly, and for people with hyperthyroidism, fever, cold exposure, stress, infection, trauma and burns.

**Overdose:** Doses higher than 1,000 mg per day can cause nausea, vomiting, heartburn, cramps, gastrointestinal obstruction, sleepiness and diarrhea. High doses of vitamin C can acidify urine and increase the risk of kidney stones. If prolonged use of high doses is stopped suddenly, scurvy can occur due to the increased metabolism of vitamin C.<sup>4,6,7</sup>

**Drug interactions:** More than 3 g of vitamin C per day can decrease the elimination of acetaminophen and increase the risk of adverse effects. Acetylsalicylic acid (ASA) and other salicylates increase the urinary excretion of vitamin C. The antioxidant effects of vitamin C can decrease the treatment efficacy of cancer chemotherapy. Warfarin's absorption and anticoagulant

effect can be decreased with high doses of vitamin C.<sup>1</sup>

### The technician's role

Pharmacy technicians can play a vital role in assisting a busy pharmacist in identifying individuals who may need intervention when purchasing vitamin supplements. Although vitamins are generally safe, this lesson has identified situations where an individual may be at risk. Patients taking a number of medications that may potentially interact with vitamins, those who have certain medical conditions, as well as the elderly, pregnant women and very young patients may need the intervention of the pharmacist when purchasing vitamin supplements.

In addition, technicians should pay special attention to patients who are purchasing more than one vitamin supplement, since they may be taking excessive doses of a vitamin without realizing it (e.g., vitamin A in two products).

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## QUESTIONS

**1. Night blindness is the inability to see in dim light, caused by the deficiency of:**

- vitamin C.
- vitamin B6.
- vitamin A.
- all of the above.

**2. Dietary sources of vitamin B12 are:**

- fatty fish and legumes.
- green, leafy vegetables.
- fortified cereals.
- animal products.

**3. A patient who is taking one halibut liver oil capsule daily is getting:**

- the recommended daily intake of B12.
- 10,000 IU of vitamin A and 400 IU of vitamin E.
- 5,000 IU of vitamin A and

400 IU of vitamin D.  
d. 5,000 IU of vitamin A and beta-carotene.

**4. Patients using orlistat (Xenical) might be at risk of:**

- vitamin C deficiency.
- scurvy.
- pellagra.
- fat-soluble vitamins deficiency.

**5. People with diabetes should avoid using high dose of:**

- niacin.
- vitamin E.
- vitamin D.
- none of the above.

**6. Women taking oral contraceptives might be deficient in:**

- vitamin E and D.
- vitamin B6 and folic acid.
- vitamin B1, B2 and B3.
- fat-soluble vitamins.

**7. Which statement is TRUE about folic acid?**

- Folic acid is available only from dietary sources.
- Folic acid is available from fortified foods and supplements.
- Folic acid can decrease the risk of seizures in patients taking certain anti-convulsants.
- The daily dose of folic acid is 400 mg.

**8. Eggs and milk are dietary sources of:**

- vitamin A.
- vitamin B2.

- vitamin B12.
- all of the above.

**9. Vitamin D:**

- prevents neural tube defects.
- decreases risk of cardiovascular disease.
- decreases risk of osteoporosis.
- increases risk of stroke.

**10. A flushing sensation and redness of the face and arms is common when taking high doses of:**

- vitamin C.
- vitamin A and beta-carotene.
- water-soluble vitamins.
- vitamin B3.

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MAY/JUNE 2004

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## Vitamins and the role of the pharmacy technician

1 CEU

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Are you a certified technician?

- Yes  No

**Please help ensure this program continues to be useful to you by answering these questions.**

1. Do you now feel more informed about vitamins and the role of the pharmacy technician?  
 Yes  No
2. Was the information in this lesson relevant to you as a technician?  Yes  No
3. Will you be able to incorporate the information from this lesson into your job as a technician?  Yes  No  N/A
4. Was the information in this lesson...  Too basic  Appropriate  Too difficult
5. How satisfied overall are you with this lesson?  Very  Somewhat  Not at all
6. What topic would you like to see covered in a future issue? \_\_\_\_\_

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