LifeWise
Health Plan of Washington

MEDICAL POLICY – 2.04.507

Testing Serum Vitamin D Levels

BCBSA Ref Policy: 2.04.135

Effective Date:	Mar. 1, 2025	RELATED MEDICAL POLICIES:
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Replaces:	2.04.135	

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Introduction

Vitamin D is an important nutrient for maintaining good health. It is especially important for good bone health and calcium metabolism. Many studies and articles have been published in scientific journals and in lay magazines about the benefits of vitamin D. Despite all of this interest, there is very little data about optimal levels of vitamin D, and most published studies are of low quality. The endocrine society and public health experts strongly recommend against measuring vitamin D levels in healthy individuals. Vitamin D is found in some foods, has been added to other foods (cereals and milk), and is increased with exposure to the sun. The U.S. National Institutes of Health (NIH) has recommended vitamin D supplementation for Americans based on age (600 IU per day for ages 1 to 70 years of age). Testing for vitamin D levels is covered when a person has signs or symptoms of vitamin D deficiency or risk factors for vitamin D deficiency.

Claims for vitamin D tests are reviewed after submission based on the diagnosis listed. The diagnoses considered medically necessary and that are covered are listed in this medical policy.

Note: The Introduction section is for your general knowledge and is not to be taken as policy coverage criteria. The rest of the policy uses specific words and concepts familiar to medical professionals. It is intended for providers. A provider can be a person, such as a doctor, nurse, psychologist, or dentist. A provider also can be a place where medical care is given, like a hospital, clinic, or lab. This policy informs them about when a service may be covered.

Policy Coverage Criteria

Testing Condition	Medical Necessity

Asymptomatic	**Testing vitamin D levels is considered medically necessary for asymptomatic individuals when:**
	• The individual has risk factors for vitamin D deficiency:
	  ○ Chronic kidney disease, stage greater or equal than 3
	  ○ Cirrhosis/chronic liver disease
	  ○ Malabsorption states (e.g., cystic fibrosis, inflammatory bowel disease, Crohn's disease, bariatric surgery, radiation enteritis, short bowel syndrome, pancreatitis, amyloidosis, celiac sprue)
	  ○ Osteomalacia
	  ○ Osteoporosis
	  ○ Rickets
	  ○ Hypo-or hyper-calcemia
	  ○ Granulomatous diseases (e.g., sarcoidosis, tuberculosis, histoplasmosis, coccidiomycosis, berylliosis)
	  ○ Vitamin D deficiency, on replacement
	  ○ Obstructive jaundice/biliary tract disease
	  ○ Osteogenesis imperfecta
	  ○ Osteosclerosis/osteopetrosis
	  ○ Chronic use of anticonvulsant medication or corticosteroids
	  ○ Parathyroid disorders
	  ○ Osteopenia
	
	Testing vitamin D levels is considered not medically necessary for asymptomatic individuals when criteria in this policy are not met.

Institutionalized individuals	**Testing vitamin D levels in asymptomatic individuals may be considered medically necessary in the following populations:**
	• Individuals receiving some degree of medical care who reside at any of the following:
	  ○ Long-term care facilities
	  ○ Long term hospital stays
	  ○ Nursing homes

	○ Assisted living facilities
Testing Condition	**Medical Necessity**
Symptomatic vitamin D deficiency	**Testing vitamin D levels may be considered medically necessary when the individual presents with signs and symptoms of vitamin D deficiency.** • Signs and symptoms of vitamin D deficiency are largely manifested by changes in bone health and biochemical markers associated with bone production and resorption ○ In most cases, a clinical diagnosis of an abnormality in bone health (e.g., rickets, osteomalacia, osteoporosis) will lead to a decision to test vitamin D levels. ○ Symptoms related to the clinical condition may be present, such as pain or low-impact fractures, but these symptoms are usually not indications for testing prior to a specific diagnosis ○ Some biochemical markers of bone health may indicate an increased risk for vitamin D deficiency, as such testing of vitamin D levels may therefore be appropriate. These biochemical markers include unexplained abnormalities in the following: ▪ In serum calcium ▪ Phosphorous ▪ Alkaline phosphatase ▪ Parathyroid hormone
Symptomatic vitamin D toxicity (hypervitaminosis D)	**Testing vitamin D levels may be considered medically necessary when the individual presents with signs and symptoms of vitamin D toxicity (hypervitaminosis D)** • Signs and symptoms of vitamin D toxicity generally result from induced hypercalcemia. ○ Acute intoxication can cause the following symptoms: ▪ Anorexia ▪ Confusion ▪ Polydipsia ▪ Polyuria ▪ Vomiting ▪ Weakness ○ Chronic intoxication can cause the following: ▪ Bone demineralization

	▪ Bone pain ▪ Kidney stones
Repeat testing	**A repeat test may be appropriate to determine whether supplementation has been successful in restoring normal serum levels when the initial test was for a medically necessary indication (as noted above).** **More than 1 repeat test may be indicated in cases where supplementation has not been successful in restoring levels, documented by continued or recurrent signs and symptoms (as noted above), which may indicate ongoing deficiency, and/or inadequate absorption.**

Coding

The following codes are specific to vitamin D testing and related to medically necessary diagnoses:

Code	Descriptor
CPT	
0038U	Vitamin D, 25 hydroxy D2 and D3, by LC-MS/MS, serum microsample, quantitative
82306	Vitamin D; 25 hydroxy, includes fraction(s), if performed
82652	Vitamin D; 1, 25 dihydroxy, includes fraction(s), if performed
ICD-10 Diagnosis Codes - Covered	
A15.0-A15.8	Tuberculosis of respiratory system
A17.0-A17.89	Tuberculosis of nervous system
A18.01-A18.09	Tuberculosis of bone and joints
A18.11-A18.2	Tuberculosis of genitourinary system
A18.31-A18.39	Tuberculosis of intestines, peritoneum, and mesenteric glands
A18..4	Tuberculosis of skin and subcutaneous tissue
A18.51-A18.7	Tuberculosis of eye, ear and adrenal glands
A18.81-A18.89	Tuberculosis of other specified organs
A19.0-A19.8	Miliary tuberculosis

Code	Descriptor
A28.1	Cat-scratch disease
B20	Human immunodeficiency virus (HIV) disease
B38.0-B38.89	Coccidiomycosis
B39.0-B39.89	Histoplasmosis
B41.0	Pulmonary paracoccidioidomycosis
B41.7	Disseminated paracoccidiodmycosis
B59	Pneumocystosis
D71	Functional disorders of polymorphonuclear neutrophils
D86.0-D86.3	Sarcoidosis
D86.81-D86.89	Sarcoidosis of other sites
E05.00 – E05.91	Thyrotoxicosis
E20.0 – E20.9	Hypoparathyroidism
E21.0 – E21.5	Hyperparathyroidism and other disorders of parathyroid gland
E41	Nutritional marasmus
E43	Unspecified severe protein-calorie malnutrition
E55.0-E55.9	Vitamin D deficiency
E64.3	Sequelae of rickets
E67.3	Hypervitaminosis D
K67.8-K68	Hyperalimentation
E72.0 – E72.09	Disorders of amino-acid transport
E74.21	Galactosemia
E83.30 – E83.39	Disorder of phosphorus metabolism and phosphatases
E83.50 – E83.59	Disorders of calcium metabolism
E84.0-E84.8	Cystic fibrosis
E85.0-E85.89	Amyloidosis
E89.2	Postprocedural hypoparathyroidism
I12.0-I12.9	Hypertensive chronic kidney disease

Code	Descriptor
I13.0-I13.2	Hypertensive heart and chronic kidney disease
J63.2	Berylliosis
K50.00-K50.818	Crohn's disease of small intestine
K50.10-K50.118	Crohn's disease of large intestine
K50.80-K50.818	Crohn's disease of both small and large intestine
K50.90-K50.918	Crohn's disease, unspecified
K51.00-K51.018	Ulcerative colitis
K51.20-K51.218	Ulcerative (chronic) proctitis
K51.30-K51.318	Ulcerative (chronic) rectosigmoiditis
K51.40-K51.418	Inflammatory polyps of colon
K51.50-K51.518	Left-sided colitis
K51.80-K51.818	Other ulcerative colitis
K51.90-K51.918	Ulcerative colitis, unspecified
K52.0	Gastroenteritis and colitis due to radiation
K70.0 – K70.41	Alcoholic liver disease
K71.0-K71.8	Toxic liver disease
K72.00-K72.91	Hepatic failure
K73.0-K73.8	Chronic hepatitis
K74.00-K74.69	Fibrosis and cirrhosis of liver
K75.3-K75.89	Other inflammatory liver disease
K76.0-K76.89	Other diseases of liver
K77	Liver disorders in diseases classified elsewhere
K83.1 – K83.8	Other diseases of biliary tract
K86.0-K86.89	Other diseases of pancreas
K90.0 – K90.3	Intestinal malabsorption
K90.41-K90.49	Malabsorption due to intolerance

Code	Descriptor
K90.821-K90.89	Other intestinal malabsorption
K91.2	Postsurgical malabsorption
M80.00 – M81.8	Osteoporosis, with current pathological fracture
M83.0 – M83.9	Adult osteomalacia
M85.80 – M85.9	Other specified disorders of bone density and structure
N18.30 – N18.9	Chronic kidney disease
N20.0 – N20.8	Calculus of kidney and ureter
N22	Calculus of urinary tract in diseases classified elsewhere
N25.0	Renal osteodystrophy
N25.81	Secondary hyperparathyroidism of renal origin
P71.0 – P71.1	Transitory neonatal disorders of calcium and magnesium metabolism
P71.3-P71.8	Transitory neonatal disorders of calcium and magnesium metabolism
Q78.0	Osteogenesis imperfecta
Q78.2	Osteopetrosis
Z79.52	Long term (current) use of systemic steroids
Z79.899	Other long term (current) drug therapy

Related Information

Benefit Application

Consistent with federal mandates, vitamin D supplements are covered as preventive care for individuals age 65 and older (without cost sharing) when the member's contract is subject to those mandates. A written prescription is needed for coverage.

The USPSTF recommends exercise or physical therapy and vitamin D supplementation to prevent falls in community-dwelling adults aged 65 years or older who are at increased risk for falls. (Grade B recommendation)

Note: The USPSTF does not recommend routine testing of vitamin D levels as a preventive strategy (see **Practice Guidelines and Position Statements**).

Evidence Review

Description

Vitamin D, also known as calciferol, is a fat-soluble vitamin that has a variety of physiologic effects, most prominently in calcium homeostasis and bone metabolism. In addition to the role it plays in bone metabolism, other physiologic effects include inhibition of smooth muscle proliferation, regulation of the renin-angiotensin system, a decrease in coagulation, and a decrease in inflammatory markers.[1]

Background

Vitamin D

Vitamin D deficiency is best assessed by measuring serum levels of 25-hydroxyvitamin D. However, there is no consensus on the minimum vitamin D level or on the optimal serum level for overall health. A 2011 Institute of Medicine (IOM) report concluded that a serum level of 20 ng/mL is sufficient for most healthy adults.[2] Some experts, such as the Bone Health and Osteoporosis Foundation (formerly the National Osteoporosis Foundation) have recommend a higher level (30 ng/mL) in some individual populations.[3]

Vitamin D deficiency, as defined by suboptimal serum levels, is common in the US. In the National Health and Nutrition Examination Survey covering the period of 2011 to 2014, 5% of patients aged 1 year and older were at risk of vitamin D deficiency (25-hydroxyvitamin D levels <12 ng/mL) and 18.3% of patients were at risk of vitamin D inadequacy (25-hydroxyvitamin D levels 12 to 19.6 ng/mL).[4] Vitamin D deficiency occurs most commonly as a result of inadequate dietary intake coupled with inadequate sun exposure. Evidence from the National Nutrition Monitoring System and the National Health and Nutrition Examination Survey has indicated that the average vitamin D consumption is below recommended levels of intake. Yetley (2008) estimated that average daily intake for US adults ranged from 228 to 335 IU/d, depending on gender and ethnicity.[5] This level is below the average daily requirement, estimated by IOM (400

IU/d for healthy adults) and well below IOM's required daily allowance (estimated to be 600 IU for nonelderly adults and 800 IU for elderly adults).

Vitamin D deficiency may occur less commonly for other reasons. Kidney or liver disease can cause deficiency as a result of impaired conversion of inactive vitamin D to its active products. In rare situations, there is vitamin D resistance at the tissue level, which causes a functional vitamin D deficiency despite "adequate" serum levels.

The safe upper level for serum vitamin D is also not standardized. The IOM report concluded that there is potential harm associated with levels greater than 50 ng/mL and recommended that serum levels be maintained in the 20- to 40-ng/mL range.[2] However, conclusions on this point have differed. A 2011 Agency for Healthcare Research and Quality (AHRQ) systematic review on vitamin D and bone health concluded that "There is little evidence from existing trials that vitamin D above current reference intakes is harmful."[6] The Women's Health Initiative concluded that hypercalcemia and hypercalciuria in patients receiving calcium and vitamin D were not associated with adverse clinical events.[7] The Women's Health Initiative did find a small increase in kidney stones for women aged 50 to 79 years who received vitamin D and calcium.

Associations of vitamin D levels with various aspects of health have been noted over the last several decades,[8-12] and these findings have led to the question of whether supplementation improves health outcomes. For example, a relation between vitamin D levels and overall mortality has been reported in most observational studies examining this association. [13,14] Mortality is lowest at vitamin D levels in the 25- to 40-nmol/L range. At lower levels of serum vitamin D, mortality increases steeply, and overall mortality in the lowest quintile was more than three times that in the middle quintiles. Theodoratou et al (2014) identified 107 systematic reviews of observational studies examining the association between vitamin D levels and more than 100 different outcomes.[15]

Vitamin D Replacement

The Institute of Medicine (IOM) (now the National Academy of Medicine [NAM]) has recommended reference values for the intake of vitamin D and serum levels, based on available literature and expert consensus.[2] Recommended daily allowances are 600 IU/d for individuals between 1 and 70 years of age and 800 IU/d for individuals older than 70 years.

Estimates of vitamin D requirements are complicated by the many other factors that affect serum levels. Sun exposure is the most prominent of factors that affect serum levels, and this is because individuals can meet their vitamin D needs entirely through adequate sun exposure. Other factors such as age, skin pigmentation, obesity, physical activity, and nutritional status

also affect vitamin D levels and can result in variable dietary intake requirements to maintain adequate serum levels.

Excessive intake of vitamin D can be toxic. Toxic effects are usually due to hypercalcemia and may include confusion, weakness, polyuria, polydipsia, anorexia, and vomiting. In addition, high levels of vitamin D may promote calcium deposition and has the potential to exacerbate conditions such as calcium kidney stones and atherosclerotic vascular disease.

The IOM defined three parameters of nutritional needs for vitamin D, on the assumption of minimal sun exposure. These parameters were the estimated average requirement, defined as the minimum intake required to maintain adequate levels; the recommended daily allowance, defined as the optimal dose for replacement therapy; and the upper-level intake, defined as the maximum daily dose to avoid toxicity. These recommendations are summarized in **Table 1**.

Table 1. Institute of Medicine Recommendations for Vitamin D Dietary Intake[2]

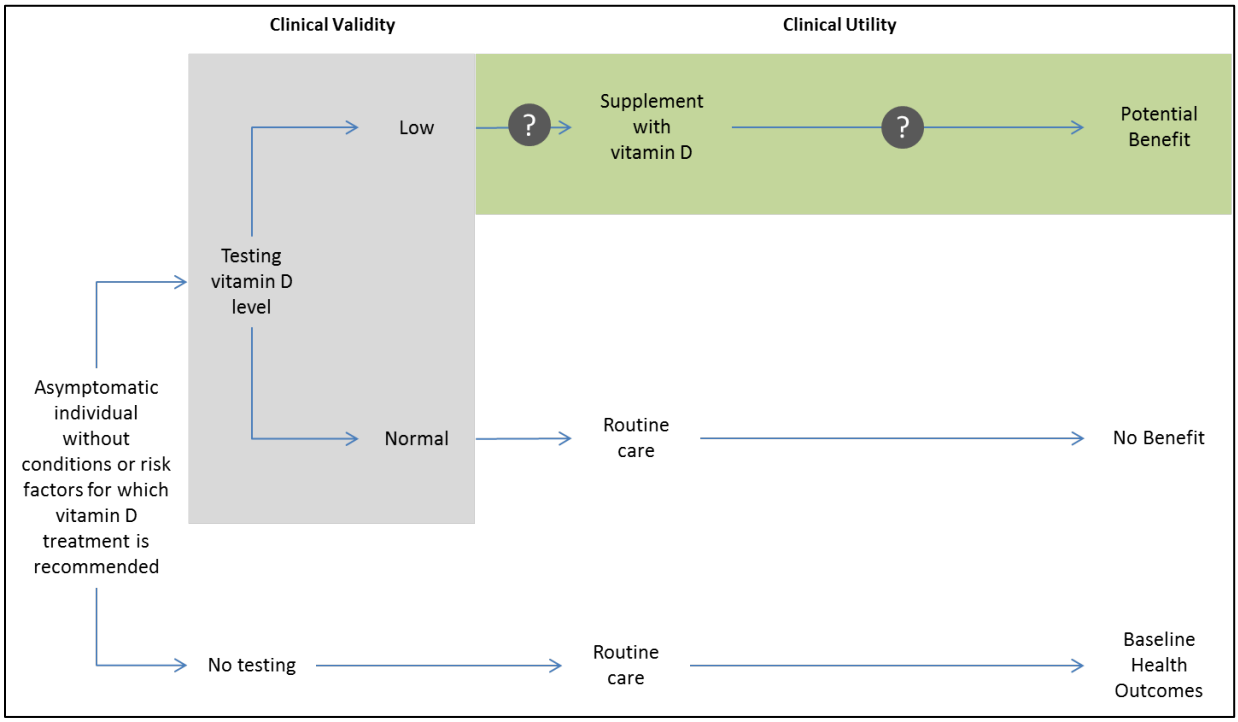
Patient Group	Estimated Average Requirement, IU/d	Recommended Daily Allowance, IU/d	Upper Limit Intake, IU/d
1 to 3 years old	400	600	2500
4 to 8 years old	400	600	3000
9 to 70 years old	400	600	4000
>70 years old	400	800	4000

Adapted from Institute of Medicine (2011)[2]

Analytic Framework

Figure 1 summarizes the approach to this policy. The diagram demonstrates the framework for how vitamin D testing affects outcomes. Using this framework, the main question is whether testing individuals for vitamin D deficiency improves outcomes.

Figure 1. Analytic Framework



Based on this analytic framework, the most relevant studies for showing the clinical utility of vitamin D testing are trials that directly compare care including testing vitamin D levels against care without testing vitamin D levels. Should vitamin D screening in an asymptomatic, general population be shown to be effective, guidelines would then be needed to establish criteria for screening, screening intervals, and appropriate follow-up for positive tests. Indirect evidence of the utility of vitamin D testing would include evidence of the effectiveness of supplementation from trials testing supplementation to no supplementation in individuals who are vitamin D deficient. Many of the existing randomized controlled trials (RCTs), including the largest trial (Women's Health Initiative), did not test vitamin D levels prior to treatment. Rather, they treated all individuals enrolled regardless of vitamin D levels. Results of some of the main systematic reviews that take this approach will be reviewed, but this evidence is indirect and must be extrapolated from the treatment of all individuals to treatment of individuals who are vitamin D deficient.

Summary of Evidence

For individuals who are asymptomatic without conditions or risk factors for which vitamin D treatment is recommended who receive testing of vitamin D levels, the evidence includes no

randomized controlled trials (RCTs) of clinical utility (i.e., evidence that patient care including testing vitamin D levels vs care without testing vitamin D levels improves outcomes). The relevant outcomes are overall survival, test validity, symptoms, morbid events, and treatment-related morbidity. Indirect evidence of the potential utility of testing includes many RCTs and systematic reviews of vitamin D supplementation. There is a lack of standardized vitamin D testing strategies and cutoffs for vitamin D deficiency are not standardized or evidence-based. In addition, despite the large quantity of evidence, considerable uncertainty remains about the beneficial health effects of vitamin D supplementation. Many RCTs have included participants who were not vitamin D deficient at baseline and did not stratify results by baseline 25-hydroxyvitamin D level. Nonwhite race/ethnic groups are underrepresented in RCTs but have an increased risk of vitamin D deficiency. For skeletal health, there may be a small effect of vitamin D supplementation on falls, but there does not appear to be an impact on reducing fractures for the general population. The effect on fracture reduction may be significant in elderly women, and with higher doses of vitamin D. However, high doses of vitamin D may be associated with safety concerns in individuals at risk for falls. For individuals with asthma, there may be a reduction in severe exacerbations with vitamin D supplementation, but there does not appear to be an effect on other asthma outcomes. For individuals who are pregnant, vitamin D supplementation may improve certain maternal and fetal outcomes. For overall mortality, there is also no benefit to the general population. RCTs evaluating extraskeletal, cancer, cardiovascular, and multiple sclerosis outcomes have not reported a statistically significant benefit for vitamin D supplementation. Although vitamin D toxicity and adverse events appear to be rare, few data on risks have been reported. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

Ongoing and Unpublished Clinical Trials

Some currently ongoing and unpublished trials that might influence this review are listed in **Table 2**.

Table 2. Summary of Key Trials

NCT No.	Trial Name	Planned Enrollment	Completion Date
Ongoing			
NCT05431920	Effects of Vitamin D3 Supplementation in Asthma Control, Pulmonary Function and Th17 Inflammatory Biomarkers in	264	Aug 2024

NCT No.	Trial Name	Planned Enrollment	Completion Date
	Adolescents With Asthma, Obesity and Vitamin D Deficiency: a Randomized Clinical Trial		
NCT05043116	High-dose Vitamin D Supplement for the Prevention of Acute Asthma-like Symptoms in Preschool Children - a Double-blind, Randomized, Controlled Trial	320	Oct 2031
NCT05329428	PREDIN: Pregnancy and Vitamin D Intervention Study - A Randomized Controlled Trial	102	Dec 2024
NCT05208827	A Multicenter Randomized Controlled Study of Vitamin D Supplementation in Pregnant Women for the Prevention of Gestational Diabetes.	1600	Jan 2025
NCT04291313	Vitamin D Deficiency in Pregnancy - Identifying Associations and Mechanisms Linking Maternal Vitamin D Deficiency to Placental Dysfunction and Adverse Pregnancy Outcomes	2000	May 2023
NCT00856947	Vitamin D Supplementation During Pregnancy for Prevention of Asthma in Childhood: An Interventional Trial in the ABC (Asthma Begins in Childhood) Cohort	600	Jul 2027
Unpublished			
NCT04117581	A Daily 5000 IU Vitamin D Supplement for the Improvement of Lung Function and Asthma Control in Adults With Asthma: a Randomised Controlled Trial	32 (actual)	Apr 2022

NCT: national clinical trial

Practice Guidelines and Position Statements

The purpose of the following information is to provide reference material. Inclusion does not imply endorsement or alignment with the policy conclusions.

Guidelines or position statements will be considered for inclusion if they were issued by, or jointly by, a US professional society, an international society with US representation, or the National Institute for Health and Care Excellence (NICE). Priority will be given to guidelines that are informed by a systematic review, include strength of evidence ratings, and include a description of management of conflict of interest.

American College of Obstetrics and Gynecology

The American College of Obstetrics and Gynecology (2011, reaffirmed 2024) issued a committee opinion on the testing of vitamin D levels and vitamin D supplementation in pregnant women.[124] The following recommendation was made concerning testing vitamin D levels:

> "At this time there is insufficient evidence to support a recommendation for screening all pregnant women for vitamin D deficiency. For pregnant women thought to be at increased risk of vitamin D deficiency, maternal serum 25-hydroxyvitamin D levels can be considered and should be interpreted in the context of the individual clinical circumstance. When vitamin D deficiency is identified during pregnancy, most experts agree that 1,000-2,000 international units per day of vitamin D is safe."

Bone Health and Osteoporosis Foundation

The Bone Health and Osteoporosis Foundation updated recommendations for the prevention and treatment of osteoporosis in 2021.[3] They recommended monitoring serum 25-hydroxy vitamin D levels in postmenopausal women and men 50 years of age and older, and vitamin D supplementation as necessary to maintain levels between 30 and 50 ng/mL.

Endocrine Society

In 2024, the Endocrine Society published clinical practice guidelines on Vitamin D for the prevention of disease.[125] The 2024 guideline updates and replaces a 2011 Endocrine Society guideline on the evaluation, treatment, and prevention of vitamin D deficiency. The 2024 guideline suggests against routine testing vitamin D levels in the following populations who do not otherwise have established indications for 25(OH)D testing (eg, hypocalcemia):

- General adult population younger than age 50 years, aged 50 to 74 years, and aged 75 years and older
- Pregnant individuals
- Healthy adults
- Adults with dark complexion
- Adults with obesity

For these populations, the guideline notes that: "25(OH)D levels that provide outcome-specific benefits have not been established in clinical trials."

US Preventive Services Task Force Recommendations

The US Preventive Services Task Force published an updated recommendation[126], and associated evidence report and systematic review in 2021[127] on vitamin D screening. The Task Force concluded that the current evidence was insufficient to assess the balance of benefits and harms of screening for vitamin D deficiency in asymptomatic individuals (grade I [insufficient evidence]).

Medicare National Coverage

There is no national coverage determination.

Regulatory Status

The US Food and Drug Administration (FDA) has cleared a number of immunoassays for in vitro diagnostic devices for the quantitative measurement of total 25-hydroxyvitamin D through the 510(k) process.

Clinical laboratories may develop and validate tests in-house and market them as a laboratory service; laboratory-developed tests must meet the general regulatory standards of the Clinical Laboratory Improvement Amendments (CLIA). Lab tests for vitamin D are available under the auspices of the CLIA. Laboratories that offer laboratory-developed tests must be licensed by the CLIA for high-complexity testing. To date, the FDA has chosen not to require any regulatory review of this test.

References

1. Shapses SA, Manson JE. Vitamin D and prevention of cardiovascular disease and diabetes: why the evidence falls short. JAMA. Jun 22 2011; 305(24): 2565-6. PMID 21693745

2. Committee to Review Dietary Reference Intakes for Vitamin D and Calcium, Food and Nutrition Board. Dietary Reference Intakes for Calcium and Vitamin D. Washington, DC: National Academies Press; 2011.

3. LeBoff MS, Greenspan SL, Insogna KL, et al. The clinician's guide to prevention and treatment of osteoporosis. Osteoporos Int. Oct 2022; 33(10): 2049-2102. PMID 35478046

4. Herrick KA, Storandt RJ, Afful J, et al. Vitamin D status in the United States, 2011-2014. Am J Clin Nutr. Jul 01 2019; 110(1): 150-157. PMID 31076739

5. Yetley EA. Assessing the vitamin D status of the US population. Am J Clin Nutr. Aug 2008; 88(2): 558S-564S. PMID 18689402

6. Cranney A, Horsley T, O'Donnell S, et al. Effectiveness and Safety of Vitamin D in Relation to Bone Health (Evidence Reports/Technology Assessments No. 158). Rockville, MD: Agency for Healthcare Research and Quality; 2011.

7. Jackson RD, LaCroix AZ, Gass M, et al. Calcium plus vitamin D supplementation and the risk of fractures. N Engl J Med. Feb 16 2006; 354(7): 669-83. PMID 16481635

8. Holvik K, Ahmed LA, Forsmo S, et al. Low serum levels of 25-hydroxyvitamin D predict hip fracture in the elderly: a NOREPOS study. J Clin Endocrinol Metab. Aug 2013; 98(8): 3341-50. PMID 23678033

9. Cauley JA, Lacroix AZ, Wu L, et al. Serum 25-hydroxyvitamin D concentrations and risk for hip fractures. Ann Intern Med. Aug 19 2008; 149(4): 242-50. PMID 18711154

10. Mithal A, Wahl DA, Bonjour JP, et al. Global vitamin D status and determinants of hypovitaminosis D. Osteoporos Int. Nov 2009; 20(11): 1807-20. PMID 19543765

11. Cauley JA, Parimi N, Ensrud KE, et al. Serum 25-hydroxyvitamin D and the risk of hip and nonspine fractures in older men. J Bone Miner Res. Mar 2010; 25(3): 545-53. PMID 19775201

12. Looker AC, Mussolino ME. Serum 25-hydroxyvitamin D and hip fracture risk in older U.S. white adults. J Bone Miner Res. Jan 2008; 23(1): 143-50. PMID 17907920

13. Jia X, Aucott LS, McNeill G. Nutritional status and subsequent all-cause mortality in men and women aged 75 years or over living in the community. Br J Nutr. Sep 2007; 98(3): 593-9. PMID 17442130

14. Visser M, Deeg DJ, Puts MT, et al. Low serum concentrations of 25-hydroxyvitamin D in older persons and the risk of nursing home admission. Am J Clin Nutr. Sep 2006; 84(3): 616-22; quiz 671-2. PMID 16960177

15. Theodoratou E, Tzoulaki I, Zgaga L, et al. Vitamin D and multiple health outcomes: umbrella review of systematic reviews and meta-analyses of observational studies and randomised trials. BMJ. Apr 01 2014; 348: g2035. PMID 24690624

16. DEQAS (Vitamin D External Quality Assurance Scheme). n.d.; **http://www.deqas.org/**. Accessed January 7, 2025.

17. LeBlanc ES, Zakher B, Daeges M, et al. Screening for vitamin D deficiency: a systematic review for the U.S. Preventive Services Task Force. Ann Intern Med. Jan 20 2015; 162(2): 109-22. PMID 25419719

18. Tan L, He R, Zheng X. Effect of vitamin D, calcium, or combined supplementation on fall prevention: a systematic review and updated network meta-analysis. BMC Geriatr. May 02 2024; 24(1): 390. PMID 38698349

19. Ling Y, Xu F, Xia X, et al. Vitamin D supplementation reduces the risk of fall in the vitamin D deficient elderly: An updated meta-analysis. Clin Nutr. 2021;40(11):5531-5537. doi:10.1016/j.clnu.2021.09.031

20. Avenell A, Gillespie WJ, Gillespie LD, et al. Vitamin D and vitamin D analogues for preventing fractures associated with involutional and post-menopausal osteoporosis. Cochrane Database Syst Rev. Apr 15 2009; (2): CD000227. PMID 19370554

21. Bischoff-Ferrari HA, Willett WC, Wong JB, et al. Prevention of nonvertebral fractures with oral vitamin D and dose dependency: a meta-analysis of randomized controlled trials. Arch Intern Med. Mar 23 2009; 169(6): 551-61. PMID 19307517

22. Palmer SC, McGregor DO, Craig JC, et al. Vitamin D compounds for people with chronic kidney disease requiring dialysis. Cochrane Database Syst Rev. Oct 07 2009; (4): CD005633. PMID 19821349

23. Bischoff-Ferrari HA, Willett WC, Wong JB, et al. Fracture prevention with vitamin D supplementation: a meta-analysis of randomized controlled trials. JAMA. May 11 2005; 293(18): 2257-64. PMID 15886381

24. Appel LJ, Michos ED, Mitchell CM, et al. The Effects of Four Doses of Vitamin D Supplements on Falls in Older Adults : A Response-Adaptive, Randomized Clinical Trial. Ann Intern Med. Feb 2021; 174(2): 145-156. PMID 33284677

25. Sanders KM, Stuart AL, Williamson EJ, et al. Annual high-dose oral vitamin D and falls and fractures in older women: a randomized controlled trial. JAMA. May 12 2010; 303(18): 1815-22. PMID 20460620

26. Elamin MB, Abu Elnour NO, Elamin KB, et al. Vitamin D and cardiovascular outcomes: a systematic review and meta-analysis. J Clin Endocrinol Metab. Jul 2011; 96(7): 1931-42. PMID 21677037

27. Pittas AG, Chung M, Trikalinos T, et al. Systematic review: Vitamin D and cardiometabolic outcomes. Ann Intern Med. Mar 02 2010; 152(5): 307-14. PMID 20194237

28. Chung M, Balk EM, Brendel M, et al. Vitamin D and calcium: a systematic review of health outcomes. Evid Rep Technol Assess (Full Rep). Aug 2009; (183): 1-420. PMID 20629479

29. Wang TJ, Pencina MJ, Booth SL, et al. Vitamin D deficiency and risk of cardiovascular disease. Circulation. Jan 29 2008; 117(4): 503-11. PMID 18180395

30. Su C, Jin B, Xia H, et al. Association between Vitamin D and Risk of Stroke: A PRISMA-Compliant Systematic Review and Meta-Analysis. Eur Neurol. 2021; 84(6): 399-408. PMID 34325429

31. Fu J, Sun J, Zhang C. Vitamin D supplementation and risk of stroke: A meta-analysis of randomized controlled trials. Front Neurol. 2022; 13: 970111. PMID 36062009

32. Bolland MJ, Avenell A, Baron JA, et al. Effect of calcium supplements on risk of myocardial infarction and cardiovascular events: meta-analysis. BMJ. Jul 29 2010; 341: c3691. PMID 20671013

33. Keum N, Lee DH, Greenwood DC, et al. Vitamin D supplementation and total cancer incidence and mortality: a meta-analysis of randomized controlled trials. Ann Oncol. May 01 2019; 30(5): 733-743. PMID 30796437

34. Bjelakovic G, Gluud LL, Nikolova D, et al. Vitamin D supplementation for prevention of cancer in adults. Cochrane Database Syst Rev. Jun 23 2014; 2014(6): CD007469. PMID 24953955

35. Ott SM, Chesnut CH. Calcitriol treatment is not effective in postmenopausal osteoporosis. Ann Intern Med. Feb 15 1989; 110(4): 267-74. PMID 2913914

36. Grady D, Halloran B, Cummings S, et al. 1,25-Dihydroxyvitamin D3 and muscle strength in the elderly: a randomized controlled trial. J Clin Endocrinol Metab. Nov 1991; 73(5): 1111-7. PMID 1939527

37. Komulainen M, Kröger H, Tuppurainen MT, et al. Prevention of femoral and lumbar bone loss with hormone replacement therapy and vitamin D3 in early postmenopausal women: a population-based 5-year randomized trial. J Clin Endocrinol Metab. Feb 1999; 84(2): 546-52. PMID 10022414

38. Gallagher JC, Fowler SE, Detter JR, et al. Combination treatment with estrogen and calcitriol in the prevention of age-related bone loss. J Clin Endocrinol Metab. Aug 2001; 86(8): 3618-28. PMID 11502787

39. Trivedi DP, Doll R, Khaw KT. Effect of four monthly oral vitamin D3 (cholecalciferol) supplementation on fractures and mortality in men and women living in the community: randomised double blind controlled trial. BMJ. Mar 01 2003; 326(7387): 469. PMID 12609940

40. Wactawski-Wende J, Kotchen JM, Anderson GL, et al. Calcium plus vitamin D supplementation and the risk of colorectal cancer. N Engl J Med. Feb 16 2006; 354(7): 684-96. PMID 16481636

41. Daly RM, Petrass N, Bass S, et al. The skeletal benefits of calcium- and vitamin D3-fortified milk are sustained in older men after withdrawal of supplementation: an 18-mo follow-up study. Am J Clin Nutr. Mar 2008; 87(3): 771-7. PMID 18326617

42. LaCroix AZ, Kotchen J, Anderson G, et al. Calcium plus vitamin D supplementation and mortality in postmenopausal women: the Women's Health Initiative calcium-vitamin D randomized controlled trial. J Gerontol A Biol Sci Med Sci. May 2009; 64(5): 559-67. PMID 19221190

43. Bolton-Smith C, McMurdo ME, Paterson CR, et al. Two-year randomized controlled trial of vitamin K1 (phylloquinone) and vitamin D3 plus calcium on the bone health of older women. J Bone Miner Res. Apr 2007; 22(4): 509-19. PMID 17243866

44. Lappe JM, Travers-Gustafson D, Davies KM, et al. Vitamin D and calcium supplementation reduces cancer risk: results of a randomized trial. Am J Clin Nutr. Jun 2007; 85(6): 1586-91. PMID 17556697

45. Prince RL, Austin N, Devine A, et al. Effects of ergocalciferol added to calcium on the risk of falls in elderly high-risk women. Arch Intern Med. Jan 14 2008; 168(1): 103-8. PMID 18195202

46. Janssen HC, Samson MM, Verhaar HJ. Muscle strength and mobility in vitamin D-insufficient female geriatric patients: a randomized controlled trial on vitamin D and calcium supplementation. Aging Clin Exp Res. Feb 2010; 22(1): 78-84. PMID 20305368

47. Brunner RL, Wactawski-Wende J, Caan BJ, et al. The effect of calcium plus vitamin D on risk for invasive cancer: results of the Women's Health Initiative (WHI) calcium plus vitamin D randomized clinical trial. Nutr Cancer. 2011; 63(6): 827-41. PMID 21774589

48. Avenell A, MacLennan GS, Jenkinson DJ, et al. Long-term follow-up for mortality and cancer in a randomized placebo-controlled trial of vitamin D(3) and/or calcium (RECORD trial). J Clin Endocrinol Metab. Feb 2012; 97(2): 614-22. PMID 22112804

49. Glendenning P, Zhu K, Inderjeeth C, et al. Effects of three-monthly oral 150,000 IU cholecalciferol supplementation on falls, mobility, and muscle strength in older postmenopausal women: a randomized controlled trial. J Bone Miner Res. Jan 2012; 27(1): 170-6. PMID 21956713

50. Larsen T, Mose FH, Bech JN, et al. Effect of cholecalciferol supplementation during winter months in patients with hypertension: a randomized, placebo-controlled trial. Am J Hypertens. Nov 2012; 25(11): 1215-22. PMID 22854639

51. Murdoch DR, Slow S, Chambers ST, et al. Effect of vitamin D3 supplementation on upper respiratory tract infections in healthy adults: the VIDARIS randomized controlled trial. JAMA. Oct 03 2012; 308(13): 1333-9. PMID 23032549

52. Wood AD, Secombes KR, Thies F, et al. Vitamin D3 supplementation has no effect on conventional cardiovascular risk factors: a parallel-group, double-blind, placebo-controlled RCT. J Clin Endocrinol Metab. Oct 2012; 97(10): 3557-68. PMID 22865902

53. Witham MD, Price RJ, Struthers AD, et al. Cholecalciferol treatment to reduce blood pressure in older patients with isolated systolic hypertension: the VitDISH randomized controlled trial. JAMA Intern Med. Oct 14 2013; 173(18): 1672-9. PMID 23939263

54. Baron JA, Barry EL, Mott LA, et al. A Trial of Calcium and Vitamin D for the Prevention of Colorectal Adenomas. N Engl J Med. Oct 15 2015; 373(16): 1519-30. PMID 26465985

55. Jorde R, Sollid ST, Svartberg J, et al. Vitamin D 20,000 IU per Week for Five Years Does Not Prevent Progression From Prediabetes to Diabetes. J Clin Endocrinol Metab. Apr 2016; 101(4): 1647-55. PMID 26829443

56. Lappe J, Watson P, Travers-Gustafson D, et al. Effect of Vitamin D and Calcium Supplementation on Cancer Incidence in Older Women: A Randomized Clinical Trial. JAMA. Mar 28 2017; 317(12): 1234-1243. PMID 28350929

57. Scragg R, Khaw KT, Toop L, et al. Monthly High-Dose Vitamin D Supplementation and Cancer Risk: A Post Hoc Analysis of the Vitamin D Assessment Randomized Clinical Trial. JAMA Oncol. Nov 01 2018; 4(11): e182178. PMID 30027269

58. Manson JE, Cook NR, Lee IM, et al. Vitamin D Supplements and Prevention of Cancer and Cardiovascular Disease. N Engl J Med. Jan 03 2019; 380(1): 33-44. PMID 30415629

59. Liu M, Wang J, Sun X. A Meta-Analysis on Vitamin D Supplementation and Asthma Treatment. Front Nutr. 2022; 9: 860628. PMID 35873428

60. Jolliffe DA, Greenberg L, Hooper RL, et al. Vitamin D supplementation to prevent asthma exacerbations: a systematic review and meta-analysis of individual participant data. Lancet Respir Med. Nov 2017; 5(11): 881-890. PMID 28986128

61. Williamson A, Martineau AR, Sheikh A, et al. Vitamin D for the management of asthma. Cochrane Database Syst Rev. Feb 06 2023; 2(2): CD011511. PMID 36744416

62. Martineau AR, Cates CJ, Urashima M, et al. Vitamin D for the management of asthma. Cochrane Database Syst Rev. Sep 05 2016; 9(9): CD011511. PMID 27595415

63. Luo J, Liu D, Liu CT. Can Vitamin D Supplementation in Addition to Asthma Controllers Improve Clinical Outcomes in Patients With Asthma?: A Meta-Analysis. Medicine (Baltimore). Dec 2015; 94(50): e2185. PMID 26683927

64. Ramos-Martínez E, López-Vancell MR, Fernández de Córdova-Aguirre JC, et al. Reduction of respiratory infections in asthma patients supplemented with vitamin D is related to increased serum IL-10 and IFNγ levels and cathelicidin expression. Cytokine. Aug 2018; 108: 239-246. PMID 29402723

65. Jiang C, Yi R, Na H, Lin S. A randomized controlled study of Vitamin D3 supplementation on childhood asthma control. Chongqing Medicine. 2017;46(32):4505-7.

66. Jerzynska J, Stelmach W, Rychlik B, et al. The clinical effect of vitamin D supplementation combined with grass-specific sublingual immunotherapy in children with allergic rhinitis. Allergy Asthma Proc. 2016; 37(2): 105-14. PMID 26932169

67. Forno E, Bacharier LB, Phipatanakul W, et al. Effect of Vitamin D3 Supplementation on Severe Asthma Exacerbations in Children With Asthma and Low Vitamin D Levels: The VDKA Randomized Clinical Trial. JAMA. Aug 25 2020; 324(8): 752-760. PMID 32840597

68. Ducharme FM, Jensen M, Mailhot G, et al. Impact of two oral doses of 100,000 IU of vitamin D 3 in preschoolers with viral-induced asthma: a pilot randomised controlled trial. Trials. Feb 18 2019; 20(1): 138. PMID 30777118

69. Camargo CA, Toop L, Sluyter J, et al. Effect of Monthly Vitamin D Supplementation on Preventing Exacerbations of Asthma or Chronic Obstructive Pulmonary Disease in Older Adults: Post Hoc Analysis of a Randomized Controlled Trial. Nutrients. Feb 06 2021; 13(2). PMID 33561963

70. Andújar-Espinosa R, Salinero-González L, Illán-Gómez F, et al. Effect of vitamin D supplementation on asthma control in patients with vitamin D deficiency: the ACVID randomised clinical trial. Thorax. Feb 2021; 76(2): 126-133. PMID 33154023

71. Aglipay M, Birken C, Dai D, et al. High Dose Vitamin D for the Prevention of Wheezing in Preschoolers: A Secondary Analysis of a Randomized Clinical Trial. J Paediatr Child Health. 2019;24(S2):e27-e28.

72. Worth H, Stammen D, Keck E. Therapy of steroid-induced bone loss in adult asthmatics with calcium, vitamin D, and a diphosphonate. Am J Respir Crit Care Med. Aug 1994; 150(2): 394-7. PMID 8049820

73. Majak P, Rychlik B, Stelmach I. The effect of oral steroids with and without vitamin D3 on early efficacy of immunotherapy in asthmatic children. Clin Exp Allergy. Dec 2009; 39(12): 1830-41. PMID 19817753

74. Urashima M, Segawa T, Okazaki M, et al. Randomized trial of vitamin D supplementation to prevent seasonal influenza A in schoolchildren. Am J Clin Nutr. May 2010; 91(5): 1255-60. PMID 20219962

75. Majak P, Olszowiec-Chlebna M, Smejda K, et al. Vitamin D supplementation in children may prevent asthma exacerbation triggered by acute respiratory infection. J Allergy Clin Immunol. May 2011; 127(5): 1294-6. PMID 21315433

76. Lewis E, Fernandez C, Nella A, et al. Relationship of 25-hydroxyvitamin D and asthma control in children. Ann Allergy Asthma Immunol. Apr 2012; 108(4): 281-2. PMID 22469451

77. Baris S, Kiykim A, Ozen A, et al. Vitamin D as an adjunct to subcutaneous allergen immunotherapy in asthmatic children sensitized to house dust mite. Allergy. Feb 2014; 69(2): 246-53. PMID 24180595

78. Castro M, King TS, Kunselman SJ, et al. Effect of vitamin D3 on asthma treatment failures in adults with symptomatic asthma and lower vitamin D levels: the VIDA randomized clinical trial. JAMA. May 2014; 311(20): 2083-91. PMID 24838406

79. Yadav M, Mittal K. Effect of vitamin D supplementation on moderate to severe bronchial asthma. Indian J Pediatr. Jul 2014; 81(7): 650-4. PMID 24193954

80. de Groot JC, van Roon EN, Storm H, et al. Vitamin D reduces eosinophilic airway inflammation in nonatopic asthma. J Allergy Clin Immunol. Mar 2015; 135(3): 670-5.e3. PMID 25617224

81. Martineau AR, MacLaughlin BD, Hooper RL, et al. Double-blind randomised placebo-controlled trial of bolus-dose vitamin D3 supplementation in adults with asthma (ViDiAs). Thorax. May 2015; 70(5): 451-7. PMID 25724847

82. Tachimoto H, Mezawa H, Segawa T, et al. Improved control of childhood asthma with low-dose, short-term vitamin D supplementation: a randomized, double-blind, placebo-controlled trial. Allergy. Jul 2016; 71(7): 1001-9. PMID 26841365

83. Jensen ME, Mailhot G, Alos N, et al. Vitamin D intervention in preschoolers with viral-induced asthma (DIVA): a pilot randomised controlled trial. Trials. Jul 26 2016; 17(1): 353. PMID 27456232

84. Kerley CP, Hutchinson K, Cormican L, et al. Vitamin D3 for uncontrolled childhood asthma: A pilot study. Pediatr Allergy Immunol. Jun 2016; 27(4): 404-12. PMID 26845753

85. Musharraf MU, Sandhu GA, Mumtaz MU, Rashid MF. Role of vitamin D in prevention of acute exacerbation of bronchial asthma in adults. J Postgrad Med Inst. 2017;31:3103. doi: 10.1002/rmv.1909

86. Dodamani MH, Muthu V, Thakur R, et al. A randomised trial of vitamin D in acute-stage allergic bronchopulmonary aspergillosis complicating asthma. Mycoses. Apr 2019; 62(4): 320-327. PMID 30561849

87. Shabana MA, Esawy MM, Ismail NA, et al. Predictive role of IL-17A/IL-10 ratio in persistent asthmatic patients on vitamin D supplement. Immunobiology. Nov 2019; 224(6): 721-727. PMID 31570180

88. Jat KR, Goel N, Gupta N, et al. Efficacy of vitamin D supplementation in asthmatic children with vitamin D deficiency: A randomized controlled trial (ESDAC trial). Pediatr Allergy Immunol. Apr 2021; 32(3): 479-488. PMID 33207014

89. Thakur C, Kumar J, Kumar P, et al. Vitamin-D supplementation as an adjunct to standard treatment of asthma in children: A randomized controlled trial (ViDASTA Trial). Pediatr Pulmonol. Jun 2021; 56(6): 1427-1433. PMID 33522698

90. Litonjua AA, Carey VJ, Laranjo N, et al. Effect of Prenatal Supplementation With Vitamin D on Asthma or Recurrent Wheezing in Offspring by Age 3 Years: The VDAART Randomized Clinical Trial. JAMA. Jan 26 2016; 315(4): 362-70. PMID 26813209

91. Palacios C, Kostiuk LK, Peña-Rosas JP. Vitamin D supplementation for women during pregnancy. Cochrane Database Syst Rev. Jul 26 2019; 7(7): CD008873. PMID 31348529

92. Palacios C, Kostiuk LL, Cuthbert A, et al. Vitamin D supplementation for women during pregnancy. Cochrane Database Syst Rev. Jul 30 2024; 7(7): CD008873. PMID 39077939

93. Brooke OG, Brown IR, Bone CD, et al. Vitamin D supplements in pregnant Asian women: effects on calcium status and fetal growth. British Medical Journal 1980;1:751-754.

94. Delvin EE, Salle BL, Glorieux FH, et al. Vitamin D supplementation during pregnancy: effect on neonatal calcium homeostasis. J Pediatr. Aug 1986; 109(2): 328-34. PMID 3488384

95. Mallet E, Gügi B, Brunelle P, et al. Vitamin D supplementation in pregnancy: a controlled trial of two methods. Obstet Gynecol. Sep 1986; 68(3): 300-4. PMID 3755517

96. Marya RK, Rathee S, Dua V, et al. Effect of vitamin D supplementation during pregnancy on foetal growth. Indian J Med Res. Dec 1988; 88: 488-92. PMID 3243609

97. Kaur J, Marya RK, Rathee S, lal H, Singh GP. Effect of pharmacological doses of vitamin D during pregnancy on placental protein status and birth weight. Nutrition Research. 1991;11(9):1077-1081.

98. Yu C, Newton L, Robinson S, Teoh TG, Sethi M. Vitamin D deficiency and supplementation in pregnant women of four ethnic groups. Archives of Disease in Childhood. Fetal and Neonatal Edition. 2008;93(Suppl 1):Fa68.

99. Roth DE, Al Mahmud A, Raqib R, et al. Randomized placebo-controlled trial of high-dose prenatal third-trimester vitamin D3 supplementation in Bangladesh: the AViDD trial. Nutr J. Apr 12 2013; 12: 47. PMID 23587190

100. Sabet Z, Ghazi AA, Tohidi M, Oladi B. Vitamin D supplementation in pregnant Iranian women: Effects on maternal and neonatal vitamin D and parathyroid hormone status. Acta Endocrinologica. 2012;8(1):59-66.

101. Asemi Z, Samimi M, Tabassi Z, et al. Vitamin D supplementation affects serum high-sensitivity C-reactive protein, insulin resistance, and biomarkers of oxidative stress in pregnant women. J Nutr. Sep 2013; 143(9): 1432-8. PMID 23884390

102. Grant CC, Stewart AW, Scragg R, et al. Vitamin D during pregnancy and infancy and infant serum 25-hydroxyvitamin D concentration. Pediatrics. Jan 2014; 133(1): e143-53. PMID 24344104

103. Tehrani HG, Mostajeran F, Banihashemi B. Effect of Vitamin D Supplementation on the Incidence of Gestational Diabetes. Adv Biomed Res. 2017; 6: 79. PMID 28808645

104. Mirghafourvand M, Mohammad-Alizadeh-Charandabi S, Mansouri A, Najafi M, Khodabande F. The effect of vitamin D and calcium plus vitamin D on sleep quality in pregnant women with leg cramps: A controlled randomized clinical trial. Journal of Isfahan Medical School. 2015;32(320):2444-2453.

105. Rodda CP, Benson JE, Vincent AJ, et al. Maternal vitamin D supplementation during pregnancy prevents vitamin D deficiency in the newborn: an open-label randomized controlled trial. Clin Endocrinol (Oxf). Sep 2015; 83(3): 363-8. PMID 25727810

106. Sablok A, Batra A, Thariani K, et al. Supplementation of vitamin D in pregnancy and its correlation with feto-maternal outcome. Clin Endocrinol (Oxf). Oct 2015; 83(4): 536-41. PMID 25683660

107. Singh J, Hariharan C, Bhaumik D. Role of vitamin D in reducing the risk of preterm labour. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. 2015;1:86-93.

108. Khan F. A randomized controlled trial of oral vitamin D supplementation in pregnancy to improve maternal periodontal health and birth weight. Journal of International Oral Health 2016;8(6):657-65.

109. Cooper C, Harvey NC, Bishop NJ, et al. Maternal gestational vitamin D supplementation and offspring bone health (MAVIDOS): a multicentre, double-blind, randomised placebo-controlled trial. Lancet Diabetes Endocrinol. May 2016; 4(5): 393-402. PMID 26944421

110. Naghshineh E, Sheikhaliyan S. Effect of vitamin D supplementation in the reduce risk of preeclampsia in nulliparous women. Adv Biomed Res. 2016; 5: 7. PMID 26962509

111. Shahgheibi S, Farhadifar F, Pouya B. The effect of vitamin D supplementation on gestational diabetes in high-risk women: Results from a randomized placebo-controlled trial. J Res Med Sci. 2016; 21: 2. PMID 27904548

112. Vaziri F, Dabbaghmanesh MH, Samsami A, et al. Vitamin D supplementation during pregnancy on infant anthropometric measurements and bone mass of mother-infant pairs: A randomized placebo clinical trial. Early Hum Dev. Dec 2016; 103: 61-68. PMID 27513714

113. Behjat Sasan S, Zandvakili F, Soufizadeh N, et al. The Effects of Vitamin D Supplement on Prevention of Recurrence of Preeclampsia in Pregnant Women with a History of Preeclampsia. Obstet Gynecol Int. 2017; 2017: 8249264. PMID 28912817

114. Samimi M, Kashi M, Foroozanfard F, et al. The effects of vitamin D plus calcium supplementation on metabolic profiles, biomarkers of inflammation, oxidative stress and pregnancy outcomes in pregnant women at risk for pre-eclampsia. J Hum Nutr Diet. Aug 2016; 29(4): 505-15. PMID 26467311

115. Vafaei H, Asadi N, Kasraeian M, et al. Positive effect of low dose vitamin D supplementation on growth of fetal bones: A randomized prospective study. Bone. May 2019; 122: 136-142. PMID 30798000

116. Pozuelo-Moyano B, Benito-León J, Mitchell AJ, et al. A systematic review of randomized, double-blind, placebo-controlled trials examining the clinical efficacy of vitamin D in multiple sclerosis. Neuroepidemiology. 2013; 40(3): 147-53. PMID 23257784

117. James E, Dobson R, Kuhle J, et al. The effect of vitamin D-related interventions on multiple sclerosis relapses: a meta-analysis. Mult Scler. Oct 2013; 19(12): 1571-9. PMID 23698130

118. Jagannath VA, Fedorowicz Z, Asokan GV, et al. Vitamin D for the management of multiple sclerosis. Cochrane Database Syst Rev. Dec 08 2010; (12): CD008422. PMID 21154396

119. LeBlanc ES, Chou R, Pappas M. Screening for vitamin D deficiency. Ann Intern Med. May 19 2015; 162(10): 738. PMID 25984861

120. Newberry SJ, Chung M, Shekelle PG, et al. Vitamin D and Calcium: A Systematic Review of Health Outcomes (Update). Evidence Report/Technology Assessment No. 217. Rockville, MD: Agency for Healthcare Research and Quality; 2014.

121. Chowdhury R, Kunutsor S, Vitezova A, et al. Vitamin D and risk of cause specific death: systematic review and meta-analysis of observational cohort and randomised intervention studies. BMJ. Apr 01 2014; 348: g1903. PMID 24690623

122. Bjelakovic G, Gluud LL, Nikolova D, et al. Vitamin D supplementation for prevention of mortality in adults. Cochrane Database Syst Rev. Jan 10 2014; 2014(1): CD007470. PMID 24414552

123. Palmer SC, McGregor DO, Craig JC, et al. Vitamin D compounds for people with chronic kidney disease not requiring dialysis. Cochrane Database Syst Rev. Oct 07 2009; (4): CD008175. PMID 19821446

124. ACOG Committee Opinion No. 495: Vitamin D: Screening and supplementation during pregnancy. Obstet Gynecol. Jul 2011; 118(1): 197-198. PMID 21691184

125. Demay MB, Pittas AG, Bikle DD, et al. Vitamin D for the Prevention of Disease: An Endocrine Society Clinical Practice Guideline. J Clin Endocrinol Metab. Jul 12 2024; 109(8): 1907-1947. PMID 38828931

126. Krist AH, Davidson KW, Mangione CM, et al. Screening for Vitamin D Deficiency in Adults: US Preventive Services Task Force Recommendation Statement. JAMA. Apr 13 2021; 325(14): 1436-1442. PMID 33847711

127. Kahwati LC, LeBlanc E, Weber RP, et al. Screening for Vitamin D Deficiency in Adults: Updated Evidence Report and Systematic Review for the US Preventive Services Task Force. JAMA. Apr 13 2021; 325(14): 1443-1463. PMID 33847712

128. Holick MF, Binkley NC, Bischoff-Ferrari HA, et al. Evaluation, treatment, and prevention of vitamin D deficiency: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab. Jul 2011; 96(7): 1911-30. PMID 21646368

129. Noridian Healthcare Solutions. Local Coverage Determination (LCD): Vitamin D Assay Testing (L36692). 2017; **https://med.noridianmedicare.com/documents/10546/6990981/Vitamin+D+Assay+Testing+LCD**. Resource archived.

History

Date	Comments
6/12/12	New policy, add to Pathology/Laboratory section. Approved with 90-day hold for provider notification; the effective date is November 12, 2012. Policy not applicable to Oregon at this time.
02/11/13	Policy became effective in Oregon.
06/10/13	Replace policy. Indications put in alphabetical order. Literature review through April 2013 resulted in addition of practice guidelines from the National Osteoporosis Foundation and USPSTF. Reference 6-7 added, others renumbered. Policy statement unchanged. Benefit Application updated with recommendations from the USPSTF and language supporting federal preventative care mandates on coverage of vitamin D supplementation for those aged 65 years and older. A single policy will now be maintained; the Oregon version will no longer be maintained, as it was the same policy with only a different effective date (2/11/13) following approval 6/12/12 and a hold for provider notification.
06/13/14	Annual Review. No change in policy statements.
08/13/14	Coding update: duplicate codes removed from ICD-9 diagnosis section; codes incorrectly listed corrected; 27549 and 275.40 added.
02/25/15	Annual Review. Policy updated with a literature review through January, 2015. References 9-12 added; others renumbered. Policy statements unchanged.
04/13/15	Coding update. ICD-9 diagnosis code descriptors updated.
07/14/15	Interim Review. Added rationale and reference 3 and renumbered others. Updated diagnosis codes, removing several and adding ICD-10 diagnosis codes.
01/12/16	Delete policy, replaced with 2.04.135 (BC version).
02/04/16	Coding update. Added ICD10 diagnosis code E74.21.

Date	Comments
02/19/16	Coding update. Minor clarifications to osteomalacia code range and correction to code K70.0.
08/01/16	Interim Update, approved July 12, 2016. Policy published in new template with introduction added. Clarified institutional information. Intent remains the same.
03/01/17	Annual review, approved February 14, 2017. Policy updated literature review through October 10, 2016; references 14-16, 29, 31-36, 43, and 45 added. Policy statements unchanged.
08/15/17	Minor formatting updates.
03/01/18	Annual Review, approved February 6, 2018. Policy updated with literature review through October 2017; references 32-34 and 36-48 added; notes 15 and 62 updated. Policy statements unchanged.
10/01/18	Coding update. Updated diagnosis code range for "other diseases of biliary tract" from K83.0 – 8.39 to K83.1 – K83.9.
12/01/18	Interim Review, approved November 6, 2018. Clarified policy statements regarding repeat testing. Added diagnosis code range L92.0 – L92.9.
02/01/19	Annual Review, approved January 22, 2019. Policy updated, literature review through October 2018; reference 58 added; reference 57, 59, and 61 updated. Policy statements unchanged. Coding update, added diagnosis ranges A15.0, B38.0-B38.9, B39.0-B39.9, E84.0-E84.9, E85.0-E85.9, J63.2, K50.00-K50.919, K51.00-K51.919, K52.0, K86.0-K86.9, and Z98.84. Added code 0038U.
03/01/20	Annual Review, approved February 4, 2020. Policy updated literature review through October 2019; references on Guidelines updated. Policy statements unchanged.
03/01/21	Annual Review, approved February 2, 2021. Policy updated literature review through October 14, 2019; references on Guidelines updated. Policy statements unchanged.
03/01/22	Annual Review, approved February 7, 2022. Policy updated with literature review through October 20, 2021; references added. Policy statements unchanged.
03/01/23	Policy renumbered, approved February 14, 2023 from 2.04.135 to 2.04.507 Testing Serum Vitamin D Levels. Policy statements unchanged. Policy updated with literature review through October 24, 2022; references added. Changed the wording from "patient" to "individual" throughout the policy for standardization.
05/01/23	Coding update. Added ICD-10-CM codes A28.1, B20, B41.0, B41.7, B41.9, B59, E05.00-E05.91, M88.0, M88.1, M88.811, M88.812, M88.821, M88.822, M88.831, M88.832, M88.841, M88.842, M88.851, M88.852, M88.861, M88.862, M88.871, M88.88, M88.89, M88.9, Z79.51, Z94.0-Z94.9, Z98.0 to coding table.
03/01/24	Annual Review, approved February 12, 2024. Policy updated with literature review through October 16, 2023; references added. Policy statements unchanged.
03/01/25	Annual Review, approved February 24, 2025. Policy updated with literature review through October 15, 2024; references added. Policy statements unchanged. Some

Date	Comments
	content reformatted for greater visibility, policy intent unchanged. Added ICD-10 CM codes A15.4-A15.8, A17.0-A17.89, A18.01-A18.09, A18.11-A18.2, A18.31-A18.39, A18.4, A18.51-A18.7, A18.81-A18.89, A19.0-A19.8, E64.3, E67.8, E68, I12.0, I12.9, I13.0, I13.10-I13.11, I13.2, N25.0. Removed ICD-10 CM codes B38.9, B39.9, B41.9, D86.9, E84.9, E85.9, K50.019, K550.119, K50.819, K51.019, K51.218, K51.318, K51.418, K51.519, K51.819, K51.919, K70.9, K71.9, K73.9, K75.0-K75.2, K75.9, K76.9, K83.9, K86.9, K90.9, L92.0-L92.9, M88.0-M88.9, N18.1-N18.2, N20.9, P71.2, P71.9, Z79.51, Z94.0-Z94.9, Z98.0, Z98.84.

Scope: Medical policies are systematically developed guidelines that serve as a resource for Company staff when determining coverage for specific medical procedures, drugs or devices. Coverage for medical services is subject to the limits and conditions of the member benefit plan. Members and their providers should consult the member benefit booklet or contact a customer service representative to determine whether there are any benefit limitations applicable to this service or supply. This medical policy does not apply to Medicare Advantage.