# Anemia in Childhood

## More Common Types

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# DISCLOSURE

I have no actual or potential conflict of interest in relation to any product or service mentioned in this program or presentation.

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# LEARNING OBJECTIVES

1. Define childhood anemia and explain its significance, including the prevalence and potential impact on a child's growth and development
2. Identify the common causes of anemia.
3. Be familiar with the major symptoms associated with anemia  such as fatigue, shortness of breath and pale skin
4. Describe potential treatment options for some anemias
5. Know that Iron Deficiency Anemia is the most common cause of childhood anemia.

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# ANEMIA in CHILDHOOD
# Educational Goals

## Understand Each Item

1. What is Anemia in Childhood
2. Causes of Anemia
3. Presentation and Symptoms
4. Small Red Blood Cells
5. Big Red Blood Cells
6. Funny Looking Red Blood Cells
7. Treatment

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# WHAT IS ANEMIA?

# WHAT IS ANEMIA

Not enough RED BLOOD CELLS (RBC) or they do not function normally

- 20% of US children may be anemic
- May be a problem by itself
- May be a symptom of other diseases
- Affects overall health and well being

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# WHAT IS ANEMIA

There are 3 kinds of blood cells

- Red Blood Cells (RBC)
- White Blood Cells (WBC)
- Platelets (PLT)

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# WHAT IS ANEMIA

## Red Blood Cells

- Contain hemoglobin
  - Hemoglobin is the oxygen carrying protein
- Carries oxygen in the blood
- RBCs are disk-shaped
- No nucleus

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# WHAT IS ANEMIA

## White Blood Cells

- Immune cells: fight infection
- Amorphous
- Have a nucleus

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# WHAT IS ANEMIA

## Platelets

- Help to form clots
- Amorphous
- No nucleus

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# WHAT IS ANEMIA

## Acquired

- Iron deficiency anemia
- Megaloblastic anemia
- Hemolytic anemia
- Aplastic anemia

## Congenital/Genetic

- Iron-refractory iron deficiency anemia (IRIDA)
- Congenital sideroblastic anemia
- Sickle cell anemia
- Thalassemia (Cooley's anemia)
- Aplastic anemia
  - Fanconi anemia (bone marrow failure)
  - Diamond-Blackfan anemia (RBC aplasia-not being formed)

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# WHAT IS ANEMIA

## Risk Factors

- Premature or low birth weight
- Living in poverty or immigrating from developing country (SDoH)
- Early use of cow's milk
- Dietary deficiencies
- Blood loss (surgery, accidents)
- Chronic illnesses (infection, kidney dx, liver dx)
- Inherited anemia
  - Sickle Cell Anemia
  - Thalassemia

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# HOW DOES ANEMIA PRESENT

## Most Common Symptoms

- Increased heart rate
- Breathlessness
- Lack of energy
- Tiring easily
- Dizziness
- Orthostatic vertigo
- Headache
- Irritability
- Sore or swollen tongue (glossitis)
- Jaundice
- Enlarged spleen or liver
- Slow growth
- Delayed development
- Poor wound healing
- Irregular menstrual cycles

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# WHAT IS ANEMIA

Anemia has 3 main causes:

- Inability to make enough red blood cells
- Loss of red blood cells
- Destruction/malformation of red blood cells

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# WHAT IS ANEMIA

## Laboratory Tests (Screen for Causes)

| Complete Blood Count | | |
|---|---|---|
| | Normal Values (Hg) | (Hct) |
| | Hemoglobin g/dl | Hematocrit % |
| **6m - <2y** | 11-13.5 | 31-42 |
| **2 - 6y** | 11-13.7 | 34-44 |
| **6 - 12y** | 11.2-14.5 | 35-44 |
| **12 - 18y** | F 11.4-14.7 | 36-46 |
| | M 12.4-16.4 | 40-51 |

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# WHAT IS ANEMIA

## Laboratory Tests (Screen for Causes)

- Hct is % of RBC in 1 ml of blood
- Normal values MCHC

  In RBCs, the ratio of Hg to cell size is a constant (Mean Corpuscular Volume or MCV)

  Hg in an RBC/RBC Size (MCV)
- Mean Corpuscular Hemoglobin Concentration (MCHC) 32–36 g/dL
- Becomes abnormal with some anemias

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# WHAT IS ANEMIA

## Laboratory Tests (Screen for Causes)

Peripheral Smear

- Urine Test
- Metabolic profile
- Bilirubin
- Fecal Blood Test
- Genetic Tests

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# WHAT IS ANEMIA

Today I will discuss some of the more common anemias of childhood

- Iron deficiency anemia
- Megaloblastic anemia
- Sickle cell anemia
- Hemolytic Anemia

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# IRON DEFICIENCY ANEMIA (Small RBCs)

- Most common cause of anemia
- Not enough iron
  - Iron needed to form Hemoglobin (Hg)
  - Hg carries Oxygen in the blood
- Not enough red blood cells
- RBCs have a smaller size (Microcytosis)
- Red Blood Cells have less Hg per cell (Hypochromia)
- Not enough Oxygen carrying capacity
- MCHC is low (less Hg/MCV)

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# IRON DEFICIENCY ANEMIA
## Additional Symptoms

- Cold hands and feet
- Pica
  - Unusual cravings for non-nutritive substances, such as ice, dirt or starch
- Poor appetite
- Pale skin
- Brittle nails
- Koilonychia
  - Ridges, thin, up-curved edges

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# IRON DEFICIENCY ANEMIA
## Additional Laboratory Tests

- Serum ferritin
- Total Iron
- Iron binding capacity
- Bone marrow biopsy

These all have standardized normal values for comparison

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# IRON DEFICIENCY ANEMIA

## Causes

- Inadequate Iron intake
- Blood loss
- Poor intestinal Iron absorption

  -Milk

- Pregnancy

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# IRON DEFICIENCY ANEMIA

## Complications

Mild anemia may have no symptoms

- Heart problems
  - Heart works harder
  - Causes enlarged heart
- Pregnancy Problems
  - Premature birth
  - Low birth weight

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# IRON DEFICIENCY ANEMIA

## Complications

- Growth problems
  - Small size
  - Delayed development
    - Iron is a coenzyme metabolic processes
  - Increased risk of infection

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# IRON DEFICIENCY ANEMIA

## Prevention

- Choose Iron rich foods
  - -Meat, poultry, fish
  - -Beans, peas, dried fruit
  - -Green leafy vegetables
  - -Iron fortified foods
- Foods with high Vitamin C
  - -Improves Iron absorption

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# IRON DEFICIENCY ANEMIA
## Prevention

- For infants
  - -BREAST FEED ALL INFANTS
  - -Ensure the mother takes iron supplements
- When solids are introduced after 6 mo.
  - -Use iron-fortified foods
- Limit milk after 1 year of age
- Ensure a variegated diet with Iron rich foods

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# IRON DEFICIENCY ANEMIA

## Treatment

- Treat the underlying cause

- Oral iron treatment based upon weight

  -Prevention dose 1-2mg/kg/day

  -Treatment dose 3-6mg/kg/day

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# IRON DEFICIENCY ANEMIA

## Treatment

- Recheck
  - -Hg/Hct monthly initially, then less frequently with increasing Hg/Hct
  - -Failure to respond to oral Iron
    - Consider IV Iron
    - Reevaluate for underlying causes

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# MEGALOBLASTIC ANEMIA
## (Big RBCs)

- Not enough Red Blood Cells produced
- Not enough oxygen carrying capacity of the blood
- Bone marrow makes fewer RBCs
- Cells are larger than normal RBCs
- May be abnormally shaped

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# MEGALOBLASTIC ANEMIA

## Symptoms

- In addition to the prior list
- Pale or yellow skin
- Stomach upsets, nausea, diarrhea, gas, constipation
- Trouble walking
- Numbness or tingling in hands and feet
- Weak muscles

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# MEGALOBLASTIC ANEMIA

## Causes

- Deficiency of Vitamin B12
- Deficiency of Folic Acid
  - -Both are necessary for Red Blood Cell production
  - -Both are necessary for normal nerve and brain function

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# MEGALOBLASTIC ANEMIA

## Causes

- Digestive diseases, e.g. celiac disease or inflammation of the intestine

  -Reduces intrinsic factor

  -Causes failure to absorb B12 and folate

- Congenital folate malabsorption, genetic
- Medications, e.g., seizure medications

  -Restrictive Diets

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# MEGALOBLASTIC ANEMIA
## Laboratory Tests

- These are the same as for diagnosing Iron Deficiency Anemia
  - -MCHC is normal
- B12 and Folate levels
- Evaluation of nerve and muscle functioning
  - -Nerve conduction
  - -EEG
  - -Electromyography

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# MEGALOBLASTIC ANEMIA
## Complications

- Problems with growth and development
- Fatigue
- Poor exercise tolerance
- If the B12/folate deficiency is severe
  - -Enlarged heart or heart failure
  - -Seizures
  - -Mental deterioration

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# MEGALOBLASTIC ANEMIA
## Treatment

- Treat the underlying problem, e.g. digestive problems
- B12 or folic acid supplements
  - -Vitamin B-12 supplements are best absorbed when given by injection
  - -Oral treatment to follow
- Foods naturally high in B12 and Folate are mostly the same as those high in Iron
- B12 and Folate fortified foods

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# SICKLE CELL ANEMIA
## (Funny-looking RBCs)

Sickle Cell Anemia is a genetic disorder

- When the RBC gives the Oxygen to the tissue, the cell changes shape

  -It becomes crescent shaped

- The abnormal RBCs get stuck in the smaller blood vessels or break up

- Sickle RBCs live 1/5 as long as normal RBCs

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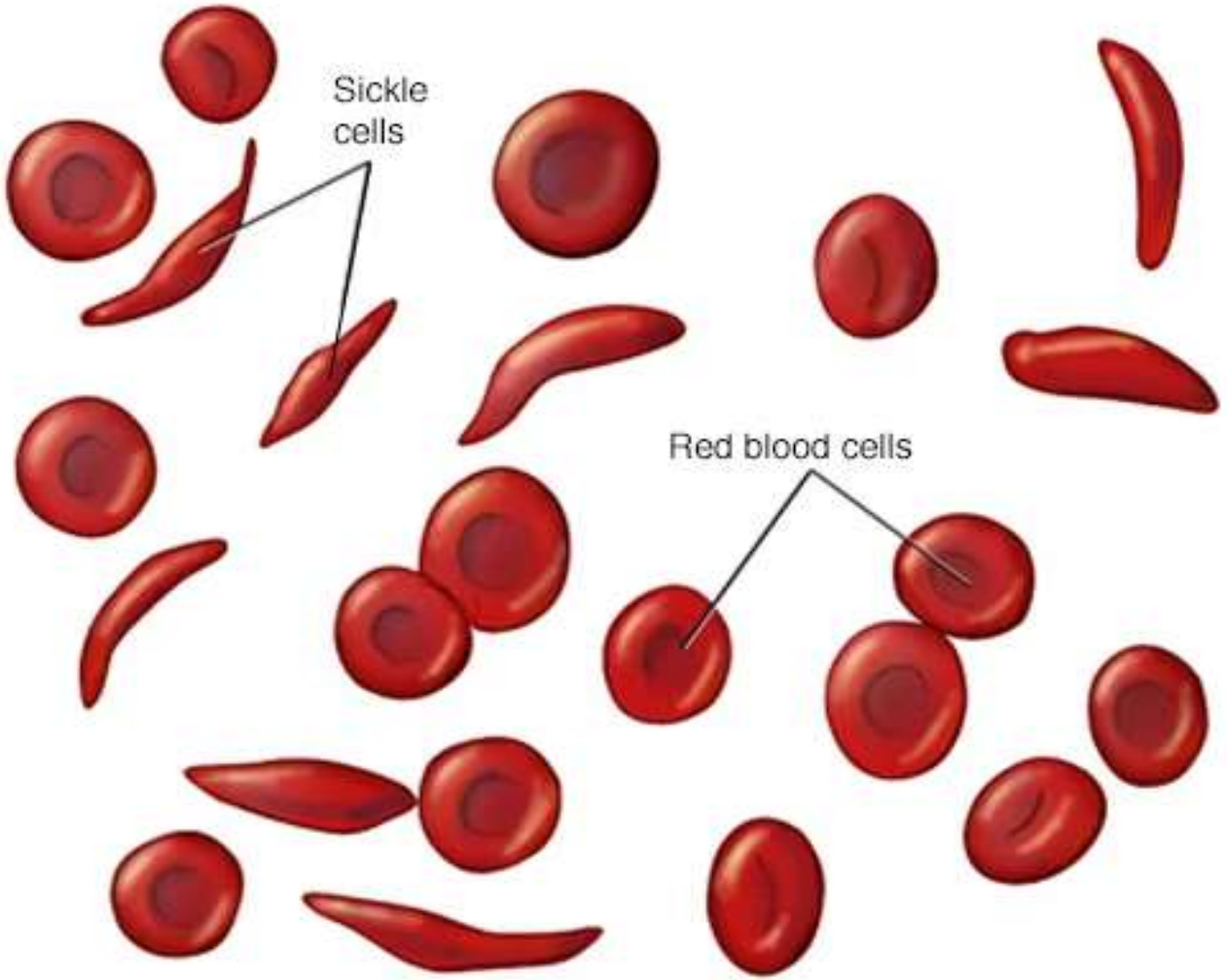
# SICKLE CELL ANEMIA

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# SICKLE CELL ANEMIA

## Symptoms

- Anemia
- Episodes of pain
  - -Sickled RBCs block blood flow in tiny vessels
- Duration can be hours to days
- Intensity moderate to severe
- Damages bones and joints
- Causes ulcers and organ damage

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# SICKLE CELL ANEMIA

## Symptoms

### Sickle Cell Disease (SCD)

- Swelling of hands and feet
- Frequent infections
  - More susceptible to bacterial infection
- Delayed growth or puberty
  - Blocked vessels impair delivery of Oxygen and nutrients
- Vision problems from damage to retinal vessels

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# SICKLE CELL ANEMIA
## Laboratory Tests

- Hemoglobin is 5-9 g/dL
- Hematocrit is 17-29%
- Both well below normal
- MCHC may be high

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# SICKLE CELL ANEMIA
## Genetics

- Simple Mendelian inheritance
- May have full SCD
- May have partial SCD (SCTrait)
- Some children of sickle cell parents have no SCD or SCT

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# SICKLE CELL ANEMIA
## Complications

Blocked vessels can cause

- Strokes
- Thinking problems
- Paralysis or weakness
- Numbness
- Headache

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# SICKLE CELL ANEMIA
## Complications

- Acute chest syndrome
  - -Critical blockage of lung vessels
  - -Emergency
- Pulmonary hypertension
- Blindness

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# SICKLE CELL ANEMIA
## Complications

- Avascular necrosis
  - -Loss of blood supply parts of bone
  - -Those parts die
- Organ damage
- Splenic sequestration
  - -Sickle RBCs trapped in spleen
  - -Enlarges, Pain
  - -Life-threatening

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# SICKLE CELL ANEMIA
## Complications

- Leg ulcers
- Gallstones
  - -Excess Bilirubin
- Priapism/Impotence
- Deep vein thrombosis
- Pregnancy complications
  - -Hypertension, blood Clots
  - -Miscarriage, premature birth

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# SICKLE CELL ANEMIA

## Treatments

- Bone marrow or stem cell transplantation
  - Can cure SCD
  - Transplants are risky
  - Severe SCD

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# SICKLE CELL ANEMIA

## Treatments

- Gene therapies
  - -12 years and older
  - -Repeated sickle cell crises
  - -Bone marrow cells
    - Adding new DNA
    - Changing existing DNA
    - Make normal RBCs

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# SICKLE CELL ANEMIA
## Treatments

Treatments that relieve symptoms

- Antibiotics to prevent infections
- Pain relievers for pain
  - Hydroxyurea (prevents sickling)
    - Reduce or prevent complications
    - Reduces production of sickle RBCs
    - Increases fetal hemoglobin RBCs

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# SICKLE CELL ANEMIA

- Treatments
  - -Blood transfusions for severe anemia
- Other treatments
  - -Blood pressure medication
  - -Vitamins/nutritional supplements

SICKLE CELL DISEASE
NATIONAL LIBRARY OF MEDICINE

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# HEMOLYTIC ANEMIA
## (Funny-looking RBCs)

- RBCs are destroyed faster than they can be made
- Destruction is called hemolysis
- 2 Forms

  -Congenital (Genetic)

  -Acquired

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# HEMOLYTIC ANEMIA

- Acquired
  - -RBCs are normal
  - -RBCs are destroyed
- Causes
  - -Some infections
  - -Cancer
  - -Hypersplenism
  - -Mechanical Heart Valves
  - -Autoimmune reactions

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# HEMOLYTIC ANEMIA

## Symptoms

- Pale or Jaundiced skin
- Jaundiced eyes
- Dark urine
- Lack of energy
- Enlarged liver or spleen
- Murmur
- May present like other anemias

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# HEMOLYTIC ANEMIA
## Laboratory Tests

- CBC
- Peripheral smear
- Urinalysis
  - -Hg in urine
- Bone marrow aspiration

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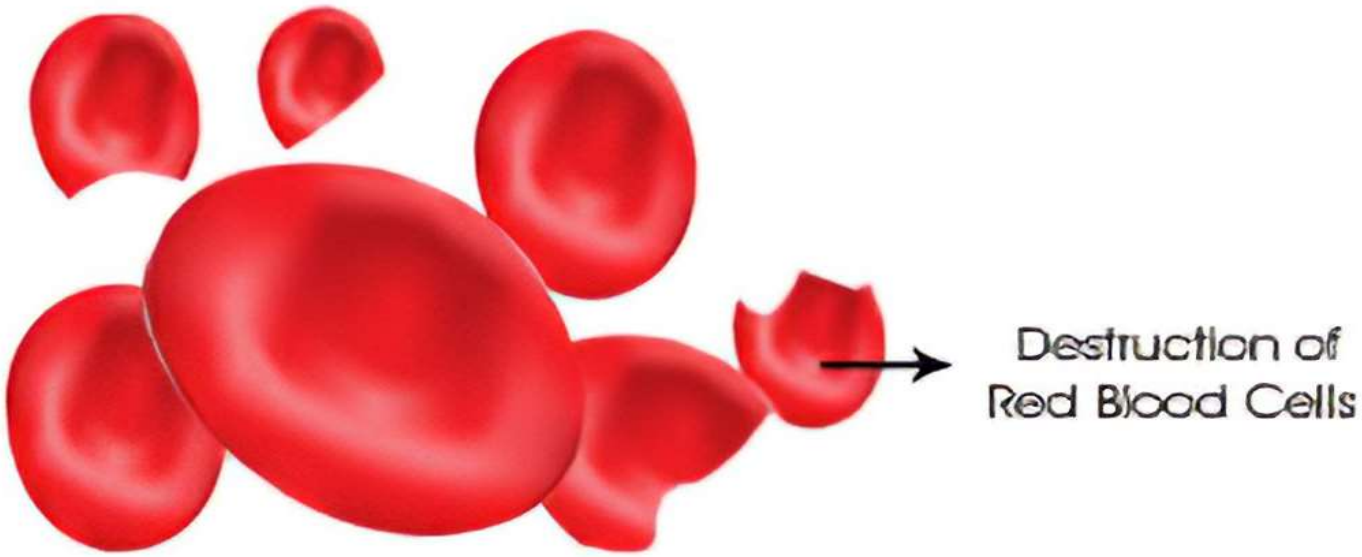
# HEMOLYTIC ANEMIA
## Laboratory Tests

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# HEMOLYTIC ANEMIA
## Treatment

Genetic

- Transfusions
- Avoid illness exposures
- Frequent hand washing
- Avoid undercooked foods
- Good dental hygiene
- Same other treatments as acquired

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# HEMOLYTIC ANEMIA
## Treatment

Acquired

- Blood transfusions
- Corticosteroids
- Immune suppressants
- IV immunoglobulin
- Splenectomy

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# ANEMIA IN CHILDHOOD
## Takeaways

- Anemia is a condition of decreased ability of the blood to supply the body with oxygen

- There are many different causes:
  - Not enough RBCs
  - Not enough oxygen carrying capacity
  - Defects in the RBGs
  - Defects in the hemoglobin

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# ANEMIA IN CHILDHOOD
## Takeaways

- Iron Deficiency Anemia is the most common anemia of childhood
- 20% of US children may be affected
- The lack of adequate iron to make RBCs is the final common pathway causing the problem

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# ANEMIA IN CHILDHOOD
## Takeaways

- Anemias are associated with changes in the shape and size of the RBCs
- Identifying these variations contributes to recognizing the kind of anemia
- Treatment is specific to the type of anemia
- Treating the underlying cause of anemia is necessary to achieve a positive outcome

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# ANEMIA IN CHILDHOOD

## Why is this important?

Having this knowledge enables you to better guide the caregivers of children

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# ANEMIA IN CHILDHOOD

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# ANEMIA IN CHILDHOOD

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# ANEMIA IN CHILDHOOD

## Questions

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