

## Anemia: A Guide for Parents

This document defines anemia and explains how it is diagnosed and treated. This information is intended for parents and other relatives of children who are being evaluated for anemia or diagnosed as having anemia. We hope this information will also be a useful resource for pediatricians and other health care providers as they counsel parents of children who have anemia.

### ***What Is Anemia?***

Anemia is a condition in which an individual's red blood cells are too few in number (i.e., the person's red blood cell count is too low). Since the red blood cells (also called erythrocytes) carry oxygen in the blood stream, an inadequate number of erythrocytes results in the body not getting enough oxygen because of so-called "tired blood."

Oxygen is carried in the blood by a protein called hemoglobin, which is packaged within the red blood cells. Red blood cells pick up oxygen in the lungs and carry it throughout the body to all of the organs and tissues. When there is not enough hemoglobin (resulting from an insufficient number of red blood cells) in patients with anemia, the body's cells are deprived of oxygen. That can cause significant problems (see below).

### ***How Is It Determined That A Child Has Anemia?***

A doctor usually identifies anemia by means of a complete blood count (also called a CBC) that is often performed for one of several reasons:

- ***Because of signs or symptoms of anemia:*** Signs of anemia include pale skin (also called pallor), a rapid pulse or heartbeat, and jaundice ( a yellowing of the eyes or skin). Symptoms of anemia that often prompt performance of a CBC include fatigue, weakness, shortness of breath, excessive sleepiness or fainting. These signs and symptoms can also be caused by problems other than anemia.
- ***As part of routine screening for anemia:*** It is customary for many pediatricians and family doctors to perform a routine screening test to identify anemia. This is most often done between 9 and 15 months of age (the peak age for anemia due to iron deficiency). Screening is sometimes performed at other ages, such as in teenage girls, when iron deficiency may result from heavy menstrual periods. Routine screening for anemia in children of all ages is not necessary because, fortunately, only a small minority of children develop anemia.
- ***When tests are performed for another purpose:*** Sometimes anemia is picked up on a CBC performed by your child's doctor because he or she is evaluating your child for other problems, such as infection or growth delay. When anemia is found, its cause must be determined so that proper treatment can be given. Mild anemia is a feature of many childhood diseases.

### ***How Is The Degree Of Anemia Measured?***

Anemia's presence and its severity are both usually measured by the complete blood count (CBC). The most frequently used measure of anemia is the hemoglobin concentration, or hemoglobin level. The usual hemoglobin level during childhood varies depending upon the age, sex and race of the child, but the normal range is generally 11.0 to 13.0 grams per deciliter (g/dl). The values are much higher in newborn infants, slightly lower in infants at 2 or 3 months of age, and higher in teen-agers. In general, if the child's hemoglobin is less than 11.0 g/dl, he or she is anemic.

Another way of measuring anemia is the hematocrit (or HCT). The hematocrit is virtually always approximately three times the hemoglobin value.

### ***When Is Anemia Dangerous?***

**Mild:** Anemia generally regarded as mild when the hemoglobin measurement is between 9.0 and 11.0 g/dl. Most children with hemoglobin values in this range have few or no signs or symptoms specifically from the anemia. Diagnosis and treatment is not an emergency. Anemia can be indicative of a potentially serious underlying problem, however, or it may represent a minor lifelong inherited condition. Therefore, its cause should be determined and, if possible, treatment administered.

**Moderate:** When the hemoglobin is between 6.0 and 9.0 g/dl, it is considered moderate in severity. Many children with this level of anemia have fatigue and slightly pale skin. Such levels of anemia are not dangerous in themselves, but the cause of moderate anemia should always be promptly determined and treated if possible.

**Severe:** Severe anemia is present when the hemoglobin is less than 6.0 g/dl. At this level, most children have some problems from their anemia as a result of inadequate amounts of oxygen getting to the brain, muscles and other parts of the body. When the hemoglobin declines below 4.0 or 5.0 g/dl, the anemia can be extremely dangerous or even life-threatening. Hemoglobin values below 3.0 g/dl put a great strain on the heart and can cause brain damage. Emergency attention is thus necessary for severe degrees of anemia. Blood transfusions are often required.

The types of problems that a child will have from anemia vary greatly from one patient to another depending upon how long the anemia has been present and its cause. Children with long-standing and slowly developing anemia may actually have few problems despite very low hemoglobin levels.

### ***What Causes Anemia?***

Anemia results from one of three basic causes: decreased production of red blood cells, loss of red blood cells from the body or excessive destruction of red blood cells (also called hemolysis).

- ***Decreased production:*** If the bone marrow (the fatty, spongy tissue inside many of the bones) is unable to make a sufficient number of red blood cells, anemia results. This can be due to damage to the bone marrow (seen in such serious conditions as leukemia and aplastic anemia), a deficiency of iron or other nutrients necessary to make red blood cells, or other situations preventing the normal development of red blood cells (such as chronic kidney disease or an inherited disorder called thalassemia).
- ***Blood Loss:*** If blood is lost from the body (from any injury, nosebleeds, or internal hemorrhage), anemia can result. If the blood loss occurs rapidly, the child may go into shock and suffer serious consequences. Anemia due to acute blood loss is usually easily diagnosed.
- ***Excessive destruction of red blood cells (hemolysis or hemolytic anemia):*** Red blood cells normally live in the body for 120 days. If red blood cells are damaged, they survive for a much shorter time. Red blood cells can be suddenly injured by external factors (such as antibodies, drugs or abnormal blood vessels) or they can be destroyed slowly as a result of inherited problems (such as sickle cell disease). Damaged red blood cells are normally destroyed in the spleen, which often becomes enlarged as a result. When the red blood cells break down, their waste product is bilirubin, a yellow pigment that can build up in the blood thus causing a yellow tinge to the skin and eyes (called jaundice) and sometimes cause gallstones. Various tests are available to determine the specific cause of hemolytic anemia.

### ***What Tests Can Determine The Cause Of A Child's Anemia?***

As indicated above, the first step is a CBC, documenting that your child is indeed anemic and determining how severe the anemia is. Additional tests are then done to determine the cause or mechanism of the anemia and to ascertain whether other conditions or disorders are present.

The cause of anemia can usually be determined by very careful examination of the CBC results. A particularly useful test is the mean cell volume (or MCV) that is usually part of the CBC. The MCV value varies with age, but the normal value is usually between 70 and 90 femtoliters (fl). Determining whether the MCV is low, normal or high assists greatly in determining the cause of anemia. For instance, iron deficiency anemia and an inherited form of anemia called thalassemia are almost always associated with a low MCV.

Other red blood cell measures recorded as part of the CBC – such as MCH, MCHC and RDW – are not nearly as helpful as the MCV. An occasional exception to this is the RDW, which is usually elevated in cases of iron deficiency, as well as the MCHC, which often increases in hereditary spherocytosis.

Other parts of the CBC can be extremely useful in defining the cause of anemia. These include the white blood cell (WBC) count and platelet count. These tests determine the number of circulating white blood cells (which fight infection) and platelets (which make the blood clot properly). An important part of this is the differential WBC count (also called the “diff”), which measures the different kinds of white blood cells. The last part of the CBC that is extremely useful is an examination of the blood film or blood smear in which a drop of blood is placed on a glass slide and stained with a special dye under the microscope. This will always be performed as part of a consultation by a pediatric hematologist for evaluation of anemia.

Normally, red blood cells are perfectly round and have a hole in them, making them look like a donut. Many different type of anemia are associated with changes in the size or shape of the red blood cells. Also, by carefully looking at the blood smear, the hematologist can determine whether new or young red blood cells are being made and assess the other parts of the blood as well.

The final routine test performed as part of the evaluation of anemia is the reticulocyte (also called “retic”) count. Reticulocytes are young baby red blood cells that have just been made by the bone marrow during the previous day or two. The normal reticulocyte count is between 1.0 and 2.0 percent. If the reticulocyte count is elevated, this means that the bone marrow is making red blood cells. The more anemic the child is, the higher the reticulocyte count should be if the bone marrow is functioning effectively. The reticulocyte count is extremely helpful in determining the cause of a child's anemia and in monitoring the condition's progress.

### ***How Does The Doctor Go About Diagnosing A Child's Anemia?***

The determination of why a child is anemic is made on the basis of a detailed medical history, a physical examination and laboratory tests.

- ***History:*** The cause of anemia is often evident from your child's history. You may be asked about your child's history. You may be asked about your child's birth (especially whether or not he or she was jaundiced at that time), diet (especially about breast feeding and the type of milk formula administered during infancy), iron supplementation, drug exposure, results of previous blood counts, and, of course, symptoms of anemia or underlying disorders. You will also be asked questions about a family history of anemia and the child's ethnic origin (since certain anemias occur more commonly, for example, in persons of African or Asian ancestry).

- **Physical examination:** Your child will be carefully examined, with particular attention given to detecting enlargement of the lymph glands, the liver and the spleen.
- **Laboratory tests:** The extent of laboratory tests varies greatly from one child to another. In many cases, a CBC and reticulocyte count are all that are necessary for making the diagnosis. In other circumstances, additional specialized tests are necessary. Fortunately, extensive and expensive laboratory testing is generally not required for diagnosing and treating most childhood anemias. Sometimes blood counts on other family members are helpful, not only in diagnosing anemia in the child but in uncovering unsuspected anemia in other family members. In some cases a referral to other medical specialists (or back to your child's primary care physician) will be necessary, especially if the anemia is found to be secondary to another condition.

### **What Are The Most Common Causes Of Childhood Anemia?**

- **Iron deficiency:** Iron is a major component of hemoglobin. In fact, it is the substance that specifically binds to oxygen in the blood. Therefore, if insufficient iron is available, anemia results. Iron deficiency in other parts of the body can be a problem as well. It can cause behavior abnormalities such as irritability, decreased attentiveness and pica (which is characterized by a tendency to eat cardboard, dirt and other non-food items). Iron deficiency usually occurs as a result of insufficient iron in the diet (especially excessive and prolonged intake of whole cow's milk or prolonged breast feeding), but it can also result from excessive blood loss and other causes. Iron deficiency is treated with, and usually responds to, oral iron medications.
- **Anemia of inflammation:** A common cause of anemia in basically well children is mild repetitive infections (such as ear, throat and intestinal infections) that temporarily suppress the bone marrow. The anemia of inflammation may also result from potentially serious disorders, so careful evaluation and follow-up is necessary. The anemia of inflammation usually improves or resolves without treatment.
- **Thalassemia minor (also called thalassemia trait):** Thalassemia is a hereditary anemia occurring most commonly in blacks, Asians and people from the Middle East or Mediterranean areas. However, it is also seen in Caucasians. The anemia is mild and is often confused with iron deficiency. No treatment is necessary.
- **Sickle cell disease:** This group of hemolytic anemias, some of which can be quite severe, are usually seen in persons of African ancestry. Sickle cell disease is due to an inherited abnormality in the hemoglobin, resulting in a tendency for the red blood cells to form a curved or sickled shape.
- **Hereditary spherocytosis:** This is the most common form of inherited hemolytic anemia in Caucasians and Hispanics. The red blood cells are round and dense rather than shaped like donuts. This results in excessive fragility of the red blood cells, causing their numbers to decline. In some cases the condition is treated by splenectomy (removal of the spleen).
- **Transient erythroblastopenia of childhood (TEC):** This is one of the most common forms of severe anemia during early childhood. It is characterized by a complete cessation of production of red blood cells by the bone marrow for a period of several months. Its cause is unknown. Other than a red blood cell transfusion in more severe cases, no therapy is necessary.
- **Acute leukemia:** Although it is not very common (occurring in 1 in 2,000 children), leukemia or other forms of cancer must always be suspected when anemia is identified together with other changes in blood count or suspicious signs or symptoms.
- **"Rule-out" or statistical anemia:** Often children are referred to pediatric hematologists for evaluation of anemia when they are really not anemic at all. Children have lower red blood cell counts than adults, and some physicians who are more used to dealing with adults believe that children are anemic when their CBC result is actually normal for a child. Also, some totally normal children seem to have hemoglobin values that are borderline, or even slightly low, without apparent explanation or harm.

**How Is Anemia Treated?**

Treatment of anemia depends upon its underlying cause. In many cases, treatment is neither possible nor required. Treatment of childhood anemia is individualized, and specific treatment depends greatly on the anemia's cause and severity. Your physician will discuss treatment with you and, if treatment is necessary, will monitor its effectiveness.

**Summary**

We hope this information has been helpful to you. This pamphlet results from more than 30 years of experience by members of our staff in diagnosing and treating hundreds of children with anemia. If you have general questions about anemia or specific questions about a child evaluated at our center for anemia, please do not hesitate to contact a physician or hematology nurse in the Center for Cancer and Blood Disorders at Children's Medical Center.

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