Hematology and Chemistry Values

W.B.C. (White Blood Cell Count) -elevated may indicate infection or recent tissue damage

- Normal Adult Range: 3.8 - 10.8 thous/mcl
- Optimal Adult Reading: 7.3
- Higher ranges are found in children, newborns and infants.

NEUTROPHILS and NEUTROPHIL COUNT - this is the main defender of the body against infection and antigens. High levels may indicate an active infection.

- Normal Adult Range: 48 - 73 %
- Segs 54-62% -mature, if elevated indicates infection pt may be recovering from.
- Bands 3-5% -**immature**, if elevated indicates new infection

HEMOGLOBIN (HGB)

Hemoglobin is the iron-containing pigment of red blood cells (RBCs); its function is to carry oxygen from your lungs to all the tissues throughout your body.
Improved oxygen-carrying capacity markedly improves your exercise capacity, brain function (clarity of thinking) and overall quality of life.

- Taking erythropoietin (EPO) improves the RBC count and, thus, the Hb level.
- Normal Adult Female Range: 12 - 16 g/dl
- Normal Adult Male Range: 14 - 18 g/dl
- HEMATOCRIT (HCT), roughly 3x the HGB value
- Normal Adult Female Range: 37 - 47%
- Normal Adult Male Range 40 - 54%

R.B.C. (Red Blood Cell Count)-produced in the bone marrow, so if fractures are present, pt may continue to lose RBCs, but may not be seen outwardly.

- Normal Adult Female Range: 3.9 - 5.2 mill/mcl
- Normal Adult Male Range: 4.2 - 5.6 mill/mcl
- Lower ranges are found in Children, newborns and infants

PLATELET COUNT

- Normal Adult Range: 130 - 400 thous/mcl
- Optimal Adult Reading: 265
- Higher ranges are found in children, newborns and infants

SODIUM - Normal Adult Range: 135-145 mEq/L

Sodium is the most abundant cation in the blood and its chief base. It functions in the body to maintain osmotic pressure, acid-base balance and to transmit nerve impulses.

- Very Low value: seizure and Neurologic signs and symptoms. When replacing sodium, raising the NA not more than 1mEq/L per hour is typical as to not cause neurologic changes.
- Low Na (hyponatremia): Occurs when sodium intake is low but fluid intake is not. Can cause edema (fluid in body tissues), headache (fluid in brain tissue), and muscle cramps.
- High Na (hypernatremia): Caused by high sodium intake or excessive fluid loss via persistent vomiting or diarrhea. Symptoms include extreme thirst (thus temptation to drink a lot of fluid), confusion, seizures, and coma in severe cases.

POTASSIUM - Potassium is the major intracellular cation. Elevated-will decrease heart rate and bradyarrythmias. Decreased-will cause tachyarrythmias.

- Normal Range: 3.5 - 5.5 mEq/L
- Low K (hypokalemia): caused by severe diarrhea and/or vomiting. Symptoms include fatigue, feeling of weakness in muscles, changes in heart function.
- High K (hyperkalemia): most common cause is dietary intake or inability to urinate or have a bowel movement. Also can occur as a result of infection, or of taking certain medications.

CHLORIDE - Elevated levels are related to acidosis as well as too much water crossing the cell membrane. Decreased levels with decreased serum albumin may indicate water deficiency crossing the cell membrane (edema).

- Normal Adult Range: 95-105 mEq/L

CO2 (Carbon Dioxide) - The CO2 level is related to the kidney's bicarbonate buffering system. Generally when used with the other electrolytes, it is a good indicator of acidosis and alkalinity.

- Normal Adult Range: 22-32 mEq/L
- Renal Related
- BUN 10-20 mg/dl
- Creat 0.5-1.5 mg/dl

B.U.N. (Blood Urea Nitrogen) - Low urea level: not eating properly (or unable to keep food down). Either is a serious cause for concern. Pre dialysis BUN should not consistently be below 60 mg/dl (21 mmol/L). This places you at risk for multiple complications. Decreased levels may be due to a poor diet, malabsorption, liver damage or low nitrogen intake.

- High urea level: can be due to unusually high protein intake, GI bleeding, infection.
- Kidney damage, certain drugs, low fluid intake, exercise or heart failure.

CREATININE - Creatinine is a waste product of muscle metabolism. The amountof creatinine in the blood of ESRD patients reflects the amount of muscle cells present to produce it. (Thus, in general, men have higher creatinine levels than women; young people have higher levels than the elderly.) A change in your usual creatinine level is more significant than its absolute value.

- Low levels are sometimes see in not eating, protein starvation, liver disease or pregnancy.
- Elevated levels are sometimes seen in kidney disease due to the kidneys job of excreting creatinine, muscle degeneration, and some drugs involved in impairment of kidney function.

CALCIUM - Calcium is needed for normal muscle action and bone structure.

- Normal: 8.5-10.5 mg/dl (2.12-2.61 mmol/L)
- Low Ca: Results from malnutrition (i.e., inadequate calcium intake), or failure to take phosphorus (PO4) binders. High phosphorus will drive calcium ions into cells; a certain amount of ionized calcium must be circulating in the blood for normal cardiac contractions to take place. Symptoms of low calcium include muscle twitching, cramping or, in extreme cases, generalized seizures.
- High Ca: Can result from taking too high a dose of calcium-containing phosphate binders. MD may need to adjust your prescription. High calcium can cause a wide variety

of symptoms: loss of appetite, nausea and vomiting, weakness, fatigue, lethargy, confusion, irritability, even coma.
- Regulated by parathyroid.

MAGNESIUM – plays a role in neuromuscular activity and influences calcium, potassium, and protein, also functions in the activation of enzymes for carbohydrate and protein metabolism.
- Normal Adult Range: 1.8 – 3 mg/dl

PHOSPHORUS - Generally inverse with Calcium.
- Normal Adult Range: 2.5 - 4.5 mEq/dl

Albumin is a protein that helps maintain fluid balance within blood vessels.
- Normal: 3.5-5.0 g/dl (35-50 g/L)
- Low albumin levels indicates malnutrition (21 days), liver disease, and/or chronic infection. Low levels are also linked to increased rates of hospitalization and early death in ESRD patients. It is essential to eat enough protein so that serum albumin is maintained at the desired level. Prealbumin indicates recent malnutrition.

Heart Indicators
CPK or CK, CPK is found in the heart muscle, liver, skeletal muscles (such as in the arms and legs), and in the brain. **CK/MB (CPK-MB)** is found mostly in the heart muscle. Troponin I or Troponin T, Myoglobin

LDH is found in many other body tissues, including the liver, kidneys, skeletal muscles, the brain, and the lungs. LDH-1 is a subtype of LDH that is found mainly in red blood cells and in heart muscle. However, LDH is not generally used to diagnose heart attack.

Troponin I is released only by heart muscle. Normal Values and units vary from lab to lab.
- Abnormal: Blood levels of troponin I typically rise within 4 to 6 hours after a heart attack, reach peak concentrations within 10 to 24 hours, and fall to normal levels within 10 to 15 days. Levels above 1.5 ng/mL support a diagnosis of heart attack.

BNP – Brain/Beta Natriuretic Peptide, released when the Left Ventricle is stretched too far as with heart failure.
- 80 pg/ml Negative (98% to 99.8% negative predictive value)
- 80-100 pg/ml Undetermined; > 100 pg/ml Positive, common to see > 500 in HF pts

Urine Specific Gravity – 1.010 – 1.030 (Higher indicates dehydration, lower indicates fluid overload)

CVP – (central venous pressure) - 5-10 mmHg – Higher indicates increased fluid going to the right ventricle (indirect measurement of preload) – too low indicates low volume.

Cardiac Output (C O) = Stroke Volume (SV) X Heart Rate (HR)

ABG Interpretation

- Look at pH, CO2, and HCO3.
- pH determines whether it is alkalosis or acidosis. Normal is 7.35-7.45, low < 7.35 is acidotic, values < 7.2 is critically low and > 7.6 is critically high, life threatening.
- PaCO2 is carbon dioxide, what pts exhale. Normal is 35-45. It is the acid in the acid/base balance.
- HCO3 is Bicarbonate, what pts' kidneys put out to act as the buffer or base. Normal is 22-26. It is the base in the acid/base balance.

Respiratory System

PaCO2 < 35 shows alkalosis. This will raise the pH. It is usually caused by increasing rate or volume of breathing.

- Tx by decreasing rate or volume.
- PaCO2 > 45 shows acidosis. This will lower the pH. It is usually caused by decreasing rate or volume of breathing. Restrictive Lung Disease will produce this COPD, asthma, bronchitis, etc.
- Tx this by increasing rate or volume
- Remember pH is the determining factor. If pH is normal, the acid/base balance may be compensating for changes in CO2 or HCO3.

Metabolic System

HCO3 < 22 shows acidosis. This will lower the pH. This might indicate decrease in renal function, post-op heart surgery, large blood transfusions.

- Tx is to treat underlying cause. NaHCO3 (sodium bicarb.) may be given to raise pH.
- HCO3 > 26 shows alkalosis. This will raise the pH. Causes include diarrhea or large gastric loss.
- Tx is to tx underlying problem.
- Remember pH is the determining factor. Look at the pH, first.

Determining the Problem

Look first at pH. It is acidosis < 7.35 or alkalosis > 7.45 or is it normal.

- Then look at the PaCO2 and the HCO3 to see which one is causing the pH to change or both.
- If pH is acidosis and PaCO2 is high, it is respiratory acidosis.
- If pH is acidosis and HCO3 is low, it is metabolic acidosis.

Determining the Problem

If the pH is high, alkalosis, then look at CO2, if it is low, then it is respiratory alkalosis.
If the pH is high, alkalosis, then look at HCO3, if it is high, then it is metabolic alkalosis.

- If pH is normal but the CO2 and the HCO3 are abnormal, we know then the body is compensating and we see which one is causing the pH to change closer to its side (acid or base).
- **Studies**
- PH 7.18, PaO2 75%, PaCO2 22, HCO3 16