Vitamin D and its metabolites are steroid hormones and are classified in two groups: cholecalciferols and ergocalciferols. Cholecalciferols are the major natural source of vitamin D. Cholecalciferol, vitamin D3, is generated by the exposure of provitamin D3 (7-dehydrocholesterol) in the skin to ultraviolet B radiation in sunlight. Ergocalciferol, vitamin D2, is generated from the irradiation of ergosterol from yeast and plants. Very few foods naturally contain vitamin D, with fatty fish, fish oils and egg yolks serving as the main sources. Fortification of some foods with vitamin D, such as milk, cereal and bread, facilitates acquiring the current recommended daily allowance of 400 IU.

In the liver, vitamin D is metabolized to 25-hydroxyvitamin D (25-OH-D), which is the form of vitamin D that is generally analyzed to determine a patient’s vitamin D status and is considered the first-line best marker for evaluating vitamin D deficiency. It has a half-life of 2-3 weeks with a circulating concentration in the ng/mL range. 25-OH-D is hydroxylated again in the kidney to 1,25-dihydroxyvitamin D (1,25-OH₂-D), which is the active form of the vitamin. Its half-life is much shorter, at 4-6 hours, and it is found at a much lower concentration, with amounts in the pg/mL range. Production of 1,25-OH₂-D is tightly regulated by levels of parathyroid hormone, calcium and phosphorous. Parathyroid hormone stimulates the conversion of 25-OH-D to 1,25-OH₂-D, which subsequently increases calcium and phosphorous absorption in the intestines. Laboratory measurement of 1,25-OH₂-D is generally needed only in selected patients such as patients with renal failure and 1-hydroxylase deficiency.

Lack of vitamin D can interfere with bone mineralization, leading to the classic presentations of vitamin D deficiency in children and adults, rickets and osteomalacia, respectively. Recent evidence suggests that vitamin D may play a role in diabetes, cancer, autoimmune and infectious diseases and cardiovascular disease as well. Along with the increase in studies showing the involvement of vitamin D in numerous disease processes, other studies are showing that a significant portion of the population is vitamin D deficient. Since vitamin D is present in few foods, the majority of vitamin D comes via sun exposure. This has decreased in recent years with the warnings to use sunscreen and avoid the sun to prevent skin cancer. Additionally, it is not possible to synthesize vitamin D in certain latitudes of the world during several months of the year because the position of the sun does not provide the proper UVB wavelengths. Skin pigmentation is another dynamic to be considered because more sun exposure is required for adequate amounts of vitamin D to be synthesized in skin as the pigmentation increases.
A complicating factor in the determination of the prevalence of vitamin D deficiency is the lack of a consensus definition of what constitutes vitamin D deficiency. Using the current threshold of <11 ng/mL to define deficiency, reports of vitamin D deficiency have ranged from 15% to 80% of the population studied. It has been proposed that vitamin D deficiency should be defined as a 25-OH-D concentration < 15 ng/mL, with values between 15-29 ng/mL considered vitamin D insufficient. Parathyroid hormone concentrations begin to level off when 25-OH-D reaches 30-40 ng/mL, and this is considered physiologic evidence of vitamin D sufficiency. Vitamin D intoxication is seen when levels exceed 150 ng/mL. One consequence of lowering the threshold of vitamin D deficiency is an increase in the number of people classified as deficient. In a study using NHANES III samples from adolescents ages 12-19, changing the criteria of deficiency from <11 ng/mL to <20 ng/mL increased the prevalence of vitamin D deficiency from 2% to 14%.

The Toxicology laboratory at Children’s Mercy Hospital offers testing for 25-OH-D. The specimen requirement is 0.5mL of serum in a plain red top tube, and the assay is performed 1-2 times per week. The methodology used is liquid chromatography tandem mass spectrometry (LC-MS/MS). The assay measures both D2 and D3 and reports the individual values and the sum of the two as Total Vitamin D 25-OH. Serum concentrations in the range of 30-100 ng/mL are considered optimal with this assay.

Please contact the laboratory with any questions.

References: