

Laboratory Test Overview

Lab tests play one role in your health care. But while it is an important role, in most cases lab tests don't provide all the information your health professional needs to make a diagnosis or treatment decisions. Your health professional will rarely make a decision or diagnosis based only on the results of a lab test. Instead, he or she will use the results of your tests along with information about your health, gender, age, and other factors.

Making sense of your lab test involves more than just knowing why the test is done. It is also important to understand what the results mean and what factors can affect results. Sometimes test results can be affected by when you last ate or exercised, your age, and medicines or herbal supplements you're taking. The tests help your health professional make a diagnosis, measure your disease activity, or confirm that your medications are well tolerated. Understanding your results will help you and your health professional discuss the next step in your diagnosis or treatment.

Why It Is Done

Lab tests are generally done for one or more of the following reasons:

- To find the cause of symptoms
- To confirm a diagnosis
- To screen for a disease
- To help rule out a disease or condition
- To assess the activity/severity of a disease
- To monitor the progression of a disease
- To see if the treatment provided is helping or hurting.

Many conditions can change your lab results. Your health professional has the opportunity to talk with you about any abnormal results at the time of your visit, if they feel the findings are significant.

Results

Lab test results may be positive, negative, or inconclusive.

- A positive (abnormal) test result means that the substance or condition tested for was found. In some instances, positive test results can also mean that the amount of a substance being tested for is higher or lower than normal.
- A negative (normal) test result means that the substance or condition tested for was not found. Negative results can also mean that the substance being tested for was present in a normal amount.
- Inconclusive test results are those that are not clearly positive or negative.

What are false-positive and false-negative test results?

A **false-positive** test result is one that suggests a disease or condition is present when it is not present. For example, a false-positive pregnancy test result would appear to detect the substance that confirms pregnancy, when in reality the woman is not pregnant.

A **false-negative** test result is one that does not detect what is being tested for even though it is present. For example, a false-negative pregnancy test result would be one that does not detect the substance that confirms pregnancy, when the woman really is pregnant.

Some tests give only a clue that is taken into consideration with other information to support a diagnosis, identify a risk, or help choose a treatment. For example, if your ESR is elevated, your provider interprets the result, based on your symptoms, how old you are, what other diseases you may have, and physical examination findings.

What do the units mean?

Lab test results usually contain a number followed by a unit of measurement, such as 37 milligrams per deciliter (mg/dL). The units provide a way to report results so that they can be compared. Usually, *but not always*, the same test is reported in the same units no matter which lab did the test. If test results from different providers look very different, check to make sure the units are the same.

What is a reference range?

Most lab results normally fall within a reference range. A reference range is determined by testing large groups of **healthy** people to find what is normal for that group. As an example, a group of normal, healthy 30- to 40-year-old men given a specific test will have results that cluster in a range, called “a normal range”. This range (or frequently 95% of that normal range) defines normal results for anyone that is a 30- 40 year-old male. The “95% confidence limits” that are used to define the lower and upper border of normal, also contribute to a phenomenon that predicts that for every 20 tests run on a normal person, 1 will be abnormal by statistical chance (not by disease).

Each reference or normal range is different because represents laboratory information from a specific group. For example, the following table shows reference ranges for a sedimentation rate test. This test helps determine whether inflammation, infection, or an autoimmune disease may be present.

Sedimentation rate

Males younger than 50:	0–15 millimeters per hour (mm/hr)
Males 50 and older:	0–20 mm/hr
Females younger than 50:	0–25 mm/hr
Females 50 and older:	0–30 mm/hr

What if my results are different than the reference range?

It is possible to have a result that is different from the reference range even though nothing is wrong with you. It could be chance. Sometimes certain factors can affect your test results, such

as pregnancy, a medicine you are taking, eating right before a test, smoking, or being under stress. If your provider has not raised a concern, the deviation from normal is not considered significant for you.

Why do values or reference ranges vary from lab to lab?

Labs may use different types of equipment and tests, and sometimes they set their own reference ranges. Your lab report will contain the reference ranges your lab uses. Do not compare your results from different labs.

What Affects the Test

Factors that may interfere with the accuracy of a lab test include:

- Not following the instructions for how to prepare for the test. Some tests, such as a cholesterol and triglycerides analysis, require you to stop eating for at least 12 hours before the test.
- Some medicines or herbal treatments. For example, many medicines raise or lower blood sugar levels and could interfere with blood sugar tests.
- Drinking caffeinated beverages or alcohol.
- Eating meat, especially beef.
- Taking vitamins, especially vitamin C.
- Smoking or using other tobacco products.
- Stress.
- Strenuous exercise.
- Your occupation.
- Your distance from sea level.
- Pregnancy.

Follow your health professional's instructions to make sure that your test results are as accurate as possible.

Understanding Specific Laboratory Tests

Note: The information provided is for general information only. It is not a substitute for medical advice and /or consultation with a physician or technical expert.

Blood Counts

WBC

The white blood count is a measure of the infection fighting cells (leukocytes) in the blood. WBC levels increase with infections, inflammation or certain diseases (i.e. leukemia). However, the WBC can be elevated with corticosteroid (prednisone) use and even in smokers. WBC levels can decrease with autoimmune diseases, certain infections, or as an effect of medications.

WBC differential

A measure of the different types of white cells present in the blood and the proportions of each type. Abnormal proportions are found in different diseases (like rheumatoid arthritis or lupus), with corticosteroid (prednisone) therapy, or with seasonal allergies or asthma.

Hgb

Hemoglobin is a measure of the oxygen carrying pigment available in the red blood cells. When this value is low, we make a diagnosis of anemia. It is a more important number than the number of RBC or the hematocrit (HCT). Anemia occurs with blood loss, iron or vitamin deficiencies, and in the setting of chronic illness like inflammatory arthritis or kidney disease.

RBC

The red blood count is a measure of the red blood cells (erythrocytes) in the blood that are available to carry oxygen to different parts of the body.

Hct

Hematocrit is the portion of blood (36-50%) that is made up of red cells and not water.

Platelets

Platelets are tiny cells found in the blood, necessary for blood clot formation.

MCV, MCH, MCHC

All are measurements of red blood cell size, hemoglobin density and weight. If they are abnormal, it gives an indication of what type of anemia may be present.

Chemistries

Albumin (Alb)

The major protein of blood, albumin plays an important role in maintaining fluid balance (osmotic pressure) inside blood vessels, in transporting drugs, hormones, and enzymes, and in nutrition. Albumin is made by the liver. Consequently, decreased albumin levels may be associated with liver disease or malnutrition. Normal albumin levels indicate general health and nutritional status.

Alkaline Phosphatase (Alk Phos)

Alkaline phosphatase is an enzyme found in almost all body tissues, with highest levels observed in the intestine, kidney, bone, liver, and placenta. Measurements of serum alkaline phosphatase are useful in the evaluation of liver and bone disease. Minor increases in the level of alkaline phosphatase are observed during the normal aging process and in vitamin D deficiency. Low alkaline phosphatase is rarely a concern.

AST (SGOT), ALT (SGPT), GGT (liver enzyme tests)

Family of enzymes found in the heart, liver, muscle, kidneys, pancreas, spleen, lungs, and red blood cells. Diseases involving or affecting these tissues can cause elevations in serum AST levels. The most common reasons for elevated AST in this country include obesity and alcohol overuse. Less commonly, an elevation in one of these tests (like the AST), is caused by cholesterol lowering medicine or methotrexate. Low liver enzyme tests are rarely a concern.

Bilirubin, Total (T. bili)

An orange-yellow bile pigment formed in the liver when the body recycles hemoglobin. Elevated levels of serum bilirubin occur with liver disease, bile duct obstruction, hemolytic (red blood cell breakdown) anemia, and prolonged fasting. Occasionally it is elevated due to an inherited genetic difference (Gilbert's syndrome) that has no serious consequences.

BUN (Blood Urea Nitrogen)

BUN is the main waste product produced by the liver during the breakdown of proteins. More than 90% of BUN is excreted by the kidneys. A variety of kidney diseases can result in an increase in the BUN level. Elevated BUN levels also occur in people who have dehydration, urinary tract obstruction, congestive heart failure, gastrointestinal bleeding, and those who are on a high-protein diet. Low BUN values may be associated with severe liver damage, acromegaly (excessive growth hormone), and pregnancy. Diets low in protein and high in carbohydrates can cause low BUN levels.

Calcium

This mineral is necessary for bone formation, muscle contraction, and blood clotting. In addition, calcium is involved in maintaining the stability of nerve cells. Abnormal blood calcium levels are associated with bone, kidney, parathyroid or intestinal diseases.

Chloride

Chloride is involved in maintaining the normal amount of water and the acid-base balance in body fluids. In general, the serum level of chloride is closely associated with the level of sodium. Chloride levels higher or lower than normal can be associated with metabolic acidosis and alkalosis and with diseases of the gastrointestinal tract, kidney, and adrenal gland.

CPK / CK (creatine kinase)

Enzyme made in skeletal and heart muscle. Elevated CK levels occur with muscle damage or inflammation. CK levels can be elevated with thyroid disease, and in about 3% of normal people. Low CK levels are not a problem.

Creatinine

Creatinine is a waste chemical released from muscle tissue and excreted by the kidneys. The creatinine test measures kidney function. An elevated creatinine indicates kidney disease, as the kidneys cannot remove this chemical efficiently from the blood. Older people can have a normal creatinine but still have kidney disease, because they don't have as much muscle (and therefore creatinine) as they used to. Low creatinine levels are not a problem.

Globulin

Globulin is one of the main protein groups found in blood. The alpha- and beta-globulins are produced by the liver, whereas the gamma-globulins (antibodies that play an important role in the body's ability to defend itself against disease) are produced by some white blood cells and plasma cells. The level of serum globulin is often elevated in liver disease, connective tissue diseases, and multiple myeloma.

Glucose

Glucose is a sugar and a primary source of energy for bodily functions. Glucose levels are useful in diagnosing and evaluating diabetes mellitus.

Iron /Fe, Ferritin

Iron is essential to the formation and function of hemoglobin, which carries oxygen from the lungs to the tissues. Low iron levels may help diagnose a number of conditions, including anemia. High iron levels occasionally indicate a genetic disease called hemochromatosis, which causes a particular type of arthritis.

Phosphorus

This element is widely distributed throughout the body. About 85% of the body's phosphorus is in bone. Phosphorus plays an important role in bone formation, carbohydrate metabolism (sugar formation and degradation), and acid-base balance. Abnormal blood phosphorus levels occur in some bone and kidney diseases.

Potassium

Potassium is involved in the functioning of nervous tissue and in heart and muscle contraction. Low potassium levels can cause heart rhythm problems, muscle cramping and fatigue. Serum potassium levels higher or lower than normal occur with certain medications including water pills (diuretics), and diseases of the gastrointestinal tract, kidney, or adrenal gland.

Protein, Total

Protein is the second most common substance in the blood. Serum proteins have many functions, including the transport of other substances, immune defense, blood clotting, and inflammation defense. Serum protein levels are useful for evaluating nutritional status, infection, and various other disorders.

Sodium

Sodium (one of the 2 chemicals in salt) is involved in maintaining the amount of water and the acid-base balance in body fluids. Sodium is involved in nerve conduction. Serum sodium levels higher or lower than normal can be caused diseases of the gastrointestinal tract, kidney, and adrenal gland. Occasionally water pills (diuretics) and pain medications can cause a low sodium level.

Uric Acid

Uric acid is a product formed mainly by the liver during the breakdown of nucleic acids. Following processing by the kidney, elevated uric acid occurs in high protein/red meat diets, kidney failure, gout, dehydration, endocrine disorders, and other disease states. Certain drugs like water pills and alcohol cause uric acid levels to be elevated. Decreased uric acid levels occur in normal people, or those taking aspirin, and less commonly with liver disease or kidney problems.

Vitamins

Folic acid

A B-vitamin (B-9) found in leafy green vegetables, and is an essential prenatal vitamin. Folic acid helps make and maintain new cells. Low folic acid can cause anemia and large red cells

(elevated MCV). Methotrexate used in the treatment of inflammatory arthritis inhibits folic acid. Many patients on methotrexate take extra folic acid for this reason.

Vitamin B12

Vitamin B12 is important in the function of the brain and bone marrow. Most efficient dietary sources are meat and eggs. A deficiency of this vitamin can cause numbness and tingling, anemia (with elevated MCV), and even dementia.

Vitamin D

Vitamin D building blocks are obtained from plant and animal sources. The best source of these building blocks is our own skin, exposed to natural sunlight. Vitamin D building blocks are then converted to the active vitamin and hormone by the liver and kidney. More than half of all white women over 70 are vitamin D deficient. Vitamin D helps build strong bones, keeps muscles strong, and may be helpful in fighting cancer and infections.

Arthritis Testing

Rheumatoid factor (RF)

This test helps your practitioner diagnose rheumatoid arthritis. It cannot diagnose rheumatoid arthritis by itself, as it found in 5% of normal patients. Rheumatoid arthritis affects only 1% of the American population, so a positive test has to be interpreted by your provider. On the other hand there are many patients with rheumatoid arthritis (approx. 20 %) that never have a positive rheumatoid factor. Inflammatory arthritis patients with a positive rheumatoid factor tend to have more severe arthritis disease. This test is not used to measure disease activity.

C-reactive protein test (CRP)

This test measures inflammation in the body but it does not tell what is causing it. It is elevated in acute and chronic infections, obesity and hardening of the arteries. It is elevated in patients with active inflammatory arthritis. It is used to help measure the activity of inflammatory arthritis and contributes to decisions regarding the use of medications used to control inflammation and disease.

Cyclic Citrullinated Peptide Antibody (CCP)

CCP is a relatively new and specialized test that used to help diagnose RA, especially early in the disease and in patients who are Rheumatoid Factor negative. When this test is positive, it is very predictive of rheumatoid arthritis.

Erythrocyte sedimentation rate (ESR)

This test shows the presence of inflammation in the body by measuring how fast red cells fall in a tube. We use it to help evaluate and monitor arthritis and its activity along with measuring morning stiffness, joint swelling and pain. It is can also be elevated in other situations, including older age, infections, cancer, anemia, hardening of the arteries, and in smokers.

Anti-nuclear antibody (ANA)

ANA is positive in all patients with systemic lupus, and a negative ANA effectively rules this condition out. However many people have a “false positive” ANA, meaning a positive test, but no inflammatory arthritis or lupus. In fact, a positive ANA alone – without disease, is 50 times more common than lupus. Your provider needs to interpret all of the findings to determine what significance, if any that this test has. Frequent causes of a positive ANA include older age, chronic infections, liver disease, thyroid disease, and if there is a family history of systemic lupus. One way we determine if the positive ANA is significant is to break it down and see if we can be more specific about what is causing the positive test. We do this by checking an ENA panel (extractable nuclear antigen) panel.

ENA (extractable nuclear antigen) Antibody panel

Anti-Sm antibody – usually seen only in patients with SLE (systemic lupus erythematosus)

Anti-double stranded DNA – high results are characteristic of active SLE (a disease activity marker too)

Anti-SSA and Anti-SSB – may also be positive in SLE or Sjogren’s syndrome

Anti-RNP – frequently positive in Mixed Connective Tissue Disease

Anti-centromere antibody – frequently elevated in limited scleroderma/CREST syndrome

Anti-Jo-1 can be seen in dermatomyositis

Anti-Scl-70 infrequently positive in scleroderma

ANCA (anti-neutrophil cytoplasmic antibody)

ANCA helps confirm the presence of Wegener’s granulomatosis, or other systemic vasculitides such as polyarteritis nodosa, and Churg-Strauss syndrome. However many other conditions can produce a “false positive” including inflammatory bowel disease.

Cryoglobulin

Cryoglobulins are abnormal proteins in the blood that will precipitate when the body temperature drops below normal, causing blockage of the blood vessels. The test involves collecting blood and cooling it in the laboratory, then checking for the presence of the cryoglobulin precipitate.

Complement C3, C4, CH50

Serum complement includes nine major blood proteins associated with some diseases. Decreased amounts may be associated with lupus, infections, or cryoglobulins. One of the most common reasons for a low C4 complement is the inheritance of an inability to make as much as normal. High complement levels can be nonspecifically elevated in inflammatory conditions.

Lipids

Cholesterol, Total

Total blood cholesterol levels are modestly correlated with a risk for coronary heart disease. When deciding whether to treat elevated cholesterol, your practitioner needs to consider your personal underlying risk for heart disease.

HDL

High-density lipoprotein (HDL) cholesterol is sometimes referred to as “good” cholesterol. High levels of HDL are associated with a reduced risk for coronary heart disease.

LDL

Low-density lipoprotein (LDL) cholesterol is sometimes referred to as “bad” cholesterol. High levels of LDL are associated with an increased risk for coronary heart disease.

Triglycerides

Triglycerides are lipids (fats) that account for 95% of the fat stored in tissue. Elevated serum triglyceride levels occur in families, in alcoholics, and in those with liver disease, diabetes, and hypothyroidism (deficiency of thyroid activity). When serum triglyceride and cholesterol levels are both elevated, the probability of coronary heart disease is increased.

Urinalysis

Analysis is divided into chemical and cellular (microscopic) analysis.

Chemical

Sugar in the urine suggests diabetes, though it can occur by itself.

Protein in the urine (> 0.5 gm/l or with a protein/creatinine ratio > 0.5) is a sign of kidney damage and inefficient filtering of blood.

Acetone for most people simply means that you have not eaten recently. It can mean something else in patients with severe diabetes.

Nitrite positivity suggests a urinary tract infection, though several other criteria need to be present at the same time (elevated WBC in urine, bacteria, absence of epithelial cells)

Leukocyte esterase positivity carries a similar significance to nitrite positivity.

Microscopic

WBC - An elevated finding can be significant if other symptoms of a urinary tract infection are present. WBC counts can be elevated in urine if there is a history of kidney stones or bladder / kidney tumors. Up to five per high-powered field (HPF) is a normal finding.

RBC - Elevated with urine infections, kidney disease, kidney stones, urinary cancer, and trauma. Up to 5 per high powered field (HPF) is a normal finding.

Epithelial cells - Many epithelial cells usually means a vaginal contaminant and the whole urinalysis result is not to be relied upon. Most older women have a real hard time providing a “clean catch” urine and so vaginal epithelial cells are a frequent finding.

Yeast - This means you have a yeast vaginal infection.

Special Tests

Serum protein electrophoresis (SPEP)

This test quantifies the different kinds of proteins in the blood. We frequently focus on the gammaglobulins or antibodies. A low gammaglobulin level occurs in some chronic illnesses and with the prolonged use of prednisone. A high level occurs in some arthritis conditions, chronic infection, and cancers, like lymphoma or myeloma. A high ESR level is sometimes a indication to check a SPEP.

T4

T4 is a hormone produced by the thyroid gland. The level of hormone in the blood affects heart rate, muscle strength, bowel function, energy level, hair growth and mood.

TSH

TSH is the hormone produced by the pituitary gland and controls the activity of the thyroid gland. TSH is used to screen for an over active or under active thyroid gland.

HGB Alc

The Hemoglobin Alc level reflects the mean glucose concentration over the previous 6-8 weeks and provides a much better indication of long-term glucose control than a single blood glucose. It is used in evaluating the long-term control of blood glucose concentrations in diabetics.

PSA

Prostate-Specific Antigen is a screening test for prostate cancer. It is also elevated with prostate infection or simple age-related enlargement. This test must be evaluated as a part of a man’s prostate examination.