






Anemia in the pediatric patient

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Anemia is the most common
Hematologic abnormality
Identified in infants and children.

Approximately a quarter of the world's population suffers from anemia, almost 2 billion people, with almost half of children <5 years of age affected .

Anemia is associated with increased morbidity and mortality in children, particularly children of preschool age.

DEFINITION OF ANEMIA

In practice, anemia is defined by
Hemoglobin (Hb),
Hematocrit,
or
Red blood cell count levels
lower than the normal
age- and sex-adjusted ranges.

Reference ranges for Hb and Hct vary with **age** and **sex**

The threshold for defining anemia is Hb or Hct
at or below the 2.5th percentile for age and sex
based upon reference data from healthy individuals.



Age	Lower limit of normal Hb
Newborn (first day)	13.5g%
2-3m	9g%
6m	10 g%
1y	11 g%
1-12 y	11+ 0.1×age(year)
Male Adult	13 g%
Female Adult	12 g% (Nonpregnant) 11.5 g% (Pregnant)

The image features a light gray background with four sets of parallel red diagonal lines in the corners, creating a frame-like effect. The lines are thin and closely spaced.

Classification of anemia

Anemia can be classified in many ways, such as :

- Congenital or Acquired
- Acute or Chronic
- Hemolytic or Nonhemolytic
- (PBS) findings
- Erythrocyte size

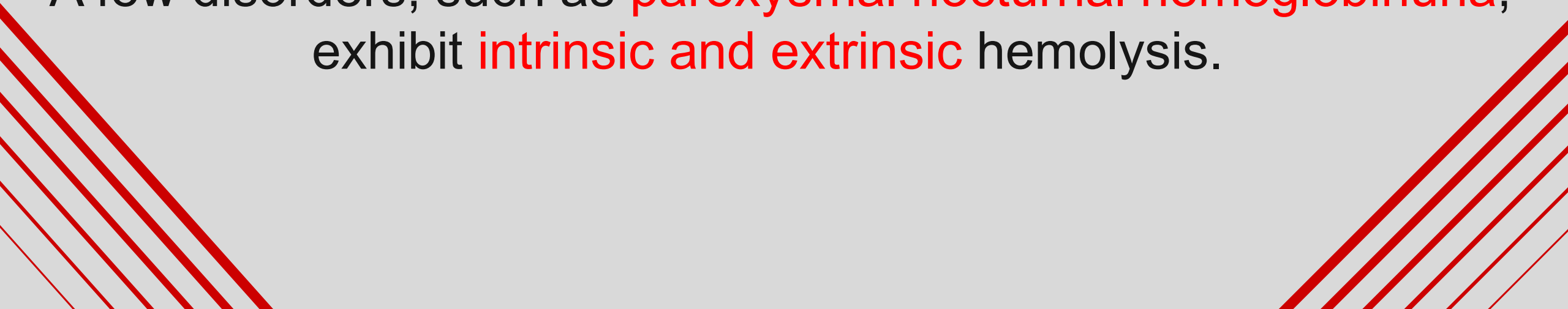
Hemolytic anemia may be further classified as:

- ✓ Inherited or acquired
- ✓ Immune or nonimmune
- ✓ Acute or chronic
- ✓ Intravascular or extravascular
- ✓ Cellular (intrinsic) or extracellular (extrinsic) abnormality

Whereas **most intrinsic defects are inherited**,
such as membrane disorders, metabolic defects, and
Hb disorders,

most extrinsic defects are acquired,
such as immune-mediated anemia, systemic disease, and
drug- or toxin-mediated effects.

A few disorders, such as **paroxysmal nocturnal hemoglobinuria**,
exhibit **intrinsic and extrinsic** hemolysis.



Microcytic

Reticulocyte count

Low/Inadequate

High

- Iron deficiency
- Thalassemia trait
- Chronic disease/ inflammation
- Lead poisoning
- Sideroblastic anemias
- Copper deficiency
- Iron refractory iron deficiency anemia
- Thalassemia syndromes
- Hemoglobin C and E disorders
- Pyropoikilocytosis

Normocytic

Reticulocyte count

Low/Inadequate

High

- Chronic disease/ Inflammation
- RBC aplasia (TEC, Infection, Drugs)
- Malignancy
- Endocrinopathies
- Renal failure
- Acute bleeding
- Hypersplenism
- Dyserythropoietic Anemia II
- Hemophagocytic syndrome
- Antibody mediated hemolysis
- Hypersplenism
- Microangiopathy (HUS, TTP, DIC, Kasabach-Merritt)
- Membranopathies (spherocytosis, elliptocytosis, ovalocytosis)
- Enzymopathies (G6PD, PK deficiencies)
- Hemoglobinopathies (HBSS, SC)

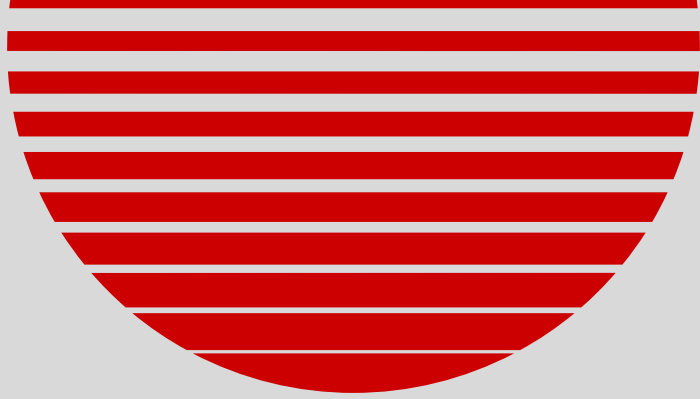
Macrocytic

Reticulocyte count

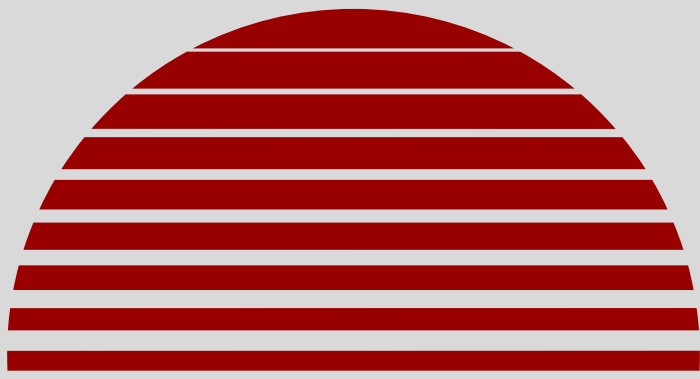
Low/Inadequate

High

- Folate deficiency
- Vitamin B12 deficiency
- Acquired aplastic anemia
- Congenital aplastic anemia (Diamond-Blackfan, Fanconi anemia, Pearson syndrome)
- Drug induced
- Trisomy 21
- Hypothyroidism
- Oroticaciduria
- Dyserythropoietic anemia I, III
- Active hemolysis with very elevated reticulocyte count



Approach to the anemic child





Diagnostic evaluation of the anemic child
combines:

- ❑ History
 - ❑ Physical examination
 - ❑ laboratory investigation
- 

Patient and family history often reveal important clues to the etiology of anemia.

Review of birth history should include labor, delivery, and neonatal course, including the history of anemia, jaundice, phototherapy, or blood transfusion.

History of other medical issues and medication use should be elicited.

History of :

Trauma

- Infections
- Surgery
- Travel
- Exposure to drugs, chemicals, toxins, or oxidants
- sources of blood loss such as:
Epistaxis, (GI) bleeding ,Dysmenorrhea.

Dietary history should include a review of:

growth and food intake focusing on key nutrients such as iron, folate, vitamin B12, and in infants, milk intake.

A family medical review:

should include the history of

anemia, jaundice, splenomegaly, gallstones, blood

or

autoimmune diseases, bleeding disorders,

splenectomy,

or cholecystectomy.



Findings of dysmorphic features, especially
craniofacial
and limb abnormalities, suggest features of one of
the genetic syndromes associated with anemia.





Laboratory investigation



Initial **basic laboratory evaluation** includes a:

CBC

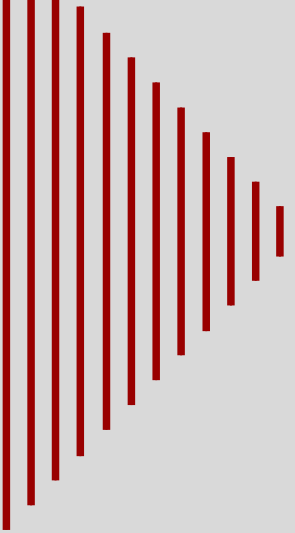
PBS

Reticulocyte count

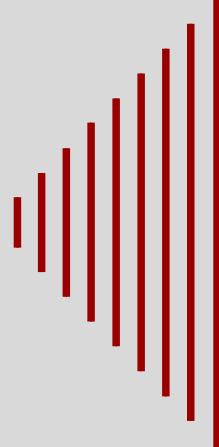
DAT

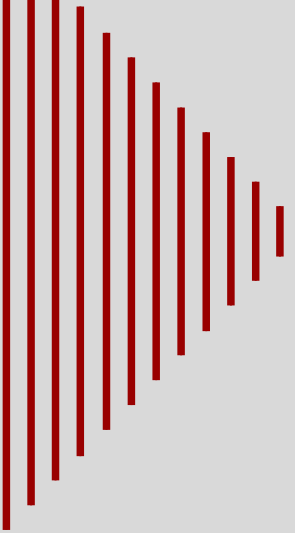
Serum bilirubin.





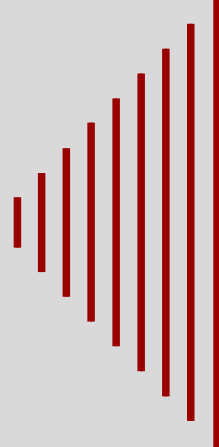
Examination of erythrocyte indices may give clues to the diagnosis;
for instance, **microcytosis** in an anemic infant may suggest the **presence of a hemoglobinopathy or iron deficiency**, whereas an **elevated MCHC** may suggest a disorder of the **erythrocyte membrane such as hereditary spherocytosis**.

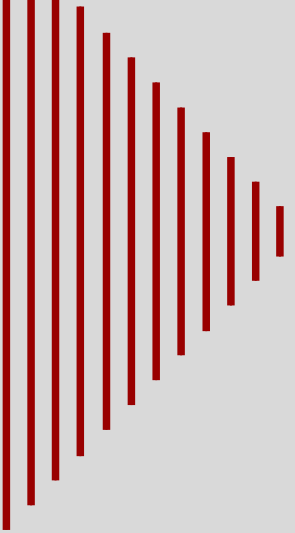




The PBS may provide insights into the diagnosis such as:

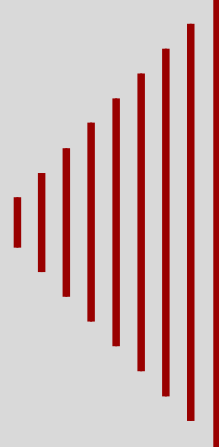
spherocytes in hereditary spherocytosis or autoimmune hemolytic anemia,
elliptocytes in hereditary elliptocytosis,
fragmented cells, schistocytes, and helmet cells in microangiopathic hemolytic anemia,
target cells in hemoglobinopathies, liver disease, and post-splenectomy,
and inclusions of various types seen in malaria or babesiosis.

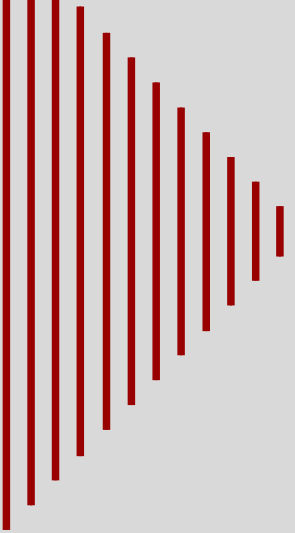




Red cell distribution width is a measure of the size and volume of populations of circulating erythrocytes.

When used with other indices it may provide clues to the diagnosis, such as thalassemia.

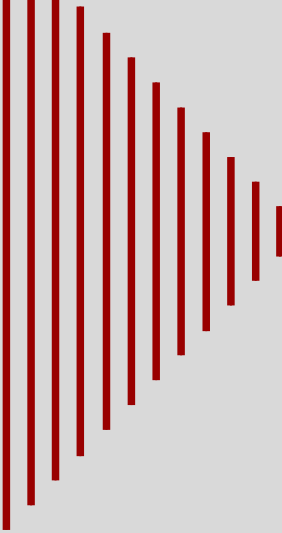




An **elevated reticulocyte** count indicates increased erythropoietic response **to blood loss or hemolysis**, whereas a **low reticulocyte** count, especially relative to the degree of anemia, indicates **inadequate erythropoietic response**.

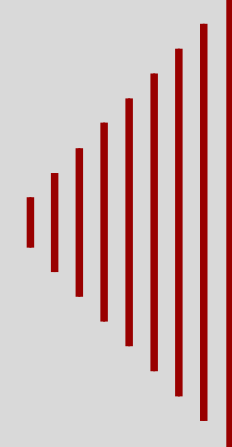
A positive DAT test suggests immune-mediated hemolysis.

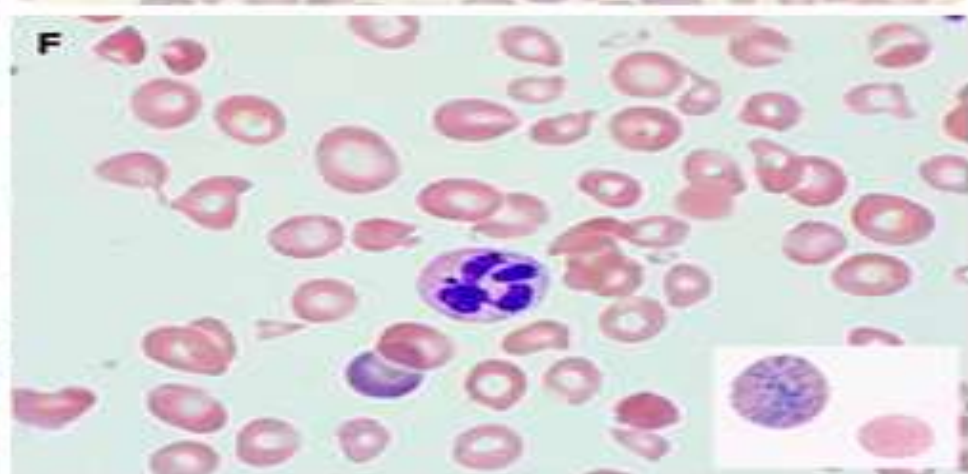
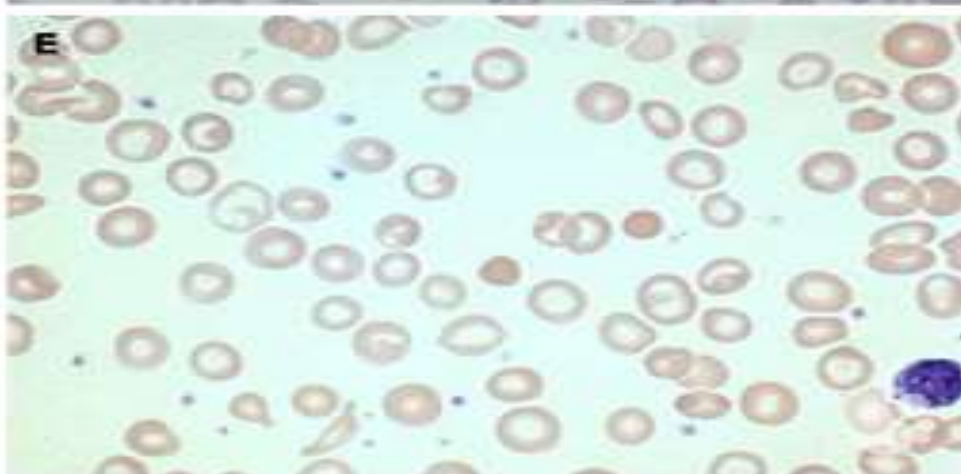
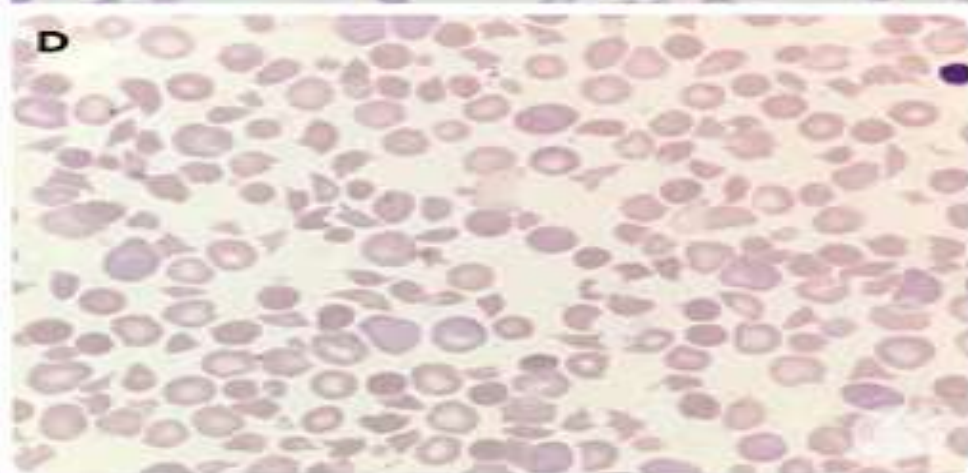
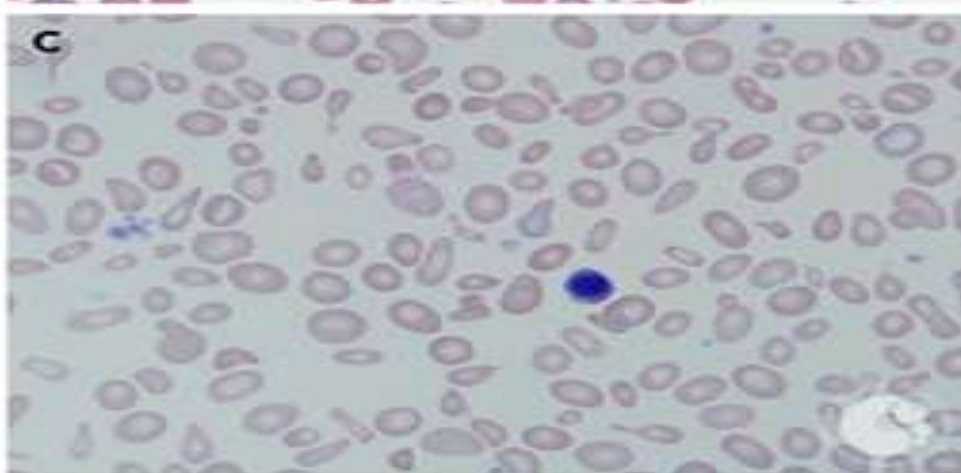
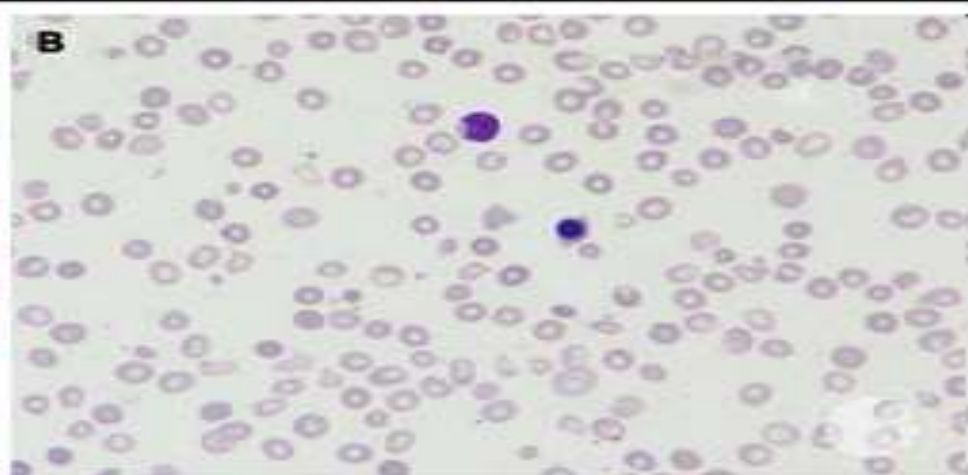
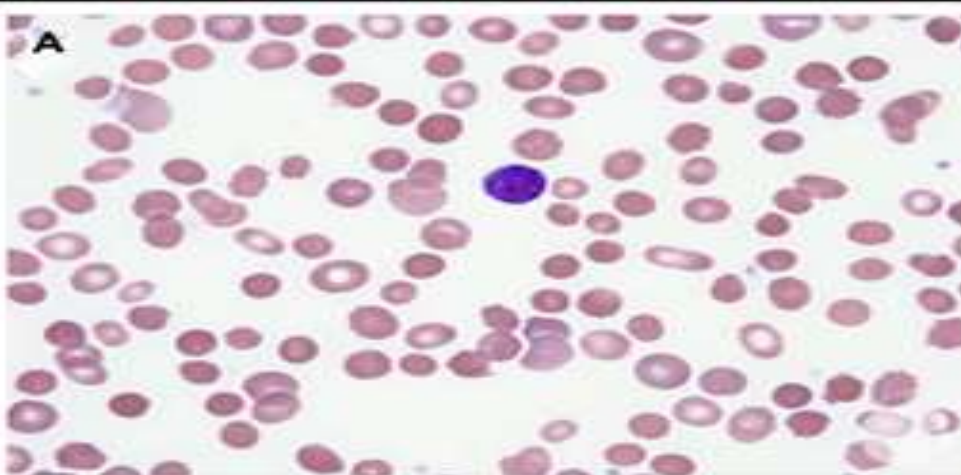




The presence of **anemia** with findings of **hemolysis** on PB smear and **hyperbilirubinemia** in a child with a **negative DAT** suggests an **intrinsic erythrocyte defect**.

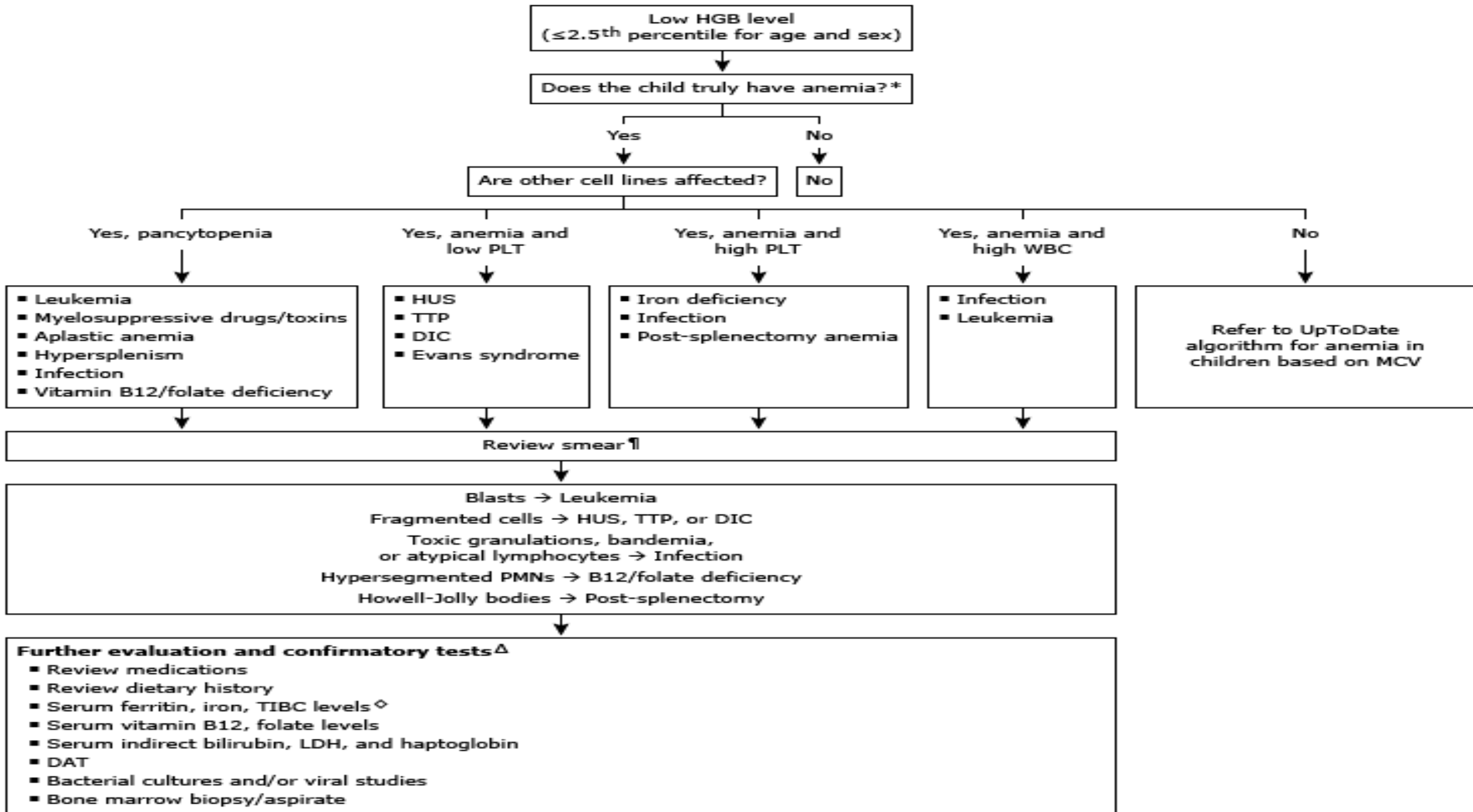
The child **with acute onset normocytic, normochromic nonhemolytic anemia** and a **negative DAT test** should be suspected of having had **acute blood loss**.





Features of hypochromic anemias

	Ferritin	Serum iron	TIBC	Transferrin saturation	Red cell distribution width	Marrow storage iron
Iron deficiency anemia	Low	Low	High	Low	High	Low
Thalassemias	Normal to high	Normal to high	Low to normal	Normal to high	Normal	Normal to high
Sideroblastic anemias	High	Normal to high	Low to normal	High	High	High
Anemia of chronic disease	Normal to high	Low	Low to normal	Low	Normal	Low to normal





Thanks
For
Your attention

