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Hepatitis

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What is it?

Hepatitis is an inflammation of the liver that can be caused by viruses, chemicals, drugs, alcohol, inherited diseases, or the patient's own immune system. This inflammation can be acute, flaring up and then resolving within a few weeks to months, or chronic, enduring over many years. Chronic hepatitis may simmer for 20 years or more before causing significant symptoms related to progressive liver damage such as cirrhosis (scarring and loss of function), liver cancer, or death.

The liver is a vital organ located in the upper right-hand side of the abdomen. It performs many functions in the body, including processing the body's nutrients, manufacturing bile to help digest fats, synthesizing many important proteins, regulating blood clotting, and breaking down potentially toxic substances into harmless ones that the body can use or excrete. Inflammation may (in severe cases) interfere with these processes and allow potentially toxic substances to accumulate.

The symptoms of hepatitis are the same, regardless of the cause, but vary from person to person and may vary over time. With acute hepatitis, many people have few or mild symptoms that may be mistaken for the flu. These may include fatigue, nausea, loss of appetite, fever, and abdominal pain. Others may experience jaundice, itching, dark colored urine, and light colored stools. A physical examination may reveal a liver that is tender and enlarged. Chronic hepatitis usually causes no symptoms or may be noticeable as only a loss of energy and tiredness. In some people, chronic hepatitis can gradually damage the liver and, after many years, cause liver failure. The chronic form typically lasts for many years and only rarely goes away without treatment.

Viral Hepatitis

The most common cause of hepatitis is an infection with a virus. The viruses primarily associated with hepatitis are named in the order of their discovery: A, B, C, D, and E (see Viral Hepatitis Table).

- Hepatitis A is spread through infected water and food that have been contaminated with fecal material. The Centers for Disease Control and Prevention (CDC) estimates that as many as one third of the U.S. population becomes infected with hepatitis A at some point in their life. Symptoms may be flu-like and are frequently not identified as being due to hepatitis. Most patients recover fully within about six months.
- Hepatitis B is the most common cause of acute viral hepatitis. It can be spread by exposure to blood, infected needles, through sexual relations, and from mother to baby. The number of new cases in the U.S. each year is approximately 73,000, a decline from the 1980s when the average was 260,000. Most people will get better without any intervention, but about 1-3% become carriers - chronically infected and able to continue to infect

others. Newborns are especially vulnerable to chronic infection, with up to 90% of those exposed becoming carriers. With the advent of screening pregnant women for hepatitis B and the vaccination of newborns, the number of infected babies has fallen. Most chronic hepatitis B infections are now seen in people born in parts of the world (particularly southern and eastern Asia, southern Europe, and Africa) where infection among newborns still remains common.

- Hepatitis C is spread by exposure to contaminated blood. Some mechanisms of exposure include the sharing of needles or other 'works' used in consuming drugs such as cocaine or heroin; use of contaminated equipment for activities such as body piercing and tattooing; occupational exposure of healthcare workers to used needles or other sharp objects; through sexual activity that results in tissue tears; from mother to baby during childbirth; or from cuts sustained during athletic or other activity. It is less common than hepatitis B as a cause of acute hepatitis but is the most common cause of chronic hepatitis. According to the CDC, about 55% to 85% of those exposed to the virus develop chronic hepatitis.
- Hepatitis D and E are rare in the U.S. Hepatitis D only causes an infection when hepatitis B is present and can make that infection more severe. It is usually spread by exposure to blood or infected needles. Hepatitis E is spread in a similar fashion to hepatitis A and is found primarily in Asia, Africa, and South America.

Chemically-Induced Hepatitis

The liver is responsible for the metabolism of alcohol, drugs, and environmental toxins. It breaks them down into substances that can be used and then excreted by the body. Some drugs or chemicals cause liver damage whenever a person is exposed to high levels of them. Acetaminophen, which is found in many over-the-counter and prescription medications, is an example of this. In therapeutic doses, it is a useful pain reliever, but in very high dosages or in combination with alcohol, it has the potential to cause life-threatening acute liver failure. Excessive consumption of alcohol, by itself, is also toxic to the liver and is one of the most common causes of chemical hepatitis.

Many drugs have the potential to cause hepatitis in a few people, in a seemingly random fashion. Their effect cannot be foreseen and appears to be related to an allergic reaction to the medication. Drugs that have had this affect in some people include anesthetics, antibiotics, anabolic steroids, and seizure medications.

Inherited Forms of Hepatitis

Several inherited diseases can become apparent primarily by causing acute or chronic hepatitis. The most common of these is hemochromatosis, an inherited disease associated with accumulation of too much iron in the body. The liver is one of the principal organs damaged, and chronic hepatitis may be due to hemochromatosis. Deficiency of alpha-1-antitrypsin is also a relatively common inherited disease, and in children who have this deficiency state, both acute and chronic hepatitis are common. In adults, the liver involvement is often hard to detect, but cirrhosis and liver cancer are both more common in those with alpha-1-antitrypsin deficiency. A more rare inherited disorder, Wilson's disease, is associated with an accumulation of excess copper in the liver, brain, and in other tissues. This disease may cause both acute and chronic hepatitis. Unless Wilson's disease is treated, it becomes progressively worse and is eventually fatal.

Non-Alcoholic Fatty Liver Disease (NAFLD) and Chronic Hepatitis

One of the most common causes of chronic hepatitis is accumulation of excess fat in the liver. This is most commonly seen in people with the metabolic syndrome, a combination of problems such as obesity (especially

too much fat in the belly), hypertension, high triglyceride levels, low HDL cholesterol, and insulin resistance or type 2 diabetes. The more severe form of hepatitis is sometimes also termed non-alcoholic steatohepatitis (NASH). There are no laboratory tests that can make the diagnosis of NAFLD or NASH other than a liver biopsy.

Autoimmune Hepatitis
Autoimmune hepatitis is usually a chronic form of hepatitis that frequently leads to progressive damage of the liver; in about 25% of cases, it may present like acute hepatitis. It is more common in women than men; in fact, according to the American Liver Foundation, 70% of those affected are female. For reasons that are not fully understood, the body's immune system targets and attacks the liver. Autoimmune hepatitis may be found in association with other autoimmune disorders, such as type 1 diabetes, ulcerative colitis, and Sjogren's syndrome.

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Tests: Hepatitis A, Hepatitis B, Hepatitis C, Liver panel, AST, ALP, ALT, Albumin, Bilirubin, PT, Total Protein, Autoantibodies
Conditions: Alcoholism, Liver Disease

Elsewhere On The Web

CDC, National Center for Infectious Diseases: Viral Hepatitis B
American Liver Foundation
American Liver Foundation: Liver Biopsy
The American Journal of Managed Care (Oct 2005) Chronic Hepatitis C: An Age Wave of Disease Burden (PDF for download)
Wilson's Disease Association

This article last reviewed on April 30, 2006.

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Chemistry Panels

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Chemistry panels are groups of tests that are routinely ordered to determine a person's general health status. They help evaluate the body's electrolyte balance and/or the status of several major body organs. The tests are performed on a blood sample, usually drawn from a vein in the arm. Some of the number and type of tests contained in specific panels, and the names of the panels, have been standardized nationally. The Comprehensive Metabolic Panel (CMP) usually includes 14 tests and the Basic Metabolic Panel (BMP) usually contains 8 tests, all of which are found in the CMP. The Electrolyte Panel, Liver Panel, and Lipid Profile are also types of chemistry panels. While most laboratories offer the same set of CMP and BMP tests, some of these other panels may be tailored to meet the needs of the ordering doctor. (If a laboratory changes the tests in a CMP or BMP, it will usually also change the name of the panel to avoid confusion). For a list of the tests included in each of these panels and when they may be ordered, click on the name of the panel.

This article last reviewed on September 2, 2005.

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Comprehensive Metabolic Panel

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Also known as: Chem 12, SMA 12, SMA 20, SMAC (somewhat outdated terms)
Formal name: Comprehensive Metabolic Panel
Related Tests: BMP

The Comprehensive Metabolic Panel (CMP) is typically a group of 14 specific tests that have been approved, named, and assigned a CPT code (a Current Procedural Terminology number) as a panel by Medicare (although labs may adjust the number of tests up or down). Since the majority of insurance companies also use these names and CPT codes in their claim processing, this grouping of tests has become standardized throughout the United States. The CMP is a frequently ordered panel that gives your doctor important information about the current status of your kidneys, liver, and electrolyte and acid/base balance as well as of your blood sugar and blood proteins. Abnormal results, and especially combinations of abnormal results, can indicate a problem that needs to be addressed.

The CMP is used as a broad screening tool to evaluate organ function and check for conditions such as diabetes, liver disease, and kidney disease. The CMP may also be ordered to monitor known conditions, such as hypertension, and to monitor patients taking specific medications for any kidney- or liver-related side effects. If your doctor is interested in following two or more individual CMP components, he may order the entire CMP because it offers more information.

The CMP is routinely ordered as part of a blood work-up for a medical exam or yearly physical and is collected by inserting a needle into a vein in your arm. Although it may be performed on a random basis, the CMP sample is usually collected after a 10 to 12 hour fast (no food or liquids other than water). While the individual tests are sensitive, they do not usually tell your doctor specifically what is wrong. Abnormal test results or groups of test results are usually followed-up with other specific tests to confirm or rule out a suspected diagnosis.

The CMP includes:

- Glucose
- Calcium

Both increased and decreased levels can be significant.

Proteins

- Albumin
- Total Protein

Albumin, a small protein produced in the liver, is the major protein in serum. Total protein measures albumin as well as all other proteins in serum. Both increases and decreases in these test results can be significant.

Electrolytes

- Sodium
- Potassium
- CO2 (carbon dioxide, bicarbonate)
- Chloride

The concentrations of sodium and potassium are tightly regulated by the body as is the balance between the four tests. Electrolyte (and acid-base) imbalances can be present with a wide variety of acute and chronic illnesses. Chloride and CO2 tests are rarely ordered by themselves.

Kidney Tests

- BUN (blood urea nitrogen)
- Creatinine

BUN and creatinine are waste products filtered out of the blood by the kidneys. Increased concentrations in the blood may indicate a temporary or chronic decrease in kidney function. When not ordered as part of the CMP, they are still usually ordered together.

Liver Tests

- ALP (alkaline phosphatase)
- ALT (alanine amino transferase, also called SGPT)
- AST (aspartate amino transferase, also called SGOT)
- Bilirubin

ALP, ALT, and AST are enzymes found in the liver and other tissues, while bilirubin is a waste product of the liver. All can be found in elevated concentrations in the blood with liver disease or dysfunction.

Sources

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Lipid Profile

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Related tests: Cholesterol, HDL, LDL, Triglycerides

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What is a lipid profile?

The lipid profile is a group of tests that are often ordered together to determine risk of coronary heart disease. The tests that make up a lipid profile are tests that have been shown to be good indicators of whether someone is likely to have a heart attack or stroke caused by blockage of blood vessels (hardening of the arteries).

What tests are included in a lipid profile?

The lipid profile includes total cholesterol, HDL-cholesterol (often called good cholesterol), LDL-cholesterol (often called bad cholesterol), and triglycerides. Sometimes the report will include additional calculated values such as the Cholesterol/HDL ratio or a risk score based on lipid profile results, age, sex, and other risk factors.

How is a lipid profile used?

The lipid profile is used to guide providers in deciding how a person at risk should be treated. The results of the lipid profile are considered along with other known risk factors of heart disease to develop a plan of treatment and follow-up.

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Liver Panel

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Overview
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A liver panel, also known as liver (hepatic) function tests or LFT, is used to detect, evaluate, and monitor liver disease or damage. It usually consists of seven tests that are run at the same time on a blood sample. These include:

- Alanine aminotransferase (ALT) – an enzyme mainly found in the liver; the best test for detecting hepatitis
- Alkaline phosphatase (ALP) – an enzyme related to the bile ducts; often increased when they are blocked
- Aspartate aminotransferase (AST) – an enzyme found in the liver and a few other places, particularly the heart and other muscles in the body
- Bilirubin – two different tests of bilirubin often used together (especially if a person has jaundice): total bilirubin measures all the bilirubin in the blood; direct bilirubin measures a form that is conjugated (combined with another compound) in the liver
- Albumin – measures the main protein made by the liver and tells whether or not the liver is making an adequate amount of this protein
- Total Protein - measures albumin and all other proteins in blood, including antibodies made to help fight off infections

Other tests that could be requested along with the liver panel are gamma-glutamyl transferase (GGT), lactic acid dehydrogenase (LDH), and prothrombin time (PT).

When are these tests ordered?

One or more of these tests may be ordered when symptoms suspicious of a liver condition are noticed. These include: jaundice, dark urine, or light-colored bowel movements; nausea, vomiting and/or diarrhea; loss of appetite; vomiting of blood; bloody or black bowel movements; swelling or pain in the belly; unusual weight change; or fatigue or loss of stamina. One or more of these tests may also be ordered when a person has been or may have been exposed to a hepatitis virus; has a family history of liver disease; has excessive alcohol intake; or is taking a drug that can cause liver damage.

Many patients with early or mild to moderate liver disease may have few if any symptoms. Liver disease may be first detected through routine blood testing that is performed as part of a physical. This testing usually includes a group of 14 tests called the Comprehensive Metabolic Panel (CMP). Most of the tests found in the liver panel (all but the direct bilirubin) are included in the CMP. When liver disease is detected with a CMP blood test, it may be monitored over time with follow-up liver panels.

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BMP

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Also known as: Chem 7, SMA 7 (somewhat outdated terms)
Formal name: Basic Metabolic Panel
Related tests: CMP

The Basic Metabolic Panel (BMP) is a group of 8 specific tests that have been approved, named, and assigned a CPT code (a Current Procedural Terminology number) as a panel by Medicare. Since the majority of insurance companies also use these names and CPT codes in their claim processing, this grouping of tests has become standardized throughout the United States.

The BMP is often ordered in the hospital emergency room setting because its components give doctors important information about the current status of your kidneys, electrolyte and acid/base balance, blood sugar, and calcium levels. Significant changes in these test results can indicate acute problems, such as kidney failure, insulin shock or diabetic coma, respiratory distress, or heart rhythm changes.

The BMP is also used to monitor hospitalized patients and to monitor patients with some known conditions, such as hypertension and hypokalemia. If your doctor is interested in following two or more individual BMP components, she may order the entire BMP because it offers more information. Alternatively, she may order individual tests when monitoring, such as a follow-up glucose, potassium, or calcium, or order an electrolyte panel to monitor sodium, potassium, chloride, and CO2. If your doctor wants more information, she may order a Complete Metabolic Panel (CMP), a group of 14 tests that includes the BMP.

The BMP includes:

- Glucose
- Calcium

Both increased and decreased levels can be significant.

Electrolytes

- Sodium
- Potassium
- CO2 (carbon dioxide, bicarbonate)
- Chloride

The concentrations of sodium and potassium are tightly regulated by the body as is the balance between the four tests. Electrolyte (and acid-base) imbalances can be present with a wide variety of acute and chronic illnesses. Chloride and CO2 tests are rarely ordered by themselves.

Kidney Tests

- BUN (blood urea nitrogen)
- Creatinine

BUN and creatinine are waste products filtered out of the blood by the kidneys. Increased concentrations in the blood may indicate a temporary or chronic decrease in kidney function. When not ordered as part of the BMP, they are still usually ordered together.

The BMP uses a tube of blood collected by inserting a needle into a vein your arm. Ask your doctor whether you should be fasting for 10 to 12 hours prior to the blood draw. Depending on the reason for ordering the BMP, it may be drawn after fasting or on a random basis.

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TSH

Also known as:
Thyrotropin
Formally known as:
Thyroid-stimulating hormone
Related tests: T4, T3,
Thyroid Antibodies

At A Glance

Why get tested?
To screen for and help diagnose thyroid disorders; to monitor treatment of hypothyroidism and hyperthyrcidism

When to get tested?
For screening: There is no consensus within the medical community as to at what age adult screening should begin or whether it should even be done; however, newborn screening is widely recommended.
For monitoring treatment: as directed by your doctor
Otherwise: when a patient has symptoms of hyper- or hypothyroidism and/or an enlarged thyroid

Sample required?
A blood sample drawn from a vein in the arm or from pricking the heel of an infant

The Test Sample

What is being tested?
This test measures the amount of thyroid-stimulating hormone (TSH) in your blood. TSH is produced by the pituitary gland, a tiny organ located below the brain and behind the sinus cavities. It is part of the body's feedback system to maintain stable amounts of the thyroid hormones thyroxine (T4) and triiodothyronine (T3) in the blood. Thyroid hormones help control the rate at which the body uses energy. When concentrations decrease in the blood, the hypothalamus (an organ in the brain) releases thyrotropin releasing hormone (TRH). This stimulates the release of TSH by the pituitary gland, and then TSH in turn stimulates the production and release of T4 and T3 by the thyroid gland, a small butterfly-shaped gland that lies flat against the windpipe. When all three organs are functioning normally, thyroid production turns on and off to maintain blood thyroid hormone levels.

If there is pituitary dysfunction, then increased or decreased amounts of TSH may result. If

TSH concentrations are increased, the thyroid will make and release inappropriate amounts of T4 and T3 and the patient may experience symptoms associated with hyperthyroidism (overactive thyroid), such as rapid heart rate, weight loss, nervousness, hand tremors, irritated eyes, and difficulty sleeping. If there is decreased production of thyroid hormones (hypothyroidism), then the patient may experience symptoms such as weight gain, dry skin, constipation, cold intolerance, and fatigue. In addition to pituitary dysfunction, hyper- or hypothyroidism can occur if there is a problem with the hypothalamus (insufficient or excessive TRH). They may also occur with a variety of thyroid diseases that affect thyroid hormone production regardless of the amount of TSH present in the blood.

How is the sample collected for testing?
A blood sample obtained from a needle placed in a vein in your arm or from pricking the heel of an infant

The Test

How is it used?
The TSH test is often the test of choice for evaluating thyroid function and/or symptoms of hyper- or hypothyroidism. It is frequently ordered along with or preceding a T4 test. Other thyroid tests that may be ordered along with it or following an abnormal TSH result include a T3 test and thyroid antibodies (if autoimmune-related thyroid disease is suspected).

TSH testing is used to:

- diagnose a thyroid disorder in a person with symptoms,
- screen newborns for an underactive thyroid,
- monitor thyroid replacement therapy in people with hypothyroidism
- diagnose and monitor female infertility problems,
- help evaluate the function of the pituitary gland (occasionally), and
- screen adults for thyroid disorders as recommended by some organizations, such as the American Thyroid Association

When is it ordered?
The doctor may order a TSH test when a patient has symptoms of hyper- or hypothyroidism and/or when a patient has an enlarged thyroid gland. It may be ordered at regular intervals to monitor the effectiveness of treatment when a patient is being treated for a known thyroid disorder.

TSH screening is routinely performed in the United States on newborns as part of each state's newborn screening program. The American Thyroid Association recommends that adults older than age 35 be screened for thyroid disease with a TSH test every five years, although other organizations, such as the U.S. Preventive Services Task Force, challenge this recommendation. Several organizations recommend instead screening women over 50, asymptomatic adults over 60, or those at high risk for thyroid disorders, such as pregnant and postpartum women.

What does the test result mean?
A high TSH result often means an underactive thyroid gland that is not responding adequately to the stimulation of TSH due to some type of acute or chronic thyroid dysfunction. Rarely, a high TSH result can indicate a problem with the pituitary gland, such as a tumor producing unregulated levels of TSH, in what is known as secondary hyperthyroidism. A high TSH value

can also occur when patients with a known thyroid disorder (or those who have had their thyroid gland removed) are receiving too little thyroid hormone medication.

A low TSH result can indicate an overactive thyroid gland (hyperthyroidism) or excessive amounts of thyroid hormone medication in those who are being treated for an underactive (or removed) thyroid gland. Rarely, a low TSH result may indicate damage to the pituitary gland that prevents it from producing adequate amounts of TSH.

Whether high or low, an abnormal TSH indicates an excess or deficiency in the amount of thyroid hormone available to the body, but it does not indicate the reason why. An abnormal TSH test result is usually followed by additional testing to investigate the cause of the increase or decrease.

The following table summarizes test results and their potential meaning.

TSH	T4	T3	Interpretation
High	Normal	Normal	Mild (subclinical) hypothyroidism
High	Low	Low or normal	Hypothyroidism
Low	Normal	Normal	Mild (subclinical) hyperthyroidism
Low	High or normal	High or normal	Hyperthyroidism
Low	Low or normal	Low or normal	Rare pituitary (secondary) hypothyroidism

Is there anything else I should know?
Many medications — including aspirin and thyroid-hormone replacement therapy — may affect thyroid gland function test results, so tell your doctor about any drugs you are taking.

When your doctor adjusts your dose of thyroid hormone, it is important to wait at least one to two months before you check your TSH again so that your new dose can have its full effect.

Extreme stress and acute illness may also affect TSH test results, and results may be low during the first trimester of pregnancy.

Common Questions

1. Do doctors test for TSH levels during pregnancy?
Doctors do not generally test asymptomatic women, but those with symptoms and/or a known thyroid disorder may be tested at intervals recommended by the doctor to detect and evaluate hyper- or hypothyroidism and its likely effect on the mother and baby – both during pregnancy and after. For more information, see Thyroid Foundation of America: Thyroid Problems During and After Pregnancy - Are You At Risk?

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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American Thyroid Association
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The Hormone Foundation: Thyroid Information
U.S. Preventive Services Task Force's recommendations on thyroid screening
Thyroid Screening Guidelines, Washington State Clinical Laboratory Advisory Council to the Washington State Department of Health (PDF file)

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T4

Also known as: Total T4 and Free T4
Formally known as: Thyroxine
Related tests: TSH, T3, Thyroid Antibodies, T7 (T3 and T4)

At A Glance

Why get tested?
To help evaluate thyroid gland function; to help diagnose hypothyroidism or hyperthyroidism; to screen for hypothyroidism in newborns

When to get tested?
Usually ordered in response to an abnormal TSH test result or when a patient has symptoms of hyper- or hypothyroidism; commonly performed on newborns

Sample required?
A blood sample drawn from a vein in the arm or from pricking the heel of an infant

The Test Sample

What is being tested?
This test measures the amount of thyroxine, or T4, in your blood. T4 is one of two major hormones produced by the thyroid gland (the other is called triiodothyronine, or T3). The thyroid is a small, butterfly-shaped gland located just below the Adam's apple. This gland plays a vital role in controlling the rate at which your body uses energy.

The body has a feedback system that turns thyroid hormone production on and off. When the level of T4 in the bloodstream decreases, the hypothalamus (an organ in the brain) releases thyrotropin releasing hormone, which stimulates the pituitary gland (an organ below the hypothalamus) to release thyroid-stimulating hormone (TSH), which in turn stimulates the thyroid gland to make and/or release more T4. As blood concentrations of T4 increase, the amount of TSH released decreases.

T4 makes up nearly all of what we call thyroid hormone, while T3 makes up less than 10%. Inside the thyroid gland, T4 is produced, bound to a protein called thyroglobulin, and stored. When the body requires thyroid hormone, the thyroid gland produces some T4 or T3 and/or

releases stored T4 into circulation. In the blood, T4 is present in a free (not bound) and protein-bound form (primarily bound to thyroxine-binding globulin). The concentration of free T4 is only about 0.1% of that of total T4, but the free T4 is the portion of thyroxine that is active. T4 only becomes an active thyroid hormone when it is converted into T3 in the liver or other tissues.

If the thyroid gland does not produce sufficient T4 (due to thyroid dysfunction or to insufficient TSH), then the affected patient experiences symptoms of hypothyroidism such as weight gain, dry skin, cold intolerance, irregular menstruation, and fatigue. If the thyroid gland produces too much T4, the rate of the patient's body functions will increase and cause symptoms associated with hyperthyroidism such as increased heart rate, anxiety, weight loss, difficulty sleeping, tremors in the hands, and puffiness around dry, irritated eyes.

The most common causes of thyroid dysfunction are autoimmune-related. Graves' disease causes hyperthyroidism and Hashimoto's thyroiditis causes hypothyroidism. Both hyper- and hypothyroidism can also be caused by thyroiditis (thyroid inflammation), thyroid cancer, and excessive or deficient production of TSH. The effect of these conditions on thyroid hormone production can be detected and monitored by measuring the total T4 (includes bound and free portion) or the free T4 (only unbound).

How is the sample collected for testing?
A blood sample is obtained from a needle placed in a vein in your arm or from pricking the heel of an infant.

The Test

How is it used?
Total T4 and free T4 are two separate tests that can help the doctor evaluate thyroid function. The total T4 test has been used for many years to help diagnose hyper- and hypothyroidism. It is a useful test but can be affected by the amount of protein available in the blood to bind to the hormone. The free T4 test is a newer test that is not affected by protein levels. Since free T4 is the active form of thyroxine, it is thought by many to be a more accurate reflection of thyroid hormone function and, in most cases, its use has replaced that of the total T4. Whichever thyroxine measurement is ordered, it is usually ordered along with or following a TSH test. This helps the doctor to determine whether the thyroid hormone feedback system is functioning as it should, and the results of the tests help to distinguish between different causes of hyper- and hypothyroidism. Sometimes a T3 test will also be ordered to give the doctor additional diagnostic information.

A T4 and TSH test may be ordered to help evaluate a patient with an enlarged thyroid gland (a goiter) and to aid in the diagnosis of female infertility. If the doctor suspects that the patient may have an autoimmune-related thyroid condition, she may order thyroid antibodies along with a T4. In patients with known thyroid dysfunction, T4 and/or TSH tests may be ordered to monitor thyroid function. In pregnant women with thyroid disorders, these tests may be ordered to help determine whether the fetus/newborn is likely to have hypo- or hyperthyroidism.

In the United States, newborns are commonly screened for T4 levels as well as TSH concentrations to check for congenital hypothyroidism, which can cause mental retardation if left untreated.

When is it ordered?

A total T4 or free T4 test is primarily ordered in response to an abnormal TSH test result. Sometimes the T4 will be ordered along with a TSH to give the doctor a more complete evaluation of the adequacy of the thyroid hormone feedback system. These tests are usually ordered when a patient has symptoms of hyper- or hypothyroidism. Sometimes they are ordered as screening tests during routine blood testing, but there is not consensus on this use. In patients with known thyroid disorders, the TSH and sometimes T4 are ordered at intervals to monitor the effectiveness of treatment. In pregnant women with thyroid disorders, the doctor is likely to order thyroid testing early and late in the pregnancy and for a time period following delivery to monitor the mother and baby. Thyroid hormone screening is commonly performed on newborns in the United States as part of newborn screening programs.

What does the test result mean?
In general, high free or total T4 results may indicate an overactive thyroid gland (hyperthyroidism), and low free or total T4 results may indicate an underactive thyroid gland (hypothyroidism). The test results alone are not diagnostic but will prompt the doctor to perform additional testing to investigate the cause of the excess or deficiency. Both decreased and increased T4 results are associated with a variety of temporary and chronic thyroid conditions. Low T4 results in conjunction with a low TSH level or high T4 results along with a high TSH may indicate a pituitary gland condition.

The following table summarizes test results and their potential meaning.

T4	TSH	T3	Interpretation
Normal	High	Normal	Mild (subclinical) hypothyroidism
Low	High	Low or normal	Hypothyroidism
Normal	Low	Normal	Mild (subclinical) hyperthyroidism
High or normal	Low	High or normal	Hyperthyroidism
Low or normal	Low	Low or normal	Rare pituitary (secondary) hypothyroidism

Is there anything else I should know?
Many medications—including estrogen, certain types of birth control pills, and large doses of aspirin—can affect total T4 test results, so tell your doctor about any drugs you are taking. In general, free T4 levels are not affected by these medications.

Common Questions

1. How does pregnancy affect thyroid hormone levels?
Pregnancy can increase total T4 levels although it does not mean that thyroid disease will develop. For more information, see Thyroid Foundation of America: Thyroid Problems During and After Pregnancy - Are You At Risk?

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.

Related Pages

On This Site
Conditions: Thyroid diseases
Screening: Thyroid dysfunction Adults (30-49), Adults (50 and up); Congenital hypothyroidism Newborns

Elsewhere On The Web
Thyroid Foundation of America
American Thyroid Association
American Foundation of Thyroid Patients
The Hormone Foundation: Thyroid Information

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Medical Encyclopedia: CPK

URL of this page: http://www.nlm.nih.gov/medlineplus/ency/article/003503.htm

Alternative names

CK; Creatine kinase; Creatine phosphokinase

Definition

A CPK is a blood test that measures creatine phosphokinase (CPK), an enzyme found mainly in the heart, brain, and skeletal muscle.

How the test is performed

Blood is drawn from a vein, usually from the inside of the elbow or the back of the hand. The puncture site is cleaned with antiseptic. An elastic band is placed around the upper arm to apply pressure and cause the vein to swell with blood.

A needle is inserted into the vein, and the blood is collected in an air-tight vial or a syringe. During the procedure, the band is removed to restore circulation. Once the blood has been collected, the needle is removed, and the puncture site is covered to stop any bleeding.

In infants or young children, the area is cleansed with antiseptic and punctured with a sharp needle or a lancet. The blood may be collected in a pipette (small glass tube), on a slide, onto a test strip, or into a small container. A bandage may be applied to the puncture site if there is any bleeding.

This test may be repeated over 2 or 3 days for a hospitalized patient. The pattern of a rise or fall in CPK (or CPK isoenzymes) can be diagnostically significant.

How to prepare for the test

Usually, no special preparation is necessary.

How the test will feel

When the needle is inserted to draw blood, you may feel moderate pain, or only a prick or stinging sensation. Afterward, there may be some throbbing.

Why the test is performed

When the total CPK level is very high, it usually means there has been injury or stress to the heart, the brain, or muscle tissue. For example, when a muscle is damaged, CPK leaks into the bloodstream. Determining which specific form of CPK is high helps doctor's determine which exact tissue has been damaged.

This test may be used to:

- Diagnose heart attack
- Evaluate cause of chest pain
- Determine how badly a muscle is damaged
- Detect early dermatomyositis and polymyositis
- Tell the difference between malignant hyperthermia and postoperative infection
- Reveal who carries muscular dystrophy (Duchenne)

The pattern and timing of a rise or fall in CPK levels can be diagnostically significant, particularly if a heart attack is suspected.

What abnormal results mean

High CPK levels may be seen in patients who have:

- Heart attack
- Myocarditis (inflammation of the heart muscle)
- Central nervous system trauma or stroke
- Convulsions
- Delirium tremens
- Dermatomyositis or polymyositis
- Electric shock
- Muscular dystrophies
- Pulmonary infarction (lung tissue death)

Additional conditions may give positive test results:

- Hypothyroidism
- Pericarditis following a heart attack
- Rhabdomyolysis

What the risks are

- Excessive bleeding
- Fainting or feeling light-headed
- Hematoma (blood accumulating under the skin)
- Infection (a slight risk any time the skin is broken)
- Multiple punctures to locate veins

Special considerations

Other tests should be done to determine the exact location of muscle damage.

Factors that may affect test results include cardiac catheterization, intramuscular injections, trauma to muscles, recent surgery, and heavy exercise.

Drugs that can increase CPK measurements include amphotericin B, ampicillin, some anesthetics, blood thinners, aspirin, clofibrate, dexamethasone, furosemide, alcohol, and cocaine.

Veins and arteries vary in size from one patient to another and from one side of the body to the other. Obtaining a blood sample may be more difficult from some people than from others.

Update Date: 1/22/2007

Updated by: Benjamin W. Van Voorhees, MD, MPH, Assistant Professor of Medicine and Pediatrics, The University of Chicago, Chicago, IL.
Review provided by VeriMed Healthcare Network.

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Medical Information

Blood Chemistry Profile
BCP Overview
- Diabetes Mellitus
- Kidney Disorders
- Liver Disorders
- Blood Lipids

Blood Proteins

CV Profile
CV Overview
Body Mass Index
Heart Disease Risk Factors
Healthy Living

Blood Chemistry Profile

Northwestern Mutual's Blood Chemistry Profile is a group of tests performed on a single sample of blood. Like other biochemical profiles, each test measures the value of a differe substance in the blood. These values provide information on the function of different organ systems (kidney, liver, etc.) or the risk for certain diseases (diabetes mellitus, coronary hea disease, etc.). Biochemical profiles have been in use for over 30 years. They have become important tools to screen for unsuspected disease. However, a normal biochemical screen and of itself is not a guarantee of good health. A physician uses it in conjunction with perso medical history, a complete physical examination and other tests to assess the overall stat a person's health. Similarly, any abnormal value on a biochemical profile must be interpret in the context of personal medical history, physical examination and other lab studies. You personal physician is the best person to perform an assessment of your overall health.

Biochemical profiles are sometimes represented by abbreviations such as "SMA", "SMAC" "Chem" followed by a number (example: Chem-12). The number indicates the number of t which is included in the profile. Northwestern Mutual's Blood Chemistry Profile is made up 17 different tests. A biochemical profile frequently has multiple tests which assess the func of the same organ system or screen for the same disease. Using multiple tests for the sam purpose increases the ability of the profile to detect unsuspected disease.

Northwestern Mutual's Blood Chemistry Profile consists of 17 tests separated into five different groups on a functional basis. These groups and their functions are listed below:

Test	Purpose	Additional Information
Glucose, Fructosamine, Hemoglobin AIC	Screen for diabetes mellitus	Diabetes Mellitus—an Overview Tests for Diabetes Mellitus
BUN, Creatinine	Screen for kidney disorders	Kidney Disorders—an Overview Tests for Kidney Disorders
Bilirubin, AP, AST, ALT, GGT	Screen for liver disorders	Liver Disorders—an Overview Tests for Liver Disorders
Cholesterol, LDL Cholesterol, HDL Cholesterol, Chol/HDL Chol Ratio, Triglycerides	Screen for blood lipids	Blood Lipids—an Overview Tests for Blood Lipids
Total Protein, Albumin, Globulin	Screen for blood proteins	Blood Proteins—an Overview

It is not the intention of Northwestern Mutual to provide specific medical advice, but rather to provide users w information to better understand their health. Please consult with a qualified physician for diagnosis and for answers to your personal questions.

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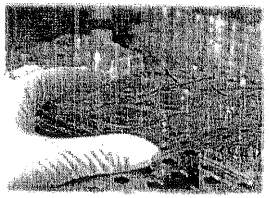
History and Physical Exam | Lab Tests | Tumor Markers | X-rays | Other Imaging | Nuclear Scans | Ultrasound | Endoscopies | Pathology | Operative Report |

Lab Tests

ALKALINE PHOSPHATASE Also called: alk phos, alk f, ALP. May be included in blood chemistry screening panel. Normal range: 20-90 I.U./liter. Normal range may vary somewhat according to the brand of laboratory assay materials used.

BUN (BLOOD UREA NITROGEN) chemistry study of blood serum to measure the level of urea in the blood, a sign of impaired kidney function or urinary obstruction. Normal range: 10-15 mg/100 ml.

CBC (COMPLETE BLOOD COUNT) WITH PLATELETS CBC (Complete Blood Count) consists of several tests on blood serum. The platelet count is usually ordered separately. The table which follows indicates the portions of the CBC relevant to malignancies. If one or more of the starred items is outside of the normal values, the CBC is considered abnormal.



TEST	NORMAL VALUES
* White Blood Count (WBC)	5,000-10,000 total WBC
Differential white cell count (diff)	
Neutrophils PMNs, polys, segsEosinophils	60-70% total WBC 1-4% total leukocyte count
Basophils	0.5-1% total leukocyte count
Monocytes	2-6% total leukocyte count
Lymphocytes	20-40% total leukocyte count
* Red Blood Count (RBC)	3.6-5.0 million/cu.mm. (F) 4.2-5.4 million/cu.mm. (M)
* Hematocrit (Hct)	37-47%
* Hemoglobin (Hgb)	12-16 g/100 ml. (F) 14-18 g/100 ml. (M)
Red Blood Cell Indices	
Mean Corpuscular Volume (MCV)	87-103 cu.micrograms/red cell
Mean Corpuscular Hemoglobin (MCH)	27-32 picograms
Mean Corpuscular Hemoglobin Concentration (MCHC)	32-36%
Stained Red Cell Examination	Normocytic, normochromic
* Platelet Count	150,000-300,000/cu.mm.

CHEMISTRY SCREENING PANEL Also called: blood chemistries, SMA-12, SMAC-6, ACA, MSSP, and many other names, usually based on the piece of equipment in use. The blood chemistry panel consists of 12 to 20 tests:

TEST	NORMAL VALUES
Total protein (TP)	6-8 g/dl
Albumin (Alb.)	4-4.5 g%
Calcium (CA+)	Total: 9-11 mg/dl
Inorganic phosphorus (Inor. Phos.)	2.5-4.8 mg/dl
Cholesterol (Chol)	150-330 mg/dl (age 40-59)
Glucose (Glu)	70-100 mg/dl (fasting serum)
Blood Urea Nitrogen (BUN)	10-15 mg/100 ml
Uric acid	2.2-7 mg/dl (F) 4.2-8 mg/100 ml (M)
Creatinine (Creat.)	0.6-1 mg/dl (F) 0.8-1.7 mg/100 ml (M)
Total Bilirubin (T. Bili.)	0.3-1.3 mg/dl
Alkaline Phosphatase (Alk. Phos)	20-90 I U/liter
Aspartate transaminase (AST or SGOT)	5-40 Sigma-Frankel u/ml OR 0-36 IU/ltr (lower in women)

FECAL OCCULT BLOOD identifies presence of blood in stool; reported as positive or negative Also called: Guaiac, Hematest, Occultest, Hemoccult, Benzidine, or Orthotoluidine test.

HISTOCHEMISTRY OF BONE MARROW pathologic examination of bone marrow biopsy specimen using special staining techniques to determine subclassification of the leukemia. Histochemistry of the bone marrow is a laboratory study performed in addition to the standard histologic analysis of the specimen.

I-131 UPTAKE TEST measures ability of thyroid gland to accumulate, concentrate and retain iodine; usually done at same time as a thyroid scan. Normal values: 1%-13% absorbed by thyroid after 2 hours; 2-25% absorbed after 6 hours; 15-45% absorbed after 24 hours. Used primarily to rule out a variety of benign conditions.

LIVER FUNCTION TESTS a series of blood chemistry tests measuring enzymes excreted by the liver during abnormal functioning due to metastases, obstruction or other conditions. Also called: liver panel. A liver panel may contain any of the following tests. If any one of these tests is outside the normal range of values, the test should be reported as abnormal.

TEST	NORMAL VALUES
Alkaline Phosphatase (Alk.Phos.)	20-90 IU/liter
Lactic Dehydrogenase (LDH)	100-190 u/L at 37 degrees
Transaminase	
SGOT	8-46 u/L (M) 4-35 u/L (F)
SGPT	7-46 u/L (M) 4-35 u/L (F)
Leucine aminopeptidase (LAP)	80-200 Goldbarg-Rutenburg u/ml (M) 75-185 u/ml (F)
Bilirubin (total)	< 1.5 mg/dl

RENAL FUNCTION TESTS urine chemistry tests to measure the output of the kidneys.

TEST	NORMAL VALUES
Albumin (protein)	2-8 mg/dl

THYROGLOBULIN see Tumor Markers section.

URINALYSIS Also called UA, random specimen, clean catch. Collection of urine to evaluate for blood, infection, or other urinary tract problems.

MayoClinic.com
Tools for healthier lives

Original Article:http://www.mayoclinic.com/health/liver-function-tests/AN00876

Liver function tests: What do they involve?

Q. I recently started a new medication, and my doctor has recommended regular testing of my liver function. What does that involve?

A.

Liver function tests are used to detect, evaluate and monitor liver disease or damage. A doctor may recommend liver function tests if you:

- Have a high risk of liver disease
- Take medication that may cause liver damage
- Have signs and symptoms of liver disease

Liver function tests generally refer to blood tests that evaluate the presence of liver damage or disease. These tests usually can be done on a single blood sample and may include:

- **Alanine transaminase (ALT).** An enzyme found mainly in liver cells, ALT helps your body metabolize protein. Normally, ALT levels in the blood are low. When the liver is damaged, ALT is released in the bloodstream.
- **Aspartate transaminase (AST).** The enzyme AST plays a role in the metabolism of alanine, an amino acid. AST is found in high concentrations in liver cells. An increase in AST levels may indicate liver damage or disease.
- **Alkaline phosphatase (ALP).** ALP is an enzyme found in high concentrations in the liver and bile ducts, as well as some other tissues. Higher than normal levels of ALP may indicate liver damage or disease.
- **Albumin and total protein.** Levels of albumin — a protein made by the liver — and total protein show how well your liver is making proteins that your body needs to fight infections and perform other functions. Lower than normal levels may indicate liver damage or

disease.

- **Bilirubin.** Bilirubin results from the breakdown of red blood cells. Normally, bilirubin passes through the liver and is excreted in your stool. Elevated levels of bilirubin (jaundice) may indicate liver damage or disease.

Additional tests that may be used to evaluate liver function include:

- **Gamma-glutamyl transferase (GGT).** This test measures the amount of the enzyme GGT in the blood. Higher than normal levels may indicate liver or bile duct injury.
- **Lactate dehydrogenase (LDH).** LDH is an enzyme found in many body tissues, including the liver. Elevated levels of LDH may indicate liver damage.
- **Prothrombin time (PT).** This test measures the clotting time of plasma. Increased PT may indicate liver damage.

By Mayo Clinic Staff
Jul 18, 2006

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AN00876

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Original Article:http://www.mayoclinic.com/health/cholesterol-test/CL00033

Cholesterol test: Sorting out the lipids

A complete cholesterol test — more accurately referred to as a lipid panel or lipid profile — includes a group of blood tests used to measure the amount of cholesterol and triglycerides in your blood. Cholesterol tests are done to help assess your risk of coronary artery disease or risk of vascular disease in other parts of your body.

Cholesterol and triglycerides are types of fats called lipids that naturally circulate in your blood. Although lipids are necessary for your body to function normally, too much fat in your blood increases your risk of heart or vascular disease.

If your cholesterol levels are abnormal, you probably won't have any signs or symptoms, so a cholesterol test is an important risk assessment tool. Many studies have shown that elevated cholesterol levels are a significant risk factor for heart disease, which is the No. 1 killer of both men and women.

What types of cholesterol are measured?

A complete cholesterol test, referred to as a lipid panel or lipid profile, includes the measurement of four types of fats (lipids) in your blood:

- **Low-density lipoprotein (LDL) cholesterol.** This is sometimes called the "bad" cholesterol. Too much of it in your blood causes the accumulation of fatty deposits (plaques) in your arteries (atherosclerosis), which reduces blood flow. These plaques sometimes rupture and lead to major heart and vascular problems. In addition, in people with diabetes and in people who are at high risk of heart disease, LDL cholesterol particles tend to be smaller and denser. These smaller, denser particles can cause greater damage to blood vessels than can the cholesterol particles found in people at lower risk of heart disease and in those without diabetes.
- **High-density lipoprotein (HDL) cholesterol.** This is sometimes called the "good" cholesterol because it helps carry away LDL cholesterol, thus keeping arteries open and your blood flowing more freely.
- **Triglycerides.** Triglycerides are another type of fat in the blood. When you eat, your body converts any calories it doesn't need to use right away into triglycerides, which are stored in fat cells and released later for energy. High triglyceride levels usually mean you regularly eat more calories than you burn. High levels are also seen in overweight people, in those consuming too many sweets or too much alcohol, and in people with diabetes who have elevated blood sugar levels.
- **Total cholesterol.** This is a sum of your blood's cholesterol content.

Together, the four numbers can provide clues about your risk of heart attack, stroke or other blood vessel damage (vascular disease). Results of a lipid panel cholesterol test are listed as a set of numbers in milligrams per deciliter (mg/dL).

It's possible to measure only total cholesterol. However, this single test isn't used as much anymore, because knowing only your total cholesterol level doesn't provide your doctor with as much useful information as the more complete lipid panel.

In 2001, a group of national experts known as the National Cholesterol Education Program Expert Panel recommended that the ideal cholesterol test measure the four types of fats (lipids) in your blood that are included in a lipid panel or lipid profile.

Who should get a cholesterol test?

All adults age 20 or older should have a cholesterol test once every five years. Cholesterol testing is very important if you have a family history of high cholesterol or heart disease, are overweight, are physically inactive, have diabetes or eat a high-fat diet. These factors put you at increased risk of developing high cholesterol and heart disease.

If you have elevated cholesterol levels, your doctor may want you to get tested more often. Discuss with your doctor how often you should have a cholesterol test if your cholesterol levels are abnormal.

It's likely your doctor will want to retest you in several weeks or months if your cholesterol test is abnormal. Before starting any treatment based only on an abnormal cholesterol test, it's common to get several tests done over a period of time to ensure an accurate diagnosis.

You should have your cholesterol measured when you're relatively healthy. An acute illness, a heart attack or severe stress can affect

cholesterol levels. Cholesterol is often high during pregnancy, so pregnant women should wait at least six weeks after giving birth to have their cholesterol measured.

How do your prepare for a cholesterol test?

You should fast (no food or liquids other than water) for nine to 12 hours before the test. You can drink water in the time leading up to the test, but avoid coffee, tea and other beverages. Talk to your doctor about any other special requirements. Some medications, such as birth control pills, can increase your cholesterol levels. For this reason, if you take these or other medications, your doctor might want you to temporarily stop taking them.

How is a cholesterol test done?

A cholesterol test is a blood test. Blood is drawn from a vein, usually from your arm. Before the needle is inserted, the puncture site is cleaned with antiseptic and an elastic band is wrapped around your upper arm to restrict blood flow through your veins. This causes the veins to fill with blood.

After the needle is inserted, a small amount of blood is collected into a vial or syringe. The band is then removed to restore circulation, and blood continues to flow into the vial. Once enough blood is collected, the needle is removed and the puncture site is covered with a pressure wrap.

The entire procedure will likely last a couple of minutes. It's relatively painless. Some people do, however, feel moderate pain when the needle is inserted, while others feel only a tiny pinprick.

Results of a cholesterol test

Cholesterol levels are measured in milligrams (mg) of cholesterol per deciliter (dL) of blood. To interpret your test results, use these general guidelines.

Total cholesterol	
Below 200 mg/dL	Desirable
200 to 239 mg/dL	Borderline high
240 mg/dL and above	High

LDL cholesterol	
Below 70 mg/dL	Optimal for people with or at very high risk of heart disease
Below 100 mg/dL	Optimal for people at risk of heart disease
100 to 129 mg/dL	Near optimal
130 to 159 mg/dL	Borderline high
160 to 189 mg/dL	High
190 mg/dL and above	Very high

HDL cholesterol	
Below 40 mg/dL	Poor
40 to 59 mg/dL	Better
60 mg/dL and above	Best

Triglycerides	
Below 150 mg/dL	Desirable
150 to 199 mg/dL	Borderline high
200 to 499 mg/dL	High
500 or above	Very high

Lp(a), C-reactive protein and other substances

The four main categories of lipids — total cholesterol, LDL cholesterol, HDL cholesterol and triglycerides — are what are most commonly measured during a cholesterol test. The value of knowing these measurements to evaluate the risk of heart disease has been repeatedly proved by medical studies. However, it's also true that about half the people who have a heart attack or stroke each year have normal cholesterol levels.

So, many doctors have begun examining other substances in the blood. They hope knowing the levels of some of these other substances might help them better predict who's most at risk of heart disease. Tests of these other substances in the blood are often done on the same sample of blood taken during a cholesterol test and meant to complement, not replace, a standard lipid panel or lipid profile cholesterol test. The evidence for how valuable these additional tests are is mixed. Here are some additional tests your doctor might order along with a standard cholesterol test:

- **Lipoprotein (a), or Lp(a) lipoprotein.** Lipoprotein (a) is widely being tested because it's thought to be a risk factor for atherosclerosis. Lp(a) is a type of LDL cholesterol. Your Lp(a) level is determined by your genes and is not generally affected by lifestyle. Some research has shown that high levels of Lp(a) might increase your risk of heart disease, though it's not clear how much risk. Your doctor might order an Lp(a) test if you already have heart

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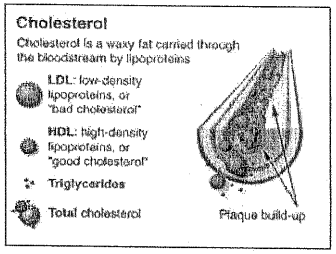
The Complete Lipid Panel measures 3 different kinds of lipids in the blood, all of which are related to a type of fat called cholesterol. Cholesterol comes from the foods we eat (anything from animals) and from our body (liver). Cholesterol can't dissolve in the blood. It must be transported to and from the cells by lipoproteins.



In Thei
"Since hea
stroke run
gave me p
have thes
you."
D. Lucius
Camarillo

The 3 kinds of lipids measured in the Complete Lipid Panel are:

1. **LDL cholesterol** - Low-density lipoprotein or LDL is the major cholesterol carrier in the blood, carrying about 65% of the cholesterol in blood. LDL is often referred to as "bad cholesterol". If too much LDL cholesterol circulates in the blood, it can slowly build up in the walls of the arteries feeding the heart and brain. Together with other substances it can form plaque, a thick, hard deposit that can clog those arteries. This condition is known as atherosclerosis.

2. **HDL cholesterol** - High-density lipoprotein or HDL carries about 30% of the cholesterol in blood. HDL is often referred to as "good cholesterol". HDL carries bad cholesterol away from the arteries and back to the liver, where it's passed from the body. A high HDL level is protective against heart disease, while a low level of HDL increases the risk of heart attack and stroke.

3. **Triglycerides** - Triglycerides are the most common type of fat in the body. Like cholesterol, they circulate in your blood but are stored in body fat and used when the body needs extra energy. Triglyceride levels increase significantly after eating. A high triglyceride level combined with a low HDL or high LDL can speed up the process of atherosclerosis.

Total cholesterol - The Complete Lipid Panel also measures total cholesterol, which is the sum of all the types of cholesterol in your blood.

Risk Ranges Published by the National Cholesterol Education Program (NCEP)

The National Heart, Lung, and Blood Institute launched the National Cholesterol Education Program (NCEP) in November 1985. The goal of the NCEP is to contribute to reducing illness and death from coronary heart disease in the United States by reducing the percent of Americans with high blood cholesterol.

In 2001, the NCEP published the 3rd version of the Adult Treatment Panel (NCEP ATP III Guidelines). Their recommended screening test is a fasting Complete Lipid Panel, measuring total cholesterol, HDL, LDL and triglycerides.

LDL Cholesterol	Category
< 100 mg/dL	Optimal
100-129 mg/dL	Near optimal/above optimal
130-159 mg/dL	Borderline high
160-189 mg/dL	High
190 mg/dL	Very High

HDL Cholesterol	Category
40 mg/dL	Low
60 mg/dL	High (desirable)

Triglycerides	Category
< 150 mg/dL	Normal
150-199 mg/dL	Borderline high
200-499 mg/dL	High
500 mg/dL	Very high

Total Cholesterol	Category
< 200 mg/dL	Desirable
200-239 mg/dL	Borderline high
240 mg/dL	High

Cholesterol Screening Recommendations

National Cholesterol Education Program (NCEP)

- Cholesterol screening every 5 years in asymptomatic adults starting at age 20
- Test every 1-2 years in patients with cardiovascular disease or abnormal lipid profiles
- For those on statins (cholesterol lowering medication), test every 6 weeks until lipid goals are met and every 4-6 months thereafter

U.S. Preventive Services Task Force (USPSTF)

- Recommends routine screening of men and women aged 20 years and older for lipid disorders, but no frequency interval given.

American Diabetes Association

- Complete lipid panel every year for all adults

Sources: American Heart Association web site www.americanheart.org, American Diabetes web site www.diabetes.org, NCEP ATP III Guidelines (2001), Screening for Lipid Disorders. Am J Prev Med 2001;20(3S):73-6.

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disease but appear to have otherwise normal cholesterol levels. Lp (a) is often tested if you have a family history of early-onset heart disease or sudden death. It should also be done if your LDL cholesterol doesn't respond well to drug treatment.

- **Apolipoprotein A-I (apo A-I).** A-I is a protein that helps your HDL cholesterol remove bad cholesterol from the body. Testing for this protein isn't routine, but can be ordered by your doctor if you have a family history of heart disease or high cholesterol. If your apo A-I levels are too low, it could be a sign that you're at increased risk of heart disease.
- **Apoliprotein B (apo B).** Apo B is a protein that is part of each LDL cholesterol particle. Knowing the level of apo B usually gives your doctor a good indication of your LDL cholesterol level. Some research suggests it might be a useful predictor of heart disease risk. It's not routinely measured, but can be if your doctor suspects you're at high risk of heart disease or you have a family history of heart disease or high blood cholesterol.
- **High-sensitivity C-reactive protein.** Hs-C-reactive protein (hs-CRP) is a protein your liver produces as part of your immune system response to injury or infection. It's produced by muscle cells within the coronary arteries. High levels of hs-CRP in your blood may be associated with an increased risk of heart attack, stroke and sudden cardiac death. Some researchers contend that hs-CRP is a better predictor of your heart disease risk than is cholesterol. Although the evidence behind hs-CRP is growing, the American Heart Association doesn't yet recommend hs-CRP screening for the general public — only those at known increased risk of heart disease.
- **Homocysteine.** Homocysteine is an amino acid your body uses to make protein and to build and maintain tissue. But excessive levels in your blood may increase your risk of stroke, certain types of heart disease, and disease.of the blood vessels of the arms, legs and feet (peripheral artery disease). Your doctor may check your homocysteine level if you've had cardiovascular problems but don't have any of the traditional risk factors, such as smoking. Homocysteine might also be useful in evaluating your risk of peripheral arterial disease.

New cholesterol testing technology

A new type of cholesterol test is becoming available that measures the size and number of your LDL and HDL cholesterol particles. This testing technique is referred to as nuclear magnetic resonance (NMR) spectroscopy. It's thought that knowing the size and quantity of each type of LDL and HDL cholesterol particle present in your blood might be a more precise indicator of your risk of heart disease. Research into NMR

technology and its usefulness is ongoing.

By Mayo Clinic Staff
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