

**Iron, Indices, and Insights:
Practical Pearls for Pediatric
Anemia**

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Objectives

- ▶ By the end of this session, participants will be able to:
- ▶ Recognize common causes of pediatric anemia across age groups.
- ▶ Use CBC indices to narrow the differential.
- ▶ Apply evidence-based strategies for diagnosing and treating iron deficiency.
- ▶ Identify red flags requiring hematology referral.
- ▶ Avoid common pitfalls in anemia evaluation.

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Why Pediatric Anemia Matters

- Affects >269 million children globally (1.2 million in the United States)
 - 1.29 billion people affected worldwide in 2021
- Most commonly due to nutritional deficiency
- Often asymptomatic → relies on screening
- Untreated iron deficiency anemia associated with neurocognitive and behavioral impacts

Raleigh ME, Yano AS, Shaffer NE. Anemia in Infants and Children: Evaluation and Treatment. Am Fam Physician. 2024 Dec;110(6):612-620. PMID: 39700365.
Lee, S., Son, Y., Hwang, J. et al. Global, regional and national burden of dietary iron deficiency from 1990 to 2021: a Global Burden of Disease study. Nat Med 31, 1809–1829 (2025).

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Current Screening Recommendations

- ▶ AAP/CDC: Universal screening 9-12mo with hemoglobin, ongoing screening for high risk
- ▶ USPSTF 2015: "The USPSTF concludes that the evidence on screening for iron deficiency anemia in asymptomatic children ages 6 to 24 months to prevent adverse growth, cognitive, or neurodevelopmental outcomes is lacking, and that the balance of benefits and harms cannot be determined."

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Age Based Differential Diagnosis

- Infants (0-12mo)**
 - IDA
 - physiologic anemia
 - Hemoglobinopathies
 - anemia of prematurity
- Toddlers (1-3yo)**
 - IDA (excess milk intake)
 - lead toxicity
 - thalassemia trait
- School Aged/Adolescents**
 - IDA (menstruation, diet)
 - chronic disease
 - Hemolysis
 - bone marrow disorders

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Classifying Anemia by MCV

- MICROcytic (MCV < 80 fL)**
 - IDA
 - thalassemia trait
 - chronic inflammation
 - lead poisoning
- NORMOcytic (MCV 80-100 fL)**
 - Acute blood loss
 - Hemolysis
 - chronic disease
 - bone marrow suppression
- MACROcytic (MCV > 100 fL)**
 - B12/folate deficiency
 - Hypothyroidism
 - bone marrow failure

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The CBC at a Glance

- ▶ Key components:
 - ▶ Hgb / Hct
 - ▶ RBC count
 - ▶ MCV
 - ▶ RDW
 - ▶ Platelets
 - ▶ WBC count
- ▶ What matters most in anemia:
 - ▶ MCV + RBC count + RDW = diagnostic triad
 - ▶ Reticulocyte count essential but often forgotten
 - ▶ Low retic → marrow not producing (IDA, chronic disease, aplasia).
 - ▶ High retic → marrow responding (hemolysis, blood loss).
 - ▶ Reticulocyte hemoglobin content (ChR/Ret-Hc) can detect early iron deficiency

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Physiologic Nadir

Normal developmental drop in hemoglobin during early infancy
Occurs due to:

- Decreased erythropoietin (EPO) after birth
- Shorter lifespan of neonatal RBCs
- Rapid growth and increased blood volume

Timing:

- Term infants: nadir at 8–12 weeks, Hgb ~ 9–11 g/dL
- Preterm infants: nadir earlier (4–8 weeks) and lower (Hgb 7–9 g/dL)

No treatment required in healthy term infants

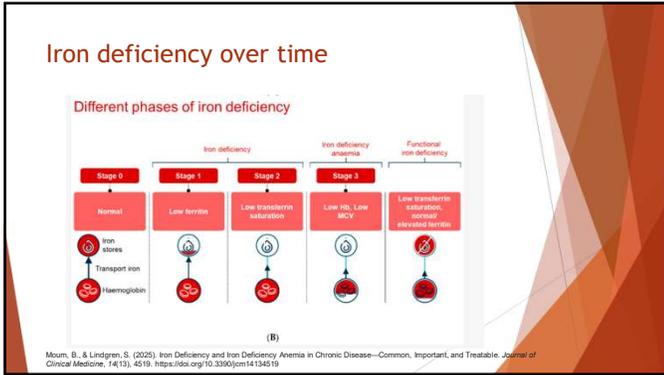
Distinguish from pathologic causes:

- Hemolysis
- Blood loss
- Infection
- Nutritional deficiencies
- Bone marrow failure

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Anemia of prematurity

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Mentzer Index – Differentiating Iron Deficiency vs Thalassemia Trait

What is the Mentzer Index?

- ▶ A simple calculation using RBC indices to help differentiate:

Mentzer Index = MCV ÷ RBC count

- ▶ > 13 → Iron Deficiency Anemia (IDA) more likely
- ▶ < 13 → Thalassemia Trait more likely

Why it works

- ▶ Thalassemia trait → microcytosis with high RBC count
- ▶ Iron deficiency → microcytosis with low or normal RBC count

Mentzer, WilliamC. (1973). Differentiation of iron deficiency from thalassaemia trait. *The Lancet*, 301(7808), 882. [https://doi.org/10.1016/S0140-6736\(73\)91446-3](https://doi.org/10.1016/S0140-6736(73)91446-3)

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Ferritin

Cutoffs:

- ▶ Ferritin < 12 ng/mL = ID
- ▶ Ferritin < 30 ng/mL strongly suggests deficiency
- ▶ Ferritin may be falsely NORMAL in inflammation
- ▶ American Society of Hematology currently developing new recommendations for diagnosis of iron deficiency

Consider order with CRP or ESR if illness is possible.

[Iron Deficiency Anemia - Hematology.org](https://www.hematology.org)

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Full Iron Studies

Order iron panel only if diagnosis unclear:

- ▶ Serum iron
- ▶ TIBC
- ▶ Transferrin saturation
- ▶ Ferritin

Remember:

- ▶ Iron studies fluctuate with illness, meals, time of day → ferritin still most reliable.

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Risk Assessment

Ask about:

- ▶ Cow's milk > 16-24 oz/day
- ▶ Limited meat intake
- ▶ Vegetarian/vegan diet
- ▶ Pica

Other blood loss:

- ▶ Heavy menstruation
- ▶ GI losses (celiac, IBD)

Must address the underlying cause of the iron deficiency

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Iron Dosing: Evidence-Based Recommendations

Oral dosing:

- ▶ 3-6 mg/kg/day elemental iron once daily
- ▶ Once-daily dosing is effective & better tolerated

Avoid coadministration with milk or tea

Improved absorption with vitamin C coadministration

Some evidence to support every other day dosing

Expect black stools

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Oral Iron Formulations

Ferrous sulfate

- ▶ Gold standard
- ▶ 44 mg elemental Fe per 5 mL (liquid); may stain teeth, rinse with water after

Others:

- ▶ Polysaccharide iron complex – less GI upset, lower absorption (novaferrum)
- ▶ Ferrous fumarate (celebrate)
- ▶ Chewables for adolescents
- ▶ Gummies palatable but 8-12mg iron per gummy requiring many gummies

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Expected Response to Iron

- ▶ Day 3-5: Reticulocytosis
- ▶ Week 2: ↑ Hgb by -1 g/dL
- ▶ Week 4-6: Hgb normalizes
- ▶ Continue for 3 months after normalization to replenish stores

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Causes of failure

Common reasons:

- ▶ Poor adherence
- ▶ Incorrect dose
- ▶ Taking with dairy
- ▶ Malabsorption (celiac)
- ▶ Ongoing blood loss
- ▶ Incorrect diagnosis

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IV Iron

Indications:

- ▶ Intolerance to oral iron
- ▶ Difficulty absorbing iron (e.g., celiac, IBD)
- ▶ Severe anemia requiring rapid correction
- ▶ Non-adherence despite counseling

Common pediatric options:

- ▶ Iron sucrose: multiple infusions necessary
- ▶ Ferric carboxymaltose: \$\$\$, hypophosphatemia

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Alpha Thalassemia trait

- ▶ Microcytosis
- ▶ Normal RDW
- ▶ Normal to mildly elevated RBC
- ▶ Mentzer index less specific
- ▶ Hemoglobin Barts on newborn screen
 - ▶ Normal hemoglobin profile after early infancy
 - ▶ Otherwise requires genetic testing to prove

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Beta Thalassemia Trait: Key Clues

- ▶ Microcytosis out of proportion to anemia
- ▶ Normal RDW
- ▶ Mentzer Index <13
- ▶ Family history or ethnicity risk
- ▶ Confirm with hemoglobin electrophoresis (after iron repletion)

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Lead Toxicity

- ▶ Microcytic anemia with basophilic stippling
- ▶ Often coexists with IDA
- ▶ Screen high risk patients

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Anemia of Chronic Inflammation

- ▶ Mild anemia, normal/low MCV
- ▶ Ferritin normal/high; iron low; TIBC low
- ▶ Treat underlying condition

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Hemolytic Anemia: Red Flags

- ▶ Jaundice, dark urine, splenomegaly
- ▶ Labs: ↑ retic, ↑ bilirubin, ↑ LDH, ↓ haptoglobin
- ▶ Causes: G6PD deficiency, hereditary spherocytosis, AIHA

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Macrocytic Anemia

- ▶ B12 deficiency (vegan diet, malabsorption)
- ▶ Folate deficiency (poor intake)
- ▶ Hypothyroidism
- ▶ Bone marrow failure (Fanconi, Diamond Blackfan)

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Case #1: Milk, it does a body good?

- ▶ 2 year old male
- ▶ Full term, previously breastfed
- ▶ 12m hemoglobin: 11
- ▶ At 2yo WCC, maternal concern for pallor
- ▶ Hgb: 9
- ▶ Next steps?
- ▶ Dietary screening (how many gallons of milk do you buy per week?, pica, other iron rich foods)
- ▶ Full CBC? Ferritin? TIBC?
- ▶ Empiric iron treatment?

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Case #2: Hidden in Plain Sight

- ▶ 13 year old female new to office
- ▶ Menarche at 10 years old
- ▶ Increasing fatigue, hair loss
- ▶ Hgb in office 8.5
- ▶ Menstrual history
- ▶ Other blood loss? GI?
- ▶ Dietary history (concern for eating disorder?)
- ▶ Systemic symptoms (rash, joint pain?)
- ▶ Any personal or family history of anemia

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Case #3: Beyond Iron Deficiency

- ▶ 2mo infant in office for poor feeding and pallor
- ▶ Full term, no positive maternal antibody
- ▶ Hgb 6
- ▶ CBC with elevated MCV
- ▶ Low retic
- ▶ High ADA level
- ▶ Diamond Blackfan anemia (pure red cell aplasia)

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Case #4: A visit to granny's house

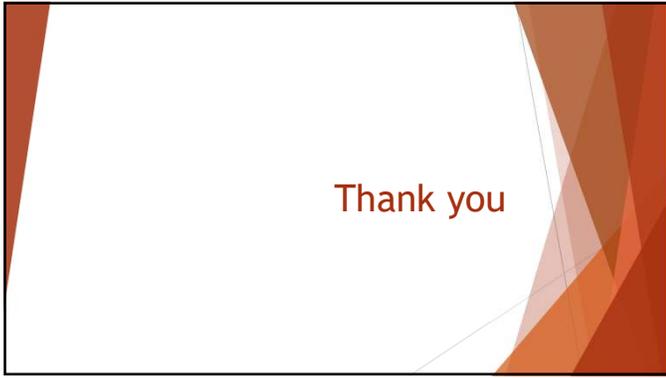
- ▶ 3 year old previously healthy
- ▶ Presents with pallor, dark urine, yellow eyes after visit to grandmother's house
- ▶ Hgb 7
- ▶ Retic 10%
- ▶ Indirect bilirubin elevated
- ▶ LDH elevated
- ▶ Coombs negative
- ▶ Granny recently put out mothballs after seeing a snake in the yard
- ▶ G6PD Deficiency

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When to refer

- ▶ Identified or concern for hemoglobinopathy (sickle cell)
- ▶ Iron deficiency not responsive to therapy
- ▶ Concern for nonimmune hemolytic anemia
- ▶ Concern for DBA or other evidence of bone marrow failure
- ▶ ***Evidence of autoimmune hemolytic anemia
- ▶ You have concern

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Thank you
