

Basic Laboratory Tests

Complete Blood Counts (CBC)

Test	Alternative Names	Units	Usual Normal Range	Examples of conditions in which abnormal values occur
Hemoglobin	Hb or Hgb	g/dL	Males: 13.6-17.5 g/dL Females: 12-16 g/dL	Levels are reduced with bleeding, iron deficiency, pernicious anemia, hemolytic anemia, aplastic anemia Increased levels occur with polycythemia vera, smoking, living at high altitude
Hematocrit	Hct	%	Males: 39%-49% Females: 35%-45%	Same as Hemoglobin
Red Blood Cell Count	RBC	Number x 10 ⁶ cells/mm ³	Males: 4.3-5.9 x10 ⁶ /mm ³ Females: 3.5-5 x10 ⁶ /mm ³	Same as Hemoglobin
Mean Corpuscular Volume	MCV	Cubic micromillimeters (μm ³)	80-100 mm ³	Low levels are seen with iron deficiency, thalassemia minor High levels are found with vitamin B12 deficiency, alcohol abuse
Mean Corpuscular Hemoglobin	MCH	picrograms (pg)	24-34 pg	Low levels are seen with iron deficiency, thalassemia minor High levels are found with vitamin B12 deficiency
Mean Corpuscular Hemoglobin Concentration	MCHC	g/dL	33-37 g/dl	Low levels are found with iron deficiency anemia, thalassemia High levels are seen with hereditary spherocytosis
Red cell distribution width index	RDW	%	11.5% to 14.5%	High levels are found with Iron deficiency anemia
Reticulocyte count	Retic	%	0.5% to 1.5%	Increased levels are seen with blood loss or hemolytic anemia Inappropriately decreased levels are found with iron deficiency, aplastic anemia
Platelet Count	Plate	Number x 10 ³ /mm ³	150-450 x 10 ³ /mm ³	Levels are decreased with idiopathic thrombocytopenia purpura, disseminated idiopathic coagulopathy, spleen enlargement High levels are seen with iron deficiency anemia, infections, essential thrombocythemia
Total White Blood Cell Count	WBC or WC	Number x 10 ³ cells/mm ³	4.5- 11 x 10 ³ /mm ³	High or low levels are associated with an increase or decrease of one or more of the different subtypes of white blood cells.
Polymorphic neutrophils (Neutrophils)	PMNs, Mature neutrophils, segmented forms, segs	% or absolute number x 10 ³ /mm ³	60-70% or 1.8-7.7 x10 ³ /mm ³	Levels are increased with bacterial infections, inflammatory disorders, physical and emotional stress, steroid medications Low levels are found with aplastic anemia, secondary to radiation or chemotherapy, hereditary conditions
Band forms	Bands, stabs, juvenile forms	% or absolute number x 10 ³ /mm ³	2-6% or 0-0.07 x10 ³ /mm ³	Increased values are seen with severe bacterial infection, severe inflammatory conditions and recovery of bone marrow function after suppression
Lymphocytes	Lymphs	% or absolute number x	25-40% or 1.0-4.8 x10 ³ /mm ³	Increased in viral infections, radiation treatment, some types of leukemia.

		$10^3/\text{mm}^3$		Low levels are seen with immunodeficiency states, systemic lupus, bone marrow failure, late stage HIV disease
Monocytes	Monos	% or absolute number x $10^3/\text{mm}^3$	2-8% or $0-0.8 \times 10^3/\text{mm}^3$	High levels are found in chronic inflammatory disorders, some infections, Hodgkin's disease, some types of leukemia Low levels may be seen with steroid medication usage
Eosinophils	Eos	% or absolute number x $10^3/\text{mm}^3$	1-4% or $0-0.45 \times 10^3/\text{mm}^3$	Increased levels are seen in parasitic infections, allergic disorders, eczema, asthma, some types of leukemia Decreased levels are found with excess steroid levels, stress reactions
Basophils	Baso	% or absolute number x $10^3/\text{mm}^3$	0-1% or $0-0.2 \times 10^3/\text{mm}^3$	Increased levels are found in myeloproliferative disorders, some types of leukemia, inflammatory conditions Decreased levels are found with stress reactions, prolonged steroid medication therapy, hyperthyroidism

[Complete Blood Count \(CBC\)](#)

[Hemoglobin \(Hb\)](#)

Hemoglobin (Hb) is a measurement of the amount of the oxygen carrying protein hemoglobin per unit volume present in the blood. Hemoglobin is found within red blood cells and gives these cells their characteristic red color. Hemoglobin levels are generally higher in males than females. A reduction in the hemoglobin level is called anemia and may result from excess blood loss, premature destruction of red cells or reduced production of new cells. Hemoglobin levels that are higher than normal (polycythemia) may be detected in individuals who live at high altitude, in smokers and in some other pathologic conditions that lead to abnormally excessive production red blood cells.

[Hematocrit \(Hct\)](#)

The hematocrit (Hct) is a measure of the amount of space or volume that the red blood cells occupy in the blood. It is generally reported at a percentage. Thus, a hematocrit reported as 40% indicates that the red blood cells occupy 40% of a given volume of blood. As with the hemoglobin, the hematocrit is generally higher in males than females. The same factors that affect the hemoglobin will affect the hematocrit and in the same way.

[Red Blood Cell Count \(RBC\)](#)

The red blood cell count (RBC) is the number of red blood cells per unit volume of blood. As with the hemoglobin and hematocrit, the red blood cell count is higher in males than females. Anemia and polycythemia cause a decrease and increase in the red blood cell count respectively.

[Mean Corpuscular Volume \(MCV\)](#)

The mean corpuscular volume (MCV) is a measure of the average size or volume of the individual red blood cells. The MCV can provide valuable clues to the possible causes of anemia. Failure to produce adequate hemoglobin results in smaller than normal cells and a low MCV. Iron deficiency anemia is an example of a condition with a lower than normal MCV. Thalassemia is an inherited condition that also produces anemia with a low MCV. Anemia associated with abnormal cell division in the production of red blood cells (for example vitamin B12 deficiency) is associated with larger than normal red blood cells or an elevated MCV. Chronic alcohol abuse may also lead to an increased MCV.

Mean Corpuscular Hemoglobin (MCH)

The mean corpuscular hemoglobin (MCH) is a measure of the average amount or weight of hemoglobin per red blood cell. MCH levels generally increase or decrease in conjunction with changes in the MCV. A low MCH is associated with decreased hemoglobin production. Iron deficiency is the most common cause of a low MCH. Large cells (high MCV), as seen with vitamin B12 deficiency, generally have a higher than normal MCH.

Mean Corpuscular Hemoglobin Concentration (MCHC)

The mean corpuscular hemoglobin concentration (MCHC) is the average concentration of hemoglobin within the red blood cells. Just as the MCV measures the average size of the red blood cell, the MCHC measures the average color of the cells. Since hemoglobin gives the red cells their characteristic color, the lower the concentration of that protein the lighter the pigment. The MCHC is lower than normal in iron deficiency anemia. It is elevated in some uncommon types of hereditary anemia.

Red Cell Distribution Width Index (RDW)

The red cell distribution width index (RDW) is a measure of the variation in size within the population of red blood cells. A large RDW indicates an abnormally increased variation in cell size. This variation may be useful in differentiating different causes of anemia.

Reticulocyte Count (Retic)

The reticulocyte count is the percentage or number of new or immature red blood cells (reticulocytes) circulating in the blood. Normally about 0.5%-1.5% of the circulating cells are reticulocytes. With normal bone marrow function the reticulocyte count is stable over time as new cells replace old ones. If the red blood cell count is reduced due to blood loss or cell destruction the reticulocyte count will normally increase to replace the lost cells. The reticulocyte count can thus be used to differentiate anemia that is due to excessive loss or destruction of cells (increased) from those where the problem is reduced production (inappropriately normal or decreased). Because the number of reticulocytes is affected by the presence of anemia or polycythemia, the reported percentage is often corrected for the hematocrit in order to judge if the bone marrow response is appropriate for the number of red blood cells present.

Platelet Count (Platelets)

The platelet count is the number of platelets per unit volume of blood. Platelets are the small fragments of cells and are involved in the blood clotting process. Low counts may be associated with excessive bleeding and can be caused by excessive consumption or clotting, increased destruction, sequestration or isolation (as in the spleen) or reduced production of platelets. Increased values may result from increased production in the bone marrow or reduced removal from the circulation. Causes for increased platelet production include inflammation, infections, blood loss, tissue destruction, some medications and some diseases of the bone marrow (myeloproliferative disorders). Reduced removal from the circulation generally occurs when the spleen is removed.

Total White Blood Cell Count (WBC)

The total white blood cell count (WBC) is the number of white blood cells per unit volume blood. The white blood cells function as part of the immune system and their primary role is to protect the body from infection. The total white blood cell count is really a composite of six different subtypes including: [polymorphic neutrophils \(PMN\)](#), [band forms](#) (bands or stabs), [lymphocytes](#) (lymphs), [monocytes](#) (mono), [eosinophils](#) (eos) and [basophils](#) (baso). Often the total count is reported as an absolute number per unit volume with the subtypes reported as a percentage of that total. The absolute number of the subtypes may also be reported directly or calculated by multiplying the percentage present by the total white blood cell count. The total white blood cell count can be abnormally high or low usually as a result of a change in one or more of its component subtypes.

Polymorphic Neutrophils (PMNs)

Polymorphic Neutrophils (PMNs) are the most common subtype of [white blood cells](#). These cells are capable of ingesting infectious agents, other cells and foreign material and are an important part of the body's defense mechanism, especially against bacteria. They are also an important part of the immune process. The polymorphic neutrophils are increased in most bacterial infections, inflammatory disorders, some types of leukemia, metabolic disorders, trauma and physical and emotional stress. Their number is decreased in bone marrow failure secondary to radiation or chemotherapy, some viral infections, overwhelming bacterial infections, some hereditary conditions, vitamin B12 deficiency and with an enlarged spleen (splenomegaly).

Band Forms (Bands or Stabs)

Band forms are the immature precursor forms of polymorphic neutrophils, the last step before full maturation of those [white blood cells](#). Certain morphologic criteria must be met for a polymorphic neutrophil to be called a band form. Because of the criteria variation between laboratories, the band form count is often not considered to be a highly reliable

measurement. An increase in the band forms usually indicates increased production of PMNs, most often in response to a serious bacterial infection. Band forms may be increased with severe inflammatory conditions or bone marrow recovery after an insult that had previously reduced production.

Lymphocytes (Lymphs)

Lymphocytes are [white blood cells](#) that are important components of the immune system. There are two main types of lymphocytes: B cells which produce antibodies and T cells which function to eliminate body cells that are infected with viruses or altered by cancer. These lymphocyte subtypes require special testing for identification and are not considered part of the complete blood count. Lymphocytes also produce substances called cytokines that are important in augmenting and modifying immune responses. Lymphocyte counts are increased in viral and certain bacterial infections, radiation treatment and some forms of leukemia. Reduced counts are found with immunodeficiency diseases, severe sepsis, systemic lupus, bone marrow failure, medication reactions and the late stages HIV infection.

Monocyte (Monos)

Monocytes are the largest of the [white blood cells](#). Monocytes digest damaged cells and other material. They work with lymphocytes as an important part of the immune process. Monocytes may migrate from blood vessels into body tissues in response to damage or immune stimulation. These tissue monocytes are known as macrophages. Monocytes counts are increased with chronic inflammatory disorders, some infections, Hodgkin's disease and some forms of leukemia. Low monocyte counts may be seen with steroid medication use.

Eosinophils (Eos)

Eosinophils are [white blood cells](#) that are primarily involved in the body defense against parasitic infections. Eosinophils are also involved in allergic reactions. Eosinophils counts are increased in parasitic infections, allergic disorders, asthma, eczema, autoimmune disease and some forms of leukemia. Eosinophil counts are decreased by corticosteroids and stress reactions.

Basophils (Basos)

Basophils are [white blood cells](#) that are important components of the immune system. They are also involved in allergic reactions. They are capable of ingesting foreign material. They contain and, under appropriate stimulation, release chemicals that are important in the immune process. Basophil levels are increased in myeloproliferative diseases, some types of leukemia and inflammatory conditions. Basophil counts may be decreased with stress reactions, prolonged corticosteroid therapy and an overactive thyroid gland