How to interpret your blood test results

Review your lab test results

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CBC Risk Factors Urinalysis

Overview

Laboratory tests are tools helpful in evaluating the health status of an individual. It is important to realize that laboratory results may be outside of the so-called "normal range" for many reasons. These variations may be due to such things as race, dietetic preference, age, sex, menstrual cycle, degree of physical activity, problems with collection and/or handling of the specimen, non-prescription drugs (aspirin, cold medications, vitamins, etc.), prescription drugs, alcohol intake and a number of non-illness-related factors, Any unusual or abnormal results should be discussed with your physician. It is not possible to diagnose or treat any disease or problem with this blood test alone. It can, however, help you to learn more about your body and detect potential problems in early stages when treatment or changes in personal habits can be most effective.

Our lab, like almost all labs, sets the normal result range for a particular test so that 95% of our healthy patients fall within the normal range. That means that 5% of our healthy patients fall outside of the normal range, even when there is nothing wrong with them. Thus an abnormal test does not necessarily mean that there is something wrong with you. Statistically if you have 20 or 30 individual tests run as part of a panel, chances are 1 or 2 will be slightly outside the normal range. Part of what you see your doctor for is to interpret whether or not these changes are significant.

This review is a brief summary and is not intended to be comprehensive or replace discussion of your results with your health care team.

Glucose: This is a measure of the sugar level in your blood. High values are associated with eating before the test, and diabetes.

The normal range for a fasting glucose is 60 -109 mg/dl. According the the 1999 ADA criteria, diabetes is diagnosed with a *fasting* plasma glucose of 126 or more. A precursor, Impaired Fasting Glucose (IFG) is defined as reading of fasting glucose levels of 110 - 125. Sometimes a glucose tolerance test, which involves giving you a sugary drink followed by several blood glucose tests, is necessary to properly sort out normal from IFG from diabetes.

Be aware that variations in lab normals exist. Also, Europeans tend to use a 2 hour after eating definition of diabetes rather than a fasting glucose. Using the European standards tends to increase the number of people who are classified as having diabetes.

Electrolytes: These are your potassium, sodium, chloride, and CO2 levels.

Potassium is controlled very carefully by the kidneys. It is important for the proper functioning of the nerves and muscles, particularly the heart. Any value outside the expected range, high or low, requires medical evaluation. This is especially important if you are taking a diuretic (water pill) or heart pill (Digitalis, Lanoxin, etc.).

Sodium is also regulated by the kidneys and adrenal glands. There are numerous causes of high and low sodium levels, but the most common causes of low sodium are diuretic usage, diabetes drugs like chlorpropamide, and excessive water intake in patients with heart or liver disease.

CO2 reflects the acid status of your blood. Low CO2 levels can be due to either to increased acidity from uncontrolled diabetes, kidney disease, metabolic disorders, or low CO2 can be due to chronic hyperventilation.

Waste products:

Blood Urea Nitrogen (BUN) is a waste product produced in the liver and excreted by the kidneys. High values may mean that the kidneys are not working as well as they should. BUN is also affected by high protein diets and/or strenuous exercise which raise levels, and by pregnancy which lowers it.

Creatinine is a waste product largely from muscle breakdown. High values, especially with high BUN levels, may indicate problems with the kidneys..

Uric Acid is normally excreted in urine. High values are associated with gout, arthritis, kidney problems and the use of some diuretics.

Enzymes

AST, ALT, SGOT, SGPT, and GGT and Alkaline Phosphatase are abbreviations for proteins called enzymes which help all the chemical activities within cells to take place. Injury to cells release these enzymes into the blood. They are found in muscles, the liver and heart. Damage from alcohol and a number of diseases are reflected in high values.

Alkaline phosphatase is an enzyme found primarily in bones and the liver. Expected values are higher for those who are growing (children and pregnant women) or when damage to bones or liver has occurred or with gallstones. Low values are probably not significant.

GGT is also elevated in liver disease, particularly with obstruction of bile ducts. Unlike the alkaline phosphatase it is not elevated with bone growth or damage.

AST/SGOT , ALT/ SGPT are also liver and muscle enzymes. They may be elevated from liver problems, hepatitis, excess alcohol ingestion, muscle injury and recent heart attack.

LDH is the enzyme present in all the cells in the body. Anything which damages cells, including blood drawing itself, will raise amounts in the blood. If blood is not processed promptly and properly, high levels may occur. If all values except LDH are within expected ranges, it is probably a processing error and does not require further evaluation.

Bilirubin: is a pigment removed from the blood by the liver. Low values are of no concern. If slightly elevated above the expected ranges, but with all other enzymes (LDH, GOT, GPT, GGT) within expected values, it is probably a condition known as Gilbert's syndrome and is not significant

CPK is an enzyme which is very useful for diagnosing diseases of the heart and skeletal muscle. This enzyme is the first to be elevated after a heart attack (3 to 4 hours). If CPK is high in the absence of heart muscle injury, this is a strong indication of skeletal muscle disease.

Proteins

Albumin and Globulin measure the amount and type of protein in your blood. They are a general index of overall health and nutrition. Globulin is the "antibody" protein important for fighting disease.

A/G Ratio is the mathematical relationship between the above.

Blood Fats

Cholesterol is a fat-like substance in the blood which, if elevated has been associated with heart disease.

Total Cholesterol: A high cholesterol in the blood is a major risk factor for heart and blood vessel disease. Cholesterol in itself is not all bad, in fact, our bodies need a certain amount of this substance to function properly. However, when the level gets too high, vascular disease can result. A total cholesterol of less than 200, and an LDL Cholesterol of 100 or less is considered optimal by the National Heart, Lung, and Blood Institute. The levels that your doctor will recommend depend upon whether you are at high risk for cardiovascular disease.

As the level of blood cholesterol increases, so does the possibility of plugging the arteries due to cholesterol plaque build-up. Such a disease process is called "hardening of the arteries" or atherosclerosis. When the arteries feeding the heart become plugged, a heart attack may occur. If the arteries that go to the brain are affected, then the result is a stroke.

There are three major kinds of cholesterol, High Density Lipoprotein (HDL) , Low Density Lipoprotein (LDL), and Very Low Density Lipoprotein (VLDL).

LDL Cholesterol is considered "bad cholesterol" because cholesterol deposits form in the arteries when LDL levels are high. An LDL level of less than 130 is recommended, 100 is optimal, values greater than 160 are considered high risk and should be followed up by your physician. Those persons who have established coronary or vascular disease may be instructed by their doctor to get their LDL Cholesterol well below 100. You should ask your doctor which LDL target he or she wants for you. There are two ways to report LDL. The most common is simply an estimate calculated from the Total Cholesterol, HDL, and triglycerides results. This may say "LDL Calc" . A directly measured LDL Cholesterol is usually more accurate, but more expensive and may require that your doctor specify the direct LDL.

HDL cholesterol is a 'good cholesterol' as it protects against heart disease by helping remove excess cholesterol deposited in the arteries. High levels seem to be associated with low incidence of coronary heart disease.

Triglyceride is fat in the blood which, if elevated, has been associated with heart disease, especially if over 500 mg. High triglycerides are also associated with pancreatitis. Triglyceride levels over 150 mg/dl may be associated with problems other than heart disease. Ways to lower triglycerides: 1) weight reduction, if overweight; 2) reduce animal fats in the diet: eat more fish; 3) take certain medications your physician can prescribe; 4) get regular aerobic exercise; 5) decrease alcohol and sugar consumption— alcohol and sugar are not fats, but the body can convert them into fats then dump those fats into your blood stream 6) restrict calories - carbohydrates are converted to triglycerides when eaten to excess.

VLDL (very low density lipoprotein) is another carrier of fat in the blood.

Cardiac Risk Factors

C Reactive Protein (CRP): This is a marker for inflammation. Traditionally it has been used to assess inflammation in response to infection. However we use a highly sensitive C Reactive Protein which is useful in predicting vascular disease, heart attack or stroke.. The best treatment for a high C reactive protein level has not yet been defined, however statin drugs, niacin, weight loss, quitting smoking, and exercise all appear to improve C- Reactive Protein

Homocysteine: Homocysteine is an amino acid that is normally found in small amounts in the blood. Higher levels are associated with increased risk of heart attack and other vascular diseases. Homocysteine levels may be high due to a deficiency of folic acid or Vitamin B12, due to heredity, older age, kidney disease, or certain medications. Men tend to have higher levels. Our lab normals are 4 - 15 micromole/l , but if you have had previous vascular disease we may recommend medications to reduce it below 10. You can reduce your homocysteine level by eating more green leafy vegetables and fortified grain products or cereals. The usual treatment is folic acid with or without Vitamin B-12.

Lipoprotein (a) or Lp(a) : Elevated lipoprotein(a) (Lp[a]) concentrations are associated with premature coronary heart disease (CHD). The exact mechanism is not yet clear, but it appears that there is a strong genetic component to elevated Lp(a) levels that correlates with coronary disease. Persons with diabetes and a high Lp(a) level appear to be at increased risk of asymptomatic coronary disease.

Note that a few insurance companies refuse to pay for cardiac risk factor testing. As of this writing, Aetna stands out as a company that refuses to cover testing for homocysteine or Lp(a) on the basis that it is "experimental" or "investigational". We have asked for a comprehensive review of their policy since it deviates from the norm.

Minerals

Calcium is controlled in the blood by the parathyroid glands and the kidneys. Calcium is found mostly in bone and is important for proper blood clotting, nerve, and cell activity. An elevated calcium can be due to medications such as thiazide type diuretics, inherited disorders of calcium handling in the kidneys, or excess parathyroid gland activity or vitamin D. Low calcium can be due to certain metabolic disorders such as insufficient parathyroid hormone; or drugs like Fosamax or furosemide type diuretics.

Calcium is bound to albumin in the blood, so a low albumin level will cause the total calcium level in the blood to drop. You doctor can easily determine if this is significant or not.

Phosphorus is also largely stored in the bone. It is regulated by the kidneys, and high levels may be due to kidney disease. When low levels are seen with high calcium levels it suggests parathyroid disease, however there are other causes. A low phosphorus, in combination with a high calcium, may suggest an overactive parathyroid gland.

Thyroid

There are 2 types of thyroid hormones easily measurable in the blood, thyroxine (T4) and triiodothyronine (T3). For technical reasons, it is easier and less expensive to measure the T4 level, so T3 is usually not measured on screening tests.

Please be clear on which test you are looking at. We continue to see a tremendous amount of confusion among doctors, nurses, lab techs, and patients on which test is which. In particular, the "Total T3", "Free T3" and "T3 Uptake tests" are very confusing, and are not the same test.

Thyroxine (T4) . This shows the total amount of the T4. High levels may be due to hyperthyroidism, however technical artifact occurs when estrogen levels are higher from pregnancy, birth control pills or estrogen replacement therapy. A Free T4 (see below) can avoid this interference.

T3 Resin Uptake or Thyroid Uptake. This is a test that confuses doctors, nurses, and patients. First, this is not a thyroid test, but a test on the proteins that carry thyroid around in your blood stream. Not only that, a high test number may indicate a low level of the protein! The method of reporting varies from lab to lab. The proper use of the test is to compute the free thyroxine index.

Free Thyroxine Index (FTI or T7) : A mathematical computation allows the lab to estimate the free thyroxine index from the T4 and T3 Uptake tests. The results tell us how much thyroid hormone is free in the blood stream to work on the body. Unlike the T4 alone, it is not affected by estrogen levels.

Free T4 : This test directly measures the free T4 in the blood rather than estimating it like the FTI. It is a more reliable , but a little more expensive test. Some labs now do the Free T4 routinely rather than the Total T4.

Total T3: This is usually not ordered as a screening test, but rather when thyroid disease is being evaluated. T3 is the more potent and shorter lived version of thyroid hormone. Some people with high

thyroid levels secrete more T3 than T4. In these (overactive) hyperthyroid cases the T4 can be normal, the T3 high, and the TSH low. The Total T3 reports the total amount of T3 in the bloodstream, including T3 bound to carrier proteins plus freely circulating T3.

Free T3: This test measures only the portion of thyroid hormone T3 that is "free", that is, not bound to carrier proteins.

Thyroid Stimulating Hormone (TSH) : This protein hormone is secreted by the pituitary gland and regulates the thyroid gland. A high level suggests your thyroid is underactive, and a low level suggests your thyroid is overactive.

Glycohemoglobin (Hemoglobin A1 or A1c, HbA1c) : Glycohemoglobin measures the amount of glucose chemically attached to your red blood cells. Since blood cells live about 3 months, it tells us your average glucose for the last 6 - 8 weeks. A high level suggests poor diabetes control. Standardization for glycohemoglobin from lab to lab is poor, and you cannot compare a test from different labs unless you can verify the technique for measuring glycohemoglobin is the same. The only exception is if your lab is standardized to the national DCCT referenced method. You can ask your lab if they use a DCCT referenced method.

FYI, at Amarillo Medical Specialists we do use a test method that is DCCT referenced.

Hormones

Insulin : Insulin is secreted by the pancreas in response to eating or elevated blood sugar. It is deficient in persons with type 1 diabetes, and present at insufficient levels in persons with type 2 diabetes. The natural evolution of type 2 diabetes causes insulin levels to fall from high levels to low levels over a course of years. Thus insulin levels in persons with type 1 and type 2 diabetes overlap significantly, and insulin levels are not very useful in determining type 1 vs type 2. Insulin levels vary widely from person to person depending upon an individuals insulin sensitivity (or conversely, their insulin resistance.) Insulin levels also vary widely according to when the last meal occurred. Insulin resistance is a risk factor for coronary disease, thus assessing an individual's insulin resistance may have some value using the HOMA-IR calculation. Insulin levels are also elevated in patients with true hypoglycemia, however the interpretation of these levels is difficult. Insulin levels, when measured by itself at a random time is rarely useful.

C-peptide : This is a fragment cleaved off of the precursor of insulin (pro-insulin) when insulin is manufactured in the pancreas. C-peptide levels usually correlate with the insulin levels, except when people take insulin injections. When a patient is hypoglycemic, this test may be useful to determine whether high insulin levels are due to excessive pancreatic release of insulin, or from an injection of insulin.

Estradiol : This is the most commonly measured type of estrogen measured. In women it varies according to their age, and whether they are having normal menstrual cycles. Hormone levels are also changed when taking birth control pills or estrogen replacement.

Complete Blood Count (CBC)

The CBC typically has several parameters that are created from an automated cell counter. These are the most relevant:

White Blood Count (WBC) is the number of white cells. High WBC can be a sign of infection. WBC is also increased in certain types of leukemia. Low white counts can be a sign of bone marrow diseases or an enlarged spleen. Low WBC is also found in HIV infection in some cases. (ed. note: The vast majority of low WBC counts in our population is NOT HIV related.)

Hemoglobin (Hgb) and Hematocrit (Hct) : The hemoglobin is the amount of oxygen carrying protein contained within the red blood cells. The hematocrit is the percentage of the blood volume occupied by red blood cells. In most labs the Hgb is actually measured, while the Hct is computed using the RBC measurement and the MCV measurement. Thus purists prefer to use the Hgb measurement as more reliable. Low Hgb or Hct suggest an anemia. Anemia can be due to nutritional deficiencies, blood loss, destruction of blood cells internally, or failure to produce blood in the bone marrow. High Hgb can occur due to lung disease, living at high altitude, or excessive bone marrow production of blood cells.

Mean Corpuscular Volume (MCV) - This helps diagnose a cause of an anemia. Low values suggest iron deficiency, high values suggest either deficiencies of B12 or Folate, ineffective production in the bone marrow, or recent blood loss with replacement by newer (and larger) cells from the bone marrow.

Platelet Count (PLT) : This is the number of cells that plug up holes in your blood vessels and prevent bleeding. High values can occur with bleeding, cigarette smoking or excess production by the bone marrow. Low values can occur from premature destruction states such as Immune Thrombocytopenia (ITP), acute blood loss, drug effects (such as heparin) , infections with sepsis, entrapment of platelets in an enlarged spleen, or bone marrow failure from diseases such as myelofibrosis or leukemia. Low platelets also can occur from clumping of the platelets in a lavender colored tube. You may need to repeat the test with a green top tube in that case.

Urinalysis

Urine tests are typically evaluated with a reagent strip that is briefly dipped into your urine sample. The technician reads the colors of each test and compares them with a reference chart. These tests are semi-quantitative; there can be some variation from one sample to another on how the tests are scored.

pH : This is a measure of acidity for your urine.

Specific Gravity (SG) : This measures how dilute your urine is. Water would have a SG of 1.000 . Most urine is around 1.010, but it can vary greatly depending on when you drank fluids last, or if you are dehydrated.

Glucose: Normally there is no glucose in urine. A positive glucose occurs in diabetes. There are a small number of people that have glucose in their urine with normal blood glucose levels, however any glucose in the urine would raise the possibility of diabetes or glucose intolerance.

Protein: Normally there is no protein detectable on a urinalysis strip. Protein can indicate kidney damage, blood in the urine, or an infection. Up to 10% of children can have protein in their urine. Certain diseases require the use of a special, more sensitive (and more expensive) test for protein called a microalbumin test. A microalbumin test is very useful in screening for early damage to the kidneys from diabetes, for instance.

Blood: Normally there is no blood in the urine. Blood can indicate an infection, kidney stones, trauma, or bleeding from a bladder or kidney tumor. The technician may indicate whether it is hemolyzed (dissolved blood) or non-hemolyzed (intact red blood cells). Rarely, muscle injury can cause myoglobin to appear in the urine which also causes the reagent pad to falsely indicate blood.

Bilirubin: Normally there is no bilirubin or urobilinogen in the urine. These are pigments that are cleared by the liver. In liver or gallbladder disease they may appear in the urine as well.

Nitrate: Normally negative, this usually indicates a urinary tract infection.

Leukocyte esterase: Normally negative. Leukocytes are the white blood cells (or pus cells). This looks for white blood cells by reacting with an enzyme in the white cells. White blood cells in the urine suggests a urinary tract infection.

Sediment: Here the lab tech looks under a microscope at a portion of your urine that has been spun in a centrifuge. Items such as mucous and squamous cells are commonly seen. Abnormal findings would include more than 0-2 red blood cells, more than 0-2 white blood cells, crystals, casts , renal tubular cells or bacteria. (Bacteria can be present if there was contamination at the time of collection.)

What Does Your Blood Test Mean?

Glucose: This is the chief source of energy for all living organisms. A level greater than 105 in someone who has fasted for 12 hours suggests a diabetic tendency. If this level is elevated even in a non-fasting setting one must be concerned that there is a risk for developing diabetes. This is an incredibly powerful test and can predict diabetes ten years or more before one develops the strict definition of diabetes which is levels greater than 120.

Sodium: This element plays an important role in salt and water balance in your body. A low level in the blood can be caused by too much water intake, heart failure, or kidney failure. A low level can also be caused by loss of sodium in diarrhea, fluid or vomiting. A high level can be caused by too much intake of salt or by not enough intake of water.

Potassium and Magnesium: These elements are found primarily inside the cells of the body. Low levels in the blood may indicate severe diarrhea, alcoholism, or excessive use of water pills. A very low level of magnesium in the blood can cause your muscles to tremble. Low potassium levels can cause muscle weakness and heart problems.

Chloride: Is an electrolyte controlled by the kidneys and can sometimes be affected by diet. An electrolyte is involved in maintaining acid-base balance and helps to regulate blood volume and artery pressure. Elevated levels are related to acidosis as well as too much water crossing the cell membrane.

BUN (Blood Urea Nitrogen): BUN is a waste product derived from protein breakdown in the liver. Increases can be caused by excessive protein intake, kidney damage, certain drugs, low fluid intake, intestinal bleeding, exercise, heart failure or decreased digestive enzyme production by the pancreas. Decreased levels are most commonly due to inadequate protein intake, malabsorption, or liver damage.

Creatinine: Creatinine is also a protein breakdown product. Its level is a reflection of the bodies muscle mass. Low levels are commonly seen in inadequate protein intake, liver disease, kidney damage or pregnancy. Elevated levels are generally reflective of kidney damage and need to be monitored very carefully.
Uric Acid: Uric acid is the end product purine metabolism. High levels are seen in gout, infections, high protein diets, and kidney disease. Low levels generally indicate protein and molybdenum (trace mineral) deficiency, liver damage or an overly acid kidney.

Phosphate: Phosphate is closely associated with calcium in bone development. Therefore most of the phosphate in the body is found in the bones. But the phosphate level in the blood is very important for muscle and nerve function. Very low levels of phosphate in the blood can be associated with starvation or malnutrition and this can lead to muscle weakness. High levels in the blood are usually associated with kidney disease. However the blood must be drawn carefully as improper handling may falsely increase the reading.

Calcium: Calcium is the most abundant mineral in the body. It is involved in bone metabolism, protein absorption, fat transfer, muscular contraction, transmission of nerve impulses, blood clotting, and heart function. It is highly sensitive to elements such as magnesium, iron, and phosphorous as well as hormonal activity, vitamin D levels, CO_2 levels and many drugs. Diet, or even the presence of calcium in the diet has a lot to do with "calcium balance" - how much calcium you take in and how much you lose from your body.

Albumin: The most abundant protein in the blood, it is made in the liver and is an antioxidant that

protects your tissues from free radicals. It binds waste products, toxins and dangerous drugs that might damage the body. Is also is a major buffer in the body and plays a role in controlling the precise amount of water in our tissues. It serves to transport vitamins, minerals and hormones. The higher this number is, the better. The highest one can reasonably expect would be 5.5.

Alkaline Phosphatase: Alkaline phosphatase is an enzyme that is found in all body tissue, but the most important sites are bone, liver, bile ducts and the gut. A high level of alkaline phosphatase in your blood may indicate bone, liver or bile duct disease. Certain drugs may also cause high levels. Growing children, because of bone growth, normally have a higher level than adults do. Low levels indicate low functioning adrenal glands, protein deficiency, malnutrition or more commonly, a deficiency in zinc.

Transaminases (SGTP) & (SGOT): These are enzymes that are primarily found in the liver. Drinking too much alcohol, certain drugs, liver disease and bile duct disease can cause high levels in the blood. Hepatitis is another problem that can raise these levels. Low levels of GGTP may indicate a magnesium deficiency. Low levels of SGPT and SGOT may indicate deficiency of vitamin B6.

Gamma-Glutamyltranserase (GGTP): Believed to be involved in the transport of amino acids into cells as well as glutathione metabolism. Found in the liver and will rise with alcohol use, liver disease, or excess magnesium. Decreased levels can be found in hypothyroidism and more commonly decreased magnesium levels.

Lactate Dehydrogenase (LDH): LDH is an enzyme found in all tissues in the body. A high level in the blood can result from a number of different diseases. Also, slightly elevated levels in the blood are common and usually do not indicate disease. The most common sources of LDH are the heart, liver, muscles, and red blood cells.

Total Protein: This is a measure of the total amount of protein in your blood. A low or high total protein does not indicate a specific disease, but it does indicate that some additional tests may be required to determine if there is a problem.

Iron: The body must have iron to make hemoglobin and to help transfer oxygen to the muscle. If the body is low in iron, all body cells, particularly muscles in adults and brain cells in children, do not function up to par. If this test is low you should consider getting a Ferritin test, especially if you are a female who still has menstrual cycles.

Triglycerides: These are fats used as fuel by the body, and as an energy source for metabolism. Increased levels are almost always a sign of too much carbohydrate intake. Decreased levels are seen in hyperthyroidism, malnutrition and malabsorption.

Cholesterol: Group of fats vital to cell membranes, nerve fibers and bile salts, and a necessary precursor for the sex hormones. High levels indicate diet high in carbohydrates/sugars. Low levels indicate low fat diet, malabsorption, or carbohydrate sensitivity.

HDL/LDL: LDL is the "bad cholesterol", which carries cholesterol for cell building needs, but leaves behind any excess on artery walls and in tissues. HDL is the "good cholesterol" which helps to prevent narrowing of the artery walls by removing the excess cholesterol and transporting it to the liver for excretion. A low HDL percentage frequently indicates diets high in refined carbohydrates and/or carbohydrate sensitivity.

CO2: The CO2 level is related to the respiratory exchange of carbon dioxide in the lungs and is part of the bodies buffering system. Generally, when used with the other electrolytes, carbon dioxide levels indicate pH or acid/alkaline balance in the tissues. This is one of the most important tests that we measure. Most people have too much acid in their body. If you garden you will know that it is very difficult to grow plants in soil where the pH is incorrect. Our blood is similar to soil in many respects and it will be difficult to be healthy if our body's pH is not well balanced.

WBC: White blood count measures the total number of white blood cells in a given volume of blood. Since WBCs kill bacteria, this count is a measure of the body's response to infection.

Hemoglobin: Hemoglobin provides the main transport of oxygen and carbon in the blood. It is composed of "globin", a group of amino acids that form a protein and "heme", which contains iron. It is an important determinant of anemia (decreased hemoglobin) or poor diet/nutrition or malabsorption.

Hematocrit: Hematocrit is the measurement of the percentage of red blood cells in whole blood. It is an important determinant of anemia (decreased), dehydration (elevated) or possible overhydration (decreased).

MCV: This measures the average size of the red blood cells and their volume. These components together can indicate iron deficiency anemia (decreased), B12/folate deficiency anemia (increased), or rheumatoid arthritis (decreased).

These comments are made for the purpose of discussion and should NOT be used as recommendations for or against therapies or other treatments. An individual patient is always advised to consult their own physician.

Grouped Together Platelets [posted 11/11/98]
Question: The results of my blood test have just come back. They say everything seems O.K but that my "platelets are grouped together". The Doctor says this is nothing to worry about but I have been feeling very tired now for a few months - could this be linked?

Answer: Not unless your serum protein levels are high, probably no relationship.

White Blood Count Concerns [posted 11/11/98]
Question: I just found out that I have a low WBC count. What is this a sign of?

Answer: Depends on how low and if it is sustained. Many things can cause this and it will need to be evaluated if persistently below 3000 or so. Certainly below 1000.

White Blood Count Concerns [posted 11/6/98]
Question: I am a 41 year old female in excellant health, low blood pressure and weigh 118 lbs. at 5'6". Three days ago I experienced abdominal pain, mostly lower right side, had no appetite and felt weak. Had a tempurature of 99 up to 101. My normal temperature is 97.8. I also had back lower back pain on both sides. Went to my gyn. on the third day, he did an ultrasound and ordered a blood work-up. He found two cysts on my right ovary but thought there was something else wrong because of my symptoms. He called me on the 4th day to tell me my white count was through the roof and sent me for an ultrasound of my appendix and consult with a surgeon. Nothing out of the ordinary with the ultrasound but the surgeon informed me my blood count was over 18,000. I do feel somewhat better, have an appetite and no more fever. What should be my next move? I asked the doctor to prescribe another blood test to see what mt count is today, now that I know I no longer have a fever and feel better, he said it wasn't a bad idea, but my husband thinks it's not nessecary. Any suggestions on what it could be?

Answer: An elevated white blood count only shows some type of inflammation. It will not give the answer. Serial exams with the md would be my recommendation.

Low White Blood Count Concerns [posted 11/5/98]
Question: My boyfriend is 24 and just had his blood taken and they told him that his WBC coount is low. Is this something that he should be concerned with or not worry about? He is going back in to get his blood taken again. He is in good health. He takes multi-vitamin and antioxidants. I am not sure but I do not hink this is something that runs in the family. Thank you for your time.

Answer: Depends on how low and if it persists. Usually counts excede 4000, occasional patients will be down to 2000. It also depends on the differential;that is, what is low of the white cells. I need some more information.

Red Blood Count [posted 10/19/98]
Question: My son has had a blood test taken as part of his college physical. The doctor said he had a high red blood cell count and has asked him to take another blood test. He is a football player and weight lifter but has not taken steriods. He has tried androsteine but that was over a year ago. What could a high red cell mean and how can it be treated. We are continuing to see the doctor, but I'd like to do a little investigating on my own.

Answer: Would depend on how high. If over 50 is very bothersome. Young men often get to the high 40s due to their level of testerone-but, shouldn't be over 50. A red cell mass should be done in nuclear medicine to see his actual red cell mass-this is the first step in diagnosing his problem. One would be suspicious of someone who has taken steroids that they are taking they again and causing the problem.

High Red Blood Count [posted 8/14/98]
Question: I recently had some blood tests done and the results came in saying I have high rbc. What does this mean? I know rbc means Red Blood Count, but what does it mean if it is high?

Answer: Probably nothing unless your count is a hematocrit much above 48 or so. High counts can cause strokes, etc., and can be a marker for polycythemia vera. However, this is always above a Hct of 50. What is your Hct?

White Blood Cell Count [posted 8/11/98]
Question: My white blood cell count came back at about 21.5, and normal is around 11. Does this imply anything besides leukemia? Is 21.5 possibly a spike, fighting off flu, or because it is high, if repeated in another test, should that mean go to a bone marrow test automatically? Will a blood test indicate if it's chronic or quick?

Answer: Possibly an infection, but pretty high for a simple infection. Re-check it in 3 weeks, but I'd keep a close eye on this. Are the white cells lymphocytes, neutrophils, etc. Are there any immature forms or blasts? These are all important questions.

Low White Blood Cell Count [posted 8/5/98]
Question: What are the reason for a below normal white blood cell count in a 14 year old male? Can it be caused by a virus such as the flu? Are there any life treating illnesses indicated by this?

Answer: Viral syndromes are notorious for causing low white blood cell counts. Simply repeat the test about 10 days later. There are numerous causes of low counts. 5% of individuals are low by definition (the counts are based on 95% of the population). I'd simply recheck it before getting too concerned.

White Blood Cell Count
Question: Please tell me what it means if one's white blood cell count is slightly high?

Answer: It can mean several things depending on the height of the blood count and the type of cells that are elevated. Many inflammatory conditions can elevate one's blood count and this is normal under certain stresses. Infections of virus, bacteria etc., are the most common and these pass after a couple of weeks. Disorders of blood production can produce elevated white counts. These are usually accompanied by unusual cells(blasts, etc.) In the blood count. First of all recheck the count 4 weeks or so after the first count (or after any infection clears). If the count is above 15 thousand this is very unusual. It is common to have counts to 15,000 and it is usually not even elevated until 10,000.

White blood cell count
Question: My white blood cell count has been consistently below normal range. The most recent reading

was 3.6. Last year, at this time, it was 4.1. I have two aunts that apparently have the same condition. They also have consistently low to below normal white blood cell counts. However, they cannot remember the name of the syndrome. What is the name of this syndrome and should I be concerned?

Answer: There are several syndromes that can produce low white cell counts. However, if it runs in your family I would not be to concerned. A more critical question is the differential count. That is, are all the white cells represented or is one type absent or decreased. This is the key to the problem.

Blood Amount
Question: How many gallons of Blood does the body have?

Answer: 60% of body mass is fluid. About 20% is extracellular. So, for a 150 lb. adult, about 9 lbs are blood. One pound = one pint.

My father has had a CEA blood test after surgery for a colon cancer. The doctor is very pleased as the level is below 1. He says that my father is now cured. Why are they testing his blood and does this really mean that he is cured?The initials CEA stand for carcinoembryonic antigen. Over thirty years ago it was discovered that levels of this protein were raised in the blood of some patients with bowel cancer. There was hope that measuring the CEA level might become a way of testing for the presence of bowel cancer.

Further research showed that the level could be raised in the presence of some other cancers, such as ovarian cancer or cancer of the pancreas, and also in some non-cancerous bowel diseases. Also it was discovered that some people with bowel cancer did not have a raised CEA level.

Having realised it was not a reliable test to make the initial diagnosis of bowel cancer doctors then wondered if it could be used to monitor people who had had surgery for bowel cancer, to check whether the condition was cured. Some careful clinical trials showed that although a rising level of CEA in the blood might help to detect the return of the cancer in some patients this did not influence the outcome of treatment and did not benefit the patient. Other trials have suggested a possible survival advantage from measuring CE

There is thus conflicting evidence and this is an area where there are international differences of opinion. Current national guidelines in the UK for the management of large bowel cancer do not recommend routine monitoring of CEA levels after surgery, but in the United States at least one set of authoritative guidelines feels that CEA measurement may be of value and has recommended that it be checked every three months after surgery.

This difference of opinion clearly shows that there is still some uncertainty regarding the usefulness of CEA monitoring. Consequently some doctors still like to do CEA checks as they feel that at least a normal level gives them, and their patients, some reassurance that the cancer has not returned.

Unfortunately, however, a normal CEA level is not a guarantee that the cancer has not come back, nor does it prove that the cancer will not come back. This means that a normal CEA level cannot be used to say that a cancer is cured.

Glucose: this is the main source of energy for all living organisms. A glucose level greater than 120 in a person, who has fasted (hasn't eaten anything) for 12 hours, may suggest a diabetic tendency. This is a very useful test that can predict diabetes years before a person may develop the actual disease.

Sodium: sodium plays an important role in salt and water balance in your body. A low level of sodium in the blood can be caused by too much water intake, heart failure, or kidney failure.

Creatinine: Creatinine is a product in the blood that occurs from protein breaking down. The level of creatinine in the body is an indicator of the body's muscle mass. Low levels may be due to low protein intake, liver disease, kidney damage or pregnancy. Elevated levels are generally due to kidney damage

and need to be monitored carefully.

Iron: iron is important for red blood cell production in the body. The body needs iron to make hemoglobin. Hemoglobin helps transfer oxygen from the lungs to your muscles and tissues. If the body does not have enough iron, all the cells in the body do not function well. If you have low iron, you may need a Ferritin test, especially if you are female and are still menstruating.

Cholesterol: cholesterols are a group of fats that are vital to the body. High levels, however, indicate a diet that is too high in carbohydrates, particularly sugars. High levels of cholesterol over time can lead to heart disease.

Most foods contain carbohydrates (carbohydrates include sugars, fibers, and starches.) Carbohydrates come from a wide variety of foods--including beans, milk, popcorn, bread, potatoes, cookies, spaghetti, and cherry pie--but these foods don't all contain the same type of carbohydrate. Carbohydrates are a necessary part of a healthy diet because they provide the body with the energy it needs for physical activity and to keep organs functioning properly. When there are too many carbohydrates in your body, more energy than you can use from your food, they settle into the body as higher levels of fats.

Low levels of cholesterol indicate a low-fat diet, or malabsorption of fat. Amount of blood drawn = 4 milliliters (equals 1 and 1/3 teaspoons)

HDL/LDL: HDL is a "good" cholesterol that helps to remove excess cholesterol from the body. LDL is a "bad" cholesterol that carries cholesterol to the cell, but leaves behind excess cholesterol on the artery walls and tissues. High LDL and low HDL levels indicate diets high in refined carbohydrates. Amount of blood drawn: 4 milliliters (equals 1 and 1/3 teaspoons)

White blood cells (WBC): white blood count measures the total number of white blood cells in a given volume of blood. Because white blood cells kill bacteria, this count is a measure of the body's response to infection.

Hemoglobin: hemoglobin transports oxygen and carbon in the blood. Low hemoglobin levels indicate the presence of anemia or poor diet and nutrition.

Lipid Profile: a group of tests that are often ordered together to determine risk of coronary heart disease. They usually measure triglycerides, cholesterols and glucose. Triglycerides are the principal form of fats, circulating in your blood stream. Most of your body fat comes in this form. Triglycerides are derived from two sources: 1) from the foods you eat, mainly sugar, animal products and saturated fats and, 2) from the liver itself. Cholesterols are also fats, mostly produced by your liver and from foods eaten. Glucose (sugar) levels in your blood are also usually measured in a Lipid Profile.

A key element to taking control over your health is learning to monitor your immune system. The bulk of immune monitoring is done through a variety of blood tests. Learning to read and understand your laboratory tests can be quite frustrating. This article will provide the basic information to help with this process. Because different labs report results a little differently, it may be wise to ask your primary health care provider to help you read your results as well.
There are some basic rules which hold true for nearly all laboratory tests:

1. Different laboratories can get different results on the same sample of blood. Make sure you ask your primary health care provide which lab was used if it is not noted on the report.

2. Laboratories can make mistakes. if your results have changed dramatically form your previous test, have it run again.

3. Most lab values need to be interpreted along with other clinical and laboratory data in order to develop a meaningful diagnosis. Very seldom will only one value give all of the answers.

4. Laboratory values differ according to age, sex, current medications, etc. Therefore, the interpretation of these values needs to be done with these other parameters in mind.

5. The "normal" range is the value that is normal for a person who does not have HIV. For example, a low cholesterol value in an HIV infected individual in not uncommon

CBC - The Complete Blood Count (CBC) is one of the most common tests ordered by a provider. It is a routine test used to evaluate the blood and general health. Asymptomatic, HIV positive individuals should have this test done twice a year. Symptomatic individuals should have their CBC done at least every three months. Additionally, if you are on antivirals or other medications you might need to have this test done more often. A CBC measures all the following parameters: red blood cell count (RBC), white blood cell count (WBC), hemoglobin, hematocrit, three red cell indices, and the white cell differential. Platelet counts are sometimes included in a CBC.

RBC Count - The RBC count is the number of RBCs in a cubic millimeter of blood. The RBCs are the cells produced in the bone marrow that carry oxygen to your tissues. The normal range is 4.5- 5.9 million/mm3 for men and 4.0-5.3 million/mm3 for women. a slight decreased value is not cause for alarm as many individuals with HIV infection have values below the normal range. However, a markedly decreased value should be thoroughly investigated. A person with a significantly low RBC count can have symptoms of fatigue, shortness of breath, and appear pale in color. A low RBC count can be due to progressive HIV illness or to certain medications or both. AZT, for example, can suppress the production of RBCs in some individuals. A decrease in the RBC count usually causes a decrease in the hemoglobin and hematocrit values.

WBC Count - The WBC count is the number of WBCs in a cubic millimeter of blood. The primary function of these cells is to prevent and fight infections. There are many different types of white blood cells that play specific roles in fight infections. These specific types of WBCs can be measured in the white cell differential. Normal WBC count is from 4,500 to 1,000. The WBC count can be decreased for a variety of reasons: certain medications decease the production of WBCs in the bone marrow, minor viral infections which you may not even be aware of, stress, and opportunistic infections. Values markedly decreased should be cause for concern, since during this situation one is more susceptible to other infections.

Hemoglobin - Oxygen is carried to the tissues via hemoglobin in the RBC. A normal hemoglobin level is 14.0-18.0 g/dl for men and 12.0-16.0 g/dl for women. A slow, progressive decline in hemoglobin is often seen in people with AIDS. This is usually due to a decline in the number of RBCs produced in the bone marrow. Any drug which causes a suppression of the bone marrow, will decrease the hemoglobin level. In most cases it's a matter of balancing the effects of the drug with its potential side effects. When the side effects become too great, either the drug must be removed or the dose reduced to a tolerable level. A drug which mimics the action of the hormone erythropoietin (AKA Procrit, EPO and other names), has its effect on the bone marrow causing the production of new RBCs. It has provided great relief to thousands of individuals with HIV infection and kidney dialysis patients. Erythropoietin has enabled many people to stay on bone marrow suppressive drugs without the need for transfusions.

Hematocrit - The hematocrit is the percent of the cellular components in your blood to the fluid or blood plasma. This test is one of the truest markers of anemia. Normal values for men are 40- 54% and for women 37-47%. A decrease in hematocrit is always seen with a decrease in the hemoglobin. These two values are linked to one another.

MCV - The mean cell volume or MCV is the most important of the RBC indices. It is a measure of the average size of the RBC. For those individuals taking AZT, the MCV will always be normally elevated, i.e. greater than 100. Vitamin B12 and Folic Acid deficiencies also cause increases in MCV. Normal MCV levels are 80-96.

The other 2 indices are not so important. They are the MCH and the MCHC and are used to help diagnose various anemias and leukemias.

Platelets - Platelets are cellular fragments which are necessary for the blood to clot. When activated by "trauma," platelets migrate to the site of injury where they become "sticky," adhering to the injured site and subsequently used in the developing fibrin clot (scab). Normal platelet values are 150,000-350,000. In some individuals, HIV infection itself causes a decrease in the number of platelets. Otherwise, drugs can also cause low platelet counts. Even though counts are considered low below 150,000, most people can survive without the threat of internal bleeding with counts above 50,000. On very rare occasions, the number of platelets present are adequate, but for unknown reasons they don't function correctly. Any malady involving ones platelets can be a potentially serious condition.

White Cell Differential - The white cell differential counts 100 white cells and differentiates them by type. This gives a percent of the different kinds of white cells in relation to one another. The three main types are: polymorphonuclear cells (or PMNs), lymphocytes, and monocytes. PMNs are increased during bacterial infections while lymphocytes are decreased with viral infections. Increased monocytes are sometimes seen in chronic infections. normal percent of PMNs is 55-80%. 25-33% is the normal number of lymphocytes, and 3-7% is normal for monocytes.

There are a wide range of blood chemistry tests which are done on individuals either routinely or for a specific reason. Some of the ones pertaining to HIV infection are mentioned below.

Cholesterol - Cholesterol levels, as mentioned earlier, are routinely decreased in HIV positive individuals. It's not understood why this occurs, but is thought to be related to altered metabolism. normal cholesterol levels are 150-250 mg/dl.

Amylase - amylase is an enzyme that is secreted in the mouth by the salivary glands and also in the pancreas. It can be an early warning sign of acute Pancreatitis when elevated. ddI can cause problems with the pancreas in a small number of patients taking the drug. Normal amylase levels are 25-125 milliunits/ml.

CPK - CPK or CK is an enzyme that's found in the brain and the muscles of the body. Strenuous exercise as well as a heart attack can cause increases in CPK. This makes clear the point of evaluating an abnormal test result in the context of other factors. Myopathy, dysfunction/distress with the muscles, can sometimes be confirmed with an elevated CPK. Myopathy is usually caused by HIV but can also be due to AZT, especially at higher dosages. Normal levels of this enzyme are 12-80 milliunits/ml (30 degrees) or 55-170 milliunits/ml (37 degrees). Values will be slightly lower for women.

Liver function Tests - Liver Function Tests include 5-6 individual tests which collectively can help determine the status of ones liver. elevated liver enzymes are most often caused by certain medications. The HIV infected population also has a high prevalence of hepatitis. at least 4 different viruses are known to cause hepatitis, all leading to increased liver function tests. Therefore compound factors can be at work. If liver enzymes are only moderately elevated, most providers will take a "wait and see" attitude, monitoring them over a period of a few weeks to a few months. However, if the elevation is quite high, the underlying factor must be found. this might very well be one of the medications that you're currently taking. The names of these liver function tests include SGOT, SGPT, alkaline phosphate, total bilirubin and LDH.

Kidney Functions - Two tests which measure kidney function are the BUN and Creatinine. The usefulness of these tests in an HIV infected individual usually relates to medications possibly toxic to the kidneys. Hence kidney function is monitored in this way. Foscarnet is an example of a drug which can cause renal toxicity. Normal BUN levels are 10-20 mg/dl. Normal levels of creatinine are 0.6-1.2 mg/dl.

Lymphocyte subsets - The category of lymphocyte subsets includes absolute counts and percentages of CD4 and CD8 cells as well as other parameters. Usually the number and percent of B cells is included and the number and percent of all lymphocytes (except those called "natural killer" or NK cells). Lymphocytes are broken down mainly into T and B cells. T cells are further divided into CD4(+) cells and CD8(+) cells. It is well known that HIV infection causes a slow, progressive decline in the number

and percent of CD4(+) cells in most individuals. There are exceptions. Some individuals progress in their disease very rapidly and others don't seem to progress much at all after more than 12 or 13 years of infection. Normal CD4 counts are 400-1500. The role of CD8 cells is less clearly understood. Early on in the epidemic, high CD8 cell counts caused inversion of the CD4:CD8 ratio and was thought to adversely affect illness. Now it is generally believed that elevated CD8 cell counts are advantageous in the HIV positive individual as it's thought to indicate the body's ability to keep HIV somewhat constrained. Normal CD8 cell counts in an HIV negative individual are 275-780. How CD8 cells are beneficial is still being investigated.
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BLOOD TEST REFERENCE RANGE CHART

Test	Reference Range (conventional units*)
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	8.5 - 10.5 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	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

Liver Function Tests	Tests include bilirubin (total), phosphatase (alkaline), protein (total and albumin), transaminases (alanine and aspartate), prothrombin (PTT) Please click each to view an individual test value.
Magnesium	1.5 - 2.0 mEq/L
Mean Corpuscular Hemoglobin (MCH)	27 - 32 pg/cell
Mean Corpuscular Hemoglobin Concentration (MCHC)	32 - 36% hemoglobin/cell
Mean Corpuscular Volume (MCV)	76 - 100 cu µm
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 - 5.0 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/µL/cu mm
Sodium	135 - 145 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
White Blood Cell Count (WBC)	4,300 - 10,800 cells/µL/cu mm

*Please visit our measurement and abbreviation pages.