

A 3-year-old boy from a refugee camp is brought to the physician for evaluation of a rash. He recently came to the United States and his medical history is unknown. The rash has been present for a few weeks and seems to be spreading. He is hungry "all the time" and his family had limited access to food in their home country. Review of systems is negative for nausea, vomiting, diarrhea, headaches, numbness, or tingling. The boy takes no medications and has no known allergies. His weight and length are <5th percentile for age and sex. Examination shows a malnourished boy with minimal subcutaneous fat. Scaling and fissures are present at the mouth corners and his lips are cracked and inflamed. The patient's tongue and oropharyngeal mucous membranes are swollen and hyperemic. There are erythematous scaly patches on his eyebrows, cheeks, and nose. The rash is also present on the scrotal skin and extends to the medial aspect of both thighs. The skin and conjunctivae are pale and his fingers and toenails are brittle. Laboratory results are as follows:

Complete blood count

Hemoglobin	9 g/dL
Mean corpuscular volume	82 fL
Platelets	180,000/ μ L
Leukocytes	7,500/ μ L

Serum chemistry

Sodium	136 mEq/L
Potassium	3.8 mEq/L
Chloride	100 mEq/L
Bicarbonate	26 mEq/L
Blood urea nitrogen	9 mg/dL
Creatinine	0.2 mg/dL
Glucose	73 mg/dL

Which of the following is the most likely cause of this patient's condition?

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Which of the following is the most likely cause of this patient's condition?

- ☐ A. Vitamin A toxicity
- ☐ B. Vitamin B₁ (thiamine) deficiency
- ☐ C. Vitamin B₂ (riboflavin) deficiency
- ☐ D. Vitamin B₃ (niacin) deficiency
- ☐ E. Vitamin B₆ (pyridoxine) toxicity
- ☐ F. Vitamin C deficiency
- ☐ G. Vitamin K deficiency

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Glucose

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Which of the following is the most likely cause of this patient's condition?

- ☐ A. Vitamin A toxicity [3%]
- ☐ B. Vitamin B₁ (thiamine) deficiency [4%]
- ☒ C. Vitamin B₂ (riboflavin) deficiency [47%]
- ☐ D. Vitamin B₃ (niacin) deficiency [25%]
- ☐ E. Vitamin B₆ (pyridoxine) toxicity [5%]
- ☐ F. Vitamin C deficiency [16%]
- ☐ G. Vitamin K deficiency [1%]

Proceed to Next Item

Explanation:

User Id: [REDACTED]

Water-soluble vitamins		
Vitamin	Source	Deficiency
B ₁ (thiamine)	Whole grains, meat, fortified cereal, nuts, legumes	<ul style="list-style-type: none"> Beriberi (peripheral neuropathy, heart failure) Wernicke-Korsakoff syndrome
B ₂ (riboflavin)	Dairy, eggs, meat, green vegetables	<ul style="list-style-type: none"> Angular cheilosis, stomatitis, glossitis Normocytic anemia Seborrheic dermatitis
B ₃ (niacin)	Meat, whole grains, legumes	<ul style="list-style-type: none"> Pellagra (dermatitis, diarrhea, delusions/dementia, glossitis)
B ₆ (pyridoxine)	Meat, whole grains, legumes, nuts	<ul style="list-style-type: none"> Cheilosis, stomatitis, glossitis Irritability, confusion, depression

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B₃ (niacin)	Meat, whole grains, legumes	<ul style="list-style-type: none"> • Pellagra (dermatitis, diarrhea, delusions/dementia, glossitis)
B₆ (pyridoxine)	Meat, whole grains, legumes, nuts	<ul style="list-style-type: none"> • Cheilosis, stomatitis, glossitis, • Irritability, confusion, depression
B₉ (folate, folic acid)	Green leafy vegetables, fruit, meat, fortified cereal/grains	<ul style="list-style-type: none"> • Megaloblastic anemia • Neural tube defects (fetus)
B₁₂ (cobalamin)	Meat, dairy	<ul style="list-style-type: none"> • Megaloblastic anemia • Neurologic deficits (confusion, paresthesias, ataxia)
C (ascorbic acid)	Citrus fruits, strawberries, tomatoes, potatoes, broccoli	<ul style="list-style-type: none"> • Scurvy (punctate hemorrhage, gingivitis, corkscrew hair)

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Vitamin B₂ (riboflavin) is a precursor to important coenzymes that participate in oxidation-reduction reactions for energy production. Riboflavin is present in meat, eggs, yeast, dairy products, green vegetables, and enriched foods. Deficiency of this vitamin is

Vitamin B₂ (riboflavin) is a precursor to important coenzymes that participate in oxidation-reduction reactions for energy production. Riboflavin is present in meat, eggs, yeast, dairy products, green vegetables, and enriched foods. Deficiency of this vitamin is common in underdeveloped countries with severe food shortages. This is unusual in industrialized nations but can be seen in patients with anorexia nervosa, low-dairy diet (eg, lactose intolerance), and malabsorptive syndromes (eg, celiac sprue).

Riboflavin deficiency is characterized by **angular cheilitis** (fissures at corners of lips), **glossitis** (hyperemic tongue), **stomatitis** (hyperemic/edematous oropharyngeal mucous membranes, sore throat), **normocytic-normochromic anemia**, and **seborrheic dermatitis**. Riboflavin has no known toxic effects as excess amounts of this **water-soluble** vitamin are excreted in urine.

(Choice A) Hypervitaminosis A can cause neuropsychiatric symptoms and cerebral edema. However, toxicity of any vitamin is unlikely in this severely malnourished child.

(Choice B) Thiamine deficiency can cause dry beriberi (peripheral neuropathy), wet beriberi (dilated cardiomyopathy), and Wernicke-Korsakoff syndrome.

(Choice D) Niacin deficiency causes pellagra, which is characterized by a symmetric reddish rash on exposed skin areas, glossitis, diarrhea/vomiting, and a variety of neurologic disturbances (insomnia, anxiety, disorientation, delusions, dementia, encephalopathy). This diagnosis is less likely as niacin deficiency does not cause anemia. In addition, this patient has no neurologic or gastrointestinal symptoms.

(Choice E) Although toxicity from water-soluble vitamins is uncommon, excess pyridoxine can cause peripheral neuropathy.

(Choice F) Vitamin C deficiency (scurvy) impairs collagen synthesis. Mucocutaneous symptoms include ecchymoses, petechiae, bleeding gums, hyperkeratosis, and **coiled hair**.

(Choice G) Vitamin K deficiency manifests as impaired coagulation (eg, easy bruisability, mucosal bleeding, melena, hematuria). It is generally rare, but neonates and patients on long-term antibiotics are at risk due to lack of bowel flora.

Educational objective:

Vitamin B₂ (riboflavin) is a water-soluble vitamin that is present in meat, eggs, yeast, dairy products, green vegetables, and enriched foods. Riboflavin deficiency should be suspected in a malnourished patient with angular cheilitis, stomatitis, glossitis, normocytic-normochromic anemia, and seborrheic dermatitis.

glossitis (hyperemic tongue), **stomatitis** (hyperemic/edematous oropharyngeal mucous membranes, sore throat), **normocytic-normochromic anemia**, and **seborrheic dermatitis**. Riboflavin has no known toxic effects as excess amounts of this **water-soluble** vitamin are excreted in urine.

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References:

1. **Suspected outbreak of riboflavin deficiency among populations reliant on food assistance: a case study of drought-stricken Karamoja, Uganda, 2009-2010.**
2. **Chapter 30: historical aspects of the major neurological vitamin deficiency disorders: the water-soluble B vitamins.**

Media Exhibit

