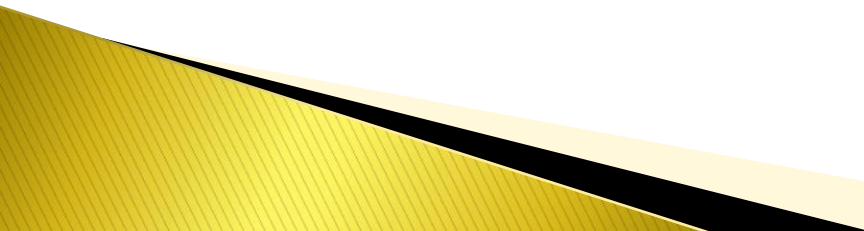


IRON DEFICIENCY ANEMIA

BY
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objectives

- ▶ background,
 - ▶ definition,
 - ▶ epidemiology, and
 - ▶ etiology
 - ▶ diagnostic algorithm of IDA
 - ▶ key laboratory findings to diagnose IDA
 - ▶ therapeutic management of IDA
- 

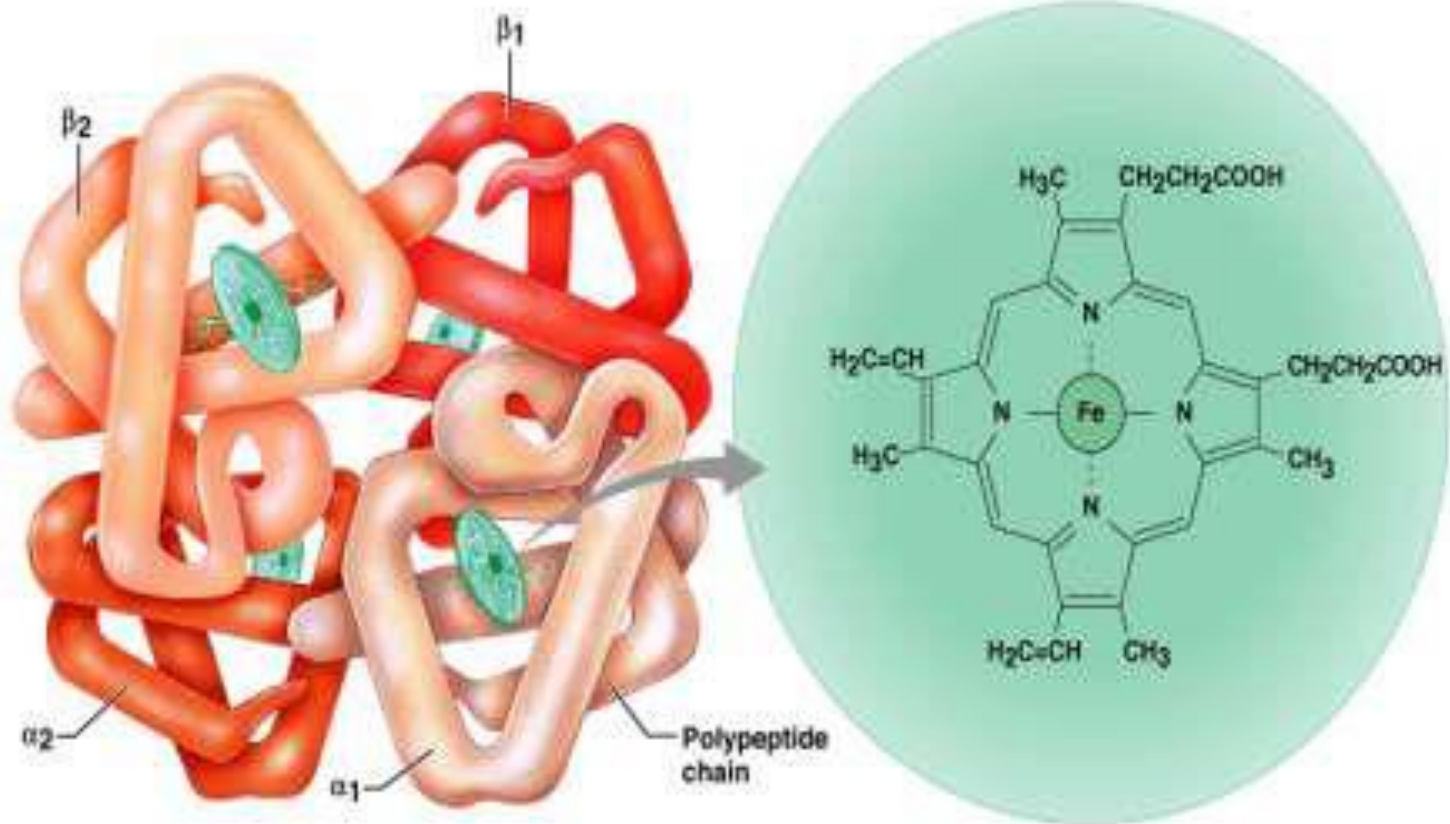
- ▶ Normal physiology &
- ▶ structure of Hb

Normal physiology & structure of Hb

- ▶ Globular protein contain Heme + Globin
- ▶ Accounts for > 95% of protein in RBC
- ▶ **Main functions: transportation of respiratory gases. It carries ~ 98.5% of all O₂**

- ▶ Hb Average values:
 - ▶ Male: 14–18 g/dl
 - ▶ Female: 12–16 g/dl
 - ▶ Infants: 14–20 g/dl

Structure of Haemoglobin




(a) Hemoglobin

(b) Iron-containing heme group

EPIDIMIOLOGY

- Approximately 30 % of the global population suffers from iron-deficiency anemia.
- Most cases are seen in developing countries.

- ▶ ▪ According to WHO
 - ▶ Anemia is defined as Hb <13 g/dl in men or <12 g/dl in female
 - ▶ IDA is the result of long-term negative iron balances
- 

DEFINITION OF IDA

Iron deficiency anemia develops when body store of iron drop too low to support normal red blood cell (RBC) production.

**Ref. S.Fe ; male = 12–300 ng/ml
female= 10–150 ng/dl**

IRON BALANCE

- ▶ Normal iron content of the body
- ▶ $\approx 3-4$ g (Hb, myoglobin, and cytochromes)
- ▶ Iron is best absorbed as ferrous (Fe^{2+}) form in the duodenum, and to a smaller extent in jejunum
- ▶ Daily recommended allowance
 - ▶ o Adult males/postmenopausal females: 8 mg
 - ▶ o Menstruating female: 18 mg

Iron sources

- ▶ **Heme iron** (2–3X more absorbable): meat, fish, and poultry
- ▶ **Non-heme iron**: vegetables, fruits, dried beans, nuts, grain products, and dietary supplements
- ▶ Gastric acid/ascorbic acid **increases non-heme iron absorption whereas**
- ▶ phytates , polyphenols (in tea), and calcium (in dairy product) form insoluble complexes
- ▶ *DiPiro J. Anemia. In: Pharmacotherapy: A Pathophysiological Approach, 2011*

- ▶ **BODY REQUIREMENT:**
- ▶ • 0.8 – 1 mg of iron must be absorbed everyday for normal functioning in children below 15 yrs of age.

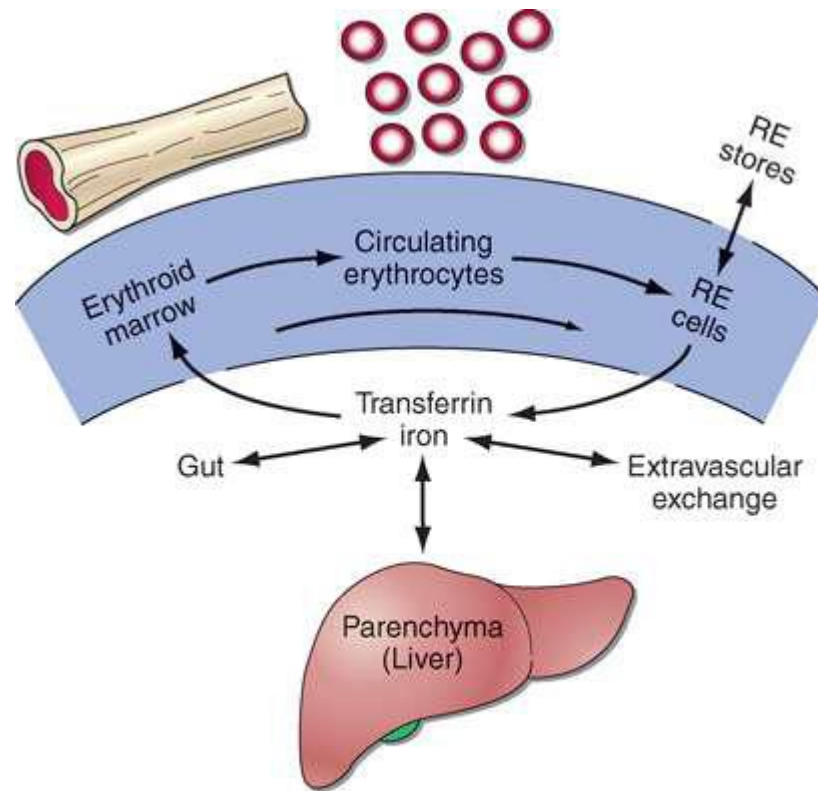
▶ **ABSORPTION:**

- ▶ • It mainly occurs in the duodenum.
- ▶ • Absorption of dietary iron is assumed to be about 10% of the intake; so the daily diet should contain at least 8–10 mg of iron.

▶ **TRANSPORT**

- ▶ • Transferrin protein helps in the transport of iron in the circulation.

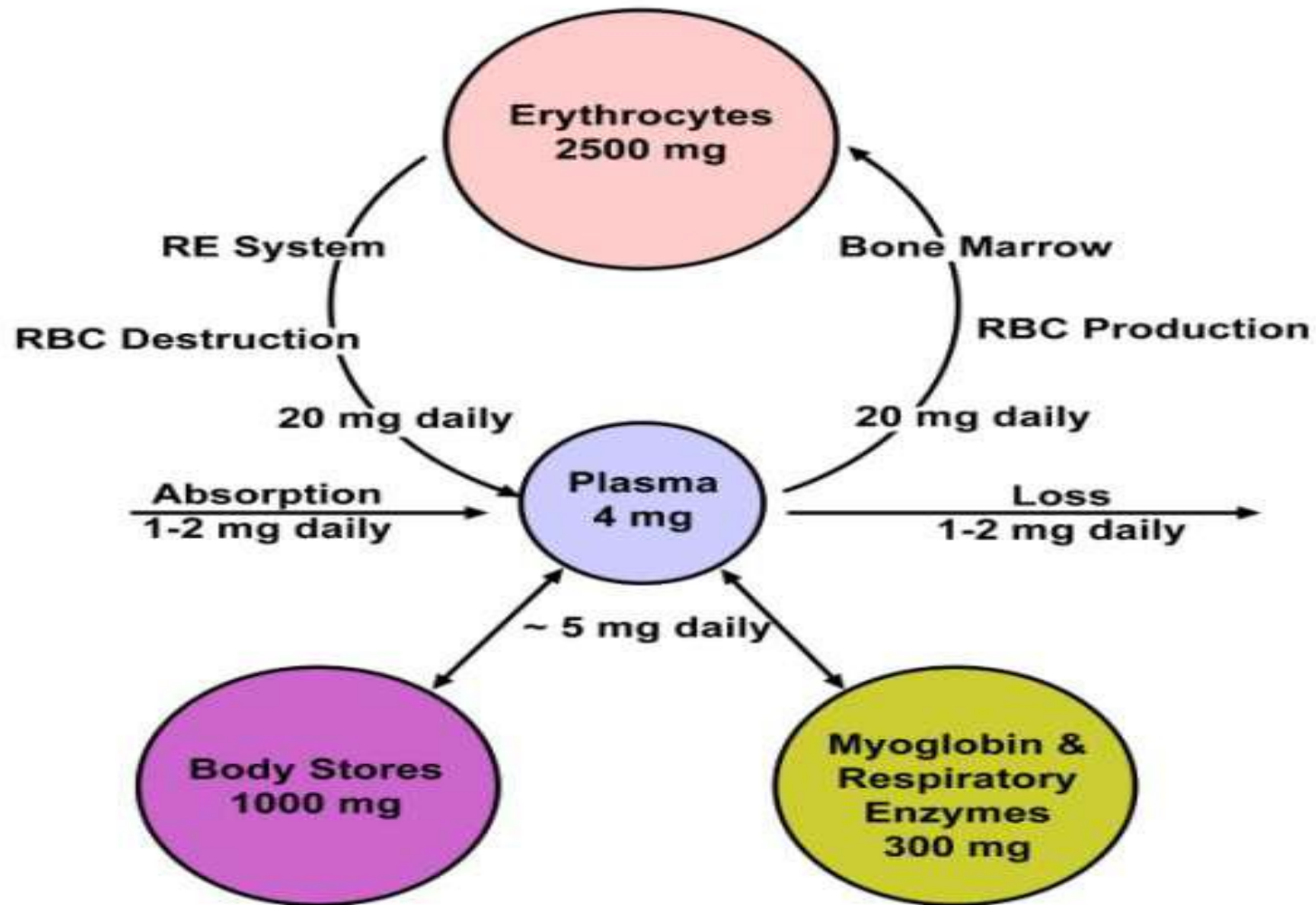
Iron metabolism



Source: Longo DL, Fauci AS, Kasper DL, Hauser SL, Jameson JL, Loscalzo J: *Harrison's Principles of Internal Medicine, 18th Edition*: www.accessmedicine.com

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Iron metabolism



Fate of Components of Heme

Iron(Fe^{+3})

- ▶ transported in blood attached to transferrin protein
- ▶ stored in liver, attached to ferritin or hemosiderin protein
- ▶ **In bone marrow**, iron is used for hemoglobin synthesis

Biliverdin (green) is converted to **bilirubin (yellow)**

Bilirubin is secreted by liver into bile

* converted to urobilinogen then stercobilin (brown pigment in feces) by bacteria of large intestine

* if urobilinogen is reabsorbed from intestines into blood is converted to a yellow pigment, urobilin and excreted in urine

ETIOLOGY OF IDA

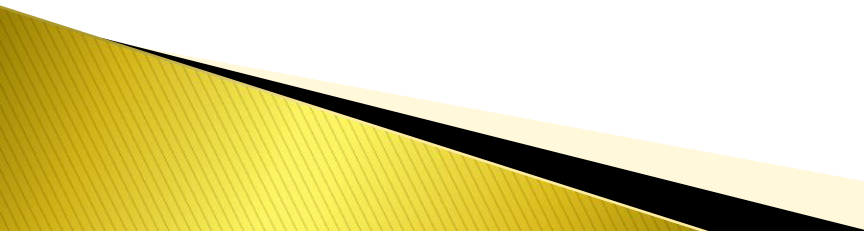
IDA results from prolonged *negative iron balance*

Mainly due to *following factors:*

- ▶ 1. Inadequate iron intake
- ▶ 2. Decreased iron absorption
- ▶ 3. Increased iron demand or hematopoiesis
- ▶ 4. Increased iron loss

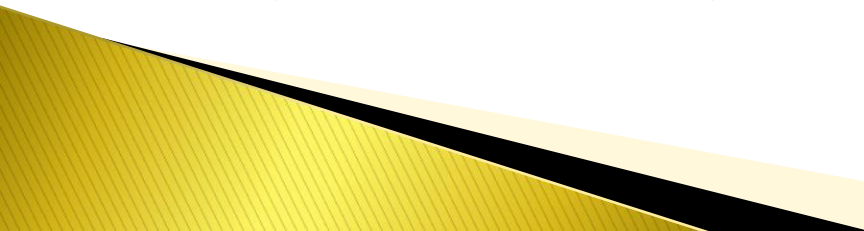
▶ *Matthew W. et al. Am Fam Physician. 2013;87(2):98–104*

Pathophysiology OF IDA

- Iron deficiency anemia is the most common form of anemia and it develops over time if the body does not have enough iron to manufacture red blood cells.
 - Without enough iron, the body uses up all the iron it has stored in the liver, bone marrow and other organs.
- 

IRON DEFICIENCY ANEMIA

" ETIOLOGY

- CHRONIC BLEEDING
 - MENORRHAGIA
 - PEPTIC ULCER
 - STOMACH CANCER
 - ULCERATIVE COLITIS
 - INTESTINAL CANCER
 - HAEMORRHOIDS
 - DECREASED IRON INTAKE
 - INCREASED IRON REQUIREMENT (JUVENILE AGE, PREGNANCY, LACTATION)
- 

IRON DEFICIENCY – STAGES

▶ Prelatent

- ▶ reduction in iron stores without reduced serum iron levels
- ▶ • Hb (N), MCV (N), iron absorption (↓), transferrin saturation (N), serum ferritin (↓), marrow iron (↓)

▶ Latent

- ▶ iron stores are exhausted, but the blood hemoglobin level remains normal
- ▶ • Hb (N), MCV (N), TIBC (↑), serum ferritin (↓), transferrin saturation (↓), marrow iron (absent)

▶ Iron deficiency anemia

- ▶ – blood hemoglobin concentration falls below the lower limit of normal
- ▶ • Hb (↓), MCV (↓), TIBC (↑), serum ferritin (↓), Transferrin saturation (↓), marrow iron (absent)


IRON DEFICIENCY ANEMIA

" GENERAL ANEMIA'S SYMPTOMS

- pallor
 - fatigability
 - dizziness
 - headache
 - irritability
 - palpitation
 - chd, chf
- 

CHARACTERISTICS

SYMPTOMS

- glossitis, stomatitis
 - dysphagia (plummer-vinson syndrome)
 - atrophic gastritis
 - dry, pale skin
 - spoon shaped nails, koilonychia,
 - blue sclerae
 - hair loss
 - pica (apetite for non food substances such as an ice, clay)
 - splenomegaly (10%)
 - increased platelet count
- 

Laboratory Dx of IDA

CBC VALUES

| ▶ Hematologic Indices | Normal Range | IDA |
|-----------------------|---------------|------|
| ▶ Hb | 7.0—16.0 g/L | Low |
| ▶ Hematocrit (Hct) | 0.32—0.47 L/L | Low |
| ▶ MCV | 75—95 fL | Low |
| ▶ MCH | 24—30 pg | Low |
| ▶ MCHC | 290—370 g/L | Low |
| ▶ RDW | 11—15% | High |

- ▶ *DiPiro J. Anemia. In: Pharmacotherapy: A Pathophysiological Approach, 2011c*

Laboratory investigations in IDA

BLOOD AND BONE MARROW SMEAR

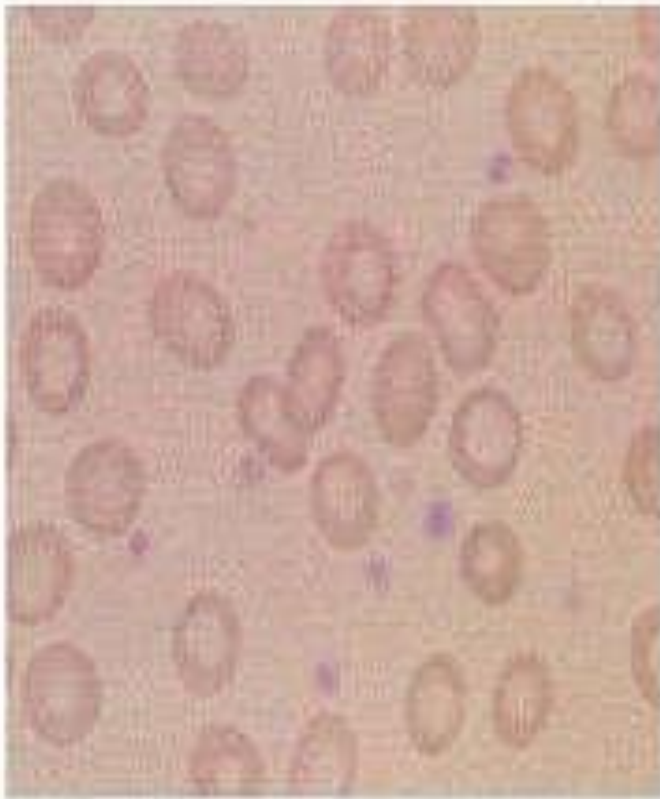
“ BLOOD:

- microcytosis, hypochromia, anulocytes, anisocytosis
poikilocytosis

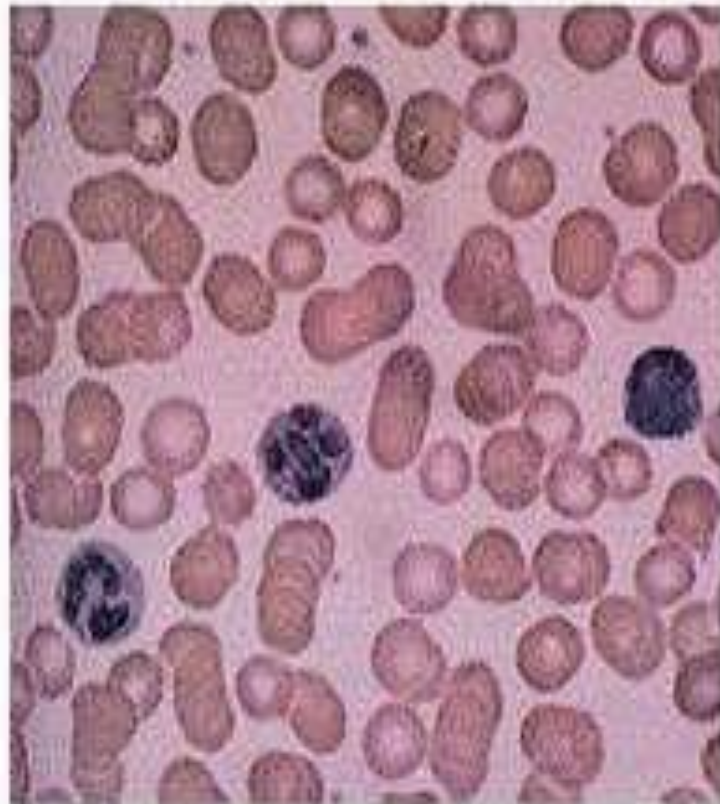
“ BONE MARROW

- high cellularity
- mild to moderate erythroid hyperplasia
- polychromatic and pyknotic cytoplasm of erythroblasts
(micronormoblastic erythropoiesis)
- absence of stainable iron

Iron Deficiency Anemia



anemia



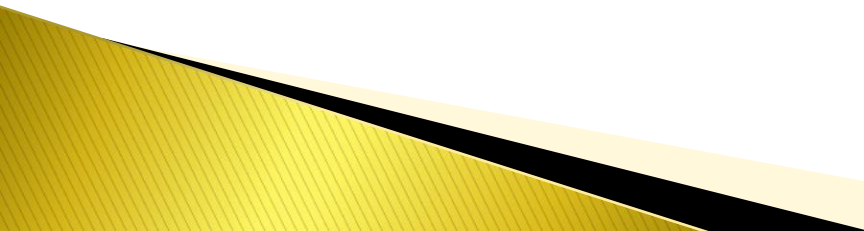
normal blood

Lab. Investigations in IDA

Results of iron studies are as follows:

- ▶ Low serum iron and ferritin levels with
- ▶ an elevated TIBC are
diagnostic of iron deficiency

THERAPEUTIC GOALS

- ▶ ▪ **Short term**
 - ▶ o Resolution of symptoms
 - ▶ o Replenish iron stores
 - ▶ ▪ **Long term**
 - ▶ o Improve quality of life (QOL)
 - ▶ o Prevention of recurrences
 - ▶ o Better growth and development (children)
- 

TREATMENT OPTIONS

- ▶ ▪ **Pharmacological management**
 - ▶ o Oral/parenteral iron therapy
- ▶ ▪ **Non-pharmacological**
 - ▶ o Blood transfusion

ORAL IRON THERAPY

Recommended dosage requirements

- o 200 mg elemental iron per day for 3–6 months
- o 2–3 divided doses to maximize tolerability
- o Administration should be 1 hour before meals or on empty stomach

Absorption of all oral preparations are similar

DiPiro J. Anemia. In: Pharmacotherapy: A Pathophysiological Approach, 2011

http://www.pharmapacks.com/product_images/g/220/a1174335_2761__43287.jpg

SUMMARY

- ▶ IDA is the most common form of anemia and is usually the result of prolonged negative iron balance in the body
- ▶ Four main factors contributing to IDA include
 - ▶ o Inadequate iron intake
 - ▶ o Decreased iron absorption
 - ▶ o Increased iron demand or hematopoiesis
 - ▶ o Increased iron loss
- ▶ Clinical diagnosis of IDA should include complete patient history and physical exams, followed by laboratory investigations
- ▶ ▪ Abnormal laboratory investigations generally include **low MCV, serum iron, and ferritin**; and **high TIBC**

SUMMARY

- ▶ ▪ Treatment of IDA usually consists of dietary supplementation and administration of oral iron preparations
- ▶ ▪ General recommendation for oral iron replacement is ~200 mg elemental iron/day, divided into 2–3 doses to maximize tolerability
- ▶ ▪ Parenteral therapy is usually not indicated *unless patient is* intolerant to oral therapy, having malabsorption, or in the case of CKD
- ▶ ▪ Anaphylactic reaction should be considered for all parenteral formulation along with strictly monitoring adverse drug reaction

Thank you