

FLORY ISABEL AGUILAR, M.D.

HOAG HEALTH CENTER IRVINE

4870 BARRANCA PARKWAY SUITE 220 • IRVINE CA 92604

PHONE: 949.552.4622 • FAX: 949.552-4622 • WWW.FAMILYDR.COM

LABORATORY EXPLANATION

These laboratory explanations are intended to act as a guide to assist you in understanding your laboratory test results. These results are useful in screening for various conditions and in establishing a baseline for each individual.

The normal ranges, however, are not absolute. For example, a mildly abnormal result does not necessarily indicate a problem, since this may be normal for you. Follow-up is usually suggested to determine whether or not a medical condition exists. Also, a normal result does not necessarily mean that a medical problem is not present, since laboratory tests in early stages of diseases may be normal. On the other hand, laboratory test abnormalities may be the first sign of a medical problem and allow earlier detection and, therefore, treatment before serious illness develops.

Blood Chemistry Tests

Glucose: This is a blood sugar test. Elevated fasting glucose levels may indicate a diabetic or pre-diabetic condition. A low glucose level may indicate too much insulin in the blood (although it can sometimes be a laboratory artifact secondary to improper processing of the blood after it is drawn). Any abnormal glucose level should be further evaluated by a physician.

Uric Acid: Uric acid is the end product of the breakdown of a component of protein in the body. Elevated uric acid levels may cause gout or kidney stones; however, the uric acid may also be elevated by a high protein diet, alcohol, certain diuretics and stress. Asymptomatic elevations of the uric acid level do not normally require treatment but elevated levels should be monitored periodically.

Phosphate: Phosphate is a mineral involved in bone development (along with calcium), but is also important for nerve and muscle function. Elevated levels of phosphorus may be seen in patients with kidney disease (but may also be a laboratory artifact secondary to improper handling of the blood after it was drawn). Low levels may be seen in patients with malnutrition and may cause muscle weakness.

Calcium: Calcium is the most abundant mineral in the body especially in the bones. Elevated calcium levels may be caused by bone or disease of the parathyroid gland (hyperparathyroidism) & excessive intake of antacids, milk, & vitamin D. Low levels may be caused by lack of exposure to sunlight, malnutrition, or by decreased kidney or parathyroid function. Calcium levels are usually inversely related to phosphate levels.

Magnesium: Magnesium is an element required for the activity of many enzymes. Low magnesium levels may be associated with malnutrition, diarrhea, alcoholism, diuretic use & various metabolic disorders.

Alkaline Phosphatase: Alkaline phosphatase is an enzyme mainly found in the liver & bones. Elevated levels may therefore be seen in diseases of the bones & liver although

certain medications & bone growth (in children & adolescents) may also cause this enzyme to be elevated.

LDH (Lactate Dehydrogenase): LDH is an enzyme found in all tissues of the body especially in the heart, liver, muscles & red blood cells. Therefore, it is a nonspecific enzyme that may be elevated in many different conditions. Mildly elevated levels, especially if the other enzyme levels are normal, are quite common & usually clinically insignificant.

GGT and SGPT (ALT): The GGT (gamma-glutamyl transpeptidase) and SGPT (serum glutamic pyruvate transaminase) (also called ALT or alanine amino-transferase) are enzymes specific to the liver. Therefore, elevations of these enzymes may be associated with liver disease, alcohol use, or side effects of certain medications; elevated liver enzymes may also be caused by viral infections.

SGOT: SGOT (serum glutamic oxaloacetic transaminase) (also called AST or aspartate amino-transferase) is another enzyme in the liver but is also present in the heart & muscles. Therefore, elevations of this enzyme may be associated with diseases involving these tissues.

Bilirubin (Total): Bilirubin is a breakdown product of pigments in the red blood cells. Elevated levels may be caused by excessive breakdown of the red blood cells, by liver or gallbladder disease, or sometimes by fasting. However, elevated bilirubin levels are also elevated in a benign congenital condition known as Gilbert's Disease, characterized by abnormal bilirubin metabolism with a high total & indirect bilirubin, and a near normal or low direct bilirubin.

Bilirubin (Direct): Direct bilirubin is the specific form of bilirubin that has been taken up by the liver and is excreted in the bile; normally only small amounts are found in the blood. Therefore, elevated direct bilirubin levels usually indicate some type of liver abnormality. Elevated total bilirubin levels but low or near normal direct bilirubin levels usually indicates a benign abnormality in bilirubin metabolism (e.g. Gilbert's Disease- see *Total Bilirubin* above).

Iron: This is a measure of the iron stores in the body. Low levels may result in anemia. Significantly elevated levels may result in a condition known as hemo-chromatosis in which there is an increase in the iron stores in the body secondary to excessive intestinal absorption of iron.

BUN (Blood Urea Nitrogen and Creatinine): These tests are measures of kidney function. Elevated levels of both tests usually indicate an abnormality of kidney function. Elevated BUN levels alone may occur secondary to dehydration or blood loss; low levels may be caused by liver disease, malnutrition or pregnancy. Mildly elevated creatinine levels may be seen in athletes or other muscular individuals; low levels may be found in individuals with reduced muscle mass.

Total Protein: This is a measure of the total amount of protein in the blood and is the sum of the albumin and globulin protein levels. Significantly elevated levels may indicate many various conditions and should be followed up by a physician. Low levels may suggest malnutrition, or liver or kidney disease.

Albumin: Albumin is a major protein in the blood & is partly responsible for maintaining proper amounts of water & pressure in the blood vessels; it also serves as a transport protein. Elevated levels are often caused by dehydration. Low levels may be caused by malnutrition, liver or kidney disease, or burns.

Globulin: The globulin proteins in the blood include the antibodies and therefore fight infection; some globulins also are involved in blood clotting. Minor variations in these levels are common but if more significant variations are present, the individual globulin protein levels should be measured.

Sodium: Sodium is a body salt (electrolyte) that is involved in salt and water balance in the body. Elevated levels may be caused by dehydration or excessive salt intake. Low levels may be caused by excessive water intake, kidney disease, diseases of the adrenal gland and heart failure.

Potassium: Potassium is another body salt (electrolyte) that is found primarily inside cells. It is particularly important in transmitting nerve impulses and in muscle cell function. Low potassium levels may be secondary to decreased potassium intake, diuretics, or gastrointestinal loss (especially vomiting and diarrhea). Elevated levels are often caused by kidney disease or excessive potassium intake (especially from supplements) but may also be found after prolonged fasting or secondary to the breakdown of blood cells after the blood was drawn (in this latter case it is considered a laboratory defect).

Chloride: Chloride is another body salt whose level may be affected by various conditions. Significant abnormalities usually occur in conjunction with abnormalities in the sodium or potassium levels. Minor abnormalities are common, however, and probably clinically insignificant.

Prostate Specific Antigen (PSA) [Males Only]: The PSA is a protein produced by the prostate gland. In general, the PSA level increases as the prostate gland enlarges; tumors may produce marked levels of prostate antigen. The normal value is 0.5 to 4.0 (value less than 0.5 are also considered normal, however). PSA levels from 4-10 often indicate benign prostatic hypertrophy (a nonmalignant increase in the size of the prostate gland which is a normal occurrence as men age) but the patient should have his prostate gland and PSA levels monitored periodically by his physician. PSA levels greater than 10 often indicate prostate cancer; therefore, urgent follow-up with an urologist is indicated. Also, any significant elevation from baseline, even if below 10, should be evaluated by an urologist.

Thyroxine (T4): Thyroxine is one of the main hormones secreted by the thyroid gland. Elevated levels suggest hyperthyroidism, often characterized by nervousness, palpitations, weight loss and diarrhea; low levels suggest hypothyroidism, often characterized by fatigue, weight gain, swelling and dry skin. Both hyperthyroidism and hypothyroidism usually require treatment with medications; therefore, abnormal thyroid levels must be further evaluated by a physician. This blood test is normally elevated during pregnancy or in the presence of birth control or estrogen pills. Free thyroxine or *Thyroid Stimulating Hormone (TSH)* levels accurately assess thyroid function under these circumstances.

LIPID PANEL

One of the most frequently requested blood profiles is the lipid panel. Cholesterol, the lipid most commonly referred to, is a fatty substance that is required for the stability of the cell membrane. It is also metabolized to form various hormones in the body. However, too much cholesterol is dangerous in that a high cholesterol level is one of the most important factors leading to coronary heart disease. It is especially dangerous when a patient has another risk factor such as hypertension, diabetes mellitus, cigarette smoking, obesity, or has had a family member with heart disease.

Although the laboratory may indicate a different "Normal Range", most physicians follow the ranges recommended by the National Cholesterol Education Program (indicated below).

Treatment for high cholesterol levels is highly individualized and depends on the patient's age, weight and other medical conditions. The recommendations for treatment of abnormal cholesterol levels differ among medical experts; the recommendations may also change as more information becomes available. In general, when a "cholesterol level" or "lipid panel" is checked, the following tests are performed:

Total Cholesterol: The sum of all the cholesterol components; the higher this value, the greater the chance of developing coronary artery disease. Ideally, this value should be less than 200.

HDL Cholesterol: The “good” cholesterol. This cholesterol is being transported from the blood to the liver where it is metabolized. The higher the HDL cholesterol, the better for the patient. Ideally, this value should be greater than 35-40.

LDL Cholesterol: The “bad” cholesterol. This cholesterol is being transported from the liver to the blood vessels where it may be deposited and build up to form plaque. The higher the value, the worse the patient. Ideally, this value should be less than 130.

Triglycerides: Another fatty substance in the blood which may contribute to the development of coronary artery disease. Ideally, this value should be less than 150.

Total Cholesterol/HDL Ratio: Since a high cholesterol level is harmful but a high HDL (“good”) cholesterol is good, the cholesterol/HDL ratio is very important. For example, if the total cholesterol level is high but a large proportion of this is in the form of HDL cholesterol, the cholesterol ratio may be normal. In contrast, if the total cholesterol level is normal, but almost all of this is LDL (“bad”) cholesterol, the cholesterol ratio may be elevated. In general, the higher the ratio, the greater the chance of developing coronary artery disease. Ideally, the ratio should be less than 4.5.

COMPLETE BLOOD COUNT (CBC)

White Blood Cell Count (WBC): The white blood cells are those that fight infection; they also respond to other types of inflammation. Therefore, elevated white blood cell counts may be caused by infections or various inflammatory conditions as well as by certain medications and stress. Severe elevations are usually secondary to more serious conditions such as bone marrow diseases (including leukemia) or other potentially life-threatening conditions. Low white blood cell counts may be caused by immunologic deficiencies or may also be a side effect of certain medications. Mildly decreased levels may also be normal for a particular individual, especially of certain ethnic backgrounds. The white blood cell differential indicates the levels of the various types of white blood cells; mild variations from the norm are common. Neutrophils, lymphocytes and eosinophils are different types of white blood cells. Elevated neutrophil counts are often seen in bacterial infections, elevated lymphocyte counts are often seen in viral infections, and elevated eosinophil counts are often seen in allergic disorders or parasitic infections.

Red Blood Cell Count (RBC): The red blood cells carry oxygen to the tissues and carbon dioxide back to the lungs, and are therefore involved in the acid/base balance of the body. Low RBC levels may result in anemia. Elevated RBC counts may be caused by high altitudes, increased production by the bone marrow and cigarette smoking. They may also be seen in thalassemia, a relatively benign condition usually seen in individuals of Mediterranean descent in which there is a defect in the synthesis of one of the subunits of hemoglobin.

Hemoglobin (Hgb) and Hematocrit (Hct): These are measures of the volume and concentration of red blood cells, respectively. Low levels indicate anemia; further evaluation is indicated to determine the etiology of the anemia. Elevated levels may be secondary to increased production of red blood cells, dehydration, high altitudes or cigarette smoking; routine monitoring of these levels is also recommended.

MCV (Mean Corpuscular Volume): The MCV is a measure of the volume of the red blood cells. Low MCV levels may be secondary to iron deficiency anemia, destruction of red blood cells (e.g., in thalassemia, described in *Red Blood Cell Count* above), or lead poisoning. Elevated MCV levels may be caused by other types of anemia, especially those due to vitamin B12 and folic acid deficiency (commonly seen in alcoholics), and by increased production of red blood cells. It may also be artificially elevated if the blood is at least two days old (secondary to the swelling of the blood cells).

MCH, MCHC, RDW, MPV: These are other red blood cell indices. Usually, abnormalities in these values are not significant unless they are also associated with abnormal hemoglobin, hematocrit, and /or MCV levels.

Platelet Count: The platelet count is a measure of the blood clotting cells. Significantly elevated levels may indicate an increased blood-clotting tendency and are usually caused by increased production of platelets by the bone marrow; therefore, further evaluation is warranted for significant elevations. Mildly elevated levels may be caused by infections, blood loss, and other “medical stresses”, and are usually clinically insignificant. A low platelet count may cause prolonged bleeding. Low platelet counts may be caused by decreased production or increased destruction of platelets, blood loss or certain medications; close monitoring of low platelet counts is strongly recommended.

URNIALYSIS

pH: The pH indicates whether the urine is acidic or basic. Urine is usually acidic with a pH of 5-6. However, the pH may increase secondary to a urinary tract infection or certain medications.

Specific Gravity: This is a measure of the concentration of the urine. Low levels indicate a dilute urine; higher levels indicate more concentrated urine.

Ketones: Ketones are intermediate products of fat metabolism. When there is inadequate carbohydrate intake in the diet (as in fasting, dieting, malnutrition, etc.) or glucose metabolism is impaired (as in diabetes mellitus), excessive fatty acids are metabolized; ketones may therefore appear in the urine. Small amounts are commonly seen in the urine after fasting or secondary to vomiting or fever. Significant amounts of ketones, however, are usually secondary to more severe conditions such as diabetes mellitus or alcoholism (with poor nutritional intake), and therefore warrant further evaluation.

Protein: Protein is normally not present in the urine except in trace amounts. Its presence is usually secondary to a kidney disorder and therefore warrants further evaluation. Proteinuria may be seen occasionally following excessive exercise or fever, however.

Glucose: Glucose in the urine (glucosuria) occurs whenever the blood glucose level exceeds the amount that the kidney is able to reabsorb. Although mild glucosuria may occur after eating a heavy meal or secondary to emotional stress, significant glucosuria is most commonly caused by diabetes mellitus, an endocrine or metabolic disorder, pancreatic disorder, or a side effect of a medication, and therefore warrants further evaluation.

Blood: The reagent used to detect blood in the urine actually detects free hemoglobin and myoglobin, the pigments from red blood cells and muscle, respectively. However, red blood cells that are present in the urinary tract usually break down and release hemoglobin, thereby causing this pigment to be detected. Hematuria (blood in the urine) is usually caused by a urinary tract infection, kidney stones, a tumor or other kidney disorder and necessitates further evaluation, especially in men. Damage to muscle tissue, as may occur following severe burns, severe infectious diseases, crush injuries or excessive exercise, may lead to the release of myoglobin which appears in the urine. Menstruation in women may also cause blood to be detected in the urine, of course (in this case, it is a contaminant from the vagina).

Bilirubin: Bilirubin, a breakdown product of hemoglobin (a pigment in red blood cells) is normally not present in the urine. Its presence is usually caused by a liver disorder or bile duct disease, and therefore should be further evaluated.

Leukocyte Esterase and Nitrite: These substances are produced by white blood cells and bacteria and therefore, when seen, often indicate a urinary tract infection; further evaluation with a urine culture is recommended.

White Blood Cells (WBC): The presence of significant numbers (more than 5-10) of white blood cells in the urine may indicate a urinary tract infection, especially when bacteria are also present; therefore evaluation with a urine culture may be recommended. However, when epithelial cells (see below) are present, the white blood cells may be a "contaminant" from the skin near the urethra in which case their presence may be clinically insignificant.

Red Blood Cells (RBC) [see also Blood above]: The presence of 3 or more red blood cells in the urine is usually considered abnormal. Although mild hematuria (blood in the urine) may be caused by excessive exercise, it is usually secondary to a urinary tract infection, kidney stones, tumor, or other kidney disorder, and therefore warrants further evaluation, especially in men. Menstruation in women may also cause the urine to be "contaminated" by blood from the vagina.

Bacteria: The presence of bacteria in the urine may indicate a urinary tract infection, especially when seen in association with white blood cells (which are produced to fight bacterial infections). However, when few white blood cells are present, especially epithelial cells are present; the bacteria may be "contaminants" from nearby skin and therefore may be clinically insignificant.

Epithelial Cells: Epithelial cells are found on surfaces of the body such as the urethra, kidney tubules, vagina, and skin. Their presence in the urine may indicate damage to the kidney tubules but often indicates "contamination" of the urine from the skin or vagina; in this latter case, bacteria and white blood cells in the urine may be clinically insignificant.

Casts: Casts are formed from protein produced by the kidney tubules. "Hyaline" casts may occasionally be seen in small numbers but significant numbers of other types of casts may indicate some type of kidney disorder; therefore, further evaluation may be recommended. Casts may also appear in the urine following exercise or fever, or in acidic or highly concentrated urine.

Crystals: Crystals are commonly seen in urine and often are clinically insignificant. The most commonly seen crystals are calcium oxalate, phosphate, uric acid and amorphous. Certain types of crystals, however, may be seen in particular conditions such as kidney and liver diseases, rare metabolic abnormalities, or secondary to chemotherapy or certain types of poisoning. Large numbers of uric acid crystals may also suggest the presence of kidney stones.

Yeast: The presence of yeast in the urine may be a "contaminant" from the skin near the urethra or from the vagina. Therefore, women may be advised further evaluation for possible vaginal yeast infection. Asymptomatic urinary tract infections caused by yeast may or may not require treatment (often such treatment is reserved for immunocompromised patients).