Lab Values: Cheat Sheet


**Red Blood Cells (RBC):**
- Normal: male = 4.6-6.2 x 10^6 cells/mm³   female = 4.2-5.2 x 10^6 cells/mm³
- Actual count of red corpuscles

**Hemoglobin:**
- Normal: male = 14-18 g/dl   female = 12-16 g/dl
- A direct measure of oxygen carrying capacity of the blood
  * Decrease: suggests anemia
  * Increase: suggests hemoconcentration, polycythemia

**Hematocrit (aka packed cell volume):**
- Normal: males = 39-49%   female = 35-45%
- = the percentage of blood that is composed of erythrocytes
  - Hct = RBC X MCV
  * Low: in anemics or after acute heavy bleeding
  * High: pt has thick and sludgy blood.

**Mean Cell Volume (MCV):**
- Normal: male = 80-96   female = 82-98
- = Hct / RBC
  * Large cells = macrocytic: due to B-12 or folate deficiency
  * Small cells = microcytic: due to iron deficiency
  * Increased: caused by elevated reticulocytes

**Mean Cell Hemoglobin (MCH):**
- Normal: 27-33 pg/cell
- = % volume of hemoglobin per RBC
- = Hgb / RBC
  * Increase: indicates folate deficiency
  * Decrease: indicates iron deficiency

**Mean Cell Hemoglobin Concentration:**
- Normal: 31-35 g/dL
- = Hgb / Hct
  * Decrease: indicates iron deficiency

**Reticulocyte Count:**
- Normal: 0.5-2.5% of RBC
- An indirect measure of RBC production
  * Increase: during increased RBC production
Red Blood Cell Distribution Width (RDW):
- Normal: 11-16%
- Indicates variation in red cell volume
- *Increase:* indicates iron deficiency anemia or mixed anemia
- Note: increase in RDW occurs earlier than decrease in MCV therefore RDW is used for early detection of iron deficiency anemia

Platelet Count:
- Normal: 140,000 – 440,000/uL
- Due to high turnover, platelets are sensitive to toxicity
- *Low:* worry patient will bleed
- *High:* not clinically significant

White Blood Cell (WBC):
- Normal: 3.4 – 10 x 10³ cells/mm³
- Actual count of leukocytes in a volume of blood
- Can help confirm diagnosis. Can NOT diagnose based solely on WBC count!
- *Increase:* occur during infections and physiologic stress
- *Decreases:* marrow suppression and chemotherapy
- Differential = Seg/Band/Lymph/Mono/Eos/Baso
  - Shift to the left: implies the % of segs and bands (neutrophils) has increased. Often due to inflammation or infection
  - Note: differential must add up to 100%
- Neutrophils
  - Normal: 45-73%
  - *Increase:* mostly due to bacterial infection
- Eosinophils
  - Normal: 0-4%
  - *Increase:* due to parasitic infection and hypersensitivity reaction (drug/allergic rxn)
  - Absolute count = %Eos X WBC
- Basophils
  - Normal: 0-1%
  - Play a role in delayed and immediate hypersensitivity reactions
  - *Increase:* seen in chronic inflammation and leukemia.
- Lymphocytes
  - Normal: 20-40%
  - *Increase:* occurs in mono, TB, syphilis and viral infections
  - *Decrease:* HIV, radiation and steroids
- Monocytes
  - Normal: 2-8%
  - *Increase:* during recovery from bacterial infection, leukemia, TB-disseminated infxn

Sodium (Na):
- Normal: 136-145 mEq/L
- Major contributory to cell osmolality and in control of water balance
* Hypernatremia: greater than 145 mEq/L
  - Causes: sodium overload or volume depletion
  - Seen in: impaired thirst, inability to replace insensible losses, renal or GI loss
  - S/sx: thirst, restlessness, irritability, lethargy, muscle twitching, seizures, hyperrflexia, coma and death.
* Hyponatremia: 136 or less
  - Causes: true depletion or dilutional
  - Occur in: CHF, diarrhea, sweating, thiazides
  - Signs: abnormal sensorium, depressed DTR, hypothermia and seizures
  - Symptoms: agitation, anorexia, apathy, disorientation, lethargy, muscle cramps and nausea

**Potassium (K):**
- Normal: 3.5-5.0 mEq/L
- Regulated by renal function
* Hypokalemia: less than 3.5 mEq/L
  - Indicates: true depletion of K or apparent depletion (shifting due to acid-base status, dextrose, insulin or beta agonist)
  - Causes: True deficit
    - Decreased intake (tea and toast, bulimia, alcoholism)
    - Increased output (vomiting, diarrhea, laxative abuse, intestinal fistulas)
    - Increased renal output (steroids, amphotericin, diruretics, cushings syndrome, licorice abuse)
  - Apparent deficit
    - Alkalosis, insulin, beta adrenergic stimulants
  - S/sx: Cardiovascular (hypotension, PR prolongation, rhythm disturbances, ST depression, decreased T waves), Metabolic (decreased aldosterone release, decreased insulin release, decreased renal response to ADH), Neuromuscular (areflexia, cramps, weakness) and/or Renal (inability to concentrate urine, nephropathy)
* Hyperkalemia: greater than 5.0 (panic > 6)
  - Causes: True excess
    - Increased intake (salt subs, drugs)
    - Endogenous (rhabdomyolysis, hemolysis, muscle crush injury, burns)
    - Decreased output (renal failure, NSAIDS, ACE, Heparin, TMP, k sparing diuretics, adrenal deficiency)
  - Apparent excess
    - Metabolic acidosis
  - S/sx: cardiac rhythm disturbances, bradycardia, hypotension, cardiac arrest (severe) muscle weakness

NOTE: False K elevations are seen in hemolysis of samples!

**Chloride (Cl):**
**Chloride:**
- Normal: 96-106 mEq/L
- Chloride passively follows sodium and water
- Chloride increases or decreases in proportion to sodium (dehydration or fluid overload)
  * **Reduced:** by metabolic alkalosis
  * **Increased:** by metabolic or respiratory acidosis

**Bicarbonate (HCO3):**
- Normal: 24-30 mEq/L
- The test represents bicarbonate (the base form of the carbonic acid-bicarbonate buffer system)
  * **Decreased:** acidosis
  * **Increased:** alkalosis

**GLUCOSE:**
- Fasting level is the best indicator of glucose homeostasis
  - Normal: 70-110 mg/dl
  - **Hyperglycemia:**
    - s/sx: increase thirst, increase urination and increased hunger (3Ps). May progress to coma
    - causes: include diabetes
  - **Hypoglycemia:**
    - s/sx: sweating, hunger, anxiety, trembling, blurred vision, weakness, headache or altered mental status
    - causes: fasting, insulin administration

**BUN:** Blood Urea Nitrogen
- Normal: 8-20 mg/dl
- May be a reflection of GFR and important in renal function
- May be used to assess or monitor hydration status, renal function, protein tolerance and catabolism.
- Panic = > 100 mg/dl
  - **Increased:** leads to……
    - Pre-renal: decreased renal perfusion, dehydration, blood loss, shock, severe heart failure, increased protein breakdown, GI bleed, crush injury, burn, fever, steroids, TCN, excessive protein intake
    - Renal: acute renal failure, nephrotoxic drugs, glomerulonephritis, chronic renal failure, analgesic abuse
    - Post-renal: obstruction
  - **Decreased:**
    - Causes: malnutrition, profound liver disease, fluid overload (dilutional)
- BUN by itself is not really clinically significant. Look at it in correlation with SCr

**Serum Creatinine (SCr):**
- Normal: 0.7-1.5 mg/dl for adults and 0.2-0.7 mg/dl for children
- SCr is constant in patients with normal kidney function.
  - **Increase:**
Indicates worsening renal function
Causes: aminoglycosides, amphotericin, cyclosporine, lithium, MTX, cimetidine, dehydration, renal dysfunction, urinary tract obstruction, excess catabolism, exercise, hyperprexia, hyperthyroidism.

**BUN/SCr Relationship**
- Normal ration is 10:1
- > 20:1 → pre-renal causes of dysfunction
- 10:1-20:1 → intrinsic renal damage
- 20:1 ration may be “normal” if both BUN and SCr are wnl.

**Total Protein and Albumin:**
- Total protein: normal = 5.5-9.0 g/dl
- Albumin: normal = 3.5-5 g/dl
  - Responsible for plasma oncotic pressure and give info re liver status
* Low:
  - Leads to fluid leakage (edema) in low areas (ex: ankles if standing) due to decrease in oncotic pressure
  - Cause: liver dysfunction
  - S/sx: peripheral edema, ascites, periorbital edema and pulmonary edema.
  - May effect Ca and medication levels (those bound to albumin)
  - Treatment: find underlying problem or give albumin

**Serum Calcium (Ca):**
- Normal = 8.5-10.8 mg/dl
- Corrected calcium = [ (4-Alb) * 0.8mgdl] + apparent Ca
* Hypocalcemia: less than 8.5 mg/dl
  - Causes: low serum proteins (most common), decreased intake, calcitonin, steroids, loop diuretics, high PO4, low Mg, hypoparathyroidism (common), renal failure, vitamin D deficiency (common), pancreatitis
  - S/sx: fatigue, depression, memory loss, hallucinations and possible seizures or tetany
  - Lead to: MI, cardiac arrhytmias and hypotension
  - Early signs: finger numbness, tingling, burning of extremities and paresthias.
* Hypercalcemia: more than 10.8 mg/dl
  - Cause: malignancy or hyperparathyroidism (most common), excessive IV Ca salts, supplements, chronic immobilization, Pagets disease, sarcoidosis, hyperthyroidism, lithium, androgens, tamoxifen, estrogen, progesterone, excessive vit D or thyroid hormone.
  - Acute (>14.5) s/sx: nausea, vomiting, dyspepsia and anorexia
  - Severe s/sx: lethargy, psychosis, cerebellar ataxia and possibly coma or death
  - Increased risk of digoxin toxicity

**Phosphate (PO4):**
- Normal: 2.6-4.5 mg/dl
* Hypophosphatemia: less than 2.6 mg/dl
Causes: increased renal excretion, intracellular shifting and decreased PO4 or vitamin D intake
Symptoms (no apparent until less than 2 mg/dl): neurological irritability, muscle weakness, paresthesia, hemolysis, platelet dysfunction and cardiac and respiratory failure.
* **Hyperphosphatemia**: greater than 4.5 mg/dl

Causes: decreased renal excretion (common), shift of PO4 extracellularly, increased intake of Vit D or PO4 products
S/sx: hypocalcemia and hyperparathyroidism. Renal failure may occur.

**Magnesium (Mg):**
- Normal: 1.5-2.2 mEq/L
- Primarily eliminated by the kidney
* **Hypomagnesemia**: less than 1.5 mEq/L
  - Causes: excessive losses from GI tract (diarrhea or vomiting) or kidneys (diuretics).
  - Alcoholism may lead to low levels
  - S/sx: weakness, muscle fasciculation with tremor, tetany, increased reflexes, personality changes, convulsions, psychosis, come and cardiac arrhythmia.
* **Hypermagnesemia**: more than 2.2 mEq/L
  - Causes: increased intake in the presence of renal dysfunction (common), hepatitis and Addisons disease
  - S/sx: at 2-5 mEq/L = bradycardia, flushing, sweating, N/V, low Ca
  - at 10-15 mEq/L = flaccid paralysis, EKG changes
  - over 15 = respiratory distress and asystole.

**Alkaline Phosphatase:**
- Normal: ranges vary widely
- Group of enzymes found in the liver, bones, small intestine, kidneys, placenta and leukocytes (most activity from bones and liver)
* **Increased**: occurs in liver dysfunction

**Aminotransferases (ALT and AST):**
- ALT and AST are measure indicators of liver disease. Sensitive to hepatic inflammation and necrosis.
- Normal AST: 8-42 IU/L (found in liver, cardiac muscle, kidney, brain and lungs)
  - Increase: occurs after MI, muscle diseases and hemolysis.
- Normal ALT: 3-30 IU/L (enzyme found primarily in liver, also in muscle)
* Ratio of AST:ALT of 2:1 suggests ALD (alcoholic liver disease)

**Lactate Dehydrogenase (LDH):**
- Normal: 100-225 IU/L, but varies
* Increase: Due to hemolysis, Gilberts syndrome, Crigler-Najar syndrome or neonatal jaundice. Does NOT relate to liver disease.

**Direct Bilirubin (Conjugated):**
- Normal: 0.1-0.3 mg/d;
* Increase: associated with increases in other liver enzymes and reflect liver disease

**Urine:**
- Normal: should be clear yellow
* **Cloudy:** results from urates (acid), phosphates (alkaline) or presence of RBC or WBC
* **Foam:** from protein or bile acids in urine
- Side note: some medications will change color of urine
  - Red-Orange: Pyridium, rifampin, senna, phenothiazines.
  - Blue-Green: Azo dyes, Elavil, methylene blue, Clorets abuse
  - Brown-Black: Cascara, chloroquine, senna, iron salts, Flagyl, sulfonoamides and nitrofurantoin

**pH:**
- Normal: 4.5-8
* **Acidic urine:** deters bacterial colonization
* **Alkaline urine:** seen with Proteus mirabilis or tubular defects.

**Specific Gravity:**
- Normal: 1.010 – 1.025
- Varies depending on the particles in the urine
- Good indicator of kidney’s ability to concentrate urine

**Protein content [in urine]:**
- Normal: 0 - +1 or less than 150 mg/day
* **Protein in urine:** indication of hemolysis, high BP, UTI, fever, renal tubular damage, exercise, CHF, diabetic nephropathy, preeclampsia of pregnancy, multiple myeloma, nephrosis, lupus nephritis and others.

**Microscopic analysis of Urine:**
- Urine should be sterile (no normal flora)
- Few, if any, cells should be found
- Significant bacteriuria is defined by an initial positive dipstick for leukocyte esterase or nitrites. If more than 1 or 2 species seen, contaminated specimen is likely.