

# GUIDELINES & PROTOCOLS

## ADVISORY COMMITTEE

### Vitamin D Testing Protocol

Effective Date: October 1, 2010; Revised June 1, 2013

#### Scope

This laboratory protocol describes the appropriate use of vitamin D testing within the general adult ( $\geq 19$  years) population in British Columbia (BC). Patients with malabsorption syndromes, renal failure, unexplained bone pain, unusual fractures, and other evidence of metabolic bone disorders are excluded from this protocol.\* Recommended vitamin D supplementation is discussed and a patient handout is included.

#### Routine Diagnostic Testing

- Routine serum vitamin D testing or screening for vitamin D deficiency is not recommended.
- Routine serum vitamin D testing during vitamin D supplementation is not recommended.

#### Population at Risk

The BC population is at risk of low vitamin D levels from autumn to spring. There is no clinical utility in performing vitamin D tests on patients who are thought to be at risk for sub-optimal vitamin D levels and who would benefit from vitamin D supplementation.

#### Vitamin D Supplementation without Testing

Because vitamin D supplementation in the general adult population is safe, it is reasonable to advise supplementation without testing. Routine testing of vitamin D levels [25-hydroxyvitamin D or 25(OH)D] is not medically necessary prior to or after starting vitamin D supplementation.

#### Utilization and Cost of Serum Vitamin D Testing in BC

Utilization of vitamin D testing [as 25(OH)D] in BC has increased ten-fold in the past five years. Medical Service Plan expenditures are approximately \$3 million annually for outpatient vitamin D testing with a cost per test of \$61.32 in 2013.

Measuring serum vitamin D as 1,25-dihydroxyvitamin D [1,25-(OH)<sub>2</sub>-D] is seldom indicated, except in selected patients with advanced renal failure, mineral and/or bone diseases. Specialist consultation should be considered for patients with malabsorption, unexplained bone pain, unusual fractures or other evidence suggesting metabolic bone disorder.

#### Sun Exposure and Vitamin D Synthesis by Skin

The amount of vitamin D produced by the skin is dependent on the surface area exposed, skin pigmentation, age, season, latitude and use of sun block. During winter months in Canada there is insufficient ultraviolet (UV) radiation in sunlight for adequate vitamin D production.<sup>1</sup> Adequate vitamin D can be made in the body during careful exposure of the arms and legs to sunlight for 10-15 minutes per day in the summer months. However, the risk of skin cancer due to sun exposure and tanning beds must be considered.

#### Dietary Sources of Vitamin D

Vitamin D can be obtained from dietary sources (e.g., salmon, mackerel, tuna, egg yolk), fortified foods (e.g., cow, soy or rice milk), and supplements. There are no plant sources that provide a significant amount of vitamin D naturally. (See Patient Guide)

\* Vitamin D testing is only covered under MSP when patient is <19 years or ordered by a specialist. All other vitamin D tests are user paid.

## Vitamin D Supplementation

During the Canadian autumn, winter and spring, the adult population is unlikely to achieve adequate vitamin D levels through diet and sunlight only. Consideration should be given to supplementation during those seasons. The two major forms of vitamin D supplements are available as D<sub>2</sub> (ergocalciferol) or D<sub>3</sub> (cholecalciferol). Vitamin D<sub>3</sub> has been shown to be three times more effective than vitamin D<sub>2</sub> at increasing serum 25(OH)D levels and maintaining these levels over a longer period of time.<sup>2,3,4</sup> As a result, D<sub>2</sub> dosage must be tripled to achieve the same benefit.

Osteoporosis Canada recommends supplementing with vitamin D<sub>3</sub> over vitamin D<sub>2</sub>.<sup>4</sup> Most over the counter supplements available in Canada contain vitamin D<sub>3</sub> whereas high-dose Vitamin D<sub>2</sub> is available only by prescription. There is good evidence that supplementation with at least 800 international units (IU) of vitamin D<sub>3</sub> per day, combined with calcium, is required to reduce the risk of fragility fractures, therefore 800 – 1000 IU daily is recommended (although the optimum daily requirement of vitamin D<sub>3</sub> is not known).<sup>4,5,6</sup> Weekly dosing (one week's adult dose of vitamin D<sub>3</sub> taken as a single weekly dose, i.e. 7000 IU) or monthly dosing (one month's adult dose of vitamin D<sub>3</sub> taken once a month, i.e. 30,000 IU) may be more convenient for some patients and has been shown to be safe.<sup>1,4,7</sup> At this time, high doses of vitamin D<sub>3</sub> once a year is not recommended as recent evidence has shown possible increased fracture risk.<sup>8</sup>

## Vitamin D Toxicity

Vitamin D toxicity is uncommon.<sup>3,6,9</sup> Daily doses of up to 10,000 IU of vitamin D<sub>3</sub> for up to five months has not been shown to cause harm in adults.<sup>10,11</sup> Any harm that would occur from excessive vitamin D ingestion is mediated by hypercalcemia. Therefore, if there is a strong clinical suspicion of vitamin over-use (e.g. patients with eating disorders), then the recommended test is serum calcium (albumin-corrected total calcium\* or ionized calcium).<sup>12</sup> Only if the calcium level is elevated would a serum vitamin D measurement be indicated.

## Physiology

Vitamin D is a fat-soluble vitamin that is naturally present in very few foods.<sup>13</sup> It stimulates intestinal calcium and phosphate absorption, and is important in maintaining adequate calcium levels for bone mineralization, bone growth and remodelling.<sup>14</sup> Vitamin D deficiency has been linked to a wide variety of common diseases including cancer, diabetes, and cardiovascular disease. Vitamin D is reported to be involved in the regulation of cell growth and metabolism, modulation of immune function, and reduction of inflammation.<sup>15,16</sup>

For humans there are two sources of vitamin D: vitamin D<sub>2</sub> (ergocalciferol) is derived from plants, and D<sub>3</sub> (cholecalciferol) is produced in the skin by action of UV light on 7-dehydrocholesterol. (See Figure 1) Vitamin D<sub>2</sub> is only one-third as effective as vitamin D<sub>3</sub> in raising levels of 25(OH)D.<sup>17</sup>

Both D<sub>2</sub> and D<sub>3</sub> are hydroxylated in the liver to 25(OH)D, the major circulating form of vitamin D (metabolically inactive). It undergoes further hydroxylation in the kidney to the active metabolite, 1,25-(OH)<sub>2</sub>-D or calcitriol. Calcitriol stimulates intestinal calcium absorption, decreases parathyroid hormone secretion, enables parathyroid hormone-mediated mineral absorption within the kidney, stimulates osteoclastic bone resorption and osteoblasts, decreases production of collagen, influences muscle function, stimulates cell differentiation and modulates the immune system.

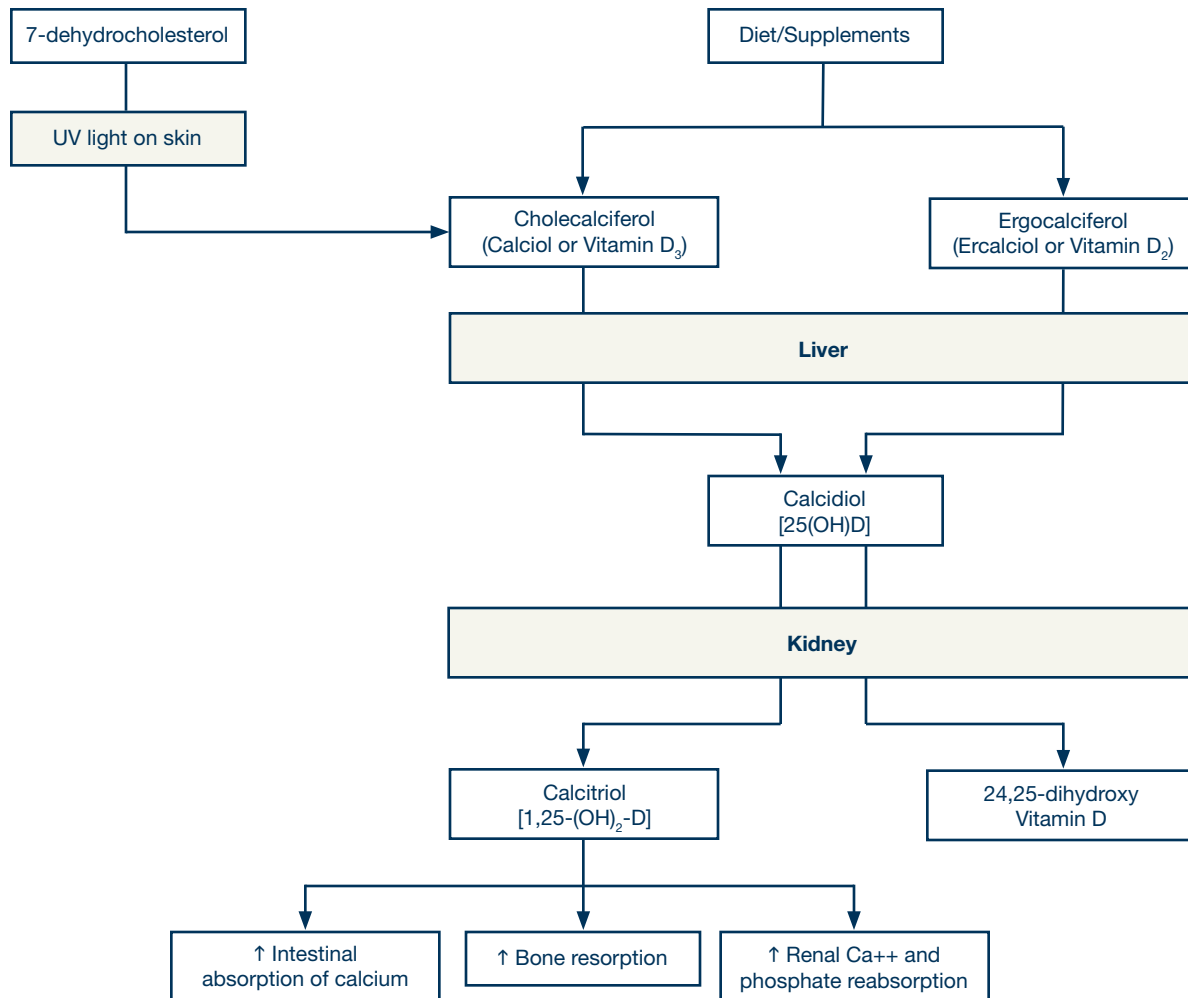
Aging brings with it a reduction in the efficiency with which the skin synthesizes vitamin D and a reduction in the kidney's ability to convert vitamin D to its active form.<sup>18</sup> Increased skin pigmentation and use of high efficiency sun blockers also reduce skin synthesis of vitamin D.<sup>1</sup>

Because serum 25(OH)D concentration represents both skin production (D<sub>3</sub>) and oral intake (D<sub>2</sub> or D<sub>3</sub>) of vitamin D, it may be used to determine the adequacy of vitamin D production and intake.<sup>19</sup> Consensus has been reached that a 25(OH)D level that is less than 25 nmol/litre indicates vitamin D deficiency. The optimum level of serum vitamin D, if one exists, has not been determined.

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\* Corrected Ca = Ca.measured + (40-alb) X 0.02, [Ca in mmol/L; albumin in g/L]

**Figure 1: Pathways of vitamin D synthesis\***



\* Adapted from Janssen HC, Samson MM, Verhaar HJ. Vitamin D deficiency, muscle function, and falls in elderly people. *American Journal of Clinical Nutrition* 2002;75:611-615.

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## Resources

HealthLink BC: [www.healthlinkbc.ca](http://www.healthlinkbc.ca)

Telephone - Anywhere in BC call 8-1-1, Translation services are available in over 130 languages on request. TTY (Deaf and hearing-impaired) call 7-1-1.

## List of Abbreviations

25(OH)D - 25 - hydroxyvitamin D  
 1,25-(OH)<sub>2</sub>-D - 1,25-dihydroxyvitamin D  
 UV - ultraviolet  
 IU - international units

## Associated Documents

Vitamin D: A Patient Guide for Adults

This guideline is based on scientific evidence current as of the Effective Date.

This guideline was developed by the Guidelines and Protocols Advisory Committee, approved by the British Columbia Medical Association and adopted by the Medical Services Commission.

A mobile version of this and other guidelines is also available at [www.BCGuidelines.ca](http://www.BCGuidelines.ca)

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