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## Diagnostic Approach to Common Anemias in Pediatrics

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# Diagnostic Approach to Common Anemias in Pediatrics

Felicia L. Wilson, MD

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## INTRODUCTION

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Anemia is generally defined as an abnormal decrease in the number of circulating erythrocytes or in the hemoglobin concentration and the hematocrit to levels that are 2 standard deviations below the mean for the normal population.<sup>1</sup> Anemia is not a diagnosis in itself; rather, it is a symptom of an underlying disease. Therefore, the evaluation of anemia is directed at elucidating the underlying cause. **Table 1** and **Table 2** show important features in patient history and physical findings that can yield valuable information, considerably narrowing possible causes for anemia and reducing the necessity of performing expensive tests.

### COMPLETE BLOOD COUNT

The complete blood count (CBC) remains a practical starting point in the laboratory evaluation and classification of anemias and consists of hemoglobin level, hematocrit, erythrocyte count, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), leukocyte count, and platelet count. The CBC results determine whether the problem is anemia alone, anemia with leukopenia or thrombocytopenia, or pancytopenia, entities that would significantly alter the differential diagnosis. On newer cell counters, the red cell distribution width (RDW) is available and serves as a quantitative measure of the degree of variability in the size and shape of the erythrocytes (anisocytosis—excessive variation in size; poikilocytosis—excessive variation in shape). The reticulocyte count, a measure of bone marrow erythrocyte production, is another helpful parameter in the initial work-up. Lastly, examination of the peripheral blood smear can be particularly useful in confirming the results of the CBC, as well as providing morphologic clues to the diagnosis.

When analyzing the CBC, it is important to consider developmental variations in reference to the hemoglobin level, the hematocrit, and erythrocyte indices in the

infant or child. Normal values in the pediatric years are listed in **Table 3**. Hemoglobin levels and hematocrit are relatively high in the newborn period, with mean values of 18.5 g/dL and 56%, respectively. At birth, the infant moves from a relatively hypoxic intrauterine environment and an arterial oxygen saturation of 45% to a normoxic environment where arterial saturation increases to 95% with the onset of respiration.<sup>2</sup> This change causes an abrupt cessation in erythropoietin production and a halt in erythropoiesis. In addition, fetal erythrocytes in the newborn have a shortened lifespan of 60 to 70 days, compared to the 120-day lifespan of adult erythrocytes. The rapid growth of the newborn baby is accompanied by an increase in plasma volume, which results in a dilutional effect to further decrease hemoglobin levels and hematocrit. A nadir is reached at approximately 6 to 8 weeks of age for the term infant and earlier—at around 5 weeks of age—for the premature infant. Hemoglobin and hematocrit levels then steadily increase, reaching adult levels at puberty. This condition is referred to as *physiologic anemia of infancy* and is an extrauterine adaptation to life rather than a pathologic anemia.

### CLASSIFICATION OF ANEMIAS

Anemias may be classified on the basis of erythrocyte size (MCV). Microcytic, hypochromic anemias are the most common class of anemias in pediatric years. The MCV is below the lower limit of normal for age. In children between the ages of 2 years to 10 years, the lower limit of normal for MCV is 70 fL plus the age in years. These anemias are caused by impaired synthesis of the heme or globin components of hemoglobin.

Normochromic, normocytic anemias are characterized by an MCV in the normal range. They are further classified by the reticulocyte count and are caused by hemorrhage, hemolysis, or hypoproduction of the bone marrow.

Macrocytic anemias are characterized by an MCV above the upper limit of normal, which is obtained by adding 0.6 fL per year to 84 fL beyond the first year of life until the upper limit of 96 fL in adults is reached.<sup>3</sup>