Fertility & Cryogenics Lab

Tests Explained

General Lab Panels

- **Blood Group (ABO & Rh)**

  A blood type (also called a blood group) is a classification of blood based on the presence or absence of inherited antigenic substances on the surface of red blood cells (RBCs). These antigens may be proteins, carbohydrates, glycoproteins, or glycolipids, depending on the blood group system, and some of these antigens are also present on the surface of other types of cells of various tissues. Several of these red blood cell surface antigens, that stem from one allele, collectively form a blood group system.
  Many pregnant women carry a fetus with a different blood type from their own, and the mother can form antibodies against fetal RBCs. Sometimes these maternal antibodies are IgG, a small immunoglobulin, which can cross the placenta and cause hemolysis of fetal RBCs, which in turn can lead to hemolytic disease of the newborn, an illness of low fetal blood counts which ranges from mild to severe.

  - The ABO system is the most important blood-group system in human-blood transfusion. The associated anti-A antibodies and anti-B antibodies are usually IgM, antibodies. ABO IgM antibodies are produced in the first years of life by sensitization to environmental substances such as food, bacteria, and viruses.
  - The Rhesus system is the second most significant blood-group system. The most significant Rhesus antigen is the RhD antigen because it is the most immunogenic of the five main rhesus antigens. It is common for RhD-negative individuals not to have any anti-RhD IgG or IgM antibodies, because anti-RhD antibodies are not usually produced by sensitization against environmental substances. However, RhD-negative individuals can produce IgG anti-RhD antibodies following a sensitizing event: possibly a fetomaternal transfusion of blood from a fetus in pregnancy or occasionally a blood transfusion with RhD positive RBCs. Rh disease can develop in these cases.

- **Comprehensive Metabolic Panel (CMP)**

The Comprehensive Metabolic Panel (CMP) is a frequently ordered panel of tests 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 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 includes:

1- Liver Function Panel

A liver (hepatic) function panel is a blood test to check how well the liver is working. This test measures the blood levels of total protein, albumin, bilirubin, and liver enzymes. High or low levels may mean that liver damage or disease is present.
The liver serves several important functions in the body, including changing nutrients into energy for the body and breaking down toxic substances.
The Panel includes checking the levels of the following:

- Total Protein.
- Albumin.
  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.

- Bilirubin (total and direct).
- Alkaline Phosphatase (ALP).
- Aspartate Amino Transferase (AST).
- Alanine Amino Transferase (ALT).

ALP, ALT, and AST are enzymes found in the liver and other tissues. Bilirubin is a waste product produced by the liver as it breaks down and recycles aged red blood cells. All can be found in elevated concentrations in the blood with liver disease or dysfunction.

2- Electrolytes

- Sodium
- Potassium
- CO_2 (carbon dioxide, bicarbonate)
- Chloride

The concentrations of sodium and potassium are tightly regulated by the body, as is the balance between the four molecules. Electrolyte (and acid-base) imbalances can be present with a wide variety of acute and chronic illnesses. Chloride and CO_2 tests are rarely ordered by themselves.

3- 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.

4- Glucose

Both increased and decreased levels can be significant illnesses related to diabetes .

5- **Calcium**

Both increased and decreased levels can be significant illnesses regarding bone density and fracture tendencies and Vitamin D levels.

- **Lipid Panel**

  - **Cholesterol**

Cholesterol is an important type of fat (lipid) that is made by the body. It is needed for the body to function. It also is found in foods that are made from animal products (meat and dairy products). Cells need cholesterol to function. But excess cholesterol in the blood builds up in blood vessels and may lead to hardening of the arteries (atherosclerosis), heart disease, and stroke. People who have diabetes are at higher risk for atherosclerosis.

There are two main forms of cholesterol:

- Low-density lipoprotein (LDL) is called "bad cholesterol." Most efforts to lower cholesterol are aimed at reducing levels of LDL.
- High-density lipoprotein (HDL) is called "good cholesterol." It can help remove excess cholesterol from the blood vessels.

  - **Triglycerides**

Triglycerides are a type of fat found in your blood. You need some triglycerides for good health. But high levels of triglycerides raise your risk for heart disease and other serious problems. Triglycerides are measured by the same blood test that measures cholesterol.

- **Complete Blood Count with Differential White Cell Count (CBC with Diff)**

  A complete blood count (CBC) gives important information about the kinds and numbers of cells in the blood, especially red blood cells, white blood cells, and platelets. CBC helps to check any symptoms, such as weakness, fatigue, or bruising, anemia, infection, and many other disorders.
  CBC test includes:
  - **White blood cell** (WBC, leukocyte) count. White blood cells protect the body against infection. If an infection develops, white blood cells attack and destroy the bacteria, virus, or other organism causing it. White blood cells are bigger than red blood cells but fewer in number. When a person has a bacterial infection, the number of white cells rises very quickly. The number of white blood cells is sometimes used to find an infection or to see how the body is dealing with cancer treatment.
    - **White blood cell types** (WBC differential). The major types of white blood cells are **neutrophils, lymphocytes, monocytes, eosinophils, and basophils**. Immature neutrophils, called band neutrophils, are also part of this test. Each type of cell plays a different role in protecting the body. The numbers of each one of these types of white blood cells give important information about the immune system. Too many or too few of the different types of white blood cells can help find an infection, an allergic or toxic reaction to medicines or chemicals, and many conditions, such as leukemia.
  - **Red Blood Cell** (RBC) count. Red blood cells carry oxygen from the lungs to the rest of the body. They also carry carbon dioxide back to the lungs so it can be exhaled. If the RBC count is low (anemia), the body may not be getting the oxygen it needs. If the count is too high (polycythemia), there is a chance that the red blood cells will clump together and block capillaries. This also makes it hard for your red blood cells to carry oxygen.

    Red Blood Cell indices. There are three red blood cell indices:
    - **Mean Corpuscular Volume (MCV**), shows the size of the red blood cells.
    - **Mean Corpuscular Hemoglobin (MCH)**, value is the amount of hemoglobin in an average red blood cell.
    - **Mean Corpuscular Hemoglobin Concentration (MCHC)**, measures the concentration of hemoglobin in an average red blood cell. These numbers help in the diagnosis of different types of anemia.
    - **Red blood cell Distribution Width (RDW)** shows if the cells are all the same or different sizes or shapes.
  - **Hematocrit** (HCT, packed cell volume, PCV). This test measures the amount of space (volume) red blood cells take up in the blood. The value is given as a percentage of red blood cells in a volume of blood. For example, a hematocrit of

38 means that 38% of the blood's volume is made of red blood cells. Hematocrit and hemoglobin values are the two major tests that show if anemia or polycythemia is present.

- **Hemoglobin** (Hgb). The hemoglobin molecule fills up the red blood cells. It carries oxygen and gives the blood cell its red color. The hemoglobin test measures the amount of hemoglobin in blood and is a good measure of the blood's ability to carry oxygen throughout the body.
- **Platelet** (thrombocyte) count. Platelets (thrombocytes) are the smallest type of blood cell. They are important in blood clotting. When bleeding occurs, the platelets swell, clump together, and form a sticky plug that helps stop the bleeding. If there are too few platelets, uncontrolled bleeding may be a problem. If there are too many platelets, there is a chance of a blood clot forming in a blood vessel. Also, platelets may be involved in hardening of the arteries (atherosclerosis).
- **Mean Platelet Volume** (MPV). Mean platelet volume measures the average amount (volume) of platelets. Mean platelet volume is used along with platelet count to diagnose some diseases. If the platelet count is normal, the mean platelet volume can still be too high or too low.

- **Urinalysis with reflex Microscopy**

A urine test may be done as part of a regular physical examination or to check the treatment of conditions such as diabetes, kidney stones, a urinary tract infection (UTI), high blood pressure (hypertension), or some kidney or liver diseases.
A urine test checks different components of urine, a waste product made by the kidneys. The kidneys take out waste material, minerals, fluids, and other substances from the blood to be passed in the urine.
Urinalysis often includes the following tests.

- **Color**. Many things affect urine color, including fluid balance, diet, medicines, and diseases. Vitamin B supplements can turn urine bright yellow. Some medicines, blackberries, beets, rhubarb, or blood in the urine can turn urine red-brown.
- **Clarity**. Urine is normally clear. Bacteria, blood, sperm, crystals, or mucus can make urine look cloudy.
- **Glucose**. Normally there is a trace or no glucose in urine. When the blood sugar level is very high, as in uncontrolled diabetes, the sugar spills over into the urine.
- **Bilirubin**. Usually is not in urine, presence may indicate liver disease.
- **Ketone**. When fat is broken down for energy, it forms ketones that are passed in the urine. High level of ketones in the urine may indicate diabetic ketoacidosis. A diet low in sugars and starches (carbohydrates), starvation, or severe vomiting may cause ketones to be in the urine.
- **Specific gravity**. This checks the amount of substances in the urine. The higher the specific gravity, the more solid material is in the urine.
- **pH**. The pH is a measure of how acidic or alkaline (basic) the urine is. A urine pH

of 4 is strongly acidic, 7 is neutral (neither acidic nor alkaline), and 9 is strongly alkaline.

- **Protein**. Protein is normally not found in the urine. Fever, hard exercise, pregnancy, and some diseases, especially kidney disease, may cause protein to be in the urine.
- **Urobilinogen**. Urobilinogen is a colorless product of bilirubin reduction. It is formed in the intestines by bacterial action. Some urobilinogen is reabsorbed, taken up into the circulation and excreted by the kidney. This constitutes the normal "enterohepatic urobilinogen cycle".
    - Absence of urine urobilinogen may result from complete obstructive jaundice or treatment with broad-spectrum antibiotics, which destroy the intestinal bacterial flora.
    - Low urine urobilinogen levels may result from congenital enzymatic jaundice or from treatment with drugs that acidify urine, such as ammonium chloride or ascorbic acid.
    - Elevated levels may indicate hemolytic anemia, restricted liver function such as hepatic infection, poisoning or liver cirrhosis.
- **Nitrites**. Bacteria that cause a urinary tract infection (UTI) make an enzyme that changes urinary nitrates to nitrites. Nitrites in urine show a UTI is present.

- **Blood**. Occult Blood (red blood cells) in urine may cause coloration and it indicates UTI or injury to the urinary tract.
- **Leukocyte.** Leukocytes (white blood cells) in the urine. WBCs in the urine may mean a UTI is present.
- **Microscopic analysis**. Urine is spun in a centrifuge so the sediment settles at the bottom. The sediment spread on a slide and looked at under a microscope may include:
    - **Red or white blood cells**. Blood cells are not found in urine normally. Inflammation, disease, or injury to the kidneys, ureters, bladder, or urethra can cause blood in urine. White blood cells may be a sign of infection or kidney disease.
    - **Casts.** Some types of kidney disease can cause plugs of material (called casts) to form in the kidney tubules. The casts then get flushed out in the urine. Casts can be made of red or white blood cells, waxy or fatty substances, or protein. The type of cast in the urine can help show what type of kidney disease may be present.
    - **Crystals**. Healthy people often have only a few crystals in their urine. A large number of crystals, or certain types of crystals, may mean kidney stones are present or there is a problem with metabolism.
    - **Bacteria**, **yeast cells, or parasites**. Normally none is in urine. If any is present, it indicates the presence of an infection.
    - **Squamous cells**. The presence of squamous cells may mean that the sample is

not as pure as it needs to be. These cells do not mean there is a medical problem, but your doctor may ask that you give another urine sample.

- **Vitamin D**

  We have known for almost two centuries now that increased sunlight exposure was a critical factor in the correction of most rachitic syndromes (soft bones and proximal muscle weakness) in man . Hence, it is not surprising that in 2008–2009 we observe a low 25OHD level in the serum to be significantly associated with low bone mineral density and increased risk of nonvertebral and hip fracture .

  Recent studies in humans have emphasized a potential role for the vitamin D monokine system as a necessary intermediate in the generation of antimicrobial peptides by monocyte-macrophages, suggesting its importance for immune syetm function

  Although low 25OHD levels have been known to be associated for some time now with colon cancer mortality, only recently have data emerged demonstrating that vitamin D insufficiency/deficiency is significantly associated with all-cause mortality, at least in the American population

- **Folate serum**

  Although essential throughout life, folate is particularly critical during early stages of human development. Since the first report of amelioration of macrocytic anemia by exposure to folate-rich food sources, pregnancy has been recognized as a time when folate requirements are increased to sustain the demand for rapid cell replication and growth of fetal, placental, and maternal tissue, relating to the critical role it plays in DNA, RNA, and protein synthesis. Maintaining an adequate folate status throughout pregnancy is important not only for the mother's health but also for the developing infant because folate inadequacy in pregnancy has been associated with a number of adverse outcomes . These include folate-responsive NTDs and neural crest disorders (e.g., congenital heart defects), fetal growth retardation, low birth weight, preterm delivery, and neonatal folate deficiency. It is also notable that folate requirements are increased during lactation in order to meet both maternal and neonatal needs

- **Vitamin B12**

  Vitamin B12 deficiency is frequently under-diagnosed in pregnancy and in infants from mothers having insufficient levels of the. Ensuring sufficient intake of vitamin B12 during pre-conception, pregnancy, and post-partum is strongly recommended. Other populations at risk of developing vitamin B12 deficiency include the elderly, vegetarians and vegans, recipients of bariatric surgery as well as those suffering from gastrointestinal diseases featuring ileal resections >20 cm. Certain medications such as metformin and proton-pump inhibitors may also transiently induce a status of cobalamin deficiency, which may be reversible upon completion of treatment and/or with oral vitamin B12 supplementation.

- **Iron**

  The main entities of inflammatory bowel diseases (IBDs) are Crohn's disease (CD) and ulcerative colitis (UC), which are chronic diseases of multifactorial pathogenesis with increased susceptibility caused by genetic factors which might be influenced by immunological mechanisms and environmental factors. The main symptoms of CD and UC are abdominal pain and (bloody) diarrhea, partly combined with other complications as extra-intestinal manifestations affecting joints, skin, or other organ systems. Besides intestinal symptoms, anemia is one frequently occurring problem in patients with IBD with significant impact on the quality of life in affected patients.

  Iron-deficiency anemia (IDA) is the most common reason for anemia in patients with IBD, mainly caused by chronic blood loss due to mucosal damage on the one hand and reduced iron absorption in inflamed mucosa in the duodenum and upper jejunum in CD patients on the other. Also dietary intake may influence iron deficiency as patients with IBD are reported to avoid food which may increase abdominal symptoms.

  The second major cause for anemia in IBD is the anemia of chronic disease (ACD), which is associated with chronic activation of cell-mediated immunity. But also decreased absorption of vitamin B12 and folate in inflamed regions may result in anemia. In addition, different therapeutical agents for IBD causing myelo-suppression can induce anemia. Anemia in patients with IBD is mostly a combination of different mechanisms, mainly iron-deficiency anemia and anemia of chronic disease.

- **Ferritin**

  Ferritin is a protein that stores iron, releasing it when your body needs it. Ferritin usually lives in your body's cells, with very little actually circulating in your blood. According to the Mayo Medical Laboratories, ferritin contains 20 percent iron. The greatest concentrations of ferritin are typically in the cells of the liver (known as hepatocytes) and immune system (known as reticuloendothelial cells).

  Ferritin is stored in the body's cells until it's time to make more red blood cells. The body will signal the cells to release ferritin. The ferritin then binds to another substance called transferrin.

  Transferrin is a protein that combines with ferritin to transport it to where new red blood cells are made. Imagine transferrin as a dedicated taxi for iron.

  While it's important for a person to have normal iron levels, having enough stored iron is important too. If a person doesn't have enough ferritin, iron stores can deplete quickly.

  Low ferritin levels may cause; unexplained fatigue, dizziness, chronic headaches, unexplained weakness, ringing in your ears, irritability, leg pains and/or shortness of breath

  High Ferritin Levels may cause; stomach pain, heart palpitations or chest pains, unexplained weakness, joint pain and/or unexplained fatigue

- **TIBC**

  A total iron binding capacity (TIBC) test is a type of blood test that gauges whether

there’s too much or too little iron in your bloodstream. Iron is found in all of the body’s cells. Once iron enters the body, it’s carried throughout the bloodstream by a protein called transferrin, which is produced by liver. The TIBC test evaluates how well transferrin carries iron through the blood.

Iron helps form hemoglobin. Hemoglobin is an important protein in red blood cells that helps carry oxygen throughout the body so it can function normally. Iron is considered an essential mineral because hemoglobin can’t be made without it.

Low TIBC levels usually indicate high levels of iron in the blood. High iron binding capacity levels typically indicate low levels of iron in the blood.

- **Magnesium**

The insights of the last decade into the genetics of type 2 diabetes and impaired glucose and insulin metabolism have yielded dozens of replicated risk loci. The genome-wide association (GWA) era has uncovered additional and novel genetic associations with disease risk that were beyond the purview of the previous genetic era’s linkage or candidate gene studies.

Observational studies and clinical trials have shown that dietary magnesium has relatively consistent beneficial associations with type 2 diabetes and related traits or sequelae, from insulin resistance and metabolic syndrome, to cardiovascular disease. Coupled to the decade’s findings on the genetics of diabetes are novel findings related to the genetics of magnesium transport and homeostasis, which have provided even more fertile ground for investigating interactions between magnesium and risk of developing diabetes and effects on related phenotypes.

Type 2 diabetes is a complex, multi-factorial disorder, heavily influenced by both genetic and environmental determinants. Yet neither genetics nor environmental factors alone explain why some develop the disease while others don’t, thus paving the way for hypotheses on environment-gene interactions, most notably interactions involving modifiable lifestyle factors such as physical activity and diet.