

Running on Empty: Recognizing and Treating Iron Deficiency Anemia



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Objectives

- Describe the symptoms associated with iron deficiency and iron deficiency anemia
- Identify the correct laboratory tests to evaluate for iron deficiency and iron deficiency anemia
- Summarize appropriate treatment strategies for iron deficiency and iron deficiency anemia



Case #1

18mos F presents for routine well child check

- Parents have no concerns
- Diet: transitioned to whole milk out of sippy cup, good variety of table foods
- Sleep: sleeping through the night, takes 2 naps during the day
- Potty: soft stools daily
- Growing and developing appropriately



Case #1

18mos F presents for routine well child check

- T 37°C, HR 110bpm, RR 28, BP 86/45
- Exam largely unremarkable
- Routine POCT Hb 6.2
 - Where do we go from here?





Iron is Important in Growing Children

- Iron receptors exist on almost every cell in the body
- Iron is important in:
 - RBC production
 - Brain development (myelin synthesis)
 - Dopamine synthesis
 - Immune cell growth, differentiation & certain cell-mediated immunity
 - Enzyme-driven aerobic metabolism



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Iron Deficiency is VERY Common

- Most common in toddlers and adolescent females
 - 13.5% of toddlers between 1-2 years old
 - 7.1% of children < 5 years old
 - 10-16% of females between 12-19 years old
- Also common in breastfed infants > 6 mos old



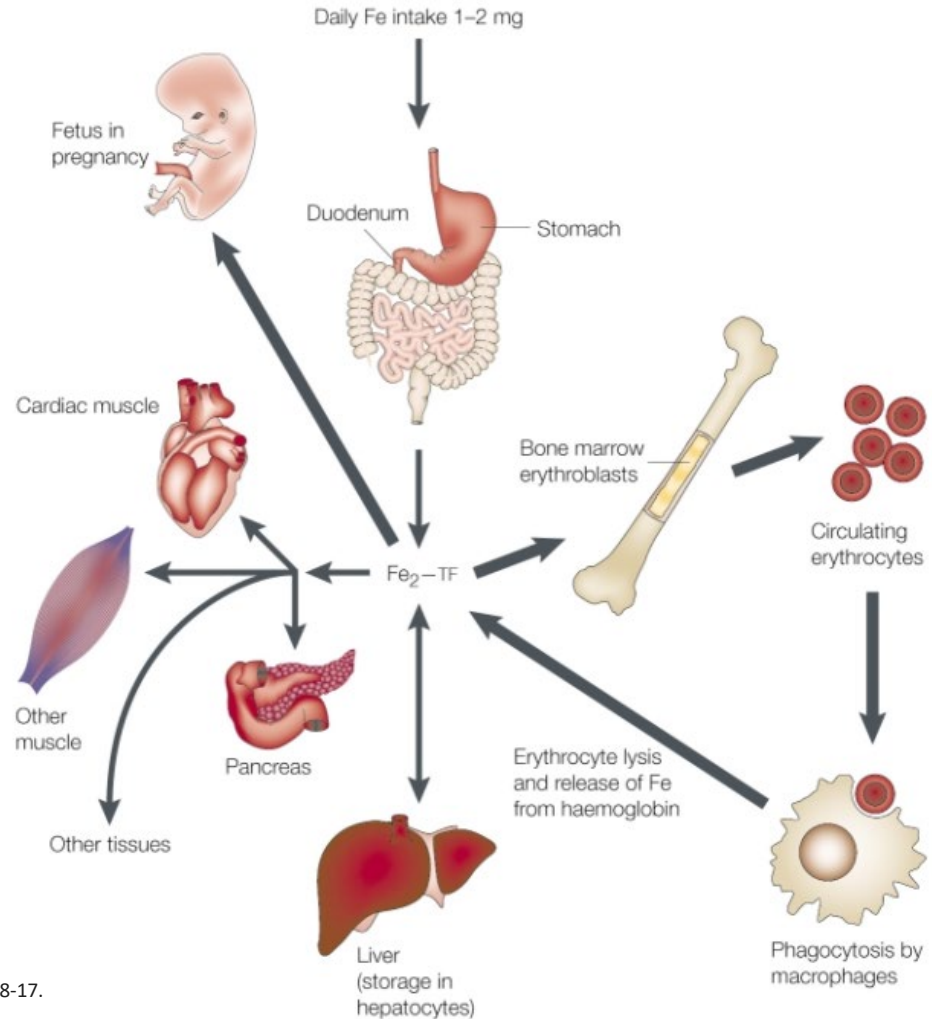
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Iron Balance is Maintained By Absorption from Intestine

Absorption is regulated by **hepcidin**:

↓ iron → ↓ hepcidin → ↑ iron absorption

Normal iron → ↑ hepcidin → decreased absorption





Iron Deficiency Occurs with Limited In/Excess Out

- Iron deficiency occurs as a result of:
 - Not enough iron getting in:
 - Poor diet, excessive milk intake
 - Poor absorption
 - Increased requirements during time of rapid growth
 - Too much iron going out:
 - Heavy menstrual bleeding
 - GI blood loss: IBD
 - Blood Donation





Iron Deficiency in Infants

- Iron transfer from mother to fetus occurs primarily during 3rd trimester
- Term infants receive full “endowment”
 - Sufficient stores for 4-6 months
 - Iron supplementation should be started by 4-6 months
- Premature delivery means less time for iron transfer





Cow's Milk and Iron Deficiency

- Very little iron in milk ($<1.5\text{mg/L}$)
- Not well absorbed (only $\sim 10\%$ absorbed)
 - Iron content in breastmilk similar, but 20-80% is absorbed
- Too much milk $\rightarrow$ not getting enough other foods
- **Limit milk to 2 cups per day (16 ounces)**
 - In those with severe anemia, eliminate milk completely



What is Heavy Menstrual Bleeding?

- **7-2-1 Rule:**
 - Bleeding for more than **7** days
 - Changing pad/tampon more than once every **2** hours
 - Clots larger than **1** inch in diameter
- Any degree of bleeding interfering with quality of life

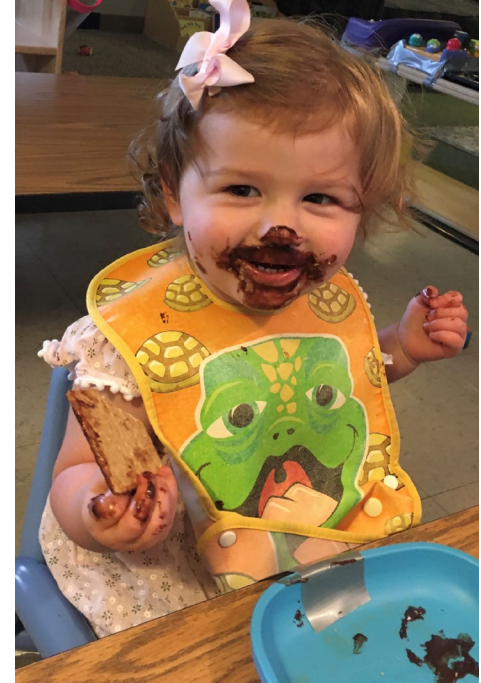




Case #1

18mos F presents for routine well child check

- T 37°C, HR 110bpm, RR 28, BP 86/45
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 - Where do we go from here?





Iron Deficiency in Toddlers is often Asymptomatic

- Toddlers can be asymptomatic
 - This is often a chronic anemia that develops over time, allowing the body to compensate (vital signs will be stable)
 - Parents often will not notice a change in behavior or energy level
 - Often caught on routine screening at well child check
 - Retrospectively, parents may report PICA symptoms





PICA is a Side Effect of Iron Deficiency

- Craving non-food items:
 - Ice
 - Dirt
 - Cardboard (books, boxes)
 - Paper
 - Cornstarch
 - Soap, Detergent





Iron Deficiency in Adolescents is Often Symptomatic

- Fatigue
- Headaches
- Dizziness, lightheadedness
- Decreased exercise performance
- Impaired cognition
- Restless legs and poor sleep
- Increased psychiatric symptoms:
 - Anxiety
 - Depression
 - Mood changes
- Hair loss
- Muscle weakness
- Difficulty concentrating



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Natural Course of Iron Deficiency

Depleted Iron Stores:

Ferritin ↓
TIBC Normal
Reticulocyte Count Normal
Hemoglobin Normal
MCV Normal

Iron-Limited Erythropoiesis

Ferritin ↓
TIBC ↑
Reticulocyte Count ↓
Hemoglobin Normal
MCV ↓/Normal

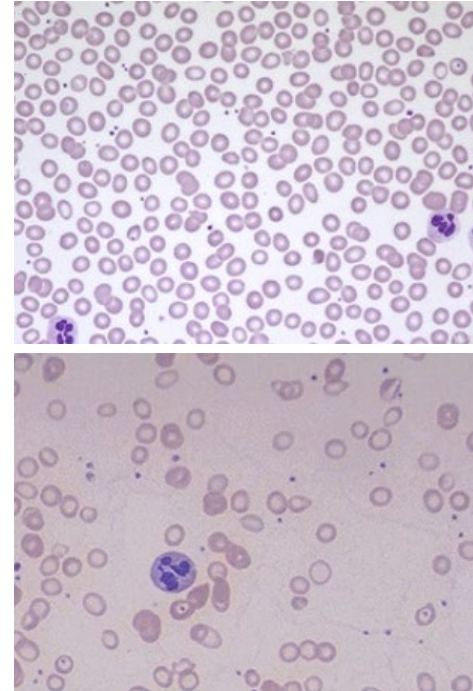
Iron Deficiency Anemia:

Ferritin ↓
TIBC ↑
Reticulocyte Count ↓
Hemoglobin ↓
MCV ↓



Diagnosing Iron Deficiency

- Clinical History:
 - Nutrition Assessment
 - Bleeding History
 - Concerns for malabsorption
- Physical Exam:
 - Pallor
 - Tachycardia, heart murmur
- Labs: CBC without diff, Ferritin



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Is a POCT Hemoglobin Sufficient?

- If standard screening in your office is a POCT hemoglobin, an empiric oral iron supplementation trial is reasonable
 - This method will miss some patients with iron deficiency
 - Recommend repeating labs in 1 month (ideally with a CBC)





Diagnosing Iron Deficiency

- **There is no gold standard test for iron deficiency**
 - Decrease in hemoglobin is a late finding!
- **Iron Studies:**
 - Serum iron reflects iron intake over last 24-72 hours
 - TIBC evaluates level of circulating iron transport protein
 - Ferritin is the best test:
 - 9mos – 11 yo: serum ferritin $\leq 20\text{mcg/L}$
 - $\geq 11\text{yo}$: serum ferritin $\leq 30\text{mcg/L}$
 - Heavy menstrual bleeding: serum ferritin $\leq 50\text{mcg/L}$



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Ideal Ferritin Level has Not Been Established

- Ferritin is an acute phase reactant
- Definition of iron deficiency in pediatrics: $<15^*$
 - This was based off observed values in a sample population, with the cutoff being at the lowest 2.5%
 - This assumes a Gaussian distribution
 - Between 30-50% of women have absent iron stores in their marrow
 - Iron needs are different in periods of rapid growth



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Ideal Ferritin Level has Not Been Established

- Prior studies have shown:
 - Administering iron to women with ferritin < 50 ng/mL significantly improved fatigue
 - Restless leg symptoms improve once ferritin > 75ng/mL has been achieved
 - Iron absorption does not return to steady state until serum ferritin is > 50ng/mL



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Ideal Ferritin Level has Not Been Established



blood advances

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REVIEW ARTICLE | SEPTEMBER 16, 2026

American Society of Hematology 2026 guidelines for diagnosis of iron deficiency

Jacquelyn M Powers , Ming Yeong Lim, Maureen O. Achebe, Imo J Akpan, Michael Auerbach, Megan C Brown, Maria Paula Cardenas, Caroline Cromwell, Thomas G. DeLoughery, Robert E. Fleming, Martina Fraga, George Goshua, Paula D. James, Adam K Lewkowitz, Jori Ellen May, Grace Nnadozie, Frances Ogunnaya, Guillermo J. Ruiz-Arguelles, Michelle Sholzberg, Layla Van Doren, Angela C. Weyand, Michelle Paula Zeller, Muayad Azzam, Ali Choib, Qais Hamarsha, Hassan Kawtharany, Jana Khawandi, Reem A. Mustafa



Check for updates

Blood Adv bloodadvances.2025015950.

<https://doi.org/10.1182/bloodadvances.2025015950>

Article history 



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Ideal Ferritin Level has Not Been Established

- Hematology cutoffs:
 - 9mos – 11 yo: serum ferritin $\leq$ 20mcg/L
 - $\geq$ 11yo: serum ferritin $\leq$ 30mcg/L
 - Heavy menstrual bleeding: serum ferritin $\leq$ 50mcg/L

A diagnosis of iron deficiency does **not** require anemia,
anemia is a late finding



Case #1

18mos F presents for routine well child check

- T 37°C, HR 110bpm, RR 28, BP 86/45
- Exam largely unremarkable
- Routine POCT Hb 6.2
 - Where do we go from here?



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Case #2

16yo F presenting with persistent headaches and decreased endurance

- T 37°C, HR 120bpm, RR 18, BP 107/65
- Exam largely unremarkable
- Routine POCT Hb 6.2
 - Where do we go from here?



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A Tale of Two Cases

18 mos F



- Asymptomatic
- Vital signs stable
- Exam unremarkable
- Hb 6.2

16yo F



- Symptomatic
- Tachycardic
- Exam unremarkable
- Hb 6.2

Where do we go from here?



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When Does IDA Require Admission?

- Symptomatic anemia:
 - Shortness of breath, headaches, near-syncope
 - Fatigue typically does not qualify
 - These are **not** the patients diagnosed incidentally
- Vital sign instability
- Ongoing blood loss
- Hemoglobin < 5



The ASH-ASPPO Choosing Wisely Campaign: 5 hematologic tests and treatments to question

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Julie Makarski⁶ | Rachel S. Bercovitz^{2,3} | Mary-Jane S. Hogan⁷ |
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Julie A. Wolfson¹³  | Marianne Yee^{14,15}  | Lisa K. Hicks¹⁶

Bottom Line: Don't transfuse pRBCs for IDA in asymptomatic pediatric patients when there is no evidence of hemodynamic instability or active bleeding.



Why are Transfusions Less Helpful in IDA?

- Transfusions are not benign: reactions, blood-borne infections, RBC alloimmunization, volume overload, etc
- Transfusion does not correct IDA
- IDA is often chronic, so cardiovascular instability is unlikely
- Iron therapy (oral or IV) is effective in correcting anemia as long as there is no ongoing bleeding/hemorrhage



Oral Iron Supplementation is First Line

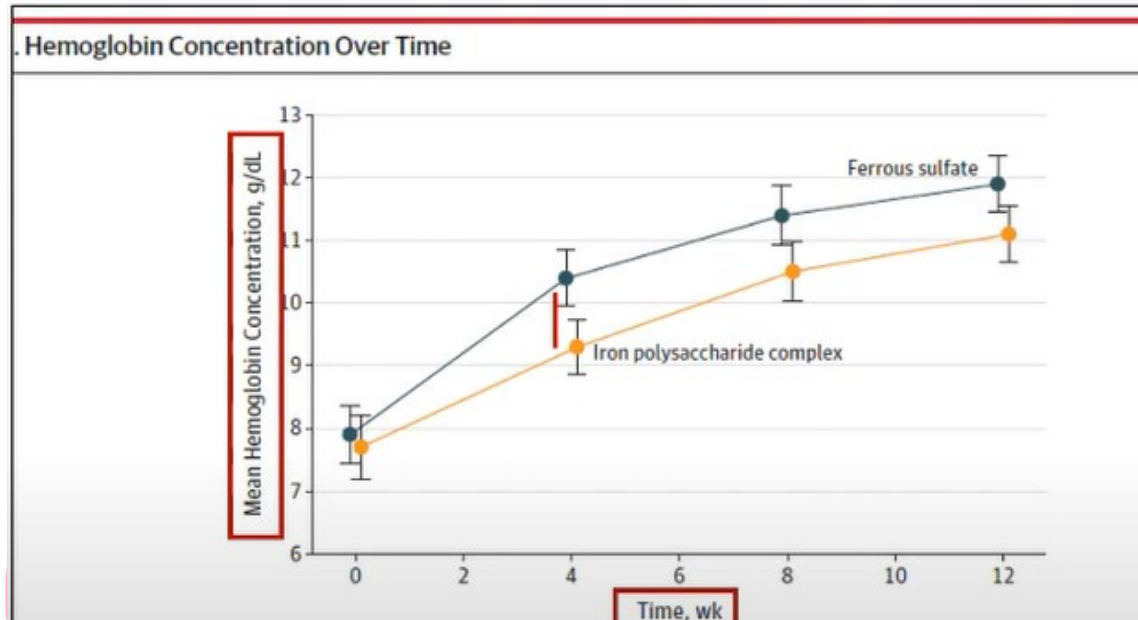
- Oral iron supplementation is first line
 - Dosing:
 - Children: 3mg/kg elemental iron daily
 - Adolescents: 65mg elemental iron daily
 - Dosing more than once daily increases hepcidin levels, which will decrease absorption
 - Creates more side effects without much benefit
- Must also address underlying cause



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Best Iron Trial

- Double-blind, randomized clinical trial of infants and children with nutritional IDA
- Compared ferrous sulfate vs iron polysaccharide complex



***Ferrous sulfate better at improving anemia**

***Giving iron in a low dose, once per day, was effective**

Iron and Vitamin C

- Vitamin C enhances absorption of iron
 - Ferric iron (Fe^{+3}) must be reduced to ferrous iron (Fe^{+2}) before it can be absorbed
 - Vitamin C has anti-oxidant properties that can reduce ferric iron to ferrous iron and prevents conversion to ferric iron
- Systematic review and meta-analysis looking at vitamin C + iron vs iron alone found no difference in standardized mean difference of hemoglobin and ferritin
 - Need an actual RCT looking at vitamin C + iron vs iron alone



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What Should Not Be Given with Iron?

- Iron is best absorbed on an empty stomach
- Calcium blocks absorption of iron
 - Avoid dairy within 1-2 hours of iron dose
- Tannins (tea, red wine) also block absorption
- Medications: acid blockers will block absorption
 - Thyroid medications do not block absorption, but thyroid must be at steady state to enhance absorption



Addressing the Underlying Cause

Limited In

- Limit or eliminate cow's milk from diet
- Encourage iron rich foods
- GI referral if concerns for malabsorption

Excess Out

- Limit or eliminate cow's milk from diet
- Management of menstrual bleeding
- GI referral if concerns for GI blood loss and IBD



Iron Rich Foods

- Eatrigh.org -- Academy of Nutrition and Dietetics
 - PDF of iron rich diets for children and adolescents with sample meal plan
- American Red Cross → Iron Rich Food and Iron Rich Food Pyramid PDF
- Consider referral to nutrition





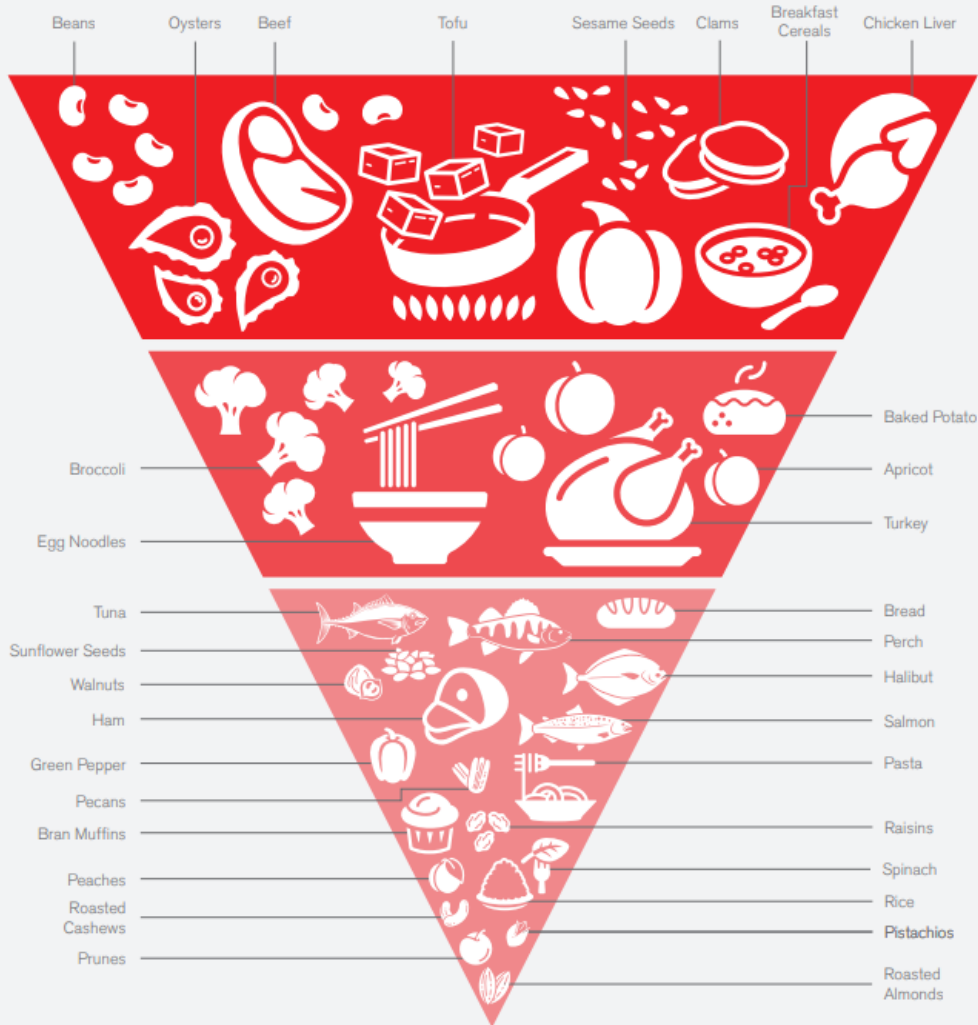
Iron is an essential mineral that is needed for healthy blood. You can get iron from the foods you eat. This guide shows the foods with the most iron to the lowest.

Try to combine nonheme iron foods with vitamin C (for example, a glass of orange juice) to increase absorption of iron.

Talk to your healthcare provider to determine how much iron you need every day.

Foods to avoid: Fried foods, butter, mayonnaise, ice cream, chips, cheesecake, fatty meat, duck, gravy, bacon and sausage, cream soups

**Schedule to Donate Blood at
RedCrossBlood.org/Give or
call 1-800-RED CROSS.**



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Iron Rich Breakfast Cereals

Many breakfast cereals are fortified with iron and other nutrients. Cereals can act as a quick and easy source of iron. Just pour some iron-fortified dry cereal into a baggie for breakfast or a simple snack. Remember, it's best to eat iron-rich foods without milk.

Good

General Mills COCOA PUFFS
General Mills CINNAMON GRAHAMS
General Mills FIBER ONE
General Mills FRANKENBERRY
General Mills CHEERIOS: honey nut, frosted, apple
cinnamon, berry burst, fruity
General Mills CURVES, fruit & nut crunch
General Mills HARMONY
General Mills GOLDEN GRAHAMS
General Mills WHEATIES, raisin bran
General Mills LUCKY CHARMS
General Mills CINNAMON TOAST CRUNCH
General Mills KIX, berry berry
General Mills BOO BERRY
General Mills COUNT CHOCULA
General Mills COOKIE CRISP
General Mills FRENCH TOAST CRUNCH
General Mills PEANUT BUTTER TOAST CRUNCH
General Mills TRI-X
General Mills REESE'S PUFFS
Kellogg's ALL BRAN: original with extra fiber
Kellogg's EGGO CRUNCH
Kellogg's RICE KRISPIES: frosted, berry
Kellogg's FRUIT LOOPS
Kellogg's APPLE JACKS
Kellogg's RAISIN BRAN
Kellogg's SMORZ
Kellogg's FRUIT HARVEST: strawberry, blueberry
Malt-O-Meal COCO-ROOS
Malt-O-Meal MARSHMALLOW MATEYS
Malt-O-Meal APPLE ZINGS
Malt-O-Meal CINNAMON TOASTERS
Malt-O-Meal TOASTY O'S: apple cinnamon, honey nut
Malt-O-Meal BLUEBERRY MUFFIN TOPS
Malt-O-Meal TOOTIE FRUITIES
Malt-O-Meal COLOSSAL CRUNCH: original, berry
Malt-O-Meal FROSTED FLAKES
Post TOASTIES, corn flakes
Quaker CINNAMON CRUNCH
Quaker HONEY NUT OATS

Better

General Mills WHEATIES
General Mills CHEX, wheat
General Mills KABOOM
Kellogg's COCOA KRISPIES
Kellogg's CORN FLAKES
Kellogg's SPECIAL K: plain, chocolatey
delight, red berries, vanilla
Kellogg's almond
Kellogg's FROSTED FLAKES
Kashi 7 JUST RIGHT, fruit & nut
Post WHOLE GRAIN NUGGETS
Post RAISIN BRAN
Post HONEY BUNCHES OF OATS,
with almonds
Post BANANA NUT CRUNCH
Quaker GRAPE NUT FLAKES
Quaker LIFE: plain, cinnamon
Quaker HONEY GRAHAM
Quaker OATMEAL SQUARES,
cinnamon
Quaker OAT BRAN
Quaker CRISPY CORN PUFFS

Best

General Mills TOTAL corn flakes
General Mills TOTAL: raisin bran, cranberry crunch
General Mills TOTAL: whole grain
General Mills CHEX: corn, rice, honey nut, multi-
bran, frosted
General Mills CHEERIOS, yogurt burst
General Mills CHEERIOS, multigrain
Kellogg's KIX
Kellogg's CRISPIX
Kellogg's FROSTED MINI WHEATS: plain,
maple & brown sugar, strawberry
delight
Kellogg's ALL BRAN COMPLETE, wheat flakes
Kellogg's PRODUCT 19
Kellogg's COMPLETE oat bran flakes
Kellogg's SMART START strong heart
antioxidants
Kashi RICE KRISPIES
Malt-O-Meal SHREDDED WHEAT
Malt-O-Meal MIGHTY BITES, honey crunch
Malt-O-Meal PUFFED WHEAT
Malt-O-Meal PLAIN
Malt-O-Meal PUFFED RICE
Malt-O-Meal FROSTED MINI SPOONERS
Malt-O-Meal CRISPY RICE
Malt-O-Meal CHOCOLATE
Malt-O-Meal Honey graham squares
Malt-O-Meal TOASTY O'S

Timeline to Improvement

5-7 Days:
↑ Reticulocytes

1 Month:
Mild: Hb normal
Moderate/Severe:
>2g/dL increase

3 Month:
Ferritin normal



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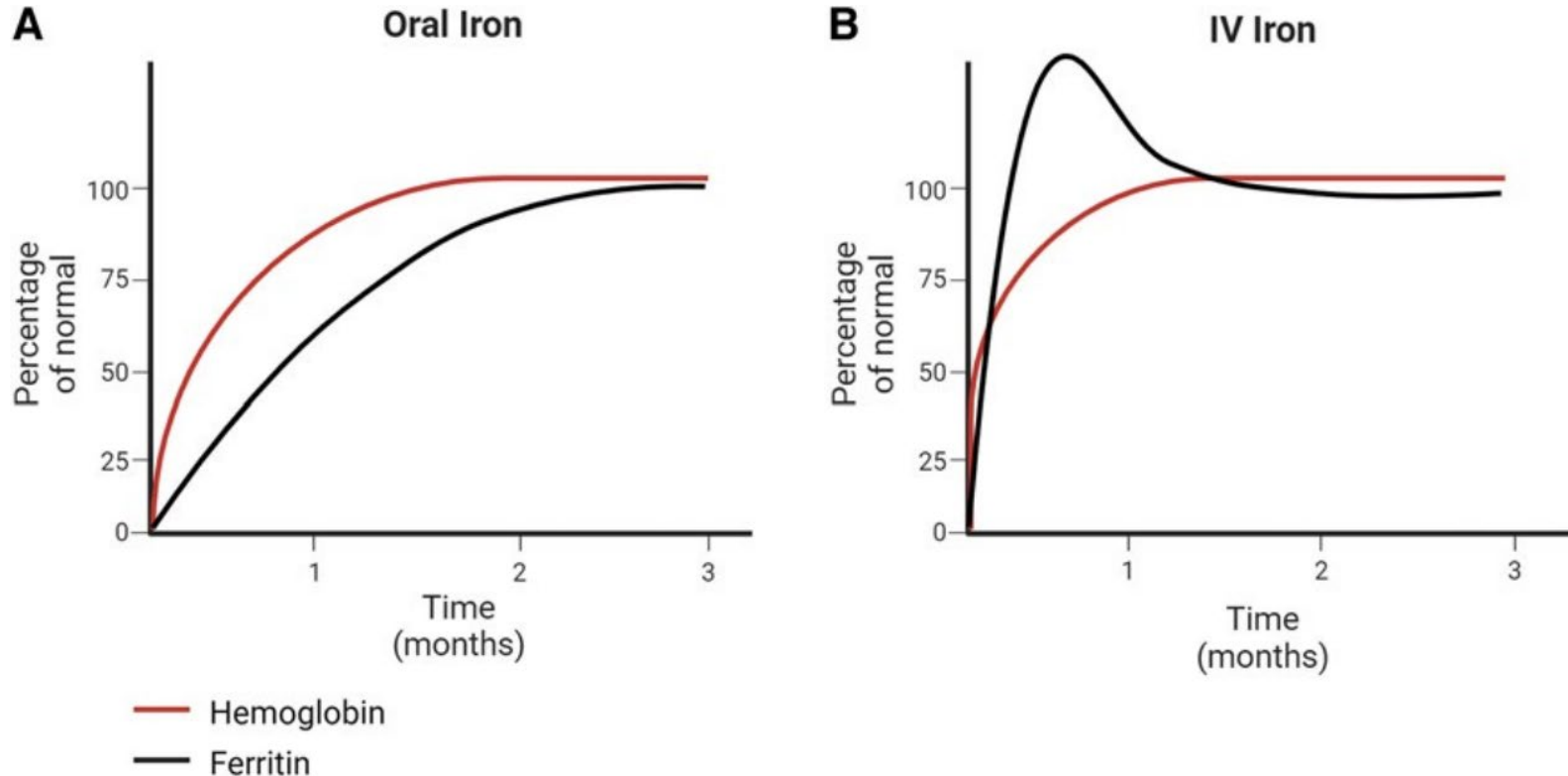
When Should IV Iron Be Considered?

- Children who cannot take iron liquid or tablets
 - Due to side effects or other medical conditions
- Children who failed oral iron (no improvement in 3 months)
- Children who have had IDA for a prolonged period
- History of medication nonadherence or poor follow up
- Recurrent IDA due to ongoing blood loss
- Severe IDA



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IV Iron Improves Labs and Symptoms Quicker



Caveats to IV Iron

- Dosing based off total iron deficit
- Requires multiple infusions
 - Multiple IV pokes
 - Infusions take 2-3 hours
 - Require insurance approval
 - If referring for IV iron, please let family know that they will not receive an infusion at their first appointment with hematology



Caveats to IV Iron

- Side Effects:
 - Allergic Reaction: much lower risk with newer products
 - Fishbane Reaction: flu-like symptoms (myalgias, headaches, nausea, dizziness, facial flushing)
 - Unclear mechanism: potentially related to complement activation by labile free iron
 - Resolves within 24-48 hours following infusion
 - Iron tattoo



Caveats to IV Iron

- Risk of Anaphylaxis:
 - Iron dextran: 9.8/10,000
 - Iron sucrose: 1.2/10,000
 - Ferumoxytol: 4/10,000
 - Ferric carboxymaltose: 0.8/10000
 - *Compared to a 1% risk with first generation products



Fishbane Reaction

- Mild hypersensitivity reaction
- Due to complement activation-related pseudo-allergy (CARPA)
- Occurs in 1/100 patients receiving iron sucrose
- Chest tightness/pain, joint pain, flushing
 - Symptoms resolve after stopping infusion
 - Symptoms do not typically recur when restarting infusion at slower rate
 - Should not be treated with Epi or Benadryl, as this can exacerbate symptoms
- Role of premedications is debated, as these medicines can cause side effects that are then attributed to the iron



Delayed Reactions

- Much more common with iron sucrose
 - Fever, arthralgias, myalgias, lymphadenopathy
 - Begin hours to a day after infusion
 - Typically resolve within 48 hours



Factors Increasing Risk of Hypersensitivity

- Previous reaction to IV iron
- Fast iron infusion rate
- History of other drug allergy
- Severe asthma or eczema
- Mastocytosis
- Severe respiratory or cardiac disease
- Older age
- Treatment with beta-blockers, ACE inhibitors
- Pregnancy
- Systemic inflammatory disease (RA, SLE)
- Anxiety (patient or staff)



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Management of IV Iron Reactions

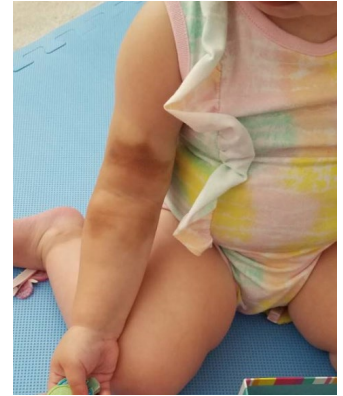


Iron Tattoo

- Very rare
- Caused by infiltration and/or extravasation of iron into the subcutaneous tissue
- Purely cosmetic
- Can be permanent



2 days after
infusion



5 weeks after
infusion



Case #2

16yo F presenting with persistent headaches and decreased endurance

- Routine POCT Hb 6.2
- Admitted and received 2u pRBC with improvement in hemoglobin to 9.8
 - Where do we go from here?



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Patients who have Received pRBCs Still Need Iron

- pRBC transfusion $\neq$ iron infusion
- Iron in pRBC transfusion exists inside RBCs
 - It is not available to make more RBCs
 - Iron is recycled from RBCs to make new RBCs, but will only maintain hemoglobin at the level patient was transfused up to
 - To continue improving hemoglobin, you need ongoing iron therapy after transfusion



Case #2

16yo F presenting with persistent headaches and decreased endurance

- Routine POCT Hb 6.2
- Received 2u pRBC with improvement in Hb to 9.8; started oral iron at discharge
- Seen 3 months later and Hb now 8.7
 - Where do we go from here?



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Poor Response to Oral Iron

- Incorrect diagnosis
- Persistent etiology:
 - Poor diet (ongoing milk intake)
 - Ongoing blood loss
- Insufficient iron dose:
 - Dosing incorrect
 - Duration too short
- Non-Adherence:
 - Difficult schedule (TID)
 - Side effects/taste
- Malabsorption
 - Inflammation or underlying GI condition
 - Iron-Refractory IDA



Iron-Refractory Iron-Deficiency Anemia

- Rare autosomal recessive disorder
- Caused by genetic mutation (*TMPRSS6*)
 - Gene inhibits the signaling pathway that activates hepcidin
 - Mutation leads to uncontrolled activation, which then decreases absorption of iron
- < 1% of cases of IDA
 - Poor response is likely secondary to another reason!





Helpful Resources

- Powers JM, O'Brien SH. How I approach iron deficiency with and without anemia. *Pediatr Blood Cancer*. 2019 Mar;66(3):e27544.
- ASH 2026 Guidelines for diagnosis of iron deficiency
- AAP ID/IDA Clinical Report on Screening, Diagnosis and treatment of ID/IDA
- Foundation for Women and Girls with Blood Disorders Podcast: 7-2-1, Episodes 9 and 10
 - Website also has very helpful provider handouts
- Within ACH: e-consults, IDA order set



IDA SmartSet

- PC AMB Iron Deficiency Anemia
- Includes:
 - Diagnoses and definitions
 - History and physical exam features to assess
 - Medications, including link to iron-rich foods handout
 - Labs and follow up guidelines



Potential Changes to Standard Practice

- Consider screening at risk children and adolescents with both a CBC and ferritin to identify both IDA and ID
- Simplified oral iron dosing strategy:
 - Children: 3mg/kg once daily
 - Adolescents: 65mg once daily
- Consider referral for IV iron in children with persistent or recurrent IDA



THANK YOU!

QUESTIONS?



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