

Prevention, Investigation and Treatment of Vitamin D Deficiency and Insufficiency in Adults

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1. Background

Role of vitamin D

Vitamin D is a fat-soluble vitamin that is essential for musculoskeletal health as it promotes calcium absorption from the bowel, enables mineralisation of newly formed osteoid tissue in bone and plays an important role in muscle function. The main manifestation of vitamin D deficiency is osteomalacia in adults and rickets in children. Less severe vitamin D deficiency, sometimes termed vitamin D insufficiency, may lead to secondary hyperparathyroidism, bone loss, muscle weakness, falls and fragility fractures in older people.¹

2. Prevention

2.1 Sources of vitamin D

Dietary sources of vitamin D are limited and only 10-20-% of vitamin D is derived from dietary sources, with oily fish being the only significant source. Small amounts are provided by egg yolk, red meat, and fortified foods. The major natural source (80-90%) is from skin synthesis following exposure to sunlight¹. However, in the UK from October to the beginning of April there is no ambient ultraviolet sunlight of the appropriate wavelength for skin synthesis of vitamin D. During this time, the population relies on both body stores from sun exposure in the summer, dietary sources or supplementation to maintain vitamin D status.³

2.2 National self-care recommendations to avoid vitamin D deficiency

UK recommendations are that everyone (including pregnant and breastfeeding women) should consider taking a daily supplement containing 400units/10 micrograms of vitamin D during the autumn and winter.⁴ Between late March/early April to the end of September, most people can make all the vitamin D they need through sunlight on their skin and from a balanced diet.

2.3 People at risk of vitamin D deficiency⁴

Some people will not make enough vitamin D from sunlight because they have very little or no sunshine exposure. The Department of Health and Social Care recommends that adults and children over 4 take a daily supplement containing 10 micrograms of vitamin D throughout the year if they:

- are not often outdoors – for example, if they're frail or housebound
- live in an institution like a care home
- usually wear clothes that cover up most of their skin when outdoors
- have dark skin – for example have an African, African-Caribbean or south Asian background because people with dark skin may not make enough vitamin D from sunlight.

Supplements containing vitamin D are readily available to purchase. 10 micrograms may be referred to as 400units (International Units).

The majority of people should be advised to purchase colecalciferol for the prevention of Vitamin D deficiency, see [here](#) for supporting information.

Prescribers who think that a person cannot treat themselves, for example people with learning disabilities, severe social vulnerability, or mental health problems can be prescribed preventative vitamin D.

3. Identification of vitamin D deficiency in adults

Thresholds for identification of deficiency

Serum 25-hydroxyvitamin D	
<25 nmol/l	Deficiency
25-50 nmol/l	Insufficiency
>50 nmol/l	Normal range (replete)

Do not routinely test for vitamin D deficiency in people who are asymptomatic. ^{1,2}

Check the vitamin D level by measuring serum 25-hydroxyvitamin D (25[OH]D) if a person has³:

- Musculoskeletal symptoms that may be attributable to vitamin D deficiency, such as:
 - Suspected osteomalacia.
 - Chronic widespread pain with other features of osteomalacia (such as proximal muscle weakness).
- Suspected bone disease that may be improved with vitamin D treatment, such as osteomalacia or osteoporosis.
- Known bone disease, where correction of vitamin D deficiency is needed prior to specific treatment, such as:
 - Prior to osteoporosis treatment with a potent antiresorptive agent (zoledronate, denosumab, or teriparatide).
 - Prior to Paget's disease treatment with a bisphosphonate.

NICE² recommends that asymptomatic people at higher risk of vitamin D deficiency do not need routine testing for vitamin D deficiency but should be advised on the need for maintenance dose vitamin D supplementation as per prevention advice. Adults who are at higher risk of vitamin D deficiency include those:

- Aged 65 years and over
- Who have low or no exposure to the sun, for example those who cover their skin for cultural, religious, or health reasons; who are housebound; or who are confined indoors for long periods
- Who have darker skin pigmentation, for example people of African, African-Caribbean, or South Asian origin
- With a gastrointestinal or malabsorption disorder, (e.g., inflammatory bowel disease, coeliac disease, cystic fibrosis), or following weight loss surgery, resulting in a reduced ability to absorb fat-soluble vitamin D
- With severe liver disease or end-stage chronic kidney disease (CKD)
- Taking certain drugs that increase the risk of vitamin D deficiency¹
- Are pregnant or breastfeeding, due to the risk of foetal neonatal hypovitaminosis
- Are obese (body mass index greater than 30 kg/m²) — vitamin D may be sequestered into adipose tissue reducing bioavailability

People with osteoporosis and fragility fracture who are treated with vitamin D supplements and an oral antiresorptive agent do not need routine testing for vitamin D deficiency.²

If vitamin D deficiency or insufficiency is diagnosed following blood testing, consider arranging additional investigations²:

- To assess for a disorder of bone mineralization, such as osteomalacia:
 - Bone profile (calcium, phosphate, and alkaline phosphatase).
 - Parathyroid hormone (PTH) level.
- To assess for an underlying cause or alternative condition that may be causing symptoms, depending on clinical judgement:
 - Full blood count, including haemoglobin and ferritin levels; B12 and folate to identify other deficiencies.
 - Renal and liver function tests.
 - Thyroid function tests.
 - Coeliac serology if coeliac disease is suspected as a cause of malabsorption.

4. Treatment of vitamin D deficiency in adults

Care needs to be taken when prescribing vitamin D preparations as there are multiple preparations of multiple strengths available. National guidance suggests the rationalisation of products to limit the risk of confusion. National patient safety reports have identified instances of patients receiving high dose vitamin D more frequently than intended, resulting in patient harm and death.

Seek specialist advice or arrange referral before starting vitamin D treatment if a person²:

- Has a medical condition that predisposes to hypercalcaemia, such as granulomatous disease (sarcoidosis, tuberculosis), metastatic bone disease, some lymphomas, or primary hyperparathyroidism, as there is an increased risk of vitamin D toxicity. See the CKS topic on Hypercalcaemia for more information.
- Has a gastrointestinal or malabsorption disorder resulting in an inability to maintain adequate vitamin D status, as intensive high-dose replacement or maintenance treatment may be needed under specialist supervision.

- Has active renal stones or a history of renal stones, due to the risk of vitamin D toxicity causing hypercalciuria and renal stone disease. See the CKS topic on [Renal or ureteric colic - acute](#) for more information.
- Has severe liver disease or chronic kidney disease with eGFR <30, as specialist treatment with activated vitamin D metabolites may be needed. See the CKS topics on chronic kidney disease and Jaundice in adults for more information.
- Is pregnant.

Treat Orally

Oral administration of vitamin D is recommended¹. Intramuscular administration has an unpredictable bioavailability, slower onset of repletion and an additional administration burden in comparison to oral preparations.

Vitamin D₃ (colecalciferol) is the vitamin D preparation of choice for treatment of vitamin D deficiency¹

Licensed colecalciferol products should be prescribed. In order to avoid unlicensed products, food supplements and other vitamin D products prescribers should ensure that only the preparations indicated in this guideline are prescribed for correction of vitamin D deficiency

4.1 Rapid Correction Dose (Loading regime)

If the person is [symptomatic](#) of vitamin D deficiency or about to start treatment with a potent antiresorptive agent (Zoledronate, denosumab, or teriparatide) prescribe a rapid loading regime: Maintenance treatment should begin one month after completion of loading regime as per section 4.2. Monitoring should be carried out as described in section 5.

Recommended vitamin D (colecalciferol) rapid correction regime

50,000units (1,250 micrograms) capsule colecalciferol once weekly for 6 weeks, total 300,000units

Prescribe full course of 6 capsules as an acute prescription to prevent accidental re-issue

Reserved for people who are unable to swallow capsules or tablets:

50,000units/1ml ampoule colecalciferol once weekly for 6 weeks, total 300,000units

Vitamin D should be prescribed as colecalciferol and be prescribed generically.

For some acute trusts a more cost-effective prescribing option may be 2 x 25,000units colecalciferol tablets once weekly for 6 weeks. In this instance, the full course of 12 tablets should be provided as part of medications on discharge from hospital.

Recommended vitamin D (colecalfiferol) rapid correction regime for patients unable to comply with weekly dosing:

4,000units (100 micrograms) tablet daily for 10 weeks

Prescribe full course of 70 tablets as a single acute prescription to prevent accidental re-issue

Reserved for people who are unable to swallow capsules or tablets:

20 drops 10,000units/ml colecalfiferol oral drops sugar free daily for 10 weeks (200units per drop, pack size 2.5ml or 10ml)

Vitamin D should be prescribed as colecalfiferol and be prescribed generically.

4.2 Routine correction and Maintenance regime

Where correction of vitamin D deficiency is less urgent and when co-prescribing vitamin D supplements with an oral antiresorptive agent, maintenance therapy may be started without the use of loading doses.¹

Routine correction/maintenance regimes should also be started one month after fixed loading regimes are completed.

Recommended vitamin D (colecalfiferol) routine correction and maintenance regime

1000unit (25 micrograms) tablet daily

Reserved for people who are unable to swallow capsules or tablets:

5 drops 10,000units/ml colecalfiferol oral drops sugar free daily (200units per drop, pack size 2.5ml or 10ml)

Vitamin D should be prescribed as colecalfiferol and be prescribed generically.

NHS England guidance is that vitamins and minerals should not be routinely prescribed in primary care with some medically defined exceptions.⁵ ***For most people maintenance therapy of cholecalciferol should be purchased,^{2,5} see [here](#) for supporting information for patients.***

4.2.1 Nationally defined exceptions⁵:

- Medically diagnosed deficiency
 - Including for those patients who may have a lifelong or chronic condition or have undergone surgery that results in malabsorption*. Continuing need should however be reviewed on a regular basis.
- Calcium and Vitamin D for osteoporosis
- Malnutrition (including alcoholism) see NICE Guidance
- To treat side effects of a prescription medicine i.e., patients on long-term primidone, carbamazepine, phenytoin, phenobarbitone and sodium valproate (MHRA recommendation)
- Patients who prescriber considers cannot treat themselves, for example with learning disabilities, severe social vulnerability or mental health problems
- Patients suitable to receive Healthy Start vitamins for pregnancy – accessed via [Healthy start](#) route

* Patients undergoing bariatric surgery should have agreed as part of pre-surgery counselling that vitamins and minerals required after surgery (including vitamin D) will be purchased by the patient. Vitamin D should only be prescribed for patients post bariatric surgery if clinical deficiency is

identified. Once levels have corrected, self-care must be resumed, with emphasis on compliance as the multivitamins recommended will prevent other deficiencies as well as vitamin D deficiency

4.2.2 Locally defined exceptions

- Prescribers may use discretion continuing to prescribe maintenance dose in institutionalised or housebound patients with **ongoing risk of deficiency after treatment**.

Considerations should be given to vitamin D content of existing medications (calcium and vitamin D preparations), purchased supplements (e.g., multivitamins, cod liver oil), purchased or prescribed oral nutritional supplement drinks and enteral tube feeds. People receiving a nutritionally complete enteral tube feed may not require additional supplementation with vitamin D. Please consult the dietitian overseeing their care for further advice as needed.

4.2.3 People who may need higher maintenance/prevention doses

Some people may require a higher dose (2000-4000units colecalciferol per day) for prevention or maintenance of deficiency, including:

- Those taking medicines that accelerate the metabolism of Vitamin D (e.g., some anticonvulsants)
- People living in residential institutions (e.g., residential or nursing care, secure units or prisons)
- People who are obese
- People with limited sun exposure due to protective clothing/ consistent use of sunscreen/higher levels of skin pigmentation
- People with osteoporosis
- People with malabsorptive conditions, including inflammatory bowel disease and coeliac disease

4.2.4 Supplementation for people with specific dietary requirements and dietary requirements

The NHS Specialist Pharmacy Service (SPS) provides guidance on prescribing vitamin D preparations for people with [Peanut or soya allergy](#) and who follow a [vegetarian or vegan](#) diet. For those who follow a halal or kosher diet, the South East London CCG provides guidance in Tables B and C of the [South East London CCG Local Prescribing Guideline for the Management of Vitamin D Deficiency in Adults](#). When a specific branded product is required, it should be prescribed by brand.

4.3 Assess need for calcium supplementation²

All people who require supplementation with vitamin D should have their dietary calcium intake assessed. Consider using an online calcium calculator, such as the UK Centre for Genomic and Experimental Medicine (CGEM) [calcium calculator](#).

If calcium intake is sufficient (>700mg per day) vitamin D alone should be supplemented as per clinical indications described in sections 4.1 and 4.2.

If the person has an inadequate calcium intake of less than 700 mg a day (or less than 1000 mg a day if the person has osteoporosis), advise them to increase their dietary calcium intake. Provide [BDA Calcium: Food Fact Sheet](#), or equivalent. If the person is unable or unwilling to increase their dietary calcium intake, consider the need for combined calcium and vitamin D supplements.

NHS England guidance is that vitamins and minerals should not be routinely prescribed in primary care with some medically defined exceptions.⁵ **For most people maintenance therapy of calcium and vitamin D should be purchased.**^{2,5}

If the person does not meet the local or national exemption criteria described in sections 4.2.1 and 4.2.2 advise them to purchase a combined calcium and vitamin D supplement providing 1000-1200mg calcium and 800-1000units vitamin D total per day.

If the person meets the local and national exemption criteria described in sections 4.2.1 and 4.2.2 prescription of calcium and vitamin D is indicated. Choose a combined supplement in line with preferred products in [Surrey Heartlands osteoporosis guidelines](#) providing 1000-1200mg calcium and 800-1000units vitamin D total per day (e.g., Adcal D3, Accrete D3, Calci-D, TheiCal D3 1000mg/880)

Note: some combination calcium and vitamin D preparations (such as Calcichew D3®) are not recommended for people needing high-dose vitamin D treatment, as they contain low levels of vitamin D (200–400units per tablet) and may increase the risk of hypercalcaemia. The [Surrey Heartlands Osteoporosis Treatment Guideline](#) lists in Appendix A the local preferred Calcium and Vitamin D preparations which provide 800-1000units colecalciferol per day.

4.4 Lifestyle advice²

Following treatment for vitamin D deficiency or insufficiency, lifestyle advice should be provided to optimise long-term levels of vitamin D

- **Provide advice on sources of information and support**, such as (ROS) leaflet [Vitamin D for bones](#), which includes a factsheet on vitamin D supplements and tests.
- **Provide advice on safe sun exposure to help skin synthesis of vitamin D⁶**
Being in the sun with forearms, hands or lower legs uncovered, without sunscreen, between 11am and 3pm for the below times should provide enough sunlight
 - Fair skinned people - 10-15 minutes each day
 - Darker skinned people (e.g. those of African, African-Caribbean or south Asian descent) - 25-40 minutes each day
- **Provide advice on dietary sources of vitamin D**, such as the British Dietetic Association (BDA) [Vitamin D: food fact sheet](#)
- **Provide advice on dietary intake of calcium**, such as the British Dietetic Association (BDA) [Calcium: food fact sheet](#) may be helpful.

Women more than 10 weeks pregnant or who have a child under 1, may be entitled to get help to buy healthy food and milk. If eligible, they will be sent a [Healthy Start](#) card which be used to collect Healthy Start vitamins⁷. Women can receive Healthy Start vitamin tablets while they are pregnant and up to their baby's 1st birthday

5. Monitoring and follow up

5.1 Monitoring

- Check adjusted serum calcium level within 1 month after last loading dose, or after starting on lower dose maintenance therapy to detect calcium deficiency or unmasked primary hyperparathyroidism.² Follow the guidance in the [NICE Clinical Knowledge Summary](#) if hyper- or hypo-calcaemia are detected

- All patients receiving pharmacological doses of vitamin D should have their plasma-calcium concentration checked at appropriate intervals relative to the indication and dosage, or where clinical symptoms indicate.⁸
- Routine monitoring of serum 25-hydroxyvitamin D (25[OH]D) levels is not needed, including post loading regimes. Consider checking the serum 25(OH)D level 3–6 months after starting vitamin D treatment in people:
 - With ongoing symptoms of vitamin D deficiency.
 - With a malabsorption disorder.
 - Where poor compliance with medication is suspected.
 - Prescribed antiresorptive therapy who have extremely low levels of vitamin D at baseline assessment.
 - Needing sequential doses of a potent antiresorptive agent (zoledronate, denosumab, or teriparatide).
 - If the serum 25(OH)D level is below 50 nmol/L, assess adherence to treatment and arrange referral to an appropriate specialist for investigation of an underlying cause, depending on clinical judgement.
 - If the serum 25(OH)D level is above 50 nmol/L, advise on the use of lower dose maintenance treatment with vitamin D.
- Post rapid correction advise ongoing maintenance therapy of 800-2000units per day using purchased supplements, see patient information leaflet [here](#).
- If the person has ongoing symptoms despite adequate treatment with vitamin D, consider an alternative diagnosis and consider a referral for specialist advice.

5.2 Toxicity

Vitamin D is a fat-soluble vitamin, and as such accumulates in the body.

Due to the wide range of strengths of colecalciferol available to prescribe (e.g. 400units, 4,000units, 40,000units) caution should be exercised to ensure the correct dose and frequency are selected. Any concerns around prescribing regimes, in particular doses above the usual upper limit, should be queried with the prescriber.⁸

Stop dates should be documented and communicated for loading regimens. The 6-week loading regime detailed in section 4.1 should be prescribed as an acute course to prevent accidental repeat.

The main consequence of vitamin D toxicity is hypercalcaemia, which can cause apathy, anorexia, constipation, diarrhoea, dry mouth, fatigue, headache, nausea and vomiting, thirst and weakness. Later symptoms are often associated with calcification of soft tissues and include bone pain, cardiac arrhythmias, hypertension, renal damage (increased urinary frequency, decreased urinary concentrating ability; nocturia, proteinuria), psychosis (rare) and weight loss.

The treatment of toxicity consists of stopping all intake of vitamin D, rehydration and clinical assessment by an appropriate medical professional.

6. References

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