Vitamin D Deficiency: Prevention and Treatment in Children and Young People

This guideline aims to support Wandsworth GPs in investigating and treating vitamin D deficiency in children and young people between the ages of 1 month and 18 years. The guideline is based on those issued by the National Osteoporosis Society, and recommended doses are as per current available licensed products.

Natural Sources of Vitamin D

Sunlight
Ultraviolet B sunlight exposure is the main natural source of vitamin D, however due to the latitude in the UK, from October to April sun exposure is usually not adequate for synthesis of vitamin D\(^1\). Children under 6 months of age should be kept out of direct strong sunlight, and between March and October, children and young people need their skin protecting. They should cover up with suitable clothing, be encouraged to spend time in the shade (particularly between 11am and 3pm) and wear sunscreen. The parents and carers of children younger than 5 should be given advice on vitamin D supplements as outlined in this guideline\(^1\).

Diet
Dietary sources of vitamin D are limited. Oily fish e.g. sardines, mackerel, salmon and tuna, fortified margarines and cereals (see product labels for information), egg yolks and red meat all contain vitamin D and can be recommended as part of a healthy balanced diet. Formula milks in the UK are all fortified with vitamin D, however plain cow’s milk is not and breast milk contains very little amounts of vitamin D\(^2\).

Groups at High Risk of Vitamin D Deficiency: Primary Prevention

Primary preventative measures should be undertaken in children and young people at high risk of developing vitamin D deficiency. This includes advice about safe sunlight exposure, dietary intake of vitamin D and the use of multivitamin supplements\(^3\).

The Department of Health (2012) recommends that all children in the following high risk groups take a vitamin D supplement to prevent vitamin D deficiency\(^4\):

- Breastfed infants <6 months whose mother has NOT taken vitamin D supplements during pregnancy
- All infants and young children 6 months to 5 years (unless they are receiving >500mLs of formula milk per day)

Children and young people in the following groups are also at high risk of developing vitamin D deficiency, and therefore can also be considered for primary prevention\(^3\):

- Children with diets insufficient in calcium and/or with generally poor diets
- Exclusively breast fed babies from the age of 6 months, especially if the mother is also at risk of vitamin D deficiency or the infant has not started to take a good range of solid foods
- Children with limited sun exposure (e.g. veiled and photosensitive patients)
- Disabled children and those who spend limited time outdoors
- Children with darker skin as their bodies are not able to make as much vitamin D
- Children taking anticonvulsant medications that induce liver enzymes including; phenytoin, phenobarbitone, carbamazepine, primidone
- Children with family members with proven vitamin D deficiency
Table 1 outlines the recommended dose of colecalciferol for prevention of vitamin D deficiency in different age groups. For asymptomatic patients, vitamin D supplements should be purchased over the counter (OTC) with advice from community pharmacists.

### Table 1: Doses of vitamin D for Supplementation in High Risk Groups

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Recommended Dose</th>
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<tbody>
<tr>
<td>Newborn up to 1 month</td>
<td>300 IU-400 IU daily</td>
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<tr>
<td>Children &gt;1 month to 18 years old</td>
<td>400 IU to 1000 IU of colecalciferol daily</td>
</tr>
</tbody>
</table>

Children <4 years may be eligible to obtain vitamins free of charge as part of the Healthy Start Scheme. Further information and eligibility criteria can be found at: [www.healthystart.nhs.uk](http://www.healthystart.nhs.uk)

### Indications for Testing Vitamin D status in Children and Young People

Low levels of vitamin D are common in the UK and therefore routine screening is not recommended. A vitamin D level should be taken only if the child has signs, symptoms or conditions that may be related to vitamin D deficiency as outlined below:

1. **Symptoms and signs of rickets**
   - Progressive bowing of legs
   - Progressive knock knees
   - Wrist/ankle Swelling
   - Swelling of the chostocondral junction
   - Skull softening with frontal bossing and delayed closure of fontanelle
   - Delayed tooth eruption and enamel hypoplasia

2. **Other symptoms or conditions associated with vitamin D deficiency**
   - Long standing (>3 months) unexplained bone pain
   - Muscular weakness (e.g. difficulty climbing stairs, waddling gait, delayed walking)
   - Tetany due to low serum calcium
   - Seizures due to low serum calcium (usually in infancy)
   - Infantile cardiomyopathy
   - Decreased growth rate

3. **Abnormal investigations**
   - Low serum calcium or phosphate, high alkaline phosphatase (greater than the age appropriate reference range)
   - Radiographs- showing osteopenia, rickets or pathological features revealed by radiographs

4. **Chronic diseases that may increase risk of vitamin D deficiency**
   - Chronic renal disease
   - Chronic Liver disease
   - Malabsorption syndromes (e.g. coeliac disease, Crohn’s disease, cystic fibrosis)

5. **Bone diseases in children where correcting vitamin D deficiency prior to specific treatment would be indicated:**
   - Osteogenesis imperfecta
   - Idiopathic juvenile arthritis
   - Osteoporosis secondary to glucocorticoids, inflammatory disorders, immobility and other metabolic bone conditions
**Initial Investigations**
Calcium, phosphate, albumin, alkaline phosphatase, creatinine, vitamin D (25(OH)D).

**When to Refer to Secondary Care**
Refer children and young people to secondary care in any of the following circumstances:

- **Repeated low serum calcium concentration with or without symptoms**
  - **Symptomatic**- (irritability, brisk reflexes, tetany, seizures or other neurological abnormalities) requires immediate referral to A&E
  - **Asymptomatic**- discuss treatment with a paediatrician

- **Underlying complex medical disorders**
  - e.g. liver/renal disease, intestinal malabsorption

- **Deformities or abnormalities likely to be related to rickets**

- **Poor response to treatment despite good adherence**
  - Level of 25(OH)D <50nmol/L after 8-12 weeks of adherent therapy

- **Persisting low serum phosphate or high alkaline phosphatase**

**When to Treat Vitamin D Deficiency**
The table below outlines treatment recommended based on 25(OH)D levels.

<table>
<thead>
<tr>
<th>Serum 25-(OH)D levels</th>
<th>Vitamin D Status and Management advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;25 nmol/L</td>
<td>Deficient</td>
</tr>
<tr>
<td></td>
<td>Treatment should be prescribed (see pg. 4 for products and dosing) and maintenance advised following treatment doses</td>
</tr>
<tr>
<td>25-50 nmol/L</td>
<td>Insufficient</td>
</tr>
<tr>
<td></td>
<td>1. Give advice on safe sun exposure and diet.</td>
</tr>
<tr>
<td></td>
<td>2. For patients who are symptomatic, or at particularly high risk of developing deficiency, consider prescribing treatment doses as for deficiency.</td>
</tr>
<tr>
<td></td>
<td>3. For all other patients, advise purchasing over the counter (OTC) vitamin D supplements containing 400–1000 IU/day in those aged 1 month to 18 years. This should be continued unless there is a significant lifestyle change to improve vitamin D status. For those unable to purchase OTC preparations, prescribe according to maintenance on pg. 4.</td>
</tr>
<tr>
<td></td>
<td>4. Ensure dietary calcium intake is adequate.</td>
</tr>
<tr>
<td>&gt;50 nmol/L</td>
<td>Sufficient</td>
</tr>
<tr>
<td></td>
<td>Reassurance and advice on safe sun exposure and diet</td>
</tr>
</tbody>
</table>
Treatment of Vitamin D Deficiency in Children and Young People: Product Choice and Dosing

This list is not exhaustive, and some patients may require higher doses to correct deficiency. This table should be used in combination with the manufacturers Summary of Product Characteristics, which can be accessed at www.medicines.org.uk

<table>
<thead>
<tr>
<th>Serum 25-(OH) D status</th>
<th>PRODUCT</th>
<th>DOSE</th>
<th>COST PER COURSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deficient Serum 25-(OH) D levels &lt;25nmol/L</td>
<td>Invita D3 25,000 IU oral solution in plastic ampoules</td>
<td>0 to 18 years: 25000 IU (1 ampoule taken orally) once every 2 weeks for 6 weeks followed by maintenance</td>
<td>£4.45</td>
</tr>
<tr>
<td></td>
<td>Thorens 25,000 IU/2.5mL oral solution</td>
<td>0 to 18 years: 25000 IU (1 bottle taken orally) once every 2 weeks for 6 weeks followed by maintenance</td>
<td>£4.39</td>
</tr>
<tr>
<td></td>
<td>DAILY DOSE LIQUID PREPARATION:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thorens 10,000 IU/mL oral drops</td>
<td>0 to 18 years: 2000 IU/day (10 drops) for 6 weeks followed by maintenance</td>
<td>£5.85</td>
</tr>
<tr>
<td></td>
<td>TABLETS/CAPSULES: Licensed only in those over 12 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plenachol 20,000 IU capsules</td>
<td>12-18 years: 20 000 IU (1 capsule) once every 2 weeks for 6 weeks followed by maintenance</td>
<td>£2.70</td>
</tr>
<tr>
<td></td>
<td>Aviticol or Fultium D3 20,000 IU capsules</td>
<td>12-18 years: 20,000 IU (1 capsule) once every 2 weeks for 6 weeks followed by maintenance</td>
<td>£2.90</td>
</tr>
<tr>
<td></td>
<td>Stexerol 1,000 IU tablets</td>
<td>12 to 18 years: 2,000 IU/day for 6 weeks followed by maintenance</td>
<td>£8.85</td>
</tr>
<tr>
<td>Insufficient Serum 25-(OH) D levels 30-50 nmol/L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Prescribe and treat as for deficiency IF symptomatic AND/OR at high risk of developing deficiency (see “Groups at High Risk of Vitamin D Deficiency- pg. 1).</td>
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<tr>
<td></td>
<td>• For ALL other patients, advise purchasing OTC vitamin D supplements to provide 400 IU to 1000 IU daily(^2,^3). For those unable to purchase OTC preparations, consider prescribing as per maintenance therapy in the table below.</td>
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</table>

Children seen in the hospital

These patients may receive much higher doses (Stoss therapy) either as stat doses or over shorter durations. If an out-patient prescription is issued at the hospital, this SHOULD be dispensed at the hospital pharmacy (because the dose/duration may be different to that used in the community). The GP can refer the parent back to the hospital pharmacy and does not need to issue an FP10.

The clinical responsibility lies with the prescriber signing the prescription, therefore, the GP has the discretion whether or not to issue a FP10 if they feel confident to do so, bearing in mind the higher dosages advised by the hospital.
Maintenance Therapy

Only prescribe maintenance therapy in children and young people who have been treated for deficiency and/or are genuinely unable to buy OTC preparations. In asymptomatic children and young people (excluding special groups e.g. malabsorption), parents/guardians should be advised to buy maintenance therapy OTC with advice from their community pharmacist. Maintenance therapy should be continued until the child has stopped growing, unless lifestyle changes are assured.

<table>
<thead>
<tr>
<th>Maintenance Therapy*</th>
<th>PRODUCT</th>
<th>DOSE</th>
<th>COST PER MONTH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LIQUIDS:</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Invita D3 25,000 IU oral solution in plastic ampoules</td>
<td>0 to 1 year: 25,000 IU every 8 weeks</td>
<td>£0.79</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1-18 years: 25,000 IU every 6 weeks</td>
<td>£1.06</td>
<td></td>
</tr>
<tr>
<td>Thorens 25,000 IU/2.5mL oral solution</td>
<td>0 to 1 year: 25,000 IU every 8 weeks</td>
<td>£0.78</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1-18 years: 25,000 IU every 6 weeks</td>
<td>£1.04</td>
<td></td>
</tr>
<tr>
<td><strong>DAILY DOSE PREPARATIONS:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thorens 10,000 IU/mL oral drops (200 IU/drop)</td>
<td>0 to 1 year: 400 IU (2 drops) daily</td>
<td>£0.69</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 to 18 years: 600 IU (3 drops) daily</td>
<td>£1.05</td>
<td></td>
</tr>
<tr>
<td>Invita D3 2,400 IU/mL drops (67 IU/drop)</td>
<td>0 to 1 year: 400 IU (6 drops) daily</td>
<td>£1.80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 to 18 years: 600 IU (9 drops) daily</td>
<td>£2.70</td>
<td></td>
</tr>
<tr>
<td><strong>TABLETS/CAPSULES:</strong> Licensed only in those over 12 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plenachol 20,000 IU capsules</td>
<td>12 to 18 years: 20,000 IU every 6 weeks</td>
<td>£0.65</td>
<td></td>
</tr>
<tr>
<td>Stexerol 1,000 IU tablets</td>
<td>12 to 18 years: 1,000 IU once a day</td>
<td>£2.95</td>
<td></td>
</tr>
</tbody>
</table>

Calcium Supplementation

Many children with vitamin D deficiency will have a depleted calcium status and/or a poor calcium intake and may therefore benefit from advice about dietary calcium intake. In some cases calcium supplementation may be worthwhile over the period of vitamin D treatment. For recommended doses, consult BNF.

Vitamin D facilitates the absorption of calcium from the intestinal mucosal into the body. Vitamin D deficiency can lead to reduced calcium serum levels. An adequate intake of dietary calcium from dairy products, fortified cereals, etc is sufficient to meet daily requirements.

Monitoring

Calcium profile test should be carried out 6 weeks after treatment course ends if the child presented with hypocalcaemia along with Vitamin D deficiency, or if patient develops features suggestive of hypercalcaemia (increased thirst, polyuria, constipation, anorexia, nausea and vomiting). Hypercalcaemia is also a risk in certain disease states such as CKD and active TB.

Routine re-testing is not recommended, unless the clinician feels it is clinically appropriate e.g. if child is still symptomatic after treating deficiency.

Note: If a child’s symptoms/signs have not improved despite a satisfactory 25(OH)D concentration, they are unlikely to be related to vitamin D deficiency.

Treating and Screening Other Family Members

If a child is diagnosed with vitamin D deficiency, it would be beneficial to screen other family members (particularly other children) who share the same lifestyle. Screening can be done by history, or if deemed necessary, a vitamin D level can be taken. If screening identifies the family members to be at risk of deficiency, OTC preventative vitamin D therapy should be advised.
Investigation and Treatment of Vitamin D Deficiency & Insufficiency for Children and Young People

Does the patient have any of the following?
- Symptoms of vitamin D deficiency
- Abnormal investigations suggestive of vitamin D deficiency
- Chronic diseases that may increase risk of vitamin D deficiency
- Bone diseases requiring correction of vitamin D levels prior to specific treatments

Is the patient symptomatic or at high risk of developing deficiency?

Test for vitamin D deficiency: 25(OH)D, Calcium, Phosphate, ALP, U&Es, LFTs, FBC

Do any of the following apply?
- Repeated hypocalcaemia (with or without symptoms)
- Underlying complex medical disorders (e.g. renal, liver, malabsorption)
- Deformities or abnormalities likely to be associated with rickets
- Poor response to vitamin D treatment despite good adherence
- Persistent low serum phosphate and raised ALP

Assess need for treatment based on serum 25(OH)D level

Deficient: Levels <25nmol/L
Insufficient: Levels 25-50nmol/L
Sufficient: Levels >50nmol/L

Is the patient symptomatic or at high risk of developing deficiency?

YES

NO

Reassurance & Lifestyle Advice
- Safe sun exposure
- Dietary advice

Refer to Secondary Care

Advise purchasing OTC vitamin D supplements
- Children under 4 may be eligible for free multivitamins via the healthy start scheme

Yes

No

TREATMENT DOSING: TO BE PRESCRIBED
- Thorens or Invita D3 25,000 IU liquids: 25,000 IU once every 2 weeks for 6 weeks
  OR (if daily dose is preferred):
- Thorens 10,000 IU/mL: 2000 IU (10 drops) daily for 6 weeks
  OR (if over 12 and able to swallow tabs/caps):
- Plenachol, Aviticol or Fultium D3 20,000 IU caps 12-18 years: 20,000 IU once every 2 weeks for 6 weeks
  OR (only if unable to comply with 2 weekly dosing)
- Stexerol 1000 IU tablets: 2000 IU daily for 6 weeks

Maintenance dosing (if prescribing)
- Thorens or Invita D3 25,000 IU liquids:
  - 0-1 year: 25,000 IU every 8 weeks
  - 1-18 years: 25,000 IU every 6 weeks
  OR (if daily dose is preferred)
- Thorens 10,000 IU/mL oral drops:
  - 0-1 year: 400 IU (2 drops) daily
  - 1-18 years: 600 IU (3 drops) daily
- Invita D3 2,400 IU/mL oral drops:
  - 0-1 year: 400 IU (6 drops) daily
  - 1-18 years: 600 IU (9 drops) daily
  OR (if over 12 and able to swallow tabs/caps):
- Plenachol 20,000 IU capsules 12-18 years: 20,000 IU every 6 weeks
- Stexerol 1000 IU tablets: 1000 IU daily

Does the patient have any of the following?
- Breastfed infants <6 months whose mothers have not taken vitamin D supplements during pregnancy
- Exclusively breastfed from 6 months especially if mother also at high risk, and/or limited range of solid foods
- All infants 6 months to 5 years (unless receiving >500mL formula milk/day)
- Insufficient calcium in diet
- Children with limited sun exposure
- Disabled or housebound children
- Darker skin
- Anticonvulsant medications that induce liver enzymes
- Family members with proven vitamin D deficiency

Have other causes for symptoms been excluded?

YES

NO

Does the patient have any of the following?
- Repeated hypocalcaemia (with or without symptoms)
- Underlying complex medical disorders (e.g. renal, liver, malabsorption)
- Deformities or abnormalities likely to be associated with rickets
- Poor response to vitamin D treatment despite good adherence
- Persistent low serum phosphate and raised ALP

Have other causes for symptoms been excluded?
References

1. NICE guidance [NG34] Sunlight exposure: risks and benefits


4. Chief Medical Officer. Vitamin D – Advice on supplements for at risk groups [letter]. Department of Health. 2nd February 2012. Available at: https://www.gov.uk/government/publications/vitamin-d-advice-on-supplements-for-at-risk-groups