

Vitamins



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What is a vitamin?

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Water-soluble
Vitamins

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Fat-soluble
Vitamins

01

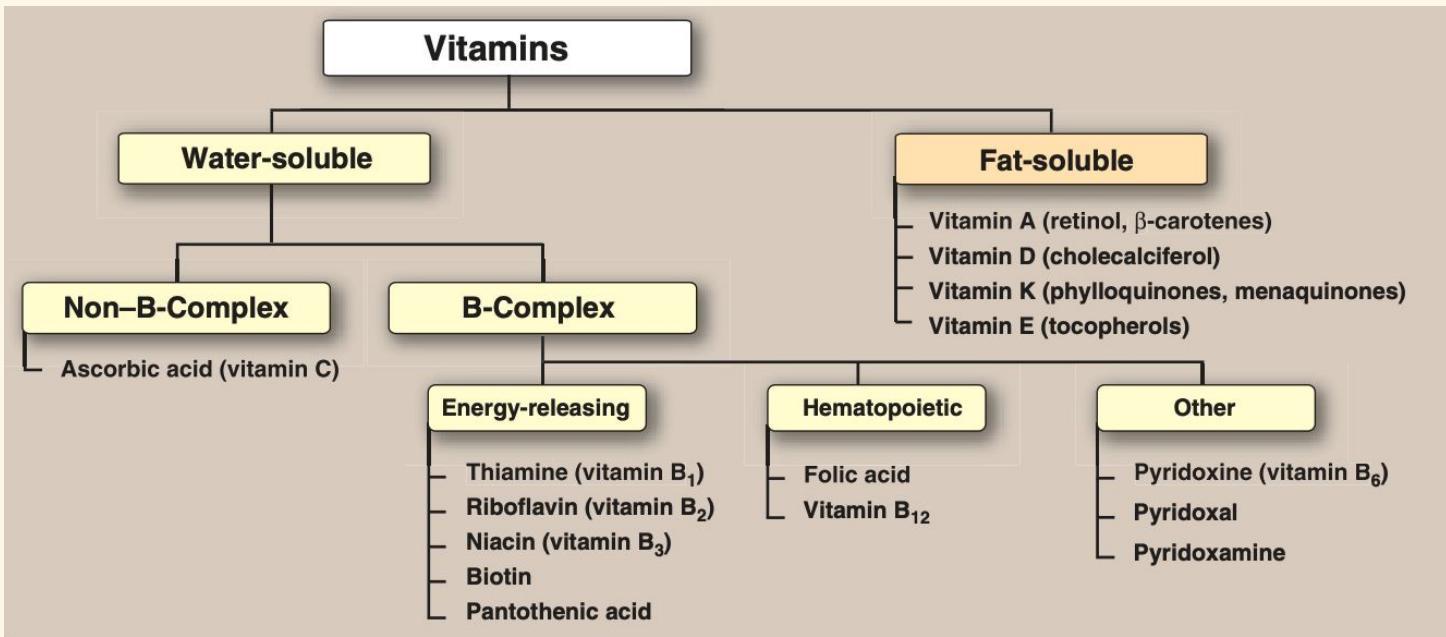
What is a vitamin?

What is a vitamin?

- * “A vitamin is a substance that makes you ill if you don’t eat it.” – Albert Szent-Györgyi
- * Organic molecules you need very little of
- * 13 are required for humans
- * The gaps in numbering are because B4, B10, etc. were thought to be essential but were later discovered not to be

Water-soluble: B and C

Fat-Soluble: ADEK



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Water-soluble

Vitamins

B's and C's

Thiamine (B1)

Source:

- * Pork
- * Legumes
- * Whole grains

Function:

- * Coenzyme to transketolase in forming/degrading α -ketols
- * Coenzyme to α -ketoglutarate dehydrogenase in the **citric acid cycle**, removing CO_2

Deficiency:

* Symptoms

- o Increase in transketolase activity in rbc's when thiamine is given
- o Beriberi

* Infantile

- Tachycardia
- Vomiting
- Convulsions
- Death

* Adult

- Dry skin
- Irritability
- Disordered thinking
- Progressive paralysis

o Wernicke-Korsakoff syndrome

- * Alcoholics
- * Apathy
- * Memory loss
- * Ataxia
- * Nystagmus

Mnemonics

- **The 1 and only**
- **Berries have thorns**

Riboflavin (B2)

Source:

- * Dairy
- * Meats
- * Enriched grains
- * Vegetables

Function:

- * FAD
- * FMN (complex I electron transport chain)

Deficiency:

- * Symptoms
 - Dermatitis
 - Chellosis (fissures at corners of mouth)
 - Glossitis (tongue is smooth and purplish)

Mnemonics

- FAD, FMN = riboFlavin

Niacin (Nicotinic acid, B3)

Source:

- * Nuts
- * Meats
- * Grains
- * Very low in corn

Function:

- * NAD+
- * NADP+
- * Can be used to treat Type IIb hyperlipoproteinemia (high VLDL and LDL) because it inhibits lipolysis in the liver, and thus, triacylglycerol synthesis

Deficiency:

- * Symptoms
 - Pellagra
- * Dermatitis
- * Diarrhea
- * Dementia
- * Death

Mnemonics

- NAD+, NADP+ = Niacin
- Niagara

Pantothenic Acid (B5)

Source:

- * Meats
- * Dairy
- * Whole grains
- * Fruits
- * Vegetables

Function:

- * Part of CoA

Deficiency: not usually present

Mnemonics

- **Pant**othenic = **penta** = 5
- Pan**C**Othenic Acid

Pyridoxine (B6)

Source:

- * Meats
- * Vegetables
- * Whole grains

Function:

- * Coenzyme in amino acid metabolism
- * May be toxic in large amounts

Deficiency:

- * Symptoms
 - Irritability
 - Convulsions
 - Muscular twitching
 - Anemia
- * Causes
 - Isoniazid
 - Low B6 formulas in infants
 - Alcoholism

Mnemonics

- Pyramid = triangle = 3, 6 is a multiple of 3

Biotin (B7)

Source:

- * Legumes
- * Other vegetables
- * Meats
- * Intestinal bacteria

Function:

- * Coenzyme in fat synthesis
- * Coenzyme in glycogen synthesis
- * Coenzyme in amino acid synthesis

Deficiency:

- * Symptoms
 - Dermatitis
 - Glossitis
 - Loss of appetite
 - Nausea
- * Causes
 - Eating 20+ raw whites (avidin)

Mnemonics

- Biotin is 6 letters long, $6+1 = 7$

Folic Acid (Folate, B9)

Source:

- * Green vegetables
- * Oranges
- * Nuts
- * Legumes
- * Whole grains

Function (tetrahydrofolate):

- * Coenzyme in amino acid synthesis
- * Coenzyme in synthesizing purines and thymine

Deficiency:

- * Symptoms
 - Macrocytic (megaloblastic) anemia
 - Neural tube defects in fetus
- * Causes
 - Increased demand (pregnancy)
 - Small intestine problems
 - Drugs (dihydrofolate reductase inhibitors)
 - * methotrexate

Mnemonics

- Folic acid is 9 letters long
- **Folic = Fetus**

Cobalamin (B12)

Source:

- * Meats
- * Eggs
- * Dairy
- * Only from microorganisms

Function:

- * Coenzyme in turning homocysteine into methionine
 - o Important for nucleic acids and red blood cells
- * Coenzyme in isomerization of CoA during the degradation of some amino acids and odd-carbon fatty acids

Deficiency:

- * Symptoms
 - o Macrocytic (megaloblastic) anemia
 - * Folate trap hypothesis
 - o Neuropsychiatric symptoms
 - o High levels of methylmalonic acid in blood
- * Causes
 - o Pernicious anemia
 - * Attacks parietal cells that make intrinsic factor

Ascorbic Acid (C)

Source:

- * Citrus fruits
- * Broccoli
- * Tomatoes

Function:

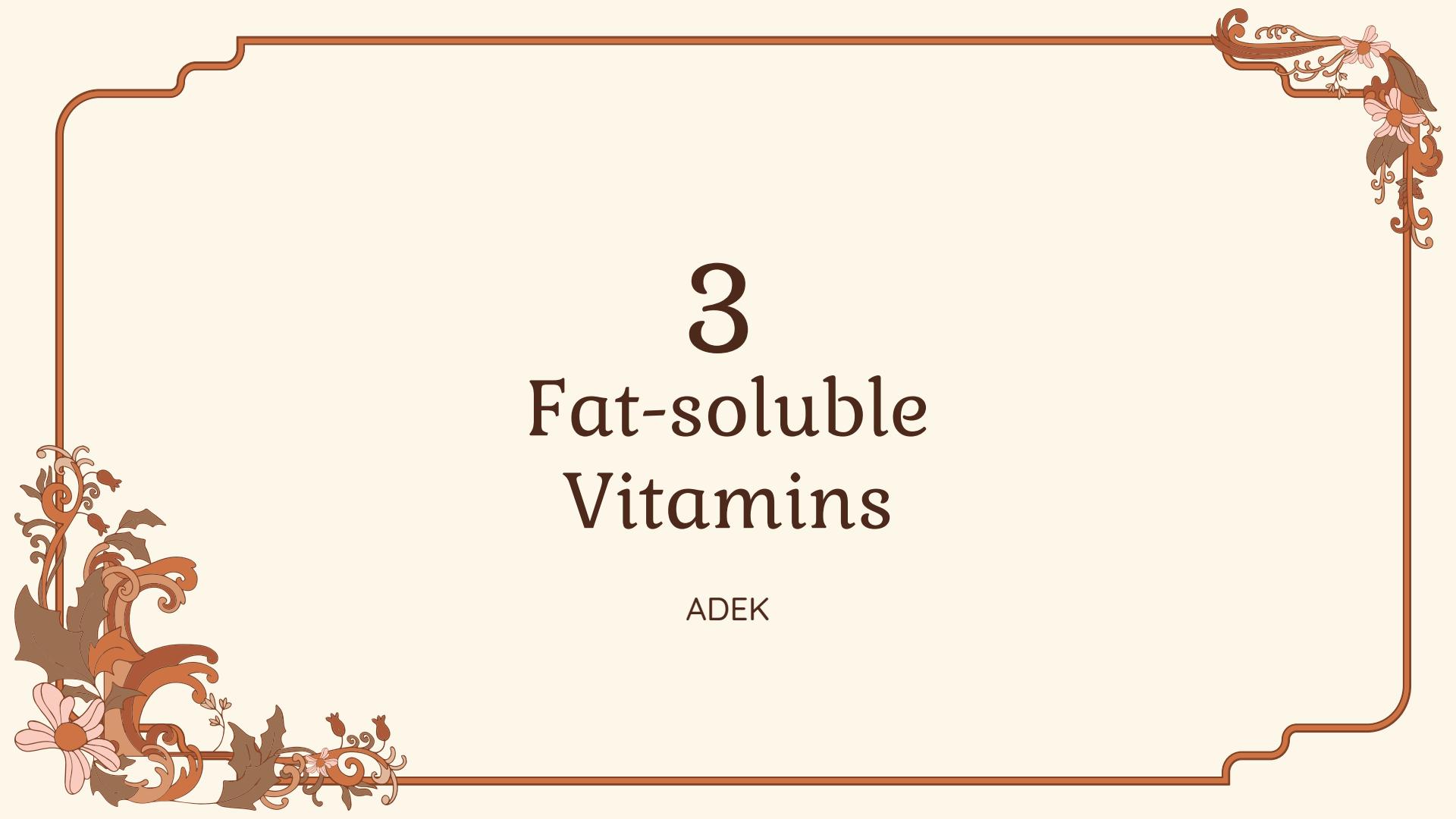
- * Reducing agent in several reactions
- * Coenzyme in hydroxylating prolyl and lysyl residues of collagen
- * Absorbing iron from intestines
- * Antioxidant

Deficiency:

- * Symptoms
 - Scurvy
 - * Sore and spongy gums
 - * Loose teeth
 - * Fragile blood vessels
 - * Swollen joints
 - * Anemia

Mnemonics

- Pirates at C



3 Fat-soluble Vitamins

ADEK

Retinol (A)

Source:

- * Dark green and orange vegetables and fruits
- * Dairy

Function:

- * Component of visual pigments
 - o Rhodopsin
- * Bone development and growth
- * Reproduction
- * Maintaining epithelial cells

Deficiency:

- * Symptoms
 - o Night blindness
 - o Xerophthalmia (dry conjunctiva and cornea) → corneal ulceration → blindness
 - o Acne and psoriasis

Mnemonics

- **Retinol = Retina**

1,25-dihydroxycholecalciferol (D)

Source:

- * Plants – ergocalciferol (D_2)
- * Animals – cholecalciferol (D_3)
 - o Dairy
 - o Egg yolks

Function:

- * Maintain plasma calcium levels
 - o Increase calcium uptake in intestine
 - o Retain calcium in kidney
 - o Stimulating resorption of bone when needed

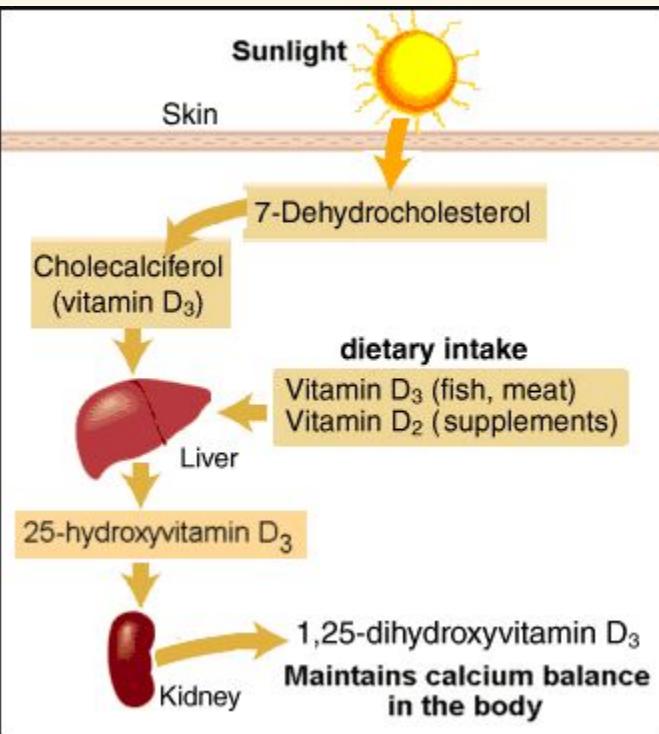
Deficiency:

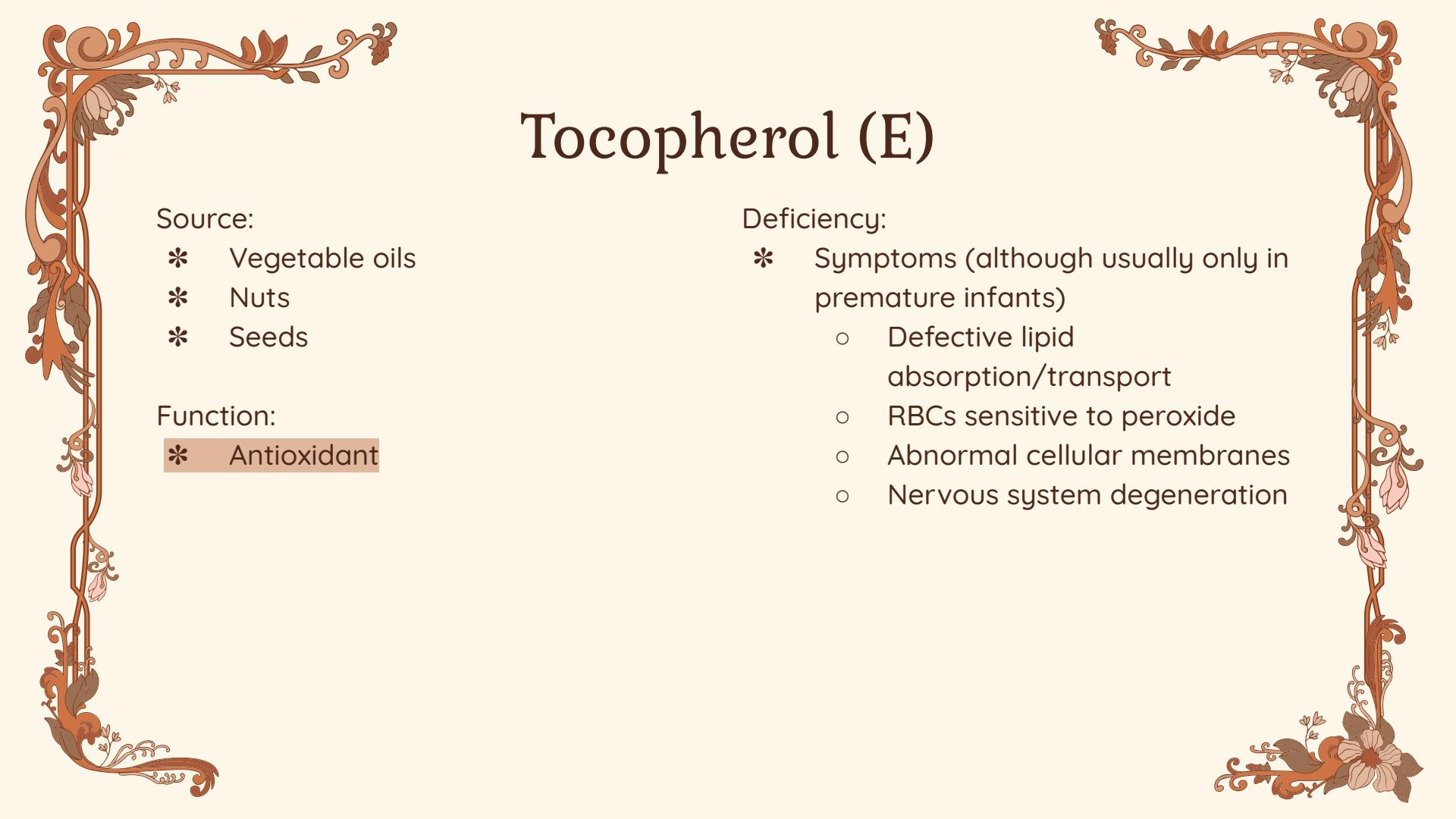
- * Symptoms
 - o **Rickets** (children) – incomplete mineralization
 - o Osteomalacia – demineralization

Mnemonics

- **Ergo = Argo**
cornstarch

Vitamin D Production





Tocopherol (E)

Source:

- * Vegetable oils
- * Nuts
- * Seeds

Function:

- * Antioxidant

Deficiency:

- * Symptoms (although usually only in premature infants)
 - Defective lipid absorption/transport
 - RBCs sensitive to peroxide
 - Abnormal cellular membranes
 - Nervous system degeneration

Vitamin K (phylloquinone, menaquinone)

Source:

- * Green vegetables
- * Tea
- * Colon bacteria

Function:

- * Blood clotting
 - o Synthesizing prothrombin
 - o Synthesizing blood clotting factors II, VII, IX, X

Deficiency:

- * Symptoms
 - o Hypoprothrombinemia (defective blood clotting)
- * Causes
 - o Antibiotics – decrease arterial in gut
 - o Newborns should receive intramuscular dose of vitamin K

Mnemonics

- Koagulation