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Complete Blood Count

Also known as: CBC, Hemogram, CBC with differential
Related tests: Blood smear, Hemoglobin, Hematocrit, Red blood cell (RBC) count, White blood cell (WBC) count, White blood cell differential count, Platelet count

At A Glance

Why get tested?
To determine general health status and to screen for a variety of disorders, such as anemia and infection

When to get tested?
As part of a routine medical exam or as determined by your doctor

Sample required?
A blood sample drawn from a vein in the arm or a fingerstick or heelstick (newborns)

The Test Sample

What is being tested?
The Complete Blood Count (CBC) test is an automated count of the cells in the blood. It provides information about the white blood cell (WBC), red blood cell (RBC), and platelet populations present. This information includes the number, type, size, shape, and some of the physical characteristics of the cells. In only a minute or two, the hematology instrument (the machine that is used to run the test) can measure thousands of RBCs, WBCs, and platelets and compare them against established normal ranges. Any abnormalities found are noted, and the clinical laboratory scientist (CLS) running the instrument then uses his or her expertise and experience to accept the automated findings and/or to target the sample for further analysis.

In most cases, the automated CBC is very accurate and the test is complete at this point. If, however, there are significant abnormalities in one or more of the cell populations, a blood smear test may be performed. In this test, a drop of blood is placed on a slide, smeared into a thin layer, allowed to dry, and then dyed with a special stain. A CLS then looks at the slide under the microscope and is able evaluate the cells present. Any additional information is added to that found by the automated count, and all of the findings are reported to the doctor.

Blood consists of cells suspended in a liquid called plasma. These cells - the RBCs, WBCs, and platelets - are produced and mature primarily in the bone marrow. Under normal

circumstances, they are released into the bloodstream as needed.

White Blood Cells (WBCs)
There are five different types of WBCs that the body uses to fight infections or other causes of injury. These types - neutrophils, lymphocytes, basophils, eosinophils, and monocytes - are present in relatively stable percentages that may temporarily shift higher or lower depending on what is going on in the body. For instance, with an infection, there may be a higher concentration of neutrophils (a "shift to the left"). With allergies, there may be an increased number of eosinophils, and with leukemia, there may be a much higher percentage of a single type of cell, such as a lymphocyte. In this case, the cell may be present in large numbers, in a mature form and in a variety of immature forms. The CBC determines whether there are sufficient WBCs present to fight infection, notes when there are more than expected, and determines the percentages and numbers of each type.

Red Blood Cells (RBCs)
RBCs are reddish in color and shaped like a donut with a thinner section in the middle instead of a hole. They have hemoglobin inside them, a protein that transports oxygen throughout the body. The CBC determines whether there are sufficient RBCs present and whether the population of RBCs appears to be normal. RBCs are normally all the same size and shape; however, variations can occur with vitamin B12 and folate deficiencies, iron deficiency, and with a variety of other conditions. If there are insufficient normal RBCs present, the patient is said to have anemia and may have symptoms, such as fatigue and weakness. Much less frequently, there may be too many RBCs in the blood (erythrocytosis or polycythemia). In extreme cases, this can interfere with the flow of blood through the veins and arteries.

Platelets
Platelets are special cell fragments that play an important role in blood clotting. If a patient does not have enough platelets, he will be at an increased risk of excessive bleeding and bruising. The CBC measures the number and size of platelets present. With some conditions and in some people, there may be giant platelets or platelet clumps that are difficult for the hematology instrument to accurately measure. In this case, a blood smear test may be necessary.

How is the sample collected for testing?
The CBC is performed on a blood sample taken by a needle placed in a vein in the arm or by a fingerstick (for children and adults) or heelstick (for infants).

The Test

How is it used?
The CBC is used as a broad screening test to check for such disorders as anemia, infection, and many other diseases. It is actually a panel of tests that examines different parts of the blood and includes the following:

- White blood cell (WBC) count is a count of the actual number of white blood cells per volume of blood. Both increases and decreases can be significant.
- White blood cell differential looks at the types of white blood cells present. There are five different types of white blood cells, each with its own function in protecting us from infection. The differential classifies a person's white blood cells into each type: neutrophils (also known as segs, PMNs, grans), lymphocytes, monocytes, eosinophils, and basophils.
- Red blood cell (RBC) count is a count of the actual number of red blood cells per volume of blood. Both increases and decreases can point to abnormal conditions.
- Hemoglobin measures the amount of oxygen-carrying protein in the blood.

- Hematocrit measures the amount of space red blood cells take up in the blood. It is reported as a percentage.
- The platelet count is the number of platelets in a given volume of blood. Both increases and decreases can point to abnormal conditions of excess bleeding or clotting. Mean platelet volume (MPV) is a machine-calculated measurement of the average size of your platelets. New platelets are larger, and an increased MPV occurs when increased numbers of platelets are being produced. MPV gives your doctor information about platelet production in your bone marrow.
- Mean corpuscular volume (MCV) is a measurement of the average size of your RBCs. The MCV is elevated when your RBCs are larger than normal (macrocytic), for example in anemia caused by vitamin B12 deficiency. When the MCV is decreased, your RBCs are smaller than normal (microcytic), such as is seen in iron deficiency anemia or thalassemias.
- Mean corpuscular hemoglobin (MCH) is a calculation of the amount of oxygen-carrying hemoglobin inside your RBCs. Since macrocytic RBCs are larger than either normal or microcytic RBCs, they would also tend to have higher MCH values.
- Mean corpuscular hemoglobin concentration (MCHC) is a calculation of the concentration of hemoglobin inside the RBCs. Decreased MCHC values (hypochromia) are seen in conditions where the hemoglobin is abnormally diluted inside the red cells, such as in iron deficiency anemia and in thalassemia. Increased MCHC values (hyperchromia) are seen in conditions where the hemoglobin is abnormally concentrated inside the red cells, such as in hereditary spherocytosis, a relatively rare congenital disorder.
- Red cell distribution width (RDW) is a calculation of the variation in the size of your RBCs. In some anemias, such as pernicious anemia, the amount of variation (anisocytosis) in RBC size (along with variation in shape – poikilocytosis) causes an increase in the RDW.

When is it ordered?

The CBC is a very common test that used to be ordered on every person during his or her yearly physical. While it is not run quite as frequently now, it is still used routinely to screen for, help diagnose, and to monitor a variety of conditions. Many patients will have baseline CBC tests to help determine their general health status. If they are healthy and they have cell populations that are within normal limits, then they may not require another CBC until their health status changes or until their doctor feels that it is necessary.

If a patient is having symptoms associated with anemia, such as fatigue or weakness, or has an infection, inflammation, bruising, or bleeding, then the doctor may order a CBC to help diagnose the cause. Significant increases in WBCs may help confirm that an infection is present and suggest the need for further testing to identify its cause. Decreases in the number of RBCs (anemia) can be further evaluated by changes in size or shape of the RBCs to help determine if the cause might be decreased production, increased loss, or increased destruction of RBCs. A platelet count that is low or extremely high may confirm the cause of excessive bleeding or clotting.

Many conditions will result in increases or decreases in the cell populations. Some of these conditions may require treatment, while others will resolve on their own. Some diseases, such as cancer (and chemotherapy treatment), can affect bone marrow production of cells, increasing the production of one cell at the expense of others or decreasing overall cell production. Some medications can decrease WBC counts, and some vitamin and mineral deficiencies can cause anemia. The CBC test may be ordered by the doctor on a regular basis to monitor these conditions and drug treatments.

What does the test result mean?

The following table explains what increases or decreases in each of the components of the

CBC may mean. To download an expanded, printable version of this table, click here.

Test	Name	Increased / Decreased
WBC	White Blood Cell	May be increased with infections, inflammation, cancer, leukemia; decreased with some medications (such as methotrexate), some autoimmune conditions, some severe infections, bone marrow failure, and congenital marrow aplasia (marrow doesn't develop normally)
% Neutrophil	Neutrophil/Band/Seg	This is a dynamic population that varies somewhat from day to day depending on what is going on in the body. Significant increases in particular types are associated with different temporary/acute and/or chronic conditions. An example of this is the increased number of lymphocytes seen with lymphocytic leukemia. For more information, see Blood Smear and WBC.
% Lymphs	Lymphocyte	
% Mono	Monocyte	
% Eos	Eosinophil	
%Baso	Basophil	
Neutrophil	Neutrophil/Band/Seg	
Lymphs	Lymphocyte	
Mono	Monocyte	
Eos	Eosinophil	
Baso	Basophil	
RBC	Red Blood Cell	Decreased with anemia; increased when too many made and with fluid loss due to diarrhea, dehydration, burns
Hgb	Hemoglobin	Mirrors RBC results
Hct	Hematocrit	Mirrors RBC results
MCV	Mean Corpuscular Volume	Increased with B_{12} and Folate deficiency; decreased with iron deficiency and thalassemia
MCH	Mean Corpuscular Hemoglobin	Mirrors MCV results
MCHC	Mean Corpuscular Hemoglobin Concentration	May be decreased when MCV is decreased; increases limited to amount of Hgb that will fit inside a RBC
RDW	RBC Distribution Width	Increased RDW indicates mixed population of RBCs; immature RBCs tend to be larger
Platelet	Platelet	Decreased or increased with conditions that affect platelet

		production; decreased when greater numbers used, as with bleeding; decreased with some inherited disorders (such as Wiskott-Aldrich, Bernard-Soulier), with Systemic lupus erythematosus, pernicious anemia, hypersplenism (spleen takes too many out of circulation), leukemia, and chemotherapy
MPV	Mean Platelet Volume	Vary with platelet production; younger platelets are larger than older ones

Common Questions

1. What can a patient do about his CBC?
Patients who have a keen interest in their own healthcare frequently want to know what they can do to change their WBCs, RBCs, and platelets. Unlike "good" and "bad" cholesterol, cell populations are not generally affected by lifestyle changes unless the patient has an underlying deficiency (such as vitamin B12 or folate deficiency or iron deficiency). There is no way that a patient can directly raise the number of his WBCs or change the size or shape of his RBCs. Addressing any underlying diseases or conditions and following a healthy lifestyle will help optimize your body's cell production and your body will take care of the rest.

Ask A Question

If you still have a question about your test or need help interpreting the results of your test, you can visit the ASCLS web site to complete a lab testing information request form, and a certified clinical laboratory scientist will gladly help you! Your communication will be kept confidential. Go there now: http://www.ascls.org/labtesting/disclaimer.asp.

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