



Blood Test: Introduction

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Complete blood count test (CBC)

The complete blood count (CBC) is one of the most commonly ordered blood tests. The complete blood count is the calculation of the cellular (formed elements) of blood. These calculations are generally determined by special machines that analyze the different components of blood in less than a minute.

A major portion of the complete blood count is the measure of the concentration of white blood cells, red blood cells, and platelets in the blood.

How is the complete blood count test (CBC) done?

The complete blood count (CBC) test is performed by obtaining a few milliliters (one to two teaspoons) of blood sample directly from the patient. It can be done in many settings including the doctor's office, laboratories, and hospitals. The skin is wiped clean with an alcohol pad, and then a needle is inserted through the area of cleansed skin into to patient's vein (one that can be visualized from the skin.) The blood is then pulled from the needle by a syringe or by a connection to a special vacuumed vial where it is collected. This sample is then taken to the laboratory for analysis.

Components of the complete blood count (CBC)

The complete blood count, or CBC, lists a number of many important values. Typically, it includes the following:

White blood cell count (WBC or leukocyte count), WBC differential count, Red blood cell count (RBC or erythrocyte count), Hematocrit (Hct), Hemoglobin (Hgb), Mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH), Mean corpuscular hemoglobin concentration (MCHC), Red cell distribution width (RDW), Platelet count, Mean Platelet Volume (MPV)

Values for a complete blood count (CBC)

The values generally included are the following:

- **White blood cell count (WBC)** is the number of white blood cells in a volume of blood. Normal range varies slightly between laboratories but is generally between 4,300 and 10,800 cells per cubic millimeter (cmm). This can also be referred to as the leukocyte count and can be expressed in international units as 4.3 to 10.8×10^9 cells per liter.
- **White blood cell (WBC) differential count.** White blood count is comprised of several different types that are differentiated, or distinguished, based on their size and shape. The cells in a differential count are granulocytes, lymphocytes, monocytes, eosinophils, and basophils.

A machine generated percentage of the different types of white blood cells is called the automated WBC differential. These components can also be counted under the microscope on a glass slide by a trained laboratory technician or a doctor and referred to as the manual WBC differential.

- **Red cell count (RBC)** signifies the number of red blood cells in a volume of blood. Normal range varies slightly between laboratories but is generally between 4.2 to 5.9 million cells/cmm. This can also be referred to as the erythrocyte count and can be expressed in international units as 4.2 to 5.9×10^{12} cells per liter.

Red blood cells are the most common cell type in blood and people have millions of them in their blood circulation. They are smaller than white blood cells, but larger than platelets.

- **Hemoglobin (Hb).** This is the amount of hemoglobin in a volume of blood. Hemoglobin is the protein molecule within red blood cells that carries oxygen and gives blood its red color. Normal range for hemoglobin is different between the sexes and is approximately 13 to 18 grams per deciliter for men and 12 to 16 for women (international units 8.1 to 11.2 millimoles/liter for men, 7.4 to 9.9 for women).
- **Hematocrit (Hct).** This is the ratio of the volume of red cells to the volume of whole blood. Normal range for hematocrit is different between the sexes and is approximately 45% to 52% for men and 37% to 48% for women. This is usually measured by spinning down a sample of blood in a test tube, which causes the red blood cells to pack at the bottom of the tube.
- **Mean corpuscular volume (MCV)** is the average volume of a red blood cell. This is a calculated value derived from the hematocrit and red cell count. Normal range may fall between 80 to 100 femtoliters (a fraction of one millionth of a liter).
- **Mean Corpuscular Hemoglobin (MCH)** is the average amount of hemoglobin in the average red cell. This is a calculated value derived from the measurement of hemoglobin and the red cell count. Normal range is 27 to 32 picograms.
- **Mean Corpuscular Hemoglobin Concentration (MCHC)** is the average concentration of hemoglobin in a given volume of red cells. This is a calculated volume derived from the hemoglobin measurement and the hematocrit. Normal range is 32% to 36%.
- **Red Cell Distribution Width (RDW)** is a measurement of the variability of red cell size and shape. Higher numbers indicate greater variation in size. Normal range is 11 to 15.

- **Platelet count.** The number of platelets in a specified volume of blood. Platelets are not complete cells, but actually fragments of cytoplasm (part of a cell without its nucleus or the body of a cell) from a cell found in the bone marrow called a megakaryocyte. Platelets play a vital role in blood clotting. Normal range varies slightly between laboratories but is in the range of 150,000 to 400,000/ cmm (150 to 400 x 10⁹/liter).
- **Mean Platelet Volume (MPV).** The average size of platelets in a volume of blood.

Functions of the cells in a complete blood count (CBC)

The cells in the CBC (white blood cells, red blood cells, and platelets) have unique functions. Generally speaking, white blood cells are an essential part of the immune system and help the body fight infections. Each different component of the white blood cell (the WBC differential) plays a specific role in the immune system.

Red blood cells are essential in transporting oxygen to all the cells in the body to serve their functions. The hemoglobin molecule in the red blood cell is the vehicle for the transportation of oxygen. Platelets are a part of the blood clotting system in the body and help in preventing bleeding.

Use of Complete blood count (CBC)

Your doctor may order this test for a variety of reasons. It may be a part of a routine check-up or screening, or as a follow-up test to monitor certain treatments. It can also be done as a part of an evaluation based on a patient's symptoms.

For example, a **high WBC count** (leukocytosis) may signify an infection some where in the body or, less commonly, it may signify an underlying malignancy. A low WBC count (leukopenia) may point toward a bone marrow problem or related to some medications, such as chemotherapy. A doctor may order the test to follow the WBC count in order to monitor the response to a treatment for an infection. The components in the differential of the WBC count also have specific functions and if altered, they may provide clues for particular conditions.

A **low red blood cell count** or low hemoglobin may suggest anemia, which can have many causes. Possible causes of high red blood cell count or hemoglobin (erythrocytosis) may include bone marrow disease or low blood oxygen levels (hypoxia).

A **low platelet count** (thrombocytopenia) may be the cause of prolonged bleeding or other medical conditions. Conversely, a high platelet count (thrombocytosis) may point toward a bone marrow problem or severe inflammation.

BLOOD TEST REFERENCE RANGE CHART

Test	Reference Range (conventional units*)
17 Hydroxyprogesterone (Men)	0.06-3.0 mg/L
17 Hydroxyprogesterone (Women) Follicular phase	0.2-1.0 mg/L
25-hydroxyvitamin D (25(OH)D)	8-80 ng/mL
Acetoacetate	<3 mg/dL
Acidity (pH)	7.35 - 7.45
Alcohol	0 mg/dL (more than 0.1 mg/dL normally indicates intoxication) (ethanol)
Ammonia	15 - 50 µg of nitrogen/dL
Amylase	53 - 123 units/L
Ascorbic Acid	0.4 - 1.5 mg/dL
Bicarbonate	18 - 23 mEq/L (carbon dioxide content)
Bilirubin	Direct: up to 0.4 mg/dL Total: up to 1.0 mg/dL
Blood Volume	8.5 - 9.1% of total body weight
Calcium	8.2 - 10.6 mg/dL (normally slightly higher in children)
Carbon Dioxide Pressure	35 - 45 mm Hg
Carbon Monoxide	Less than 5% of total hemoglobin
CD4 Cell Count	500 - 1500 cells/µL
Ceruloplasmin	15 - 60 mg/dL
Chloride	98 - 106 mEq/L
Complete Blood Cell Count (CBC)	Tests include: hemoglobin, hematocrit, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, mean corpuscular volume, platelet count, white Blood cell count Please click each to view an individual test value.
Copper	Total: 70 - 150 µg/dL
Creatine Kinase (CK or CPK)	Male: 38 - 174 units/L Female: 96 - 140 units/L
Creatine Kinase Isoenzymes	5% MB or less
Creatinine	0.6 - 1.2 mg/dL

Electrolytes	Test includes: calcium, chloride, magnesium, potassium, sodium Please click each to view an individual test value.
Erythrocyte Sedimentation Rate (ESR or Sed-Rate)	Male: 1 - 13 mm/hr Female: 1 - 20 mm/hr
Glucose	Tested after fasting: 70 - 110 mg/dL
Hematocrit	Male: 45 - 62% Female: 37 - 48%
Hemoglobin	Male: 13 - 18 gm/dL Female: 12 - 16 gm/dL
Iron	60 - 160 µg/dL (normally higher in males)
Iron-binding Capacity	250 - 460 µg/dL
Lactate (lactic acid)	Venous: 4.5 - 19.8 mg/dL Arterial: 4.5 - 14.4 mg/dL
Lactic Dehydrogenase	50 - 150 units/L
Lead	40 µg/dL or less (normally much lower in children)
Lipase	10 - 150 units/L
Zinc B-Zn	70 - 102 µmol/L

Lipids:

Cholesterol	Less than 225 mg/dL (for age 40-49 yr; increases with age)												
Triglycerides	<table> <tr> <td>10 - 29 years</td> <td>53 - 104 mg/dL</td> </tr> <tr> <td>30 - 39 years</td> <td>55 - 115 mg/dL</td> </tr> <tr> <td>40 - 49 years</td> <td>66 - 139 mg/dL</td> </tr> <tr> <td>50 - 59 years</td> <td>75 - 163 mg/dL</td> </tr> <tr> <td>60 - 69 years</td> <td>78 - 158 mg/dL</td> </tr> <tr> <td>> 70 years</td> <td>83 - 141 mg/dL</td> </tr> </table>	10 - 29 years	53 - 104 mg/dL	30 - 39 years	55 - 115 mg/dL	40 - 49 years	66 - 139 mg/dL	50 - 59 years	75 - 163 mg/dL	60 - 69 years	78 - 158 mg/dL	> 70 years	83 - 141 mg/dL
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Liver Function Tests	Tests include bilirubin (total), phosphatase (alkaline), protein (total and albumin), transaminases (alanine and aspartate), prothrombin (PTT)												
Magnesium	1.9 - 2.7 mEq/L												
Mean Corpuscular Hemoglobin	27 - 32 pg/cell												

(MCH)

Mean Corpuscular Hemoglobin Concentration (MCHC)	32 - 36% hemoglobin/cell
Mean Corpuscular Volume (MCV)	76 - 100 cu μ m
Osmolality	280 - 296 mOsm/kg water
Oxygen Pressure	83 - 100 mm Hg
Oxygen Saturation (arterial)	96 - 100%
Phosphatase, Prostatic	0 - 3 units/dL (Bodansky units) (acid)
Phosphatase	50 - 160 units/L (normally higher in infants and adolescents) (alkaline)
Phosphorus	3.0 - 4.5 mg/dL (inorganic)
Platelet Count	150,000 - 350,000/mL
Potassium	3.5 - 5.4 mEq/L
Prostate-Specific Antigen (PSA)	0 - 4 ng/mL (likely higher with age)

Proteins:

Total	6.0 - 8.4 gm/dL
Albumin	3.5 - 5.0 gm/dL
Globulin	2.3 - 3.5 gm/dL
Prothrombin (PTT)	25 - 41 sec
Pyruvic Acid	0.3 - 0.9 mg/dL
Red Blood Cell Count (RBC)	4.2 - 6.9 million/ μ L/cu mm
Sodium	133 - 146 mEq/L
Thyroid-Stimulating Hormone (TSH)	0.5 - 6.0 μ units/mL

Transaminase:

Alanine (ALT)	1 - 21 units/L
Aspartate (AST)	7 - 27 units/L

Urea Nitrogen (BUN)	7 - 18 mg/dL
BUN/Creatinine Ratio	5 - 35
Uric Acid	Male 2.1 to 8.5 mg/dL (likely higher with age) Female 2.0 to 7.0 mg/dL (likely higher with age)
Vitamin A	30 - 65 µg/dL
WBC (leukocyte count and white Blood cell count)	$4.3-10.8 \times 10^3/\text{mm}^3$
White Blood Cell Count (WBC)	4,300 - 10,800 cells/µL/cu mm

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She is Masters in Biotechnology with exposure in pharma research. Her area of interest is molecular biology and pharma biotech research.