A Basic Seminar on Blood Chemistry

This report is prepared to assist in understanding the meaning of tests used to evaluate the basic chemistry of the blood. It is not intended to be diagnostic or to name diseases, but rather to provide information and education. The primary purpose of this effort is to assist in optimizing health and wellness through knowledge. Optimum metabolic efficiency is achieved in a narrow range of values and optimum ranges are provided for a measure of guidance, but are subjective in nature and should be viewed in the context of the individual case. A brief overview for each test is provided including some of the reasons for increases and decreases. This should not be considered complete, however, because many other factors may apply. Various factors can be responsible for deviations in values and these include stress, poor dietary habits, nutritional deficiencies, endocrine and organic dysfunctions, exposure to toxins and disease entities. Fasting is required for basic chemistry tests to obtain the most accurate results. Recently consumed foods and drinks, except normal water consumption, may affect values and therefore a 12-hour fast is recommended.

Presented by:
J. William Beakey, D.O.M.

Professional Co-op Services, Inc.
Toll Free  866-999-4041  www.professionalco-op.com

Disclaimer
It is left to the discretion and is the sole responsibility of the user of the manual to determine if the information and procedures described are appropriate for their patient. The author cannot be held responsible for inadvertent errors or omissions in any of the information contained in this manual.

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Why Use Laboratory Blood Testing?

Credibility * Patient Familiarity * Documentation * Universal Acceptance

Basic Laboratory Testing

Chemistry – Evaluates enzymes, electrolytes, minerals, proteins and by-products of metabolism.

CBC and Differential – Types of blood cells and their function in oxygen transport and immunity.

Thyroid Panel – Basic metabolic rate.

Urinalysis – What the body eliminates, Ph and kidney integrity.

Drug Effects

Mosby’s Drug Consult or a PDR will provide the most extensive information for drugs a patient lists in their current history. Drugs may have an effect on lab test values.

Functional Panels

All elements in a given panel are related in some way to a particular organic function. Viewed as a group, they provide insight into the level of function or dysfunction of the target area.
**Hepatic Function Panel**
Albumin, Alkaline Phosphatase, SGPT, SGOT, Direct Bilirubin, Total Bilirubin, Total Protein.

**Lipid Panel**
Triglycerides, Total Cholesterol, HDL, LDL, VLDL, HDL/LDL ratio

**Renal Function Panel**
Albumin, BUN, Creatinine, Calcium, Carbon Dioxide, Chloride, Glucose, Phosphorus, potassium and sodium.

**Electrolyte Panel**
Carbon Dioxide, Chloride, Potassium and Sodium

**Comprehensive Metabolic Panel**
Albumin, alkaline phosphatase, SGPT, SGOT, bilirubin., BUN, BUN/Creatinine ratio, calcium, carbon dioxide, chloride, creatinine, globulin, glucose, potassium, total protein and sodium.

**Thyroid Panel**
TSH, T-4, T3 Uptake, FTI

**Uncoupled Groups**

**Iron Elements**
Serum Iron and TIBC, Ferritin Iron

**Cardiovascular Elements**
C-Reactive Protein, Fibrinogen, Homocysteine, Cholesterol, Triglycerides and Apolipoprotein Assessment
**Chemistry**

**Glucose**
- Fasting level of sugar in the bloodstream.
- Primary source of energy in the cells.
- Derived from the digestion of carbohydrates, conversion of glycogen (liver/muscles) and gluconeogenesis (lactate, glycerol, amino acids).
- Cortisol increases gluconeogenesis.
- Pancreas, liver, adrenals, thyroid and pituitary affect glucose levels.
- Glucose levels are primarily balanced through the action of insulin and glucagon.
- Brain and nerves use only glucose.
- Consult the Glycemic Index to choose foods that slowly breakdown to glucose.

Hypoglycemic factors: headaches, mental sluggishness, drowsiness, mood swings, irritability, anxiety, excess perspiration, nausea and fast pulse.
Dr. George Whipple’s Triad – Patient must have the majority of the symptoms listed, an immediate glucose of 50mg/dl or less and rapid resolution of symptoms after ingesting glucose.

**Increased Values** - diabetes, pancreatitis, Syndrome X/dysinsulinism, Cushing’s syndrome, hyperthyroidism, stress, etc. Coffee, caffeine, cortisone, estrogen may cause elevations.

**Decreased Values** are seen in hypoglycemia, Addison’s disease, liver disease, hypothyroidism, pancreatic disorders, alcoholism, nutritional deficiency, anterior pituitary dysfunction and certain types of tumors, etc.

**Normal Lab Values**: 65-109 mg/dL  
**Optimum Range** is 85 – 95 mg/dL

**Uric Acid**
- Principle end product of purine metabolism.
- Purine rich foods include organ meats, asparagus, spinach and mushrooms.
- Breakdown of nucleoproteins - Purine is a building block for DNA.
- Men tend to have slightly higher levels than women.
- Gouty arthritis may be linked in part to mycotoxin infestation.
- Uric acid is related to antioxidant defenses.
- It is considered a mucous substance formed by protein metabolism.
- Uric acid is related to antioxidant defenses.
- Uric acid becomes more saturated in acidic urine – the more alkaline the urine, the less crystallization and stone formation occurs.
- Lack of Vitamin E has been linked with an increase of uric acid.
- Avoid all alcohol. It increases the production of uric acid.
- Uric acid is increased in 80% of patients with high triglycerides.
- Stress is the most seen cause of high uric acid.

**Increased Values** - gout, kidney insufficiency and inflammation, diabetes, excessive exercise; high protein diets and excessive purine containing foods; excessive intake of PUFA’s (polyunsaturated fatty acids), Rheumatoid arthritis, malignancies and other
conditions with tissue breakdown, and atherosclerosis. Stress. Hypothyroidism, hypoadrenalism, and parathyroid dysfunction may cause elevations.

**Decreased Values** - low protein intake, high aspirin use and where antioxidant defenses are taxed through binding of metal oxidants.

**Normal Lab Values:** 2.4 – 8.2 mg/dl

**Optimum Range** is 3.5 – 5.5 mg/dL

**B.U.N.** (Blood Urea Nitrogen)
- BUN is a byproduct of protein metabolism and is produced in the liver.
- Amino acids are broken down, ammonia is released and then formed into urea through enzyme processes.
- BUN is excreted through the kidneys.
- Protein intake, liver function and the kidney's ability to eliminate can affect this value along with the hydration status.
- Alkaline phosphatase catalyzes a reaction that transfers an amino group from an amino acid to a keto acid, providing a nitrogen source for the urea cycle.
- Hypothyroidism increases hepatic degradation of amino acids.
- Moderate hyperthyroidism decreases hepatic amino acid degradation in contrast to severe hyperthyroidism, which increases it.
- Regulation of urea synthesis is one of the mechanisms by which thyroid hormones influence body composition.

**Increased Values** - acute and chronic renal disease, high protein diets, edema, gastrointestinal bleeding, metal poisoning, congestive heart failure, hyperthyroidism, Addison’s disease, anterior pituitary insufficiency, dehydration and the use of diuretics.

**Decreased Values** are seen in protein insufficiency, malabsorption, severe liver damage, alcoholism, and excessive fluid intake. Weak adrenal or pituitary function can lower values.

**Normal Lab Values:** 5-26 mg/dl

**Optimum Range** is 12 – 17 mg/dL

**Creatinine**
- Creatinine is a waste product of muscle tissue breakdown, a catabolic product of creatine phosphate.
- Can provide some insight into the level of physical activity.
- By-product of actin fiber metabolism formed by spontaneous decomposition of creatine in muscle contraction.
- Blood levels are indicative of the kidney's ability to excrete and increased values are not reflective of protein intake as with BUN.
- Excreted entirely by kidney, daily production fluctuates very little.
- Renal disorders are almost always responsible for rises in value.
- Little affect from liver function as with BUN.
- In kidney disease creatinine rises later than BUN.

**Increased Values** are seen in renal disease and insufficiency, urinary tract obstruction, congestive heart failure, dehydration, BPH, diabetic nephropathy, Heavy metals,
hyperthyroidism. Athletes may have slightly elevated amounts due to increased muscle mass.

**Decreased Values** are seen in debility, decreased muscle mass, inadequate protein intake, lack of physical activity, congenital defect and severe liver disorders.

**Normal Lab Values**: 0.5 – 1.5 mg/dL  
**Optimum Range** is 0.8 – 1.1 mg/dL

**Sodium**
- Sodium is most the abundant cation in extra-cellular fluid (outside the cells) and reflects fluid balance, kidney function, as well as heart and adrenal function.
- Balance is achieved between intake and kidney elimination. Aldosterone, ADH, ACTH and Natriuretic factor are all involved in sodium balance.
- Aldosterone decreases renal losses, Natriuretic (3rd factor) increases renal losses and ADH controls resorption of water in kidney affecting balance of sodium.
- Sodium is the acidifying mineral that opposes potassium.
- Na pumps water and nutrients into the cell and is controlled by the adrenal cortex through aldosterone, which inhibits excretion and promotes resorption.
- Na is needed for nerve transmission, pH balance and electrical control of the heartbeat.
- Sodium assists in aggregating toxins for transport to the renal tubules.
- Adrenal, kidney and pituitary function can affect levels of this electrolyte.
- Steroidal hormones, progesterone and estrogen, under anterior pituitary control can affect sodium levels causing water retention.

**Increased Values** are seen in renal dysfunction, dehydration, hyperadrenalism, congestive heart failure, edema/water retention, hypertension and excessive dietary consumption.  
**Hypernatremia** – dry mucous membranes, thirst, restlessness, agitation and in the extreme, convulsions.

**Decreased Values** are seen in hypoadrenalism, deficient dietary intake, chronic renal insufficiency, excessive ADH, diarrhea, diuretic use, excessive sweating, lethargy, and severe congestive heart failure, losses to “third space” – ascites, peripheral edema.  
Decreased sodium can be due to reduced kidney filtration.  
**Hyponatremia** – weakness confusion, lethargy, and in the extreme, coma.

**Normal Lab Values**: 135 – 148 mmol/l  
**Optimum Range** is 139 - 142 mmol/L

**NOTE**: in congestive heart failure (CHF) the venous pressure increases forcing fluid out of the vascular channel into the interstitial spaces. The location of the edema is influenced by gravity. Kidneys respond by retaining salt and water and a viscous cycle begins with drugs being used to control symptoms.

Kidney based edema is caused by Nephrotic syndrome which allows high amounts of protein to be lost in the urine and subsequently hypoalbuminemia. Albumin controls osmotic pressure. Compensatory secretion of aldosterone. Diuretics are used. Edema is more evenly distributed than in CHF. Pitting edema likely to be seen here.  
Lymphatic obstruction can cause downline edema. Can be due to filarasis (Parasitic worm).
**Potassium**
- Potassium is most abundant cation in intracellular fluid - 150mmol/L intracellular and 4.5mmol/L serum concentration.
- Serum amount is small, therefore minor changes can be important - dietary supply important because serum K can drop quickly.
- Aldosterone increases renal loss of potassium - when sodium is resorbed, potassium is lost.
- Acid – Base balance influences - alkaline states cause K to move inside cells while acidic states raise serum K by causing a shift to outside the cells.
- K is important in nerve conduction, muscle and heart contraction, and pH control.
- It is carefully controlled by the kidneys and is reflective of kidney and adrenal function. Levels may also be affected by pituitary function.
- Dry mouth is an indication of potassium need.

**Increased Values** are seen in kidney disease, congestion of the heart muscle and slow pulse, excessive tissue breakdown or injury, kidney disorders, over supplementation, acidosis (temporarily), antibiotics, and weak adrenals / hypoaldosteronism. Irritability, ECG irregularities (peaked T waves), nausea and colic may be observed.

**Decreased Values** are seen in some cases of hypertension, muscle weakness, adrenal hyperfunction, heart arrhythmias (flattened T waves), laxative abuse, insulin therapy, cortisone and diuretic use, kidney disorders, nutritional deficiency and diarrhea.

**Normal Lab Values:** 3.5 – 5.5 mmol/L  
**Optimum Range** is 4.3 - 4.7 mmol/L

**Chloride**
- Chloride is the major extracellular anion and along with the other electrolytes sodium and potassium, is essential for maintaining proper fluid balance and reflects the ability of cell membranes to exchange fluids.
- It is the opposite charge of the major cation sodium and therefore maintains relative electrical neutrality.
- Chloride is part of the buffering activity and functions as one of the controls for acid-base balance.
- Inside the cell as CO2 and H+ increase, HCO3 moves from intracellular to extracellular space causing CHLORIDE to SHIFT back into the cell to balance the electrical factor.
- It is a component of hydrochloric acid.
- Levels of chloride primarily provide information on the adrenals, stomach and kidney, but can also reflect insight to posterior pituitary function.
- High chloride and normal sodium usually means high stomach acid.
- Increased chloride with increased sodium indicates fluid retention.

**Increased Values** are seen in dehydration, acid conditions and swelling of tissues because too much water infiltrates the cells. Renal tubule acidosis, Cushing's syndrome, metabolic acidosis, anemia, and respiratory alkalosis. High chloride signs include lethargy, weakness and deep breathing. Lack of Vit. K.- protein handling – digestive issues. Various drug therapies including cortisone, estrogen and thiazides.
Decreased Values are seen in edema, stomach acid deficiency, ulcerative colitis, excessive sweating, overhydration, inappropriate ADH syndrome, metabolic alkalosis, diuretic therapy, hypokalemia, burns, hyperaldosteronism, respiratory acidosis edema and adrenal deficiency. Low chloride signs include excitability of the nervous system and muscles, shallow breathing, hypotension and tetany.

Normal Lab Values: 96-109 mmol/L  
Optimum Range is 101 - 103 mmol/L

Carbon Dioxide
- Reflects the lung’s ability to exchange gases, i.e. oxygen and CO2.
- The value in the test report is a composite measure of CO2 gas and bicarbonate ions that are responsible for maintaining pH balance through buffering activity.
- The ratio of bicarbonate to free CO2 is approximately 20 to 1, so the higher the value of the test the more alkaline the blood and the lower the value, the more acid the blood. HCO3 is the second most important anion to chloride for balancing the electrical charge of extracellular and intracellular fluids.
- HCO3 is regulated by the kidneys.
- A number of other tests also indicate various components of the pH regulation.

Increased Values are seen in alkaline blood conditions, emphysema, fevers, acute vomiting and overactive adrenals. Barbiturates and cortisone therapy may also increase values.

Decreased Values are seen in acidic blood, diabetes, renal failure, and adrenal fatigue.

Normal Lab Values: 20-32 mmol/L  
Optimum Range is 25 – 28 mmol/L

Calcium
- Calcium is the principle component of bone and teeth with 99% of the body’s calcium is found in these structures.
- The other 1% is extremely important to many physiologic processes such as blood clotting, nerve and muscle transmission and enzyme activities.
- About half the total serum calcium is free ionized and the rest is bound to proteins, mostly albumin.
- PTH causes calcium to increase by causing more absorption in the gut, decreasing renal excretion and increasing bone resorption.
- Calcium is involved in fat and protein absorption and has functions in trauma, and infection.
- An excess of “free” calcium can be a substantially negative influence and this must be ascertained by viewing calcium and phosphorus together.

Increased Values are seen in hyperparathyroidism, Paget’s disease, toxic levels of Vitamin D, malignancies, sarcoidosis; Addison’s disease, use of alkaline antacids, estrogen, progesterone. Most common cause for elevation is hyperparathyroidism. Malignancy is the second most important cause of elevation due to metastasis that destroy bone and because some cancers produce a PTH-like substance that elevates
calcium (ectopic PTH). Excess Vitamin D causes greater absorption in the gut and less elimination by the kidney. ACID METABOLISM increases free calcium.

**Decreased Values** are seen in hypoparathyroidism, Vitamin D deficiency, magnesium deficiency, chronic renal failure, hyperphosphatemia secondary to renal failure alkalosis, pancreatitis, tetany, intestinal malabsorption, low albumin and total protein and diuretic use.

**Normal Lab Values:** 8.5 – 10.6 mg/dL  
**Optimum Range** is 9.4 - 9.8 mg/dL

**Phosphorus**
- Phosphorus exists mostly as phosphate in the body.
- Most phosphate is organically bound, but it is the circulating inorganic phosphorus that is measured in blood chemistry.
- Most inorganic phosphorus is combined with calcium to form bone and teeth, but 15% is circulating in the blood.
- Phosphorus compounds are the source of chemical energy in the body and it is therefore a tremendously important mineral.
- Its many functions include influencing pH balance and it is reflective of acidity in the gut where it is responsible for stabilization of sugars (Phosphorylation) preparing them for transport to the liver.
- Important functions are in phospholipids, nucleic acids, membrane and energy production/ATP.
- Phosphorus and calcium must be in proper balance for optimum health – see formula under additional notes.
- The parathyroid helps regulate amounts in the blood and good kidney function is necessary.
- Phosphorus is efficiently absorbed in the small intestine and calcium metabolism, PTH, and renal excretion influence levels.

**Increased Values** are seen in an alkaline gut/lack of hydrochloric acid. Also Paget’s disease, Addison’s disease, sarcoidosis, hypoparathyroidism, bone metastases, diabetic ketoacidosis, renal failure, healing fractures, hypocalcemia, advanced lymphoma or myeloma. Laxatives and enemas containing sodium phosphate increase phosphorus levels.

**Decreased Values** are seen in acidemia and acidic gut, High carb diet, acute alcohol toxicity, hyperinsulinism, hyperparathyroidism; chronic use of aluminum containing antacids, hypercalcemia, Vitamin D deficiency, and malnutrition.

**Normal Lab Values:** 2.5 – 4.5 mg/dL  
**Optimum Range** is 3.4 – 3.8 mg/dL

**Free Excess Calcium Formula**

2.5 x Phosphorus = Predicted Calcium in Ideal Ratio  
Observed Calcium - Predicted Calcium = Free Calcium Index  
Example Phosphorus is 3.0 and Calcium is 9.8

\[
2.5 \times 3 = 7.5 \quad 9.8 - 7.5 = 2.3 \text{ FCI}
\]
An FCI of greater than 0.8 is associated with degenerative disease and mild dental plaque. 2.2 or higher represents the highest risk factor. (per Sam Queen, Health Realities, Vol 13, Number 4)

### Magnesium

- Magnesium's major function is in the neuromuscular area.
- Considered an electrolyte, it has synergy with sodium, potassium and calcium.
- Influences contraction of the heart muscle.
- Like potassium, magnesium is more prevalent inside cells, is bound to ATP and has a role in phosphorylation of ATP.
- Magnesium may be displaced within the cell in excess acidity.
- Obtaining the intracellular or RBC magnesium may be worthwhile if symptoms of deficiency are noted.
- Those suffering from viral disorders may have low levels of RBC magnesium.
- Magnesium has a calming effect on the nervous system.
- Intracellular minerals in order of amount are potassium, magnesium and calcium and they play a key role in electrical and pH balance of cells.
- Magnesium is also necessary for the action of insulin.

**Increased Values** are seen in renal insufficiency, diabetes, Addison’s disease, lethargy, slurred speech, nausea and vomiting, hypotension, and also thyroid and adrenal hypofunction. Since magnesium, like calcium, is partially protein bound, high levels of albumin and globulin may also cause slightly high levels of magnesium. Most often high magnesium is related to ingestion of antacids. High magnesium retards neuromuscular transmission that includes a slowing of cardiac conduction.

**Decreased Values** are seen most notably in most notably in cardiac arrhythmias, cardiac irritability, muscle spasm, asthma, malnutrition, malabsorption, hypoparathyroidism, alcoholism, chronic renal disease, ketoacidosis, diabetes, acute pancreatitis cramping and tremors. Symptoms of low Mg are mostly neuromuscular.

**Normal Lab Values:** 1.6 – 2.6 mg/dL  
**Optimum Range** is 2.1 – 2.3 mg/dL

### Total Protein

- Total protein reflects the combined albumin and globulins in the serum.
- It is the available protein of the body, the primary building block and serves as the front line defense against toxins.
- It reflects pancreatic function, pH balance, muscle metabolism and to some degree, dietary intake.
- The anterior pituitary and thyroid, parotids (through proper chewing of food), adrenal, liver and pancreas are all involved with Total Protein, albumin and globulin metabolism.
- Proteins are constituents of muscle and other tissue structures, binding proteins, muscle mass, connective tissue, antibodies, enzymes, hormones and hemoglobin.
- Important in maintaining osmotic pressure in the vascular space, albumin and globulins constitute most of the protein in the blood and together represent the Total Protein.
Increased Values are seen in some cases of chronic liver disease, dehydration, multiple myeloma, Lupus and other chronic inflammations and infections.

Decreased Values are seen in malnutrition, surgery and burns, Crohn’s disease, ulcerative colitis, cirrhosis of the liver and alcoholism, malnutrition and malabsorption, wasting diseases, kidney disorders and hyperthyroidism.

Normal Lab Values: 6.0 – 8.5 g/dL  
Optimum Range is 7.0 – 7.4 g/dL

**Albumin**
- Albumin is formed in the liver and is a measure of liver function.
- It represents about 60% of the total protein.
- Albumin maintains colloidal osmotic pressure, is water soluble and is a carrier for protein hormones, enzymes, waste products, drugs and other substances.
- In liver disease hepatocytes lose the ability to synthesize albumin, causing levels to fall.
- Albumin’s lifespan is 12-18 days and therefore a delay in lowering of values may occur.
- The liver may lose its ability to produce albumin, but the reticuloendothelial system is producing enough globulins to maintain Total Protein levels.
- Albumin is a much smaller molecule and can be selectively lost to the extravascular space as in Lupus Erythematosis.
- Chronic liver disease is associated with low albumin and normal globulin and total protein. A/G ratio reflects these changes – normally >1.
- Decreased albumin, <4 and lymphocytes <20 – possible neoplasm or other degenerative disease.
- Albumin may rise significantly in acute illness – lots of transport.

Increased Values are seen in kidney disease, dehydration, and hypothyroid. Increased albumin may indicate increased blood volume, lymphatic congestion, toxic accumulation, poor nutrient utilization, dehydration and increased osmotic pressure.

Decreased Values are seen in edema, digestive inflammation, hyperthyroid, low calcium, neoplastic disease and free radical pathology. Also see Total Protein. Albumin may be decreased in some cases while globulins are normal or elevated to keep total protein levels up – chronic liver disease.

Normal Lab Values: 3.5 – 5.5 g/dL  
Optimum Range is 4.3 – 4.7 g/dL

**Globulin**
- Globulins are in general used to assess degenerative, inflammatory and infectious disorders.
- Globulins are key building blocks for antibodies.
- Less important for maintaining osmotic pressure than albumin and also less involved in transport.
- Globulin proteins are not water soluble and they transport fats, hormones and metal ions. Globulins have fractions for specific purposes.
Increased Values are seen in kidney disease, hemochromatosis, infectious disease, multiple myeloma and many carcinomas, recovery from infections and low stomach acid. Digestive inflammation is associated with globulin levels >2.8 – possible HCl need. Increased >3.7 – possible inflammation or infection – check white counts.

Decreased Values are seen in anemia, liver disease, hemorrhage, immune compromised patients and digestive inflammation <2.4 may indicate HCl need.

Normal Lab Values: 1.5 – 4.5 g/dL Optimum Range is 2.3 – 2.7 g/dL

**Albumin/Globulin Ratio**
The ratio provides insight into liver and kidney function and also inflammation and dehydration. It will change depending on the body's needs at any given time.

Increased Values are seen in thickness of the blood and possible tendency toward clotting.

Decreased Values are seen in depletion of the body’s defense mechanisms and liver dysfunctions.

Optimum Range is 1.8 – 2.0

**Bilirubin**
- Bilirubin is a by-product of the breakdown of red blood cells.
- At the end of their lifespan the spleen, bone marrow and liver break down red blood cells, and bilirubin is formed.
- The test result is total bilirubin that is comprised of direct (broken down by the liver for elimination) and indirect (from breakdown of hemoglobin by the spleen) fractions.
- Direct bilirubin is excreted from the liver cells into the intrahepatic canaliculi through the hepatic ducts to the common bile duct and into the bowel.
- The type of Bilirubin must be determined to find where the defect is located.
- Hepatocellular dysfunction causes elevated indirect bilirubin.
- Direct bilirubin results from extrahepatic obstructions like gallstones or other obstructions of the bile duct.
- Normally indirect bilirubin makes up 70-85% of the total.
- When more than 50% is direct, some type of obstruction is suspected.
- When less than 20% is direct, hepatitis or accelerated red cell breakdown is suspected.

Increased Values are seen liver, gallbladder and spleen disorders, and mononucleosis. Jaundice and its discoloration are seen when the level of bilirubin exceeds 2.5 mg/dl. Increased levels of direct bilirubin are seen with gallstones, extrahepatic duct obstruction, as in tumor, inflammation, scarring, gallstones and liver metastases.
Increased levels of indirect bilirubin are seen with erythroblastosis fetalis, hemolytic jaundice, hepatitis, sepsis, neonatal hyperbilirubinemia, hemolytic anemia, pernicious anemia, cirrhosis, sickle cell anemia, and transfusion reaction. Liver dysfunction (with increased SGPT and SGOT.)

Decreased Values are seen in iron deficiency anemia and spleen dysfunction. Decreased direct – sluggish, reduced liver function.

**Normal Lab Values:** 0.1 – 1.2 mg/dL  
**Optimum Range** is 0.5 – 0.8 mg/dL

**Alkaline Phosphatase (ALP)**
- Produced mainly in the liver and bone with lesser amounts in the intestinal mucosa.
- In the liver ALP is present in the Kupfer cells that line the biliary collecting system and performs hydrolysis of phosphoric acid esters under conditions of alkaline pH.
- Levels may be greatly increased in both intrahepatic and extrahepatic obstructions and in cirrhosis. Hepatic tumors, hepatotoxic drugs and hepatitis cause lesser elevations.
- ALP is the most sensitive test for metastases to the liver.
- In bone it breaks down phosphates required for mineralization of bone.
- New bone growth is associated with increased levels of ALP (high in adolescents).
- It is used to assess liver function and activity in the osteoblasts of the bone.
- Adrenal function and zinc status also affect alkaline phosphatase.

**Increased Values** are seen in bone diseases, healing and growth, hepatitis, cirrhosis of the liver, biliary obstructions, cancer of the bone and liver (with high GGT), jaundice, multiple myeloma, rickets, hyperthyroidism, osteoblastic metastatic tumors, Paget’s disease, healing fractures, RA, late pregnancy, intestinal ischemia, phlebitis, herpes zoster sarcoidosis, growing children.

**Decreased Values** are seen in hypoadrenalism (secondary confirmation necessary!!! – see Pupil Rebound Test and Postural Hypotension Test), hypothyroidism, hypophosphatemia, pernicious anemia, Celiac disease, milk-alkali syndrome, zinc (confirm with Zinc Taste Test) and B-6 deficiencies.

**Normal Lab Values:** 25 – 150 IU/L  
**Optimum Range** is 65 – 80 IU/L

**LDH**
- Lactic Dehydrogenase is found in all cells as well as the blood.
- It is involved in carbohydrate/glucose metabolism, specifically the activity of lactic and pyruvic acids in the Krebs Cycle.
- Because it is in all cells, LDH is also a non-specific marker for cellular damage and is used specifically in heart attack to assess damage to the heart muscle.
- Isozymes or fractions of LDH can be used to identify which tissues are affected.
- Primary sites include heart, liver, RBCs, kidneys, muscles, brain and lungs.
When injury or disease affects cells containing LDH, the cells are lysed and the LDH spills into the bloodstream causing an increase total LDH.

- There are 5 isozymes that allow the affected tissue type to be identified.
- Strenuous exercise can also cause an elevation.
- Provides an approximation of lactic acid.

**Increased Values** are seen MI, pulmonary diseases (embolism, pneumonia, congestive heart failure). Decreased lung function and tissue oxygenation deficits are noted in increased values; liver disease (cirrhosis, hepatitis, neoplasm); red blood cell diseases (hemolytic or megaloblastic anemia); skeletal muscle diseases or injury (muscular dystrophy); renal parenchymal disease (glomerular nephritis, tubular necrosis); intestinal ischemia, testicular tumors,; lymphoma or other RET system tumors; pancreatitis.

**Decreased Values** are seen in zinc deficiency, adrenal exhaustion and poor carbohydrate utilization.

**Normal Lab Values:** 100 – 250 IU/L

**Optimum Range** is 130 – 160 IU/L

**SGOT (AST)**

- Serum Glutamic-Oxalacetic Transaminase is an enzyme found mainly in the liver and heart but also in the muscle, pancreas, kidney and gonads and it is involved in amino acid metabolism.
- SGOT is present as a result of the conversion of cholesterol into estrogen, progesterone and testosterone, hence its relationship to gonadal function (Brockman).
- It is released in proportion to cellular damage and is another marker followed during cardiac events and liver disease.
- SGOT is involved in the synthesis of glutamic, oxalacetic and keto acids.
- Also known as Aspartate aminotransferase – AST.
- Used primarily for evaluation of MI and hepatocellular disease.
- Cells are injured and then lyse releasing SGOT and causing levels to rise.
- SGOT elevation is directly related to the amount of damage.
- Diseases that affect the hepatocytes also cause elevations.
- Acute hepatitis can cause elevations 20 times normal.
- Acute extrahepatic obstructions like gallstones cause increases of ten times normal, but these may rise and fall quickly.
- In cirrhosis, levels depend on the amount of active inflammation.

**Increased Values** are seen in alcoholism, cirrhosis of the liver, hepatitis and other liver disorders, congestive heart failure, heart attack, hypertension, deficiencies of vitamin E and manganese, drug toxicity, tumor and metastases; muscle trauma, severe burns, acute hemolytic anemia, acute pancreatitis, heat stroke.

**Decreased Values** are seen in hypofunction of the gonads, B-6 and zinc deficiencies, acute renal disease, beriberi, ketoacidosis and pregnancy.

**Normal Lab Values:** 0 – 40 IU/L

**Optimum Range** is 15 – 30 IU/L
**SGPT (ALT)**

- Serum Glutamic Pyruvic Transaminase / Alanine Aminotransferase is an enzyme involved in tissue energy production and is found primarily in the liver.
- SGPT helps synthesize pyruvate and L-glutamate through the transfer of amine groups from L-alanine.
- It is produced when the fatty membranes of the liver sinuses and lymphatic ducts release foods and toxins respectively.
- When cells die they release this enzyme and since it’s highest concentration is in the liver, it is used principally as a measure of liver damage.
- SGPT is a more reliable measure of chronic cellular damage whereas SGOT is more reliable in acute damage.
- It is closely followed during heart attack.
- Found primarily in the liver with lesser amounts in the kidney, heart and muscles.
- Injury or disease to parenchymal liver cells will cause release of this enzyme.
- SGPT is present as a result of fat metabolism in the liver – the release of substances stored within fatty membranes.
- Liver sinuses and lymph ducts are covered with fatty membrane and when nutrients or toxins are released, SGPT is involved.
- Vitamin A is a part of the fatty membranes.
- This enzyme is a sensitive and specific indicator of hepatocellular disease.

**Increased Values** are seen in liver disease and inflammation, fatigue, Epstein Barr virus, alcoholism, biliary obstruction, congestive heart failure, heart attack, pancreatitis and trauma, hepatitis, hepatic necrosis, hepatic ischemia, cirrhosis, cholestasis, hepatic tumor, hepatotoxic drugs, obstructive jaundice, severe burns, muscle trauma, myositis, pancreatitis, MI, mononucleosis and shock.

**Decreased Values** are seen in insufficient liver function, congested liver and zinc and B-6 deficiencies. Decreases indicate excess storage of nutrients and toxins.

**Normal Lab Values:** 0 – 40 IU/L  
**Optimum Range** is 15-30 IU/L

**GGT**

- Gamma-glutamyltransferase is an enzyme found primarily in the liver and is used to transfer amino acids and peptides including albumin and globulins across the cell membrane.
- It reflects liver function and the status of the bile duct and is involved in glutathione metabolism.
- Highest concentrations are in the liver and biliary tract with lesser amounts found in the kidney, spleen, heart, intestines, brain and prostate.
- Primary use is in assessment of liver function and is quite sensitive to any stasis in bile flow.
- It is the best indicator of cholestasis, biliary obstruction and liver cell dysfunction.
- GGT elevation usually parallels alkaline phosphatase, but GGT is a more sensitive test of liver function.
- GGT not increased in bone disease.
- Normal GGT and elevated alkaline phosphatase probably means bone implication but may be related to other alkaline phosphatase isozymes.
Concurrent GGT and alkaline phosphatase elevations imply hepatobiliary problems. GGT is elevated in about 75% of chronic alcohol users and is therefore a useful tool in monitoring alcohol use and abuse.

**Increased Values** are seen in bile duct obstruction, liver damage, alcohol use especially chronic, mononucleosis, pancreatitis, hyperthyroidism, hepatotoxic drugs and possibly overuse of supplements, hepatitis, cirrhosis, tumor or metastases in liver, jaundice, MI, pancreatic cancer, EBV, cytomegalovirus, and Reye's syndrome.

**Decreased Values** are seen in hypothyroidism, magnesium deficiency, zinc deficiency, vitamin A and K deficiencies and poor protein metabolism.

**Normal Lab Values:** 0 – 65 IU/L  
**Optimum Range** is 18 - 28 IU/L

**Iron**

- Iron is essential for the formation of myoglobin, cytochrome and hemoglobin and is bound to a glycoprotein in the blood called transferrin.
- Stomach acid converts ferric iron to an absorbable ferrous iron.
- Iron is essential for oxygen transport and when deficient, oxygenation is less than optimal.
- The test is used to evaluate iron deficiency and overload conditions and relates primarily to spleen and liver function.
- Total Iron Binding Capacity (TIBC), Ferritin, hemoglobin and RBCs are used to differentiate various iron problems and related states of inflammation.
- Protein bound iron is healthy while free iron promotes oxidative stress.
- 70% of iron is found in the hemoglobin of RBCs. The other 30% is stored as Ferritin and hemosiderin.
- Iron deficiency anemia may be caused by insufficient intake, inadequate gut absorption and blood loss through menstruation, bleeding ulcer, colon neoplasm or extreme inflammation of the colon.
- Iron deficiency results in decreased production of hemoglobin, followed by microcytic, hypochromic RBCs.
- Iron deficiency anemia is characterized by low serum iron, elevated TIBC, and low transferrin saturation (TS).
- Iron is the primary pro-oxidant catalyst.
- Iron overload, hemochromatosis and hemosiderosis all involve excess iron.
- Excess iron is usually deposited in the brain, liver, gonad and heart and may cause severe damage and dysfunction.

**Increased Values** are seen hemosiderosis, hemochromatosis, hemolytic anemia, hepatitis, congestive heart failure, gonadal atrophy, liver disorders, lead toxicity, iron poisoning. Excess free iron is associated with heart, liver and gonadal damage.

**Decreased Values** are seen in insufficient nutrition, chronic blood loss, inadequate absorption, late pregnancy, iron deficiency anemia, neoplasm, GI conditions like ulcer, chronic hematuria and heavy menstruation.

**Normal Lab Values:** 40 – 155 mcg/dL  
**Optimum Range** is 80 – 100 mcg/dL
**Triglycerides**

- Triglycerides are circulating lipids made in the liver from fatty acids and glycerol and also from glucose, so excess intake of fats and refined carbohydrates can result in high triglycerides values.
- These blood fats are a source of energy production and are made up of three fatty acids attached to a glycerol molecule, hence the term triglycerides.
- They should be ideally about half the value of cholesterol and reflect on nervous system function and cardiac risk, mostly due to the possibility of contributing to thrombosis.
- Liver, thyroid, pancreas, pituitary and hypothalamus can affect triglycerides levels.
- A source of stored energy - when triglycerides are in excess in the blood, they are deposited as fat.
- Recent ingestion of fatty meal may show as elevated triglycerides.
- Alcohol may cause elevations.
- Primary indicator for Syndrome X.

**Increased Values** are seen in insulin resistance/ Syndrome X, diabetes, alcoholism, hypothyroidism, atherosclerosis, estrogen/oral contraceptive use, hepatitis, hyperlipidemia, high carbohydrate or high fat diet, MI, hypertension and alcoholism.

**Decreased Values** are seen in hyperthyroidism, autoimmune disorders, vegetarian diets, deficiency of hydrochloric acid, malnutrition, malabsorption, poor pancreas and liver function.

**Normal Lab Values:** 0 – 149 mg/dL

**Optimum Range is** 70 – 100 mg/dL

**Cholesterol**

- Synthesized in the liver, cholesterol is important for cell wall structure, cell immunity, steroid hormones production by the adrenal glands and gonads, membrane strength, nerve protection and formation of bile acids, which accounts for about 80%.
- Cholesterol is also necessary for formation of antibodies and enzymes and is also used to evaluate risk for atherosclerosis.
- In addition to the liver, levels are influenced by the thyroid, adrenals, pancreas and pituitary.
- There are three fractions, HDL, LDL and VLDL, reported with HDL (high density lipoprotein) considered the “good” cholesterol, while LDL and VLDL are “bad” forms because of their stickiness in arterial linings related to atherosclerosis.
- HDL is carried by alphalipoproteins and provides protection and benefit in two main ways: HDL inhibits cellular uptake of LDL and it carries cholesterol from peripheral tissues to the liver for processing.
- LDL is most associated with increased risk of CHD.

**Increased Values** are seen hypercholesterolemia, atherosclerosis, deficiency of trypsin and chymotrypsin, excessive hydrogenation of fats in the stomach, hypothyroid,
decreased anterior pituitary function, diabetes, nephrotic syndrome, pregnancy, poor diet, hypertension, MI and stress. Some have genetic hyperlipidemia.

**Decreased Values** are seen in hyperthyroidism, autoimmune disorders, vegetarian diets, deficiency of hydrochloric acid, malnutrition, malabsorption, poor pancreas and liver function.

**Normal Lab Values:** 100 – 199 mg/dL  
**Optimum Range** is 160 - 200 mg/dL

**Complete Blood Count (CBC) & Differential**

**White Blood Cells (WBC)** – measures the total number of white blood cells or leucocytes. The main function of the white cells is to defend against foreign invaders and infection. This is mainly accomplished by production and transport of antibodies and by phagocytosis. Several types of cells contribute to this total count and those are discussed below. Elevations can indicate infection, inflammation, tissue necrosis, trauma, stress or a leukemia. Decreases signal bone marrow disorders, massive infections, autoimmune disorders and general immune system weakness. Optimal range is 5,000 – 7,500/uL

**Lymphocytes** – protective especially against virus and cancer, lymphocytes are derived from either bone marrow - B cells for humoral immunity/formation of specific antibodies; or the thymus - T cells for cellular immunity/direct contact with pathogens. T cells are mobilized by interleukin 2. In general high values suggest defensive activity, particularly against viruses, while low values are seen with low protein, compromised immune function and heightened risk. Optimal range is 30 – 35 %

**Polys** – Polymorphonuclear leucocytes, often referred to as neutrophils. The primary function is phagocytosis, the killing and digesting of bacteria. Acute bacterial infection and trauma cause a rise in this count. Optimal range is 50 – 60 %

**Basophils** – Are one of the smallest fractions of white blood cells. They are associated with hypersensitivities and inflammation, and have high histamine content. Basophils are capable of performing phagocytosis on antigen-antibody complexes and are hence related to allergic reactions. Basophils also deliver heparin to areas of inflammation to prevent clotting. Elevations are usually seen in response to allergy, inflammation or exposure to toxins. These cells are not involved in viral or bacterial infections. Optimal is 0 – 1 %

**Eosinophils** – These specialists produce peroxidase enzymes and proteins that are toxic to invading elements. Increases occur in response to parasites or some other toxin/allergen. Eosinophils are also capable of phagocytosis and are not involved with viral or bacterial infections. Optimal range is < 3%

**Monocytes** – The largest cells in the blood stream, monocytes are a second line of defense in infections and inflammation. Their function is to finish the job started by the neutrophils and they are increased during the recovery phase of an infection. Monocytes are also somewhat increased in developing arteriosclerosis due to the inflammation and
repair processes occurring in the arterial wall. An increase of monocytes, basophils and eosinophils together may indicate intestinal parasites. Less than 7% is considered optimal.

**Red Blood Cells (RBC)** – The primary carriers of oxygen through hemoglobin. Males have slightly higher values than females with a optimal range of about for males of 4.4 – 4.8 and for females – 4.2 – 4.6 million/uL.

**Hematocrit** – The percentage of whole blood volume occupied by red blood cells. Low readings are associated with fatigue, anaerobic metabolism and anemia, particularly microcytic, and blood loss. Optimal range for males is 40 – 45% and females 38 – 43%

**Hemoglobin** – An iron bearing protein that is the primary carrier of oxygen. 90% of red blood cells is hemoglobin. Low readings reflect fatigue, anaerobic metabolism and anemia or low protein. Highs reflect iron overload and hyperlipidemia. Optimal range for males is 14 - 15 and females 13.5 – 14.5 g/dL

**MCH** – Mean Corpuscular Hemoglobin. Represents the weight of hemoglobin in a single red blood cell. May be increased in B-12/Folic acid anemia and decreased in iron and B-6 anemia and internal bleeding. Since larger cells tend to have more hemoglobin, the values of MCH and MCV usually trend in similar directions. Optimal range is 28 – 32 micrograms.

**MCV** – Mean Corpuscular Volume represents the volume in cubic microns of a single red blood cell. May be increased in B-12/Folic acid anemia and decreased in iron and B-6 anemia and internal bleeding. Optimal range is 82 – 90 cubic microns.

**MCHC** – Mean Corpuscular Hemoglobin Concentrate. Reflects the average concentration of hemoglobin in an RBC. Decreased in Iron deficiency anemia. Optimal range is 32 – 35%

**RDW** – Red Cell Distribution Width is a calculation used to assess the variation in size of RBCs. Increased variation in size is indicative of B-12, folate or iron anemias. Optimal value is < 13.

NOTE: MCH, MCV, MCHC and RDW are helpful as a group to assess various kinds of anemia.

**Platelets** – Essential to blood clotting. Values under 100,000 are considered to be a risk factor for spontaneous bleeding and under 20,000 the patient is at serious risk. High platelet counts may indicate a tendency to clotting and this may be aided by red wine and its proanthocyanadins. Since platelets are attracted to injury sites, slight elevations may be related to developing atheromas. Optimal values are 225,000 – 275,000.
**Urinalysis Discussion**

Urine is evaluated for a number of elements and our test includes microscopic examination if indicated by the gross exam. Keep in mind that urine comes from filtering blood and represents what the body is trying to eliminate. Normal urine is relatively clear and yellow in color. It should be noted that a number of drugs might cause aberrant coloring of the urine. These include Aldomet, Flagyl, Levodopa, Compazine and Dilantin. The B vitamin riboflavin causes intense yellow color.

**Specific Gravity** – indicates the relative concentration of the urine. Urine is compared to water, which has a value of 1. The higher the value, the more particulate material in the urine is concentrated. Higher intake of water is needed to hydrate the system when values are high. Conversely, low values can indicate too much fluid intake and also inability of the kidney to concentrate properly. The posterior pituitary hormone ADH and the kidney function may have an effect on specific gravity.

**pH** – A very important parameter in assessing acid/alkaline balance in the body. Urine Ph is one of the central components of biochemical terrain testing and also Reams testing. By virtue of the fasting status of the patient, a fair assessment of what the body is trying to eliminate may be made. In this case, it is hydrogen ions. When the pH is low, a predominance of acidity can be postulated with a tendency to yeast/mycotoxin infections and high pH will conversely be associated with excess alkalinity and a tendency towards bacterial infections. High values are usual with UTI and so pH should be assessed with microscopic findings in mind. Morning urine should optimally be 6.2 – 6.4.

**WBC Esterase** – Marker that indicates presence of white blood cells and possible infection.

**Protein** – Normally filtered by the kidney, it’s presence in the urine indicates possible kidney damage and lack of integrity.

**Glucose** – Present when blood glucose rises above 165 causing a spill over effect. If blood glucose is normal, it may be related to kidney or other problems.

**Ketones** – A product of stored fat burning that may be present in diabetes, fasting or low carbohydrate diets such as Atkins.

**Occult Blood** – Blood in the urine. May be an artifact of menstruation, but if not the cause should be determined.

**Bilirubin** – Normally conjugated by the liver and eliminated through the bile duct, a trace amount in the urine can be an early sign of liver problems.

**Urobilinogen** – A byproduct of bilirubin by way of intestinal bacteria activity. May be reabsorbed with lack of proper flora or causing trace amounts in the urine.

**Nitrite** – A sign that gram-negative bacteria may be present.
**Microscopic Exam** – Used to confirm suspicious findings of the gross exam. The nomenclature “HPF” refers to high power field while “LPH” is low power field and these serve as standardized units of measurement. Findings may disclose presence of WBC, RBC, Epithelial cells, Casts, Crystals, Mucus Threads, Bacteria and Yeast, none of which normally occur in urine. WBC and bacteria indicate infections, RBC indicates blood, Crystals may indicate stone formation, epithelial cells and casts indicate lack of kidney integrity, mucous threads indicate irritation and inflammation.

**Thyroid Function Tests**

**Thyroxine – T-4** is the major hormone secreted by the thyroid gland and is the primary regulator of metabolic activity. It is called T-4 because of the 4 iodine ions in its structure. T-4 and its more active product T-3 serve to stimulate metabolic activity, maintain body temperature, regulate heart rate and utilize nutrient carbohydrates, fats and proteins. Low T-4 indicates the pervasive condition, hypothyroidism. Some of the indications of low thyroid include fatigue, lethargy, dry skin, intolerance of cold, constipation and weight gain. Increased T-4 may mean a hyperthyroid condition with some of the indicators being, nervousness, anxiety, weight loss, palpitations, sweating and sleep disorders. An ancillary test, the Barnes Basal Temperature Test, may be performed to corroborate findings: the patient takes his/her axial temperature before arising in the morning while lying quietly in bed. Temp should be between 97.8 and 98.2 with readings below 97.8 indicating a hypo condition and above 98.2, a hyper tendency. This should be done at least 4 mornings to get a baseline and ovulation time should be avoided. Optimum values are between 8.0 – 9.0 ug/dL

**T-3 Uptake** – This can be a confusing test because of the name and also the method of testing. T-3 Uptake is more properly called T-3 Resin Uptake. A known amount of radioactive T-3 is added to the serum sample along with a resin substance; some of the T-3 is taken up preferentially by available binding sites on Thyroid Binding Globulin and the remainder is that is bound to the resin. The resulting percentage reflects the leftover portion of T-3 that is bound to the resin. This is why a lower percentage finding indicates a hypothyroid and a higher percentage indicates a hyperthyroid. The test may also reflect a deficiency of TBG but in most cases the indications are as described. It should be noted that T-3 Uptake does not measure serum T-3 levels. The best way to measure the true status of the thyroid is by Free T-4, Free T-3 and Reverse T-3. Optimum Values are 28 – 32 %

**Free Thyroxine Index** – FTI – A calculated estimate of free T-4, which is the active, unbound fraction of T-4 that enters the cells. The formula for this calculation is T4 (total) x T3 Uptake (%) / 100. Example T4 = 8.0 and T3 Uptake = 30% -- 8 x 30 = 240 / 100 = 2.4 FTI. Since this test corrects for thyroid binding globulin (TBG) abnormalities, it is a useful index of true hormonal status. The index will be lower in hypothyroid conditions and higher in hyperthyroid conditions. Optimal values are 1.9 – 2.5
**TSH** – Thyroid Stimulating Hormone is produced by the anterior pituitary in response to TRH from the hypothalamus, which responds to levels of T-3 and T-4 in a feedback control mechanism. The pituitary will increase the amount of TSH attempting to stimulate greater production of thyroid hormones in hypothyroidism and conversely, increased levels of thyroid hormones present with hyperthyroidism will cause lower amounts of TSH to be present. Levels of TSH of course be associated with pituitary and/or hypothalamus function. Optimal values are the subject of considerable discussion but will be considered to be between 1.5 and 2.5 uIU/ml.

The entire Lab Corp. *Directory Of Services* is available online. This will allow you to look-up information on any test by going to the following link and then clicking on the directory icon in the upper left hand corner of the screen. You can then use the alphabetic keypad to access information on any test, including CPT codes. [http://www.labcorp.com/hcp](http://www.labcorp.com/hcp)
An Overview Of Syndrome X

Syndrome X or Metabolic Syndrome is a group of symptoms, the central issue being insulin resistance or the inability of the body to properly metabolize glucose through insulin. Insulin doesn’t lower glucose as readily as in normal cases and increasing amounts are necessary to keep the level of glucose in check as insulin becomes less effective. This syndrome is directly related to excessive consumption of carbohydrates that rapidly metabolize to sugar and is connected to weight gain, elevated cholesterol and triglycerides, hypertension, diabetes, atherosclerosis, polycystic ovary disease, magnesium loss, acidic pH, decreased serum phosphorus and candida. Vitamin, mineral and other nutritional deficiencies are also predisposing factors along with lack of exercise and poor diet.

Syndrome X, also called Metabolic Syndrome or Cardiometabolic Syndrome was recently given defining parameters through an article in the Journal of the American Medical Association. It is defined in patients having at least 3 of the following parameters:

- Waist measurement of 40 inches or greater in men and 35 inches or greater in women.
- Serum triglycerides level > 150mg/dl.
- HDL cholesterol < 40 mg/dl. in men and < 50mg/dl in women.
- Blood pressure of 135/85 mm Hg. or greater.
- Fasting serum glucose of 110mg/dl or higher.


This JAMA article estimates that nearly 25% of Americans (47 million) have Syndrome X.

Researchers found insulin resistance in the following percentage of patients:

- 66% in subjects with impaired glucose tolerance,
- 84% in those with noninsulin dependent diabetes mellitus (NIDDM),
- 54% in participants with hypercholesterolemia,
- 84% in those with hypertriglyceridemia,
- 88% in subjects with low high-density lipoprotein (HDL) cholesterol levels,
- 63% in participants with hyperuricemia and
- 58% in those with hypertension.

Adrenalin is released after high sugar intake causing rise in BP. Cortisol elevates in response to stress and cause gluconeogenesis and peripheral insulin resistance.

Low phosphorus is an important issue in the blood that deserves greater awareness. The excess serum calcium, which comes from bones and teeth, cannot be fully utilized when phosphorus levels are too low, so it is excreted in the urine or may be deposited in kidneys, arteries and other tissues. Page demonstrated that sugar consumption upsets the natural homeostasis of calcium and phosphorus in the blood and all carbohydrates eventually metabolize to sugar! (Dr. Melvin E Page, Degeneration, Regeneration 1949.)

Diabetes is the eventual winner in at least 1:10 cases of the Syndrome X metabolic battle. When the pancreas can no longer produce enough insulin to overcome resistance, Type 2 diabetes is the natural outcome. Obesity afflicts many victims of Syndrome X due to fat storage and the inability to mobilize fat. There is a sublime sub-paradigm that inhibits weight loss. Try losing weight with elevated cortisol, reverse T-3 and insulin!

Abdominal fat is more resistant to insulin than fat elsewhere in the body; hence it’s connection as a marker for Syndrome X.
**Laboratory Blood Chemistry Assessment**

By definition the primary indicators for Syndrome X are elevated triglycerides, LDL cholesterol and glucose with decreased HDL cholesterol. Also listed below are some useful secondary indicators.

**Insulin** – Lab range – 7-22 uIU/ml. Positive results noted when reduced to < 10 in many individuals

**C-Reactive Protein** – Optimal < 2.

**Fibrinogen** – High values may reflect clotting in the arteries resulting in atherosclerosis; increased risk of cardiovascular disease. Optimal = <300.


**Cortisol** – Evaluates adrenocortical function

**Apolipoprotein Assessment**

**Additional Tests:** Calcium & Phosphorus – should be in 2.5 – 1 ratio; Uric Acid, BUN, Monocytes

Lab Tests give us the ability to diagnose, confirm & monitor progress and effectiveness of protocols.

**Diet Exercise & Supplements**

Eat whatever you want, but at least make an informed choice and understand the implications of poor choices. Atkins type diet may be necessary for a short period to help the body to start burning fat. There must be a balance of acid and alkaline influences in the diet to balance pH. Use pH strips to monitor pH saliva and urine pH – saliva should be 6.8-7.0 and urine should ideally be 6.2 – 6.8.

There is compelling evidence that increasing the intake of monounsaturated or polyunsaturated fats and decreasing saturated fats and using high fiber/low-glycemic index diets may prevent type 2 diabetes and improve insulin sensitivity in established diabetes. Current Therapeutic Algorithms for Type 2 Diabetes” Derek Le Roith, MD, PhD Clin Cornerstone 4(2):38-49, 2001.

Resistance training – weight lifting and machines designed for this purpose - is preferred to “aerobic” exercise like jogging, running, cycling, etc. Walking is a good adjunct. Maximum heart rate should be 180 minus your age. It is only aerobic exercise if the heart rate is at this level. Otherwise – anaerobic!

Useful supplements include: Vitamin E, L-Carnitine, GTF Chromium, Vanadium, Natural B complex, Niacin, Gugulipids, Buffered Vitamin C, Zinc, Coenzyme Q-10, Polycosinol, Lipoic Acid, Omega 3 Fatty Acids, Manganese, Magnesium and Taurine.

There are a number of quality products that offer various appropriate combinations of these nutrients to address Syndrome X and its associated disorders. Meditation and stress management will provide positive benefit.

For years the message has been “Watch those fats”. It should be watch those saturated, hydrogenated and trans fats, but make sure you get plenty of the good fats nature provides, like olive, flax, sunflower seed, sesame, walnut, pumpkin seed, borage and fish oils. The other message that needs to be heard is “Watch those carbs, especially the refined types, because they are really thinly disguised sugars.”

**Good Luck In Your Quest For Better Health**

Bill Beakey, B.A., Dipl. Homeopathic Medicine

Professional Co-op Services, Inc

Toll Free 866-999-4041 email - proserv22@aol.com www.professionalco-op.com
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