

Iron Deficiency Anemia



Chalinee Monsereenusorn, M.D.

Prevalence



- Most common nutritional anemia
- High in infancy, school children, pre-adolescent

Prevalence of anemia in school age



	Prevalence(%)	Quantity
Center	2,467	23.5
North	1,916	26.3
North/East	1,881	35.6
South	1,805	24.8

Why is iron deficiency important?



- Remains most common nutrient deficiency in developing countries, Including Thailand
- Long term effects on neurodevelopment, behavior, neurotransmitter myelination, energy metabolism

Iron Homeostasis: Absorption, Loss, Storage and Recycling of Iron



Dietary intake = 10 mg/day

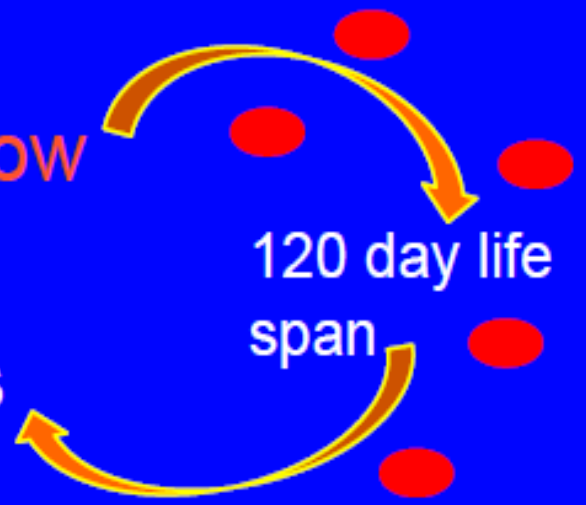
Absorption = 1 mg/day

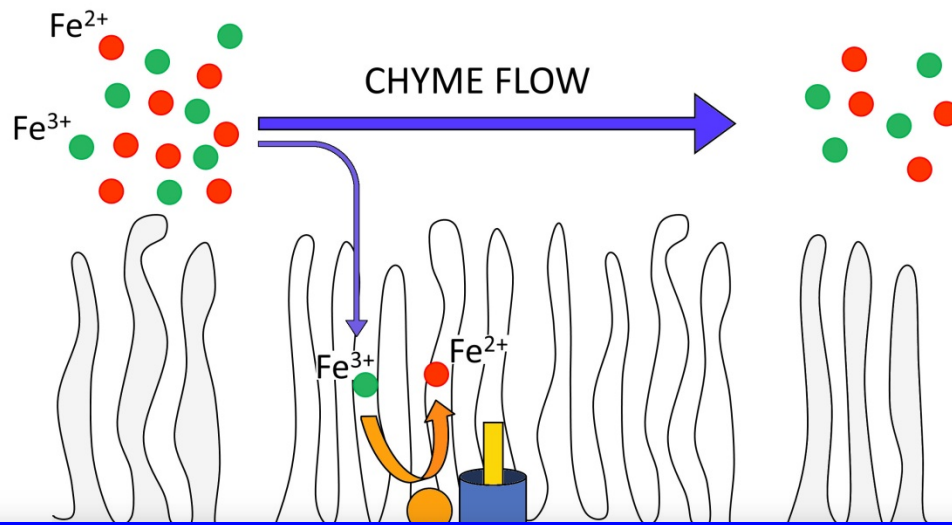
RBC production in bone marrow

Iron stores in macrophages and hepatocytes

Loss = 1 mg/day

120 day life span





• Enhanced by

Red meat

Ascorbic acid

Breast milk

Depressed by

Vegetable fiber

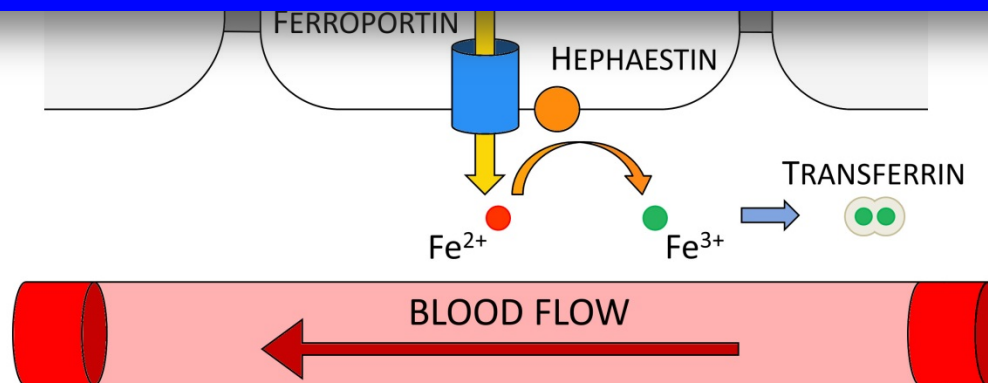
Phytates

Phosphates

Tea

Egg yolk

Cow milk



Etiology

Inadequate absorption

- Antacid therapy/High gastric pH
- ได้รับความบางชนิดที่ยับยั้งการดูดซึมธาตุเหล็ก เช่น bran, tannins
- Loss or dysfunction of absorptive enterocytes

Insufficient/ Inaccessible iron stores

- Blood loss
- Dietary insufficient
- Inflammation/Infection
- Defects in intestinal iron uptake
- Increased iron requirement (infants, adolescents)

Inadequate presentation to erythroid precursors

- Atransferrinemia
- Anti-transferrin receptor antibodies

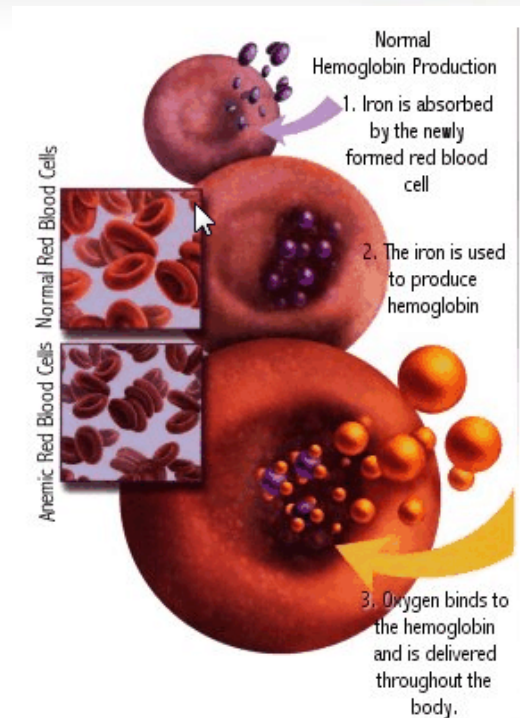
Abnormal intracellular transport/Utilization

- DMT1 mutation
- Defects in heme biosynthesis

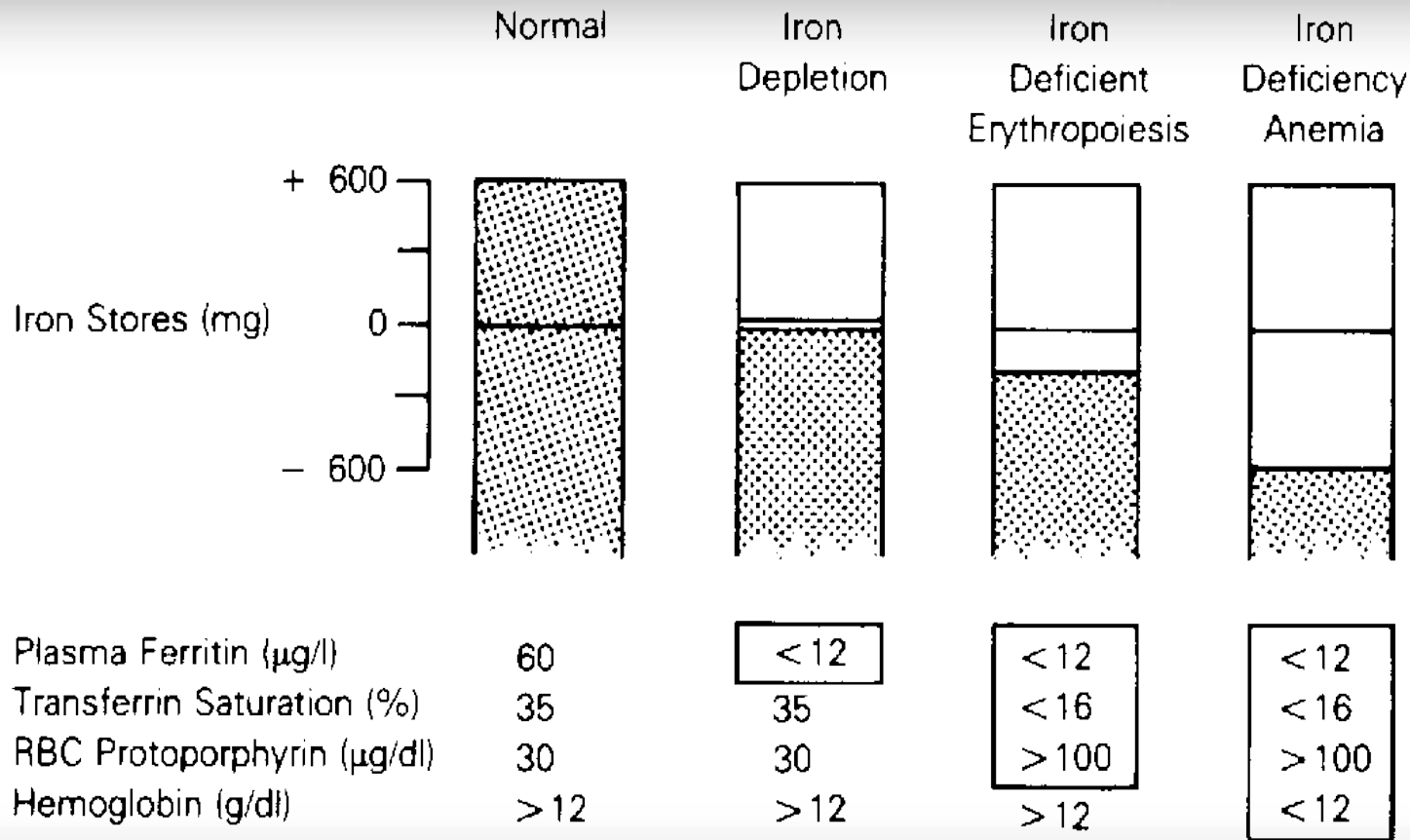
Phase of Development of Iron deficiency



- Prelatent iron deficiency:
 - : ↓ Iron stores (serum ferritin)
- Latent iron deficiency:
 - : Abnormal RBC , ↑ serum transferrin ,
↓ MCV , ↑ RDW, ↓ Transferrin saturation
- Frank iron deficiency anemia:
 - : ↓ Hemoglobin



Staging of Iron deficiency



Depletion of iron stores



Iron deficient erythropoiesis



Iron deficiency anemia

Risk factors



- Preterm infants : Decrease erythropoietin
- Exclusively breast-fed in more than 6 months old
- Toddlers in whom cow's milk was remain drink before 12 months age
- Children of immigrants : Socio-economic deprivation
- Toddlers and adolescents :
 - Increase increment in Hb iron / unit body weight
- Athletic performance : Increase iron loss

Clinical Manifestations



- Fatigue
- Decreased exercise tolerance
- Tachycardia
- Dermatologic manifestations
- Decreased intellectual performance
- Dysphagia
- Depression, increased incidence of infections

Clinical Manifestations



- Skin and conjunctival pallor
- Koilonychia
- Angular cheilosis
- Burning tongue
- Glossitis
- Hair loss (alopecia areata)



Diagnosis

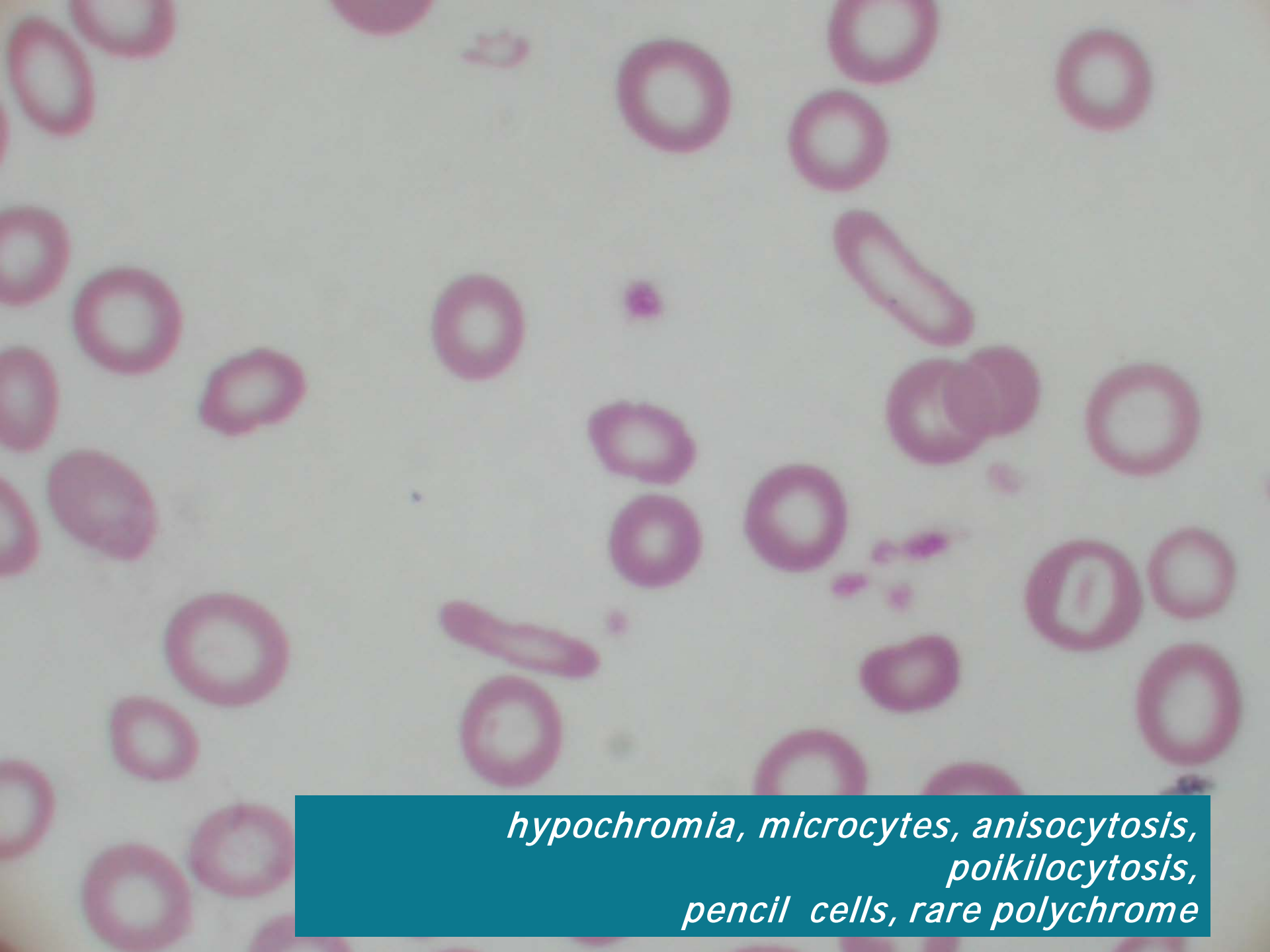


- Complete history and physical examination
- Complete blood count
 - Low Hb/Hct
 - Red cell indices: low MCV, MCH, MCHC but high RDW
 - Blood smear: hypochromic and microcytic red cells, pencil cells
 - Platelet count: thrombocytosis (esp. bleeding)
- Reticulocyte count: low

What is anemia?



Age	Lower limit of normal Hb level (g/dL)
6 mo - 6 yrs	11.0
6 - 14 yrs	12.0
\geq 15 yrs, male	13.0
\geq 15 yrs, female	12.0
Pregnancy	11.0



*hypochromia, microcytes, anisocytosis,
poikilocytosis,
pencil cells, rare polychrome*

Laboratory Diagnosis of Iron Deficiency

Compartment	Laboratory diagnosis	Value for Dx IDA
Storage iron	Serum ferritin	< 12 mcg/L
Plasma iron	Serum iron (Fe)	< 40 mcg/dL
	Serum transferrin (TIBC)	> 400 mcg/dL
	Transferrin saturation ratio (Fe/TIBC)	< 16%
RBC iron	Hemoglobin	According to age
	CHr	< 26 pg
	MCV	< 70 fL
	RDW	> 16%
	FEP	> 40 μ mol/mol

Diagnosis



- ↑ Hemoglobin within 1-4 weeks of starting iron therapy
(Complete response to a therapeutic trial of iron)

→ ***“Best test to confirm diagnosis”***

Differences Among Microcytic Anemias

	Iron deficiency	Beta Thalassemia Trait	Chronic Inflammation	Lead Toxicity
MCV	Low	Low	Normal-low	Normal-low
RDW	High	Normal	Normal	Normal-high
RBC number	Low	Normal-high	Normal	Low
Platelet count	Normal-high	Normal	Normal-high	Normal

Differences Among Microcytic Anemias

	Iron deficiency	Beta Thalassemia Trait	Chronic Inflammation	Lead Toxicity
Ferritin	Low	Normal	Normal-high	Normal
Transferrin saturation	Low	Normal	Low	Normal-high
Hb typing	Normal	↑ HbA2 ± ↑ HbF	Normal	Normal
Response to iron	Improves	No change	No change	No change
Other			↑ ESR or CRP	↑ Lead concentrate

Management



- ↑ Amount of heme-rich foods in the diet
- Oral iron replacement :
 - 6 mg/kg/day of element iron
 - bid , tid depending patient development of adverse effects
(nauseas ,stomach cramping , constipation , diarrhea)
- Vitamin C (ascorbic acid)
 - : ↑ Absorption of iron

Management



- Side effects
 - GI intolerance
 - Dark stools
 - Stained teeth
 - Bad taste
- Duration of treatment
 - Iron replacement should continue 3-4 months
(at least 2 months after correction of anemia)
- Most common causes of treatment failure
 - Noncompliance
 - Mistaken for iron deficiency eg thalassemia trait , disorders of malabsorption

Iron rich foods



- Heme iron (better bioavailability)
 - Meat (beef and turkey best)
 - Shellfish
- Non-heme iron (less bioavailability)
 - Breakfast cereal (iron fortified)
 - Pasta (iron fortified)
 - Beans and lentils
 - Baked potato with skin
- Foods that increase iron absorption
 - Fruits, vegetables, meat, fish, poultry, white wine

Tablet preparation



ชนิดของสารประกอบ	ปริมาณ (mg)	ปริมาณ elemental iron (mg)	ปริมาณ elemental iron (%)
Ferrous fumarate	200	65	33%
Ferrous gluconate	300	35	12%
Ferrous sulfate	300	60	20%
Ferrous sulfate (dried)	200	65	33%
Ferrous succinate	100	35	35%

Oral iron therapy- side effects



Extremely common	<ul style="list-style-type: none">• Parents not administering iron according to instructions เช่น รับประทานหลังอาหาร พร้อมนม หรือ รับประทานยาลดกรดร่วมด้วย• Poor compliance (intolerance)
Common	<ul style="list-style-type: none">• Incorrect dose or medication• Misdiagnosis : thalassemia, anemia of chronic disease, lead poisoning• Concurrent infection or inflammatory disorder
Occasionally	Ongoing blood loss
Uncommon	Malabsorption of iron

Responses to Iron Therapy in Iron-Deficiency Anemia

Time after Iron administration	Response
12-24 hours	Replacement of intracellular iron enzymes → subjective improvement → decreased irritability → increased appetite
36-48 hours	Initial bone marrow response → erythroid hyperplasia
48-72 hours	Reticulocytosis (peaking at 5-7 days)
4-30 days	Increase in hemoglobin level
1-3 Months	Repletion of stores

AAP recommendations



- Breastfeeding for the first 6 months of life
- Iron fortified formula for infants who are not breastfed
- Iron fortified infant cereal at 6 months of age
- Iron supplementation for preterm infants
- Iron supplementation for breastfeeding infants at 4 months of age
- Avoid cows milk before 1 year of age
- Limit cows milk to 18-24 oz/day after 12 months of age

Iron Deficiency Anemia



Chalinee Monsereenusorn, M.D.