Department of Medicine

Division of Endocrinology

Evidence Based Guideline for the Evaluation and Treatment of Vitamin D Deficiency

Inclusion Criteria (1 or more)

1. Severe malabsorption (e.g., protein-losing enteropathy)
2. None or very low dairy intake (see Table 1)
3. Chronic supplementation (>3 mo) above tolerable upper intake level (see Table 2)
4. Osteoporosis, low bone density, or low-impact fracture(s)
5. At-risk for reduced bone mass or low-impact fracture(s) (see Table 3)

Exclusion Criteria

1. Rickets - active or inherited forms
2. Liver failure
3. Chronic kidney disease
4. Hypoparathyroidism
5. Hypercalcemia, hypercalciuria or associated conditions (e.g., hyperparathyroidism, granuloma-forming disorders, William syndrome, hypophosphatasia [HPP])

Footnotes

[A]Healthy individuals

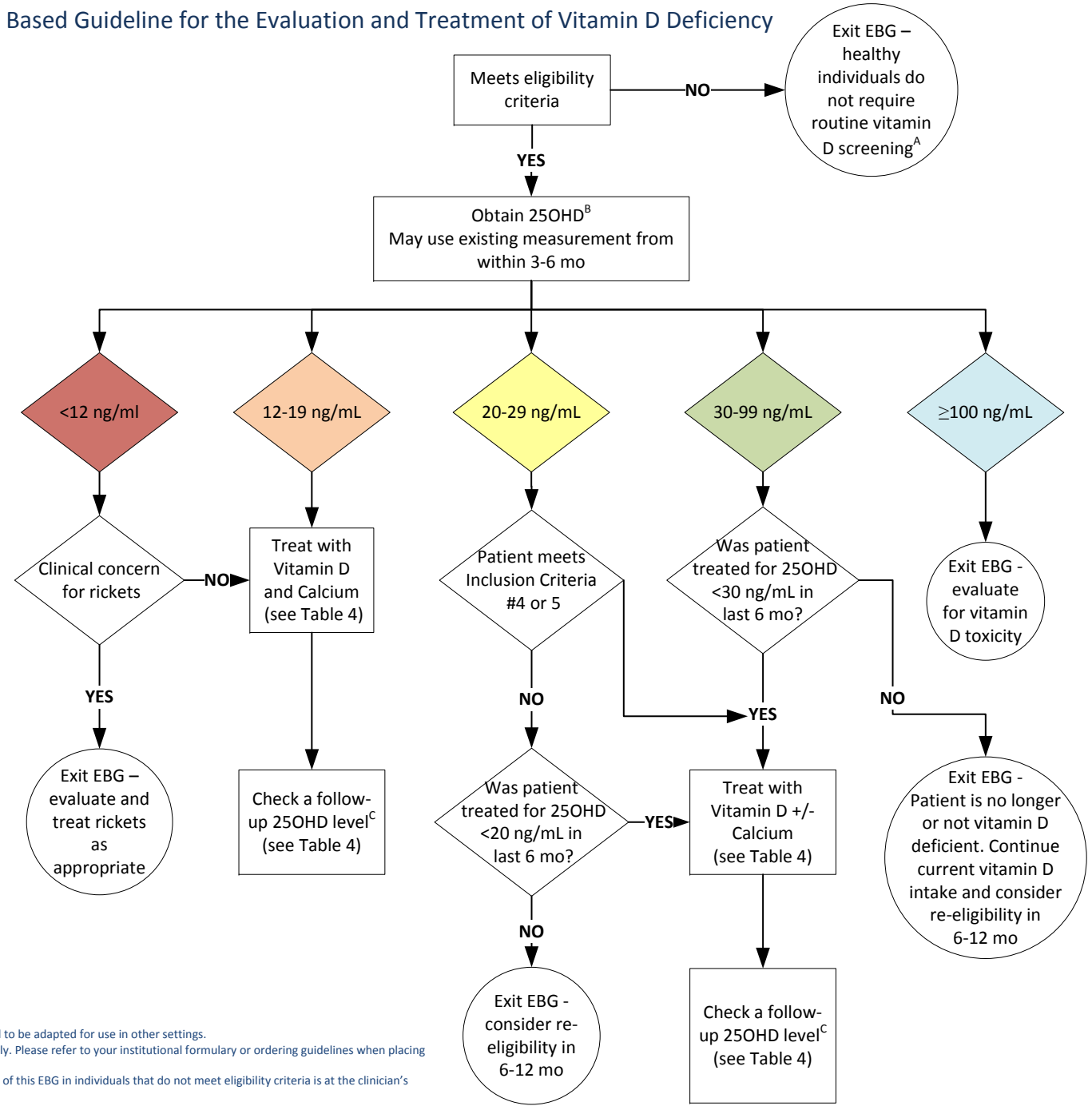
a. Breast fed or partially breastfed infants should supplement with 400 units/day until weaned and drinking at least 1L/day of vitamin D-fortified formula or cow milk

b. The RDA for vitamin D for the general population is 600 units/day; this includes otherwise healthy dark-skinned and obese individuals

c. Vitamin D evaluation and treatment for outcomes other than skeletal health is not recommended

[B]25-hydroxyvitamin D best reflects vitamin D status (not 1,25-dihydroxyvitamin D)

[C]Consider reasons for treatment failure (e.g., non-compliance, malabsorption, obesity, insufficient dosing, etc.)



NOTES:

1) This guideline was designed for use within the Division of Endocrinology ; it may need to be adapted for use in other settings.
2) The medication dosing contained within these guidelines is provided for reference only. Please refer to your institutional formulary or ordering guidelines when placing orders for clinical care of patients.
3) This EBG is not intended for use in individuals that do not meet eligibility criteria. Use of this EBG in individuals that do not meet eligibility criteria is at the clinician's discretion.

Last updated: 6/23/2015

Boston Children's Hospital
Until every child is well™

Appendix

Definitions:
-Recommended Dietary Allowance (RDA): average daily intake that meets the requirements of nearly all (97-98%) healthy individuals
-Estimated Average Requirement (EAR): average daily intake that meets the requirements of 50% of healthy individuals
-Adequate Intake (AI): average daily intake assumed to be adequate (used when evidence is insufficient to develop an RDA)

Table 1: Calcium Intake

Age	EAR
0-6 mo	200 mg AI
6-12 mo	260 mg AI
1-3 yr	500 mg
4-8 yr	800 mg
9-18 yr	1,100 mg

Examples of calcium-enriched foods (may vary by brand)
-8 oz. reduced-fat milk = 293 mg calcium (1 serving)
-8 oz. low fat plain yogurt = 415 mg calcium (1 serving)
-1.5 oz cheddar cheese = 307 mg calcium (1 serving)

Table 2: Over-supplementation

Age	Vitamin D
0-12 mo	>1,000-2,000 units/day
1-10 yr	>2,000-4,000 units/day
11-18 yr	>4,000 units/day

Table 4: Treatment and Management

25OHD Level	Age	Vitamin D Supplementation	Calcium (elemental)	Duration	Maintenance	Follow-up 25OHD
<12 ng/mL (Treatment)	0-12 mo	50,000 units/wk or 2,000 units/day	Rx: 25 mg/kg/dose BID	6 wks	Followed by Maintenance (below)	6 wks
	1-18 yr		Rx: 500-600[a] mg BID	6-8[a] wks		
12-19 ng/mL (Treatment)	0-12 mo	50,000 units/wk or 2,000 units/day	Rx: 25 mg/kg/dose BID	6 wks	Followed by Maintenance (below)	3-6 mo
	1-18 yr		Rx: 500-600[a] mg BID	6-8[a] wks		
≥20 ng/mL (Maintenance)	0-6 mo	400-1,000[a] units/day	AI (200 mg)[b]	3-12 mo or longer		3-12 mo
	6-12 mo		AI (260 mg)[b]			
	1-3 yr	600-1,000[a] units/day	RDA (700 mg)[b]			
	4-8 yr		RDA (1,000 mg)[b]			
	9-18 yr		RDA (1,300 mg)[b]			

[a]Consider lower end of range for smaller child and higher end of range for older child/adolescent or obesity
[b]Diet preferred; if unable, consider supplementation

Table 3: Selected conditions associated with low bone mass and fragility fractures in children[a]

Category	Selected Disorders
Primary osteoporosis	
Heritable disorders of connective tissue development	Bruck Syndrome Cutis laxa Ehlers-Danlos syndrome Marfan syndrome Osteogenesis imperfecta Osteoporosis-pseudoglioma syndrome
Idiopathic juvenile osteoporosis	
Secondary osteoporosis	
Neuromuscular disorders	Cerebral palsy Duchenne muscular dystrophy Prolonged immobilization (traumatic injury, limb disuse) Rett syndrome
Chronic illness	Bone infiltration (Leukemia, other cancers, thalassemia) Cystic fibrosis Eating disorders (anorexia nervosa) Gastrointestinal disease (Inflammatory bowel disease, celiac disease) HIV Organ transplantation Renal disease Rheumatologic disorders (juvenile idiopathic arthritis, lupus) Severe burns
Endocrine and reproductive disorders	Athletic amenorrhea Glucocorticoid excess (Cushing's syndrome/disease) Growth hormone deficiency (Adult, not Pediatric) Hyperparathyroidism Hyperprolactinemia Hyperthyroidism Hypogonadism Turner syndrome
Medications	Anticonvulsants (phenytoin, phenobarbital, carbamazepine, sodium valproate) Antiretrovirals Calcineurin inhibitors (Cyclosporine, tacrolimus) Glucocorticoids GnRH agonists Loop diuretics L-thyroxine suppressive therapy Medroxyprogesterone acetate Methotrexate Radiotherapy
Inborn errors of metabolism	Galactosemia Gaucher disease Glycogen storage disease Homocystinuria Lysinuric protein intolerance

[a] Adapted from Huh and Gordon, Metabolism 2013

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