

Children's National and the Pediatric Health Network

Recognizing and Managing Iron Deficiency in Children and Adolescents

October 10, 2024

Introduction and Welcome

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Pronouns: she/her

Medical Director

Pediatric Health Network

Notes About Today's Town Hall:

- All lines are muted throughout the presentation.
- Please use the Q&A to ask questions or make comments.
- We will be recording the session.
- Today's recordings and materials will be posted to the Children's National website and the Pediatric Health Network website following the presentation.
 - [ChildrensNational.org](https://www.ChildrensNational.org)
 - [PediatricHealthNetwork.org](https://www.PediatricHealthNetwork.org)

Recognizing and Managing Iron Deficiency in Children and Adolescents

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Hematology

Apheresis & Transfusion Medicine

Children's National Hospital

Learning Objectives

- Define Iron Deficiency (ID)
- Discuss the causes of ID and the importance of correcting the problem
- Discuss iron therapy options and appropriate dosing
- Describe changes in hematological parameters seen after initiating iron therapy
- Determine when to consider Hematology referral for IV Iron therapy

For Today's Presentation...

- Currently there is no standardized guidelines on diagnosis and treatment of iron deficiency
- Share Hematologist approach to diagnosing Iron Deficiency/Iron Deficiency Anemia
- Share Hematologist approach to treating Iron Deficiency/Iron Deficiency Anemia

Key Words

- **Iron Deficiency (ID)**

- **Iron Deficiency Anemia (IDA)**

Key Words

- **Iron Deficiency (ID)**
 - Iron Deficiency WITHOUT Anemia

- **Iron Deficiency Anemia (IDA)**
 - Iron Deficiency WITH Anemia
 - End organ damage from ID

Key Words

- **Iron Deficiency (ID)**
 - Iron Deficiency WITHOUT Anemia
- **Iron Deficiency Anemia (IDA)**
 - Iron Deficiency WITH Anemia
 - End organ damage from ID

**Most common
nutritional
deficiency in the
US & Worldwide**

Definition of Iron Deficiency Anemia (IDA)

- Low hemoglobin + Low Iron storage
- Iron storage measurement
 - Bone Marrow (gold standard): absent iron staining
 - Serum Ferritin: Low

Definition of Iron Deficiency (ID)

- Low iron storage without anemia
 - Bone marrow: absent iron staining
 - Ferritin: Low

Definition of Iron Deficiency (ID)

- Low iron storage without anemia
 - Bone marrow: absent iron staining
 - Ferritin: Low

What is the definition of “low ferritin”?

Ferritin Reference Range

Table 1: Quest Diagnostics

Age	Male	Female
4-14 days	100-717 ng/ml	
15 days-5 mo	14-647 ng/ml	
6-11 mo	8-182 ng/ml	
1-4 y	5-100 ng/ml	
5-13 y	14-79 ng/ml	
14-15 y	13-83 ng/ml	6-67 ng/ml
16-18 y	11-172 ng/ml	6-67 ng/ml

Table 2: Lab Corp Diagnostics

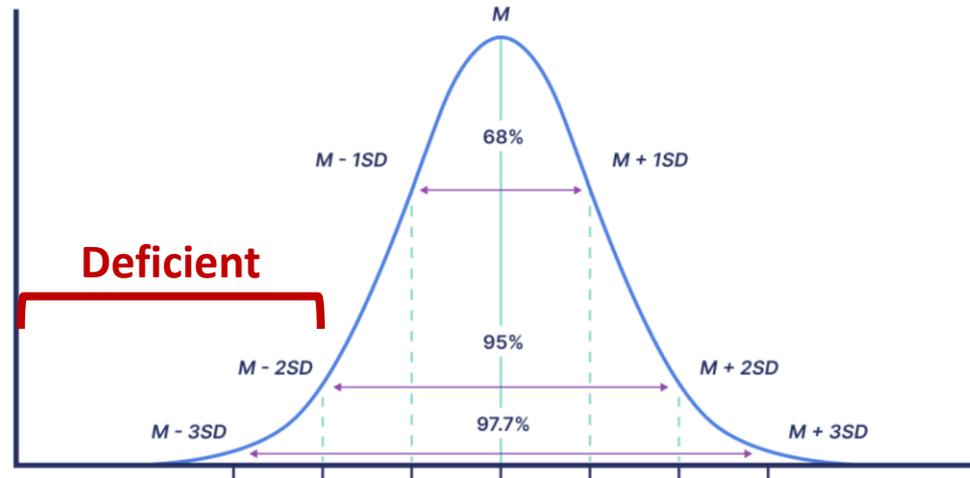
Age	Male	Female
0-5 mo	13-273 ng/ml	12-219 ng/ml
6-12 mo	12-95 ng/ml	12-110 ng/ml
1-5 y	12-64 ng/ml	12-71 ng/ml
6-11 y	16-77 ng/ml	15-79 ng/ml
12-19 y	16-124 ng/ml	15-77 ng/ml



Establishing Reference Range

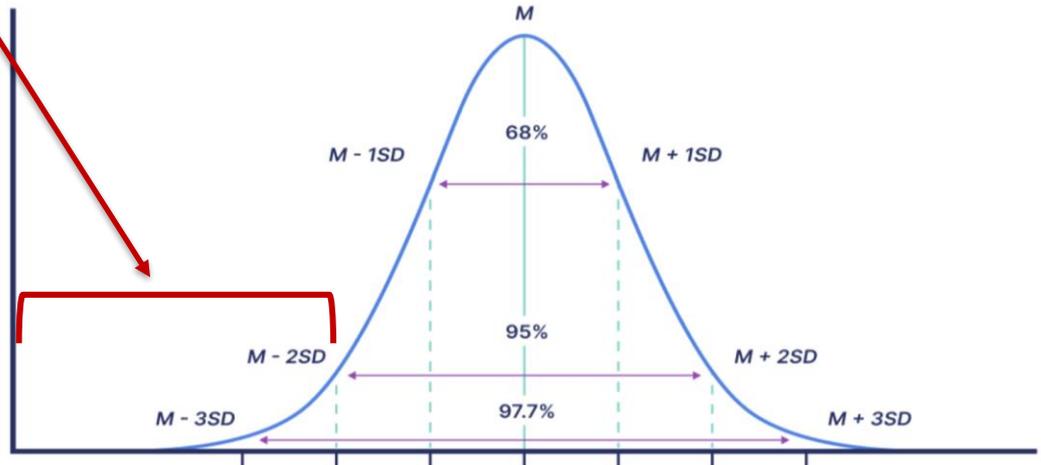
- Reference ranges made from values seen in 95% of individuals within a sample population

Standard deviations in a normal distribution



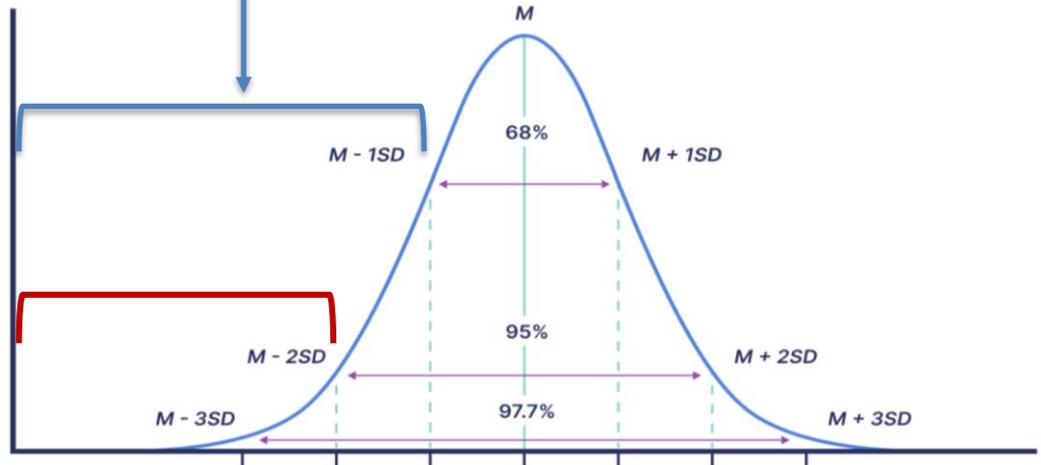
Limitation of Reference Ranges

- Assumes normal distribution (Gaussian distribution)
- Assume only 2.5% of values are abnormal



Limitation of Reference Ranges

- From healthy females, ~30-50% of women found to have absent iron stores in their marrow (Martens et al. 2023)
- Current reference range **underdiagnose ID**



Proposed Ferritin Thresholds by Hematology

Proposed Ferritin Thresholds by Hematology

1. Ferritin <20 ng/ml
2. Ferritin <50 ng/ml

Why Ferritin <20ng/ml?

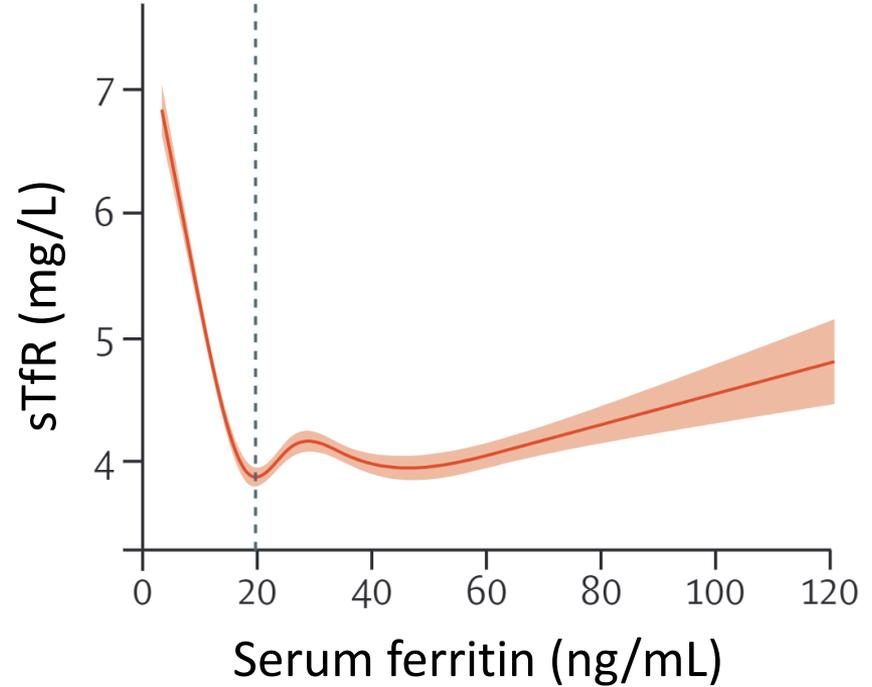
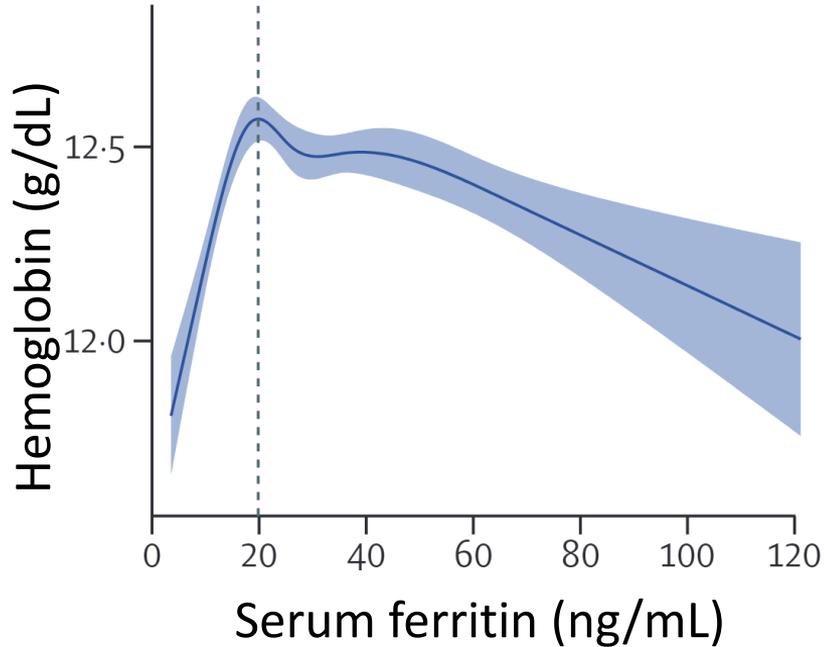
Why Ferritin <20ng/ml?

Mei et al. (2021)

- Cross-section study
 - Study population:
 - Children: 12-59 months old
 - Enrolled:
 - 2569 children
- Soluble transferrin receptor (sTfR)
 - Extracellular fragment of transferrin receptor
 - ID → ↑ sTfR
 - Determine ferritin at which:
 - Median hemoglobin (Hb) begins to ↓
 - Median sTfR begins to ↑

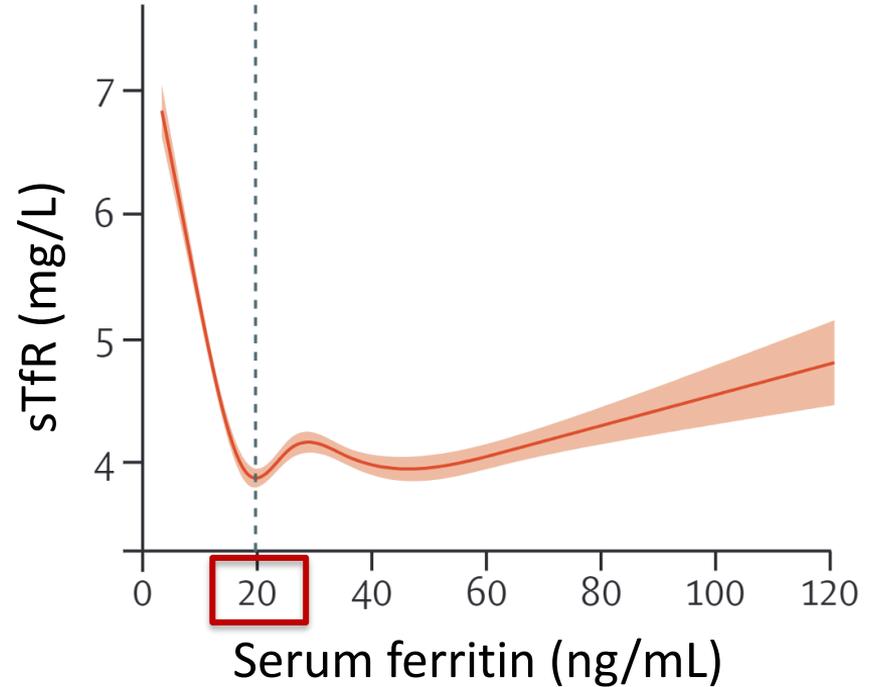
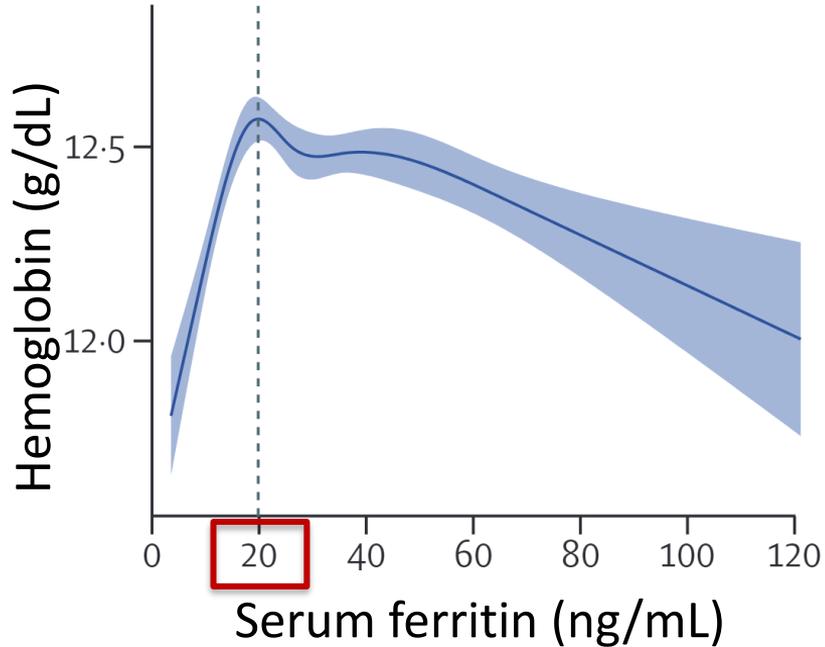
Why Ferritin <20ng/ml?

Ferritin threshold calculation for children (Mei et al. 2021)



Why Ferritin <20ng/ml?

Ferritin threshold calculation for children (Mei et al. 2021)



Why Ferritin <50 ng/ml?

Tarancon-Diez et al. (2022)

Galatti et al. (2021)

Why Ferritin <50 ng/ml?

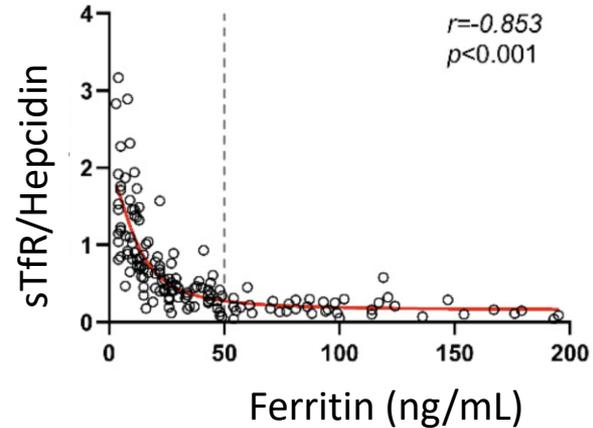
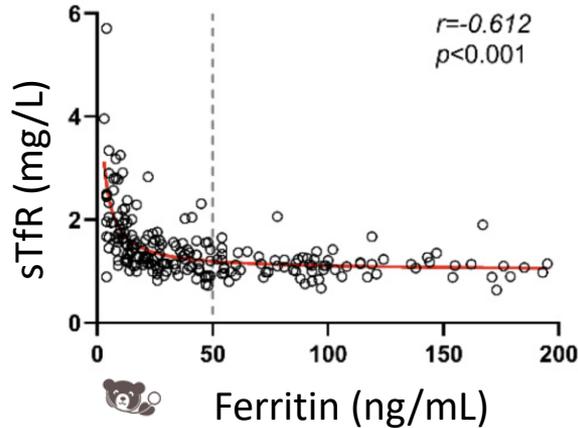
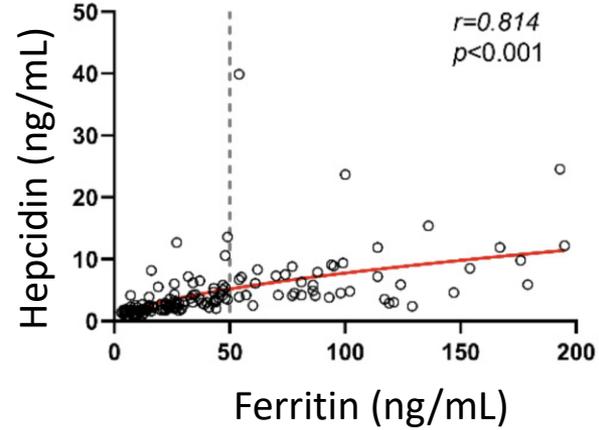
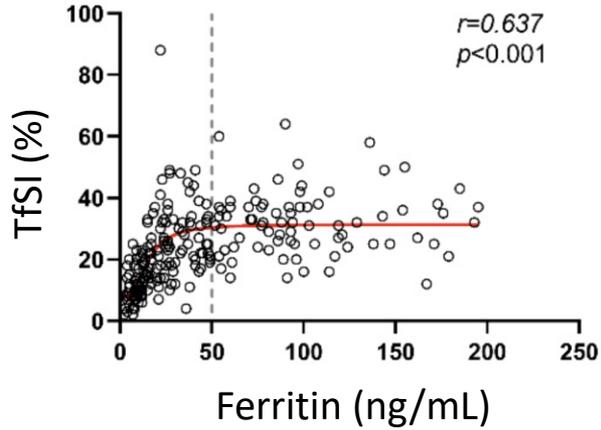
Tarancon-Diez et al. (2022)

- Healthy adult females (18-65 years)
- Measure hepcidin, sTfR and transferrin saturation index (TfSI)
 - Low iron storage:
↓Hepcidin, ↓ TfSI, ↑sTfR

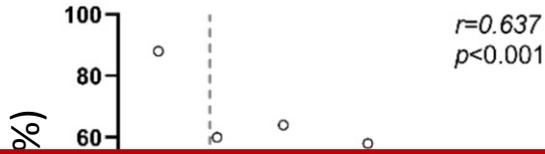
At what ferritin level do hepcidin, TfSI, sTfR and Hb start to change?



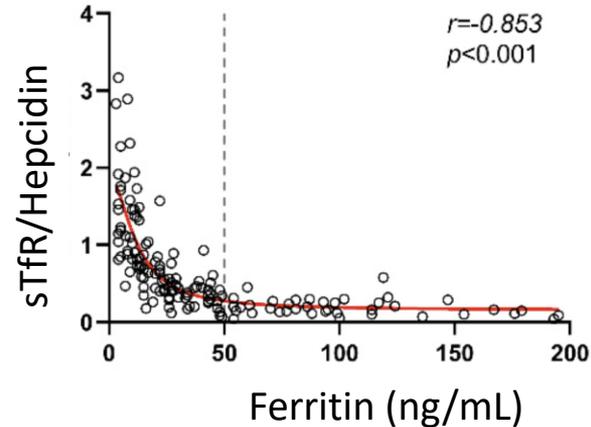
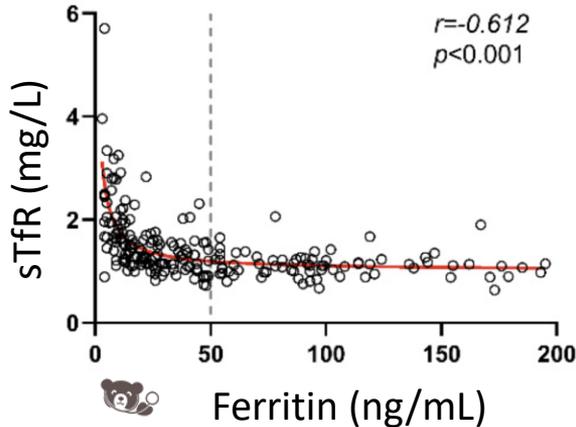
Tarancon-Diez et al. (2022)



Tarancon-Diez et al. (2022)



Ferritin of 50 ng/mL was the cut-off limit with significantly different levels of sTfR/Hepcidin ratio, sTfR and hemoglobin



Why Ferritin <50 ng/ml?

Tarancon-Diez et al. (2022)

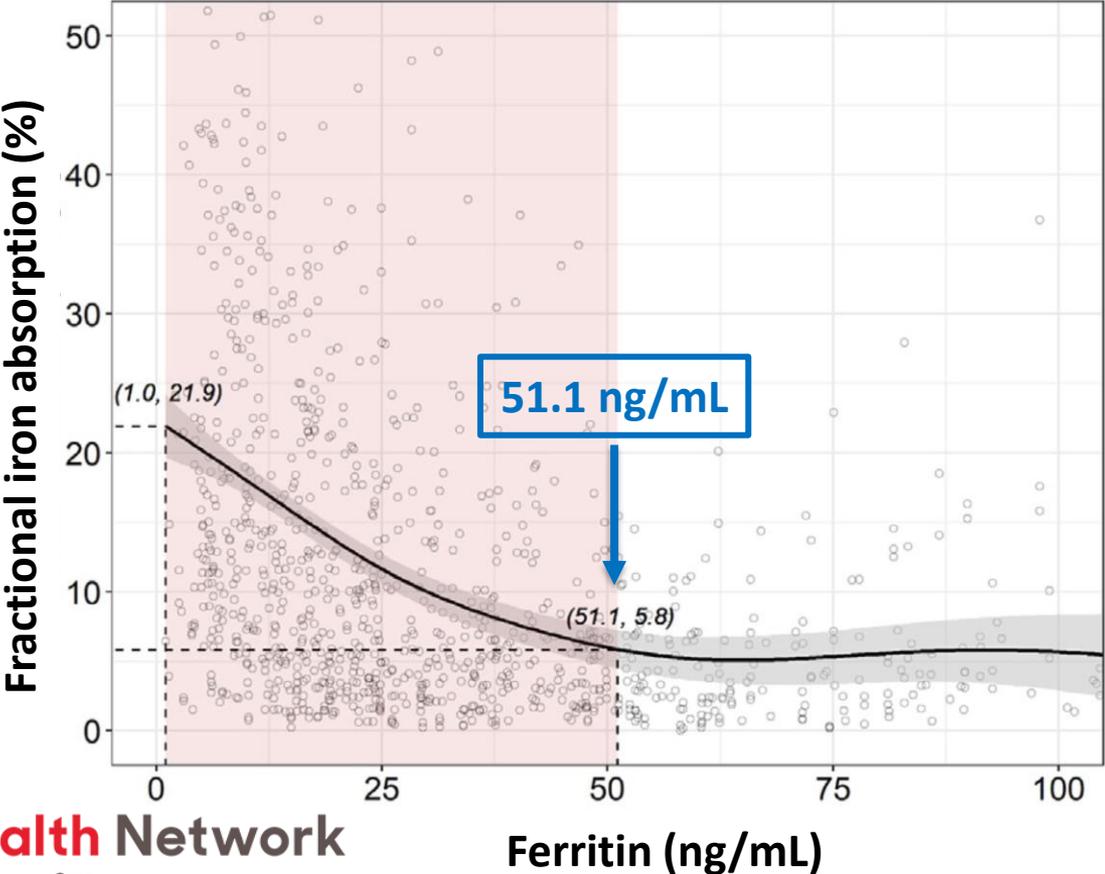
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↓Hepcidin, ↓ TfSI, ↑sTfR

Galatti et al. (2021)

- Healthy adult females (18-50 years)
- Measure isotope labeled iron absorption into RBC
 - Low iron storage: ↑ dietary iron absorption

At what ferritin level does fractional iron absorption decrease?

Galatti et al. (2021)



Proposed Ferritin Thresholds by Hematology

- Ferritin <20 ng/mL
- Ferritin <50 ng/mL
 - 2023 American Society of Hematology Annual Meeting

Ferritin Threshold—Current practice

- Ferritin <20-30 ng/mL
 - Usually, ferritin <20 ng/mL

- Ferritin <50 ng/mL
 - If children experience symptoms of ID with ferritin between 20-50 ng/mL

Symptoms

Iron Deficiency Anemia (IDA)

- Fatigue
- Weakness
- ↓ Physical performance
- Cognitive impairment
- Cold intolerance
- Headache
- Dizziness

Iron Deficiency (ID)

- Fatigue
- Weakness
- ↓ Physical performance
- Cognitive impairment
- Cold intolerance
- Alopecia
- Restless legs

Symptoms

Iron Deficiency Anemia (IDA)

- Fatigue
- Weakness

Iron Deficiency (ID)

- Fatigue
- Weakness

ID & IDA lower quality of life
BUT

ID & IDA are **CORRECTABLE** Conditions

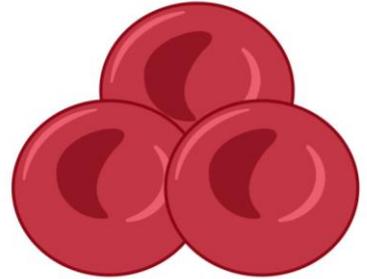
- Dizziness

- Restless legs

Why is Iron Important???

Why is Iron Important???

- RBC Production
 - Iron is essential component of hemoglobin

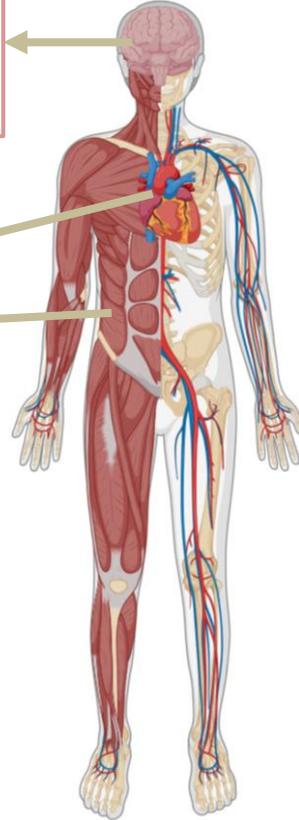


Did you know, IRON is essential in:

Did you know, IRON is essential in:

- Brain development
- Myelination
- Neurotransmitter biochemistry

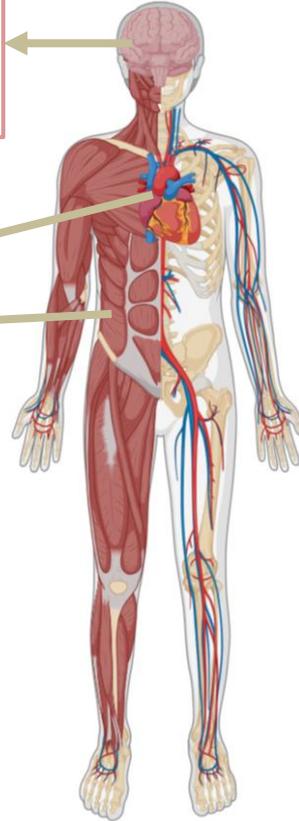
- Muscle generation
(myoglobin)



Did you know, IRON is essential in:

- Brain development
- Myelination
- Neurotransmitter biochemistry

- Muscle generation (myoglobin)



Mitochondrial energy generation

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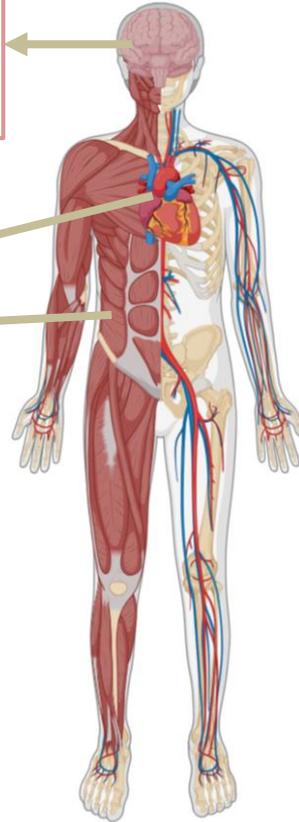
- Muscle generation (myoglobin)



Mitochondrial energy generation



- DNA Synthesis
- Gene regulation
- Cellular growth and differentiation



Did you know, IRON is essential in:

- Brain development
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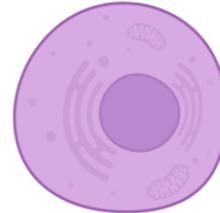
- Muscle generation (myoglobin)



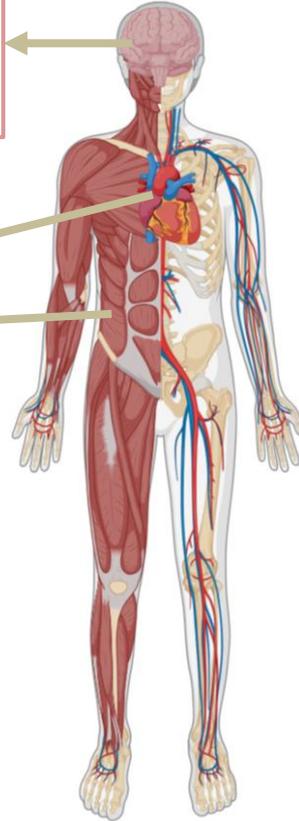
Mitochondrial energy generation



- DNA Synthesis
- Gene regulation
- Cellular growth and differentiation



- Cellular enzymatic functions



Screening for ID & IDA

AAP:

CDC:

USPSTF:

Screening for ID & IDA

AAP:

- Recommends universal screening for anemia by measuring hemoglobin (Hb) at 1 year

CDC:

- Recommends assessing infants & young children for risk factors for IDA at 9-12 months and 6 months later
- Screen Hb for those at risk

USPSTF:

- NO recommendation provided for IDA screening in children

Limitation of Current ~~ID~~/IDA Screening Recommendation

- No mention of screening for ID
- Screening hemoglobin (Hb) alone:
 - Miss diagnosing ID
 - Miss opportunity for treatment before development of anemia
- AAP (Baker et al. *Pediatrics* 2010)
 - Screening Hb alone → miss children with ID & not specific in identifying IDA
 - Ferritin should be measured with Hb

Why Check Both Ferritin & Hb?

Why Check Both Ferritin & Hb?

- Symptoms of ID (low ferritin):
 - Fatigue, weakness, immune deficiency, attention deficit, cognitive impairment, impaired muscular performance
 - 1.2 times higher depressive symptoms (Ciulei et al. 2023)
 - **Overall, LOW quality of life**
- ↑ sensitivity & specificity of ID/IDA diagnosis
- **CORRECTABLE condition!!!**

Hematology perspective: Screening for ID/IDA

- Check CBC (w/ retic) and Ferritin:
 - Children referred for anemia
 - Children with high risk of ID/IDA—excessive milk intake, inadequate nutritional intake, poor GI absorption
 - Adolescent females
 - Symptoms of ID

Treatment of ID/IDA

Treatment of ID/IDA

Iron Supplementation

Treatment of ID/IDA

Iron Supplementation

Diet alone is insufficient to correct ID/IDA
Multivitamin with Iron is insufficient to correct ID/IDA

Treatment of ID/IDA

Iron Supplementation

+

Treat the Underlying Cause(s)

Common Causes or Risk Factors for ID/IDA

Common Causes or Risk Factors for ID/IDA

1. Infants, toddlers, adolescents
2. Adolescent athletes
3. Girls and young women of reproductive age
4. Inadequate nutrition

Risk Factors for ID/IDA

Infants, Toddlers, Adolescents

- Rapid growth & development
 - Mental, physical, and social
- High iron demands
 - ↑ Muscle mass, blood volume
 - ↑ DNA synthesis, cellular growth and differentiation

Risk Factors for ID/IDA

Infants, Toddlers, Adolescents

- Rapid growth & development
 - Mental, physical, and social
- High iron demands
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 - ↑ DNA synthesis, cellular growth and differentiation

Adolescent Athletes

- Require ~30-70% more iron
 - ↑ Muscle mass
 - Foot strike hemolysis
 - GI loss (exercise induced ischemia)
 - Loss through sweats
 - Training-associated inflammation → ↓ iron absorption

Girls and young women of reproductive age

- Menstrual blood loss
 - On average, lose ~35ml of blood (16mg of iron) per cycle
 - Heavy menstrual bleed: lose ≥ 80 ml of blood (>40mg of iron) per cycle
- Recorded daily iron intake ~12.6-13.5mg/day
 - Recommended iron intake: 18mg/day

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Iron loss chronically outpace iron intake

Inadequate Nutrition

- Low socioeconomic status/Food insecurity
- Excessive dairy intake
- Poor dietary habit
 - Food choices (coffee, tea, chocolate, high carbs)
 - Skipping meals
- Restrictive diet
 - Vegetarian or vegan diets
 - Eating disorder

Dietary Sources of Iron

Heme Iron	Nonheme iron	Iron absorption Inhibitors	Iron absorption Enhancers
Meat, poultry	Beans, lentils	Calcium	Ascorbic acid
Liver	Fortified breakfast cereals	Polyphenols (tea & coffee)	Citric acid
Mollusks	Iron-enriched bread	High phytates (grains, legumes)	Heme iron
Oysters	Nuts	Oxalic acid (chocolate)	
Seafoods	Green leafy vegetables	Egg protein	

Dietary Sources of Iron

**Better Iron
absorption**

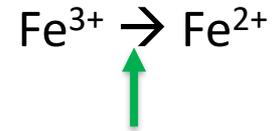
**Poor Iron
absorption**

Heme Iron	Nonheme iron	Iron absorption Inhibitors	Iron absorption Enhancers
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Dietary Sources of Iron

**Better Iron
absorption**

**Poor Iron
absorption**



Heme Iron	Nonheme iron	Iron absorption Inhibitors	Iron absorption Enhancers
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Pe

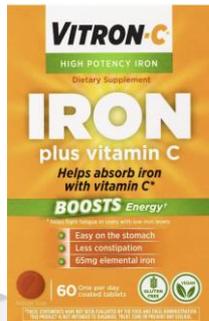
Iron Supplementation

Iron Supplementation

- PO Iron (first choice)
 - Iron Salts
 - Iron polysaccharide complex
- IV Iron
 - Iron sucrose
 - Ferric Carboxymaltose

PO Iron Supplementation

Iron Salts



Pediatrics **lealt** **ark** **onal.**

Iron polysaccharide complex



Children's National.

Iron Salts



- Ferrous sulfate, ferrous fumarate, ferrous gluconate
- Inexpensive, safe and proven effective
- ↑Absorption: ascorbic acid, empty stomach
- ↓Absorption: Food, enteric-coated or slow-release formula
- Side effects: nausea, vomiting, dyspepsia, abdominal pain, constipation, taste (metallic)

Iron Polysaccharide Complex



- NovaFerrum, Ferrex 150, Poly-Iron 150
- Better taste profile
- Still effective BUT longer duration of therapy
 - ↓ Bioavailability compared to Iron Salts
- Side effects: nausea, vomiting, dyspepsia, abdominal pain, constipation

Iron Dosing

- 3mg/kg/day elemental Iron (max 65-150 mg)
 - Ferrous sulfate 1 tab = 65 mg elemental iron
 - Ferrex™ 150 1 tab = 150 mg elemental iron
 - **Iron Dosing and Frequency studies have been done ONLY on iron salts

Iron Dosing

- 3mg/kg/day elemental Iron (max 65-~~150~~ mg)
 - Ferrous sulfate 1 tab = 65 mg elemental iron
 - Ferrex™ 150 1 tab = 150 mg elemental iron
 - **Iron Dosing and Frequency studies have been done ONLY on iron salts
 - AM dose of Ferrous sulfate ≥ 60 mg caused \uparrow hepcidin for ≤ 24 h
 - Best iron absorption at lower doses (40-80mg elemental iron daily) [Moretti et al. (2015)]

Iron Dosing Frequency

- ~~Multiple daily doses~~
- Daily
- QOD [Stoffel et al (2017), Moretti et al (2015)]
 - Higher iron absorption with QOD compared to Daily
 - Higher serum hepcidin in Daily group
 - Limitation: short study duration (3-14 days) & did not study population with moderate to severe IDA

Ideal Iron Supplementation

- 3mg/kg/day of elemental Iron (max 65mg)
- QOD
- Taken with orange juice
- Taken in the morning, separate from meals

~~Ideal~~ Iron Supplementation → Real Life Practice

(Consistency is the Key!)

- 3mg/kg/day of elemental Iron (max 65mg)
- ~~QOD~~ → Daily
- ~~Taken with orange juice~~ → water or orange juice
- ~~Taken in the morning, separate from meals~~
- Taken in a time that is easy to remember

Hematologic Responses

IDA

- Reticulocytosis within 7-10 days
- \uparrow Hb \sim 1-2 g/dL within 4 wk
- Take \sim 6 wk – 3 mo to correct anemia

ID

- Take \sim 2-6 mo to replenish iron stores
- Ensure ferritin has reached goal thresholds before stopping Iron

Follow up

IDA

Follow up in ~4-6 weeks

- Check labs (CBC, ferritin)
 - Adequate response?
- Assess compliance and side effect
- Ensure cause(s) of ID is being addressed

ID

Follow up in ~3-6 months

- Check labs (CBC, ferritin)
 - Adequate response?
- Assess compliance and side effect
- Ensure cause(s) of ID is corrected

IV Iron Therapy

IV Iron Therapy

Failure of PO Iron:

- Nonadherence
- Intolerance
- Inadequate response

Attempted PO Iron therapy
for ~3-6 mo without success

- Severe IDA
- Ongoing uncontrolled blood loss
- Poor absorption (celiac disease, short gut syndrome)
- Chronic inflammatory disorders (CKD, CHD, IBD)

IV Iron Formulation for Children

- Iron Sucrose, Ferric Carboxymaltose
- Safe and effective
- Rapid correction of ID/IDA (~4-6 weeks)
- No GI side effects

IV Iron Formulation at CNH: Iron Sucrose

- Requires IV access
- Requires weekly infusion for total 1-4 doses to replenish iron
- Infusion reaction:
 - Pruritus, urticaria, flushing, joint pain
 - Anaphylaxis
- Risk for Iron extravasation (“Tattooing”) →



IV Iron Therapy

Failure of PO Iron

- Severe IDA
- Ongoing uncontrolled blood loss
- Poor absorption (celiac disease, short gut syndrome)
- Chronic inflammatory disorders (CKD, CHD, IBD)

IV Iron Therapy

Failure of PO Iron

- Refer to Hematology
- Continue PO Iron until seen by Hematology

- Severe IDA
- Ongoing uncontrolled blood loss
- Poor absorption (celiac disease, short gut syndrome)
- Chronic inflammatory disorders (CKD, CHD, IBD)

Conclusion

- Iron is essential in children for growth and development
- Symptoms of ID is similar to IDA
 - Important to diagnose and treat ID to prevent progression to anemia
- Treatment of ID & IDA is iron supplementation (PO or IV) and addressing the underlying cause(s)
- IV Iron is used for treatment of ID & IDA
 - Indications for IV Iron is expanding

References

- Pont-Thibodeau GD, Li SYH, Ducharme-Crevier L, et al. Iron Deficiency in Anemic Children Surviving Critical Illness: Post Hoc Analysis of a Single-Center Prospective Cohort in Canada, 2019–2022. *Pediatr Crit Care Med*. Published online 2024. doi:10.1097/pcc.0000000000003442
- Ebea-Ugwanyi PO, Vidyasagar S, Connor JR, Frazer DM, Knutson MD, Collins JF. Oral iron therapy: Current concepts and future prospects for improving efficacy and outcomes. *Br J Haematol*. Published online 2024. doi:10.1111/bjh.19268
- Tang GH, Sholzberg M. The Definition of Iron Deficiency—An Issue of Health Equity. *JAMA Netw Open*. 2024;7(6):e2413928. doi:10.1001/jamanetworkopen.2024.13928
- Tang GH, Sholzberg M. Iron deficiency anemia among women: An issue of health equity. *Blood Rev*. 2024;64:101159. doi:10.1016/j.blre.2023.101159
- Barton JC, Wiener HW, Barton JC, Acton RT. Prevalence of Iron Deficiency Using 3 Definitions Among Women in the US and Canada. *JAMA Netw Open*. 2024;7(6):e2413967. doi:10.1001/jamanetworkopen.2024.13967
- Svensson L, Chmielewski G, Czyżewska E, et al. Effect of Low-Dose Iron Supplementation on Early Development in Breastfed Infants. *JAMA Pediatr*. 2024;178(7). doi:10.1001/jamapediatrics.2024.1095
- Wen S, Nisenbaum R, Weyand AC, Tang GH, Auerbach M, Sholzberg M. High prevalence of iron deficiency and socioeconomic disparities in laboratory screening of non-pregnant females of reproductive age: A retrospective cohort study. *Am J Hematol*. Published online 2024. doi:10.1002/ajh.27352
- Cohen CT, Powers JM. Nutritional Strategies for Managing Iron Deficiency in Adolescents: Approaches to a Challenging but Common Problem. *Adv Nutr*. 2024;15(5):100215. doi:10.1016/j.advnut.2024.100215
- Kardasis W, Naquin ER, Garg R, et al. The IRONY in Athletic Performance. *Nutrients*. 2023;15(23):4945. doi:10.3390/nu15234945

References (continued)

- Weyand AC, Chaitoff A, Freed GL, Sholzberg M, Choi SW, McGann PT. Prevalence of Iron Deficiency and Iron-Deficiency Anemia in US Females Aged 12-21 Years, 2003-2020. *JAMA*. 2023;329(24):2191-2193. doi:10.1001/jama.2023.8020
- Martens K, DeLoughery TG. Sex, lies, and iron deficiency: a call to change ferritin reference ranges. *Hematology*. 2023;2023(1):617-621. doi:10.1182/hematology.2023000494
- Ciulei MA, Ahluwalia N, McCormick BJJ, Teti DM, Murray-Kolb LE. Iron Deficiency is Related to Depressive Symptoms in United States Nonpregnant Women of Reproductive Age: A Cross-Sectional Analysis of NHANES 2005-2010. *J Nutr*. 2023;153(12):3521-3528. doi:10.1016/j.tjnut.2023.09.023
- Tarancon-Diez L, Genebat M, Roman-Enry M, et al. Threshold Ferritin Concentrations Reflecting Early Iron Deficiency Based on Hepcidin and Soluble Transferrin Receptor Serum Levels in Patients with Absolute Iron Deficiency. *Nutrients*. 2022;14(22):4739. doi:10.3390/nu14224739
- Mei Z, Addo OY, Jefferds ME, Sharma AJ, Flores-Ayala RC, Brittenham GM. Physiologically based serum ferritin thresholds for iron deficiency in children and non-pregnant women: a US National Health and Nutrition Examination Surveys (NHANES) serial cross-sectional study. *Lancet Haematol*. 2021;8(8):e572-e582. doi:10.1016/s2352-3026(21)00168-x
- Galetti V, Stoffel NU, Sieber C, Zeder C, Moretti D, Zimmermann MB. Threshold ferritin and hepcidin concentrations indicating early iron deficiency in young women based on upregulation of iron absorption. *EClinicalMedicine*. 2021;39:101052. doi:10.1016/j.eclinm.2021.101052
- Pantopoulos K. Oral iron supplementation: new formulations, old questions. *Haematologica*. Published online 2020. doi:10.3324/haematol.2024.284967

References (continued)

- CDC: Recommendations to Prevent and Control Iron Deficiency in the United States [https://www.cdc.gov/mmwr/preview/mmwrhtml/00051880.htm]
- US Preventive Services Task Force: Iron Deficiency Anemia in Young Children: Screening [https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/iron-deficiency-anemia-in-young-children-screening]
- WHO guideline on use of ferritin concentrations to assess iron status in individuals and populations [https://www.who.int/publications/i/item/9789240000124]
- Powers JM, Buchanan GR. Disorders of Iron Metabolism New Diagnostic and Treatment Approaches to Iron Deficiency. *Hematol Oncol Clin North Am.* 2019;33(3):393-408. doi:10.1016/j.hoc.2019.01.006
- Stoffel NU, Cercamondi CI, Brittenham G, et al. Iron absorption from oral iron supplements given on consecutive versus alternate days and as single morning doses versus twice-daily split dosing in iron-depleted women: two open-label, randomised controlled trials. *Lancet Haematol.* 2017;4(11):e524-e533. doi:10.1016/s2352-3026(17)30182-5
- Moretti D, Goede JS, Zeder C, et al. Oral iron supplements increase hepcidin and decrease iron absorption from daily or twice-daily doses in iron-depleted young women. *Blood.* 2015;126(17):1981-1989. doi:10.1182/blood-2015-05-642223
- Vaucher P, Druais PL, Waldvogel S, Favrat B. Effect of iron supplementation on fatigue in nonanemic menstruating women with low ferritin: a randomized controlled trial. *Can Méd Assoc J.* 2012;184(11):1247-1254. doi:10.1503/cmaj.110950
- Baker RD, Greer FR, Nutrition TC on. Diagnosis and Prevention of Iron Deficiency and Iron-Deficiency Anemia in Infants and Young Children (0–3 Years of Age). *Pediatrics.* 2010;126(5):1040-1050. doi:10.1542/peds.2010-2576
- Doren LV, Steinheiser M, Boykin K, Taylor KJ, Menendez M, Auerbach M. Expert consensus guidelines: Intravenous iron uses, formulations, administration, and management of reactions. *Am J Hematol.* 2024;99(7):1338-1348. doi:10.1002/ajh.27220
- Shi R, Marin JG, Beaulieu M. Skin Staining Following Intravenous Iron Extravasation in a Patient With Chronic Kidney Disease: A Case Report. *Can J Kidney Health Dis.* 2023 Apr 18;10:20543581231165705. doi: 10.1177/20543581231165705. PMID: 37101846; PMCID: PMC10123906.

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