**EASTERN** Center for Arts and Technology

**Practical Nursing-Basic Lab and Diagnostic Tests**

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|  | **SERUM (BLOOD) TESTS** |  |  |  |
| **HEMATOLOGIC** | **Normal Levels** | **What it Does** |  |  |
| **Complete Blood Count** | http://www.caribbeanmedstudent.com/wp-content/uploads/notes/lab-values/cbcfishbone.png |  | **High Level/Hyper****“philia”** | **Low Level/Hypo****“penia”** |
| Red Blood Cells or Erythrocytes (RBC) |  Men - 4.6–6.2 million/mm3Women – 4.2 – 5.4 | RBC’s transport O2 to body tissues. Body tissues that are adequately oxygenated are said to be well-perfused | DehydrationPolycythemia | Blood Loss |
| Hemoglobin (**H**gb) |  Men - 13.5–18 g/dL Women – 12 – 16 g/dl(**Cut off level to determine if patient needs a blood transfusion is 7-8 g/dL)** | O2 carrying pigment on RBC’s. Bind with iron. Predict the ability of blood to carry O2 | Polycythemia | AnemiasBlood Loss |
| Hematocrit (**H**ct) |  Men - 40–54% Women – 38 – 47% | % of RBC’s in the blood.**H & H done q 6 hours for a patient with an active internal bleed.** | Dehydration | Fluid Overload d/t blood becomes “diluted” with too much water, decreasing the value of Hct. |
| Reticulocyte | 0.8-2.5% or 0.02-0.10 cell/mm3 | Determines if bone marrow is gearing up to produce new RBC’s. **If amount is sufficient the patient may not need to have a blood transfusion because the body will produce its own soon.** | Blood Loss, and bone marrow gearing up to produce more RBC’s | Bone Marrow Suppression |
| Platelets (PLT) | 150,000–450,000/mm3 | Play a vital role in coagulation.**Low Level = Thrombocytopenia (Bleeding Risk)****High Level = Clotting Risk…Stroke)** |  | Bone Marrow Suppression |
| White Blood Cells or Leukocytes (WBC) | 5000–10,000/mm3 | Determine signs of infection**Low Level = Leukopenia (at risk for infection)** |  | ChemotherapyBone Marrow Suppression |
| **WBC Differential**(Different types of WBC’s) | **Normal Levels** | **What it Does** | **High Level** | **Low Level** |
| Neutrophils(Pus) | 54–75% (3000–7500/mm3) | First WBC at site of injury/infection | Acute InfectionsMental Stress | ChemotherapyAplastic Anemia |
| Absolute Neutrophil Count (ANC) | Range = 2500**ANC = WBC x (% of neutrophils + % of bands)** | **An ANC < 1000 = severe immunosuppression. Patient must be in Reverse Isolation** | NA | ChemotherapyAIDS |
| Bands or “Stabs” | 3–8% (3000–7500/mm3) | Immature Neutrophils**(“Shift to the Left” = increased WBC’s, but more immature neutrophils than matured (Segs or Poly’s)….cannot fight infection as well)** | Patient’s immune system not able to fight off infection as well, due to immature cells | NA |
| Eosinophils | 1–4 % (50–400/mm3) | Type of WBCSeen in allergies | Allergic reactionsParasitic Infections |   |
| Basophils | 0-2% | Type of WBCVery small amount in the blood | Leukemia |  |
| Monocytes | 2–8 % (100–500/mm3) | Type of WBCMain function is phagocytosis | TBViral InfectionsChronic Inflammatory Disorders | Prednisone Use |
| Lymphocytes | 25–40% (1500–4500/mm3) | B cells and T cells | Acute Infections | LeukemiaSepsis |
| T lymphocytes | 60–80% of lymphocytes | Attack cells when there is invader/infection**(This is the cell the HIV infects)** |  | AIDS |
| B lymphocytes | 10–20% of lymphocytes | Release antibodies for future infections. |  |  |
| **Red Blood Cell Entices** | **Normal Levels** | **What it Does** | **High Level** | **Low Level** |
| Mean corpuscular volume (MCV)Mean corpuscular hemoglobin (MCH)Mean corpuscular hemoglobin concentration (MCHC) | 76-100 micrometer327–33 picogram33–37 g/dL | Used in analysis of anemia:MCV measures cell sizeMCH measures Hgb concentration in RBC’s(MCH=Hgb/RBC)MCHC measures Hgb concentration availability in RBC’s (MCHC=Hgb/Hct) |  |  |
| **Inflammatory Markers** | **Normal Levels** | **What it Does** | **High Level** | **Low Level** |
| Erythrocyte sedimentation rate (ESR) or “Sed Rate” | Men - ≤20 mm/hr Women - ≤30 mm/hr | Indicator of non-specific inflammation | Inflammation and Infectious processes |  |
| Antinuclear Antibody Panel (ANA) | Negative Test – Normal Result | Used to detect autoimmune disorders |  |  |
| C-Reactive Protein (CRP) | < 3.0 mg/L | Hepatic enzyme that is an indicator of non-specific inflammation | High level has increased risk for CV disease |  |
| **Coagulation Labs** | http://upload.wikimedia.org/wikipedia/commons/c/c2/Coagulation_diagram.png | **What it Does** | **High Level** | **Low Level** |
| Prothrombin time (PT) | 9.6–11.8 sec (if not on Coumadin),If on Coumadin you want the level to be a bit higher. | Evaluates blood coagulation. Used with INR to monitor Coumadin levels.**(Therapeutic vs NON therapeutic levels in patients on Coumadin)** | Too much CoumadinLiver Disease (not on Coumadin, but diseased liver cannot make clotting factors) | Not enough Coumadin |
| International Normalizing Ratio (INR) | **Patients on Coumadin need the desired level (therapeutic) between 2-3** | Used with PT to monitor Coumadin levels. | Too much CoumadinLiver Disease (not on Coumadin, but diseased liver cannot make clotting factors) | Not enough Coumadin |
| Partial thromboplastin time (PTT) | 30–45 sec (for people NOT on Heparin, if ON Heparin, the level should be higher, ie..therapuetic | Used to monitor blood coagulation r/t heparin levels | Too much Heparin | Too little Heparin |
| Bleeding time (duke)(ivy/template) | 1–3 min3-6 min | Used to evaluate platelet function | Bleeding DisordersLiver Disease | NA |
| Platelets | 150,000–450,000 mm3 | Play a vital role in coagulation.**Low Level = Thrombocytopenia (Bleeding Risk)****High Level = Clotting Risk…Stroke)** |  | Bone Marrow Suppression |
| D-dimer | 0.5 mcg/mL | Assists in diagnosing hypercoagulation states. | DVT, PE, DIC, MI |  |
| **CHEMISTRY** |  | **What it Does** | **High Level** | **Low Level** |
| Sodium (Na+) | 135–145 mEq/L | Low Level – HyponatremiaHigh Level – Hypernatremia**(Analysis should consider the volume of fluid circulating in which fluid compartment, abnormal levels could be dilutional)** | DehydrationPolyuria (DI)Decreased ADH | Excessive sweating, vomiting or diarrheaDiuretic UseIncreased ADH |
| Potassium (K+) | 3.5–5.0 mEq/L | Low Level – HypokalemiaHigh Level – Hyperkalemia | **K-sparing diuretics****Salt Substitutes using potassium**Crush injuries (push K+ form cell) | **Loop Diuretic Use**Vomiting/DiarrheaDKA**(can increase digoxin levels, check arrhythmias)** |
| Chloride (Cl-) | 95–105 mEq/L | Levels are analyzed with other electrolytes. |  |  |
| Calcium-Total (Ca+)Calcium-Ionized (Ca+) | 9–11 mg/dL 4.5-5.6 mg/dL | Calcium is controlled by the parathyroid hormone. Calcium levels provide information on bone, hepatic, and other organ function.  | Prolonged ImmobilitySome Tumors**(increase fluids, OOB and moving)** | Laxative MisuseSteatorrhea/Pancreatitis**(seizure precaution, check for tetany, hyperactive DTR’s)** |
| Phosphorus/phosphate (PO-) | 2.4–4.7 mg/dL | Vital to various metabolic processes and has an **inverse relationship with calcium, If there is a high Ca+, then the PO is low and vice-versa** | Renal FailureHypoparathyroidismExtreme Trauma | Malnutrition**(check for tetany)** |
| Magnesium (Mg+) | 1.8-3.0 mg/dL  | Vital to various metabolic processes | Renal FailureOccurs with hypocalcemia | DiabetesOccurs with hypercalcemia |
| Glucose or Blood Sugar (BS) | 65–99 mg/dL | Can be Random, Fasting or in an Oral Glucose Tolerance Test (OGTT)**Analysis based on timing with last food consumed.** | DiabetesSteroid Use | DiabetesLack of calories |
| Hemoglobin A1C (Hg A1C) | < 7% (Goal for DM)4-6% (Non DM) | Since glucose molecules bind to hemoglobin longer, this tests is used to indicate the average amount of glucose in the blood over several months | Uncontrolled DM |  |
| Osmolality, Serum | 285–310 mOsm/kg | Assess F & E balance r/t hydration status. Must analyze along with urine osmolality and electrolytes(Increase level = dehydration)(Decreased level = over hydration) | DehydrationDiabetes InsipidusHypercalcemiaHypernatremia | HyponatremiaSIADHWater Intoxication |
| Ammonia (NH3) | 10–80 mcg/dL | Toxic nitrogenous (protein) waste productResponsible for urine’s odor | Liver Failure (liver cannot break down ammonia, builds up and causes brain dysfunction |  |
| Amylase | ≤130 U/L | Pancreatic enzyme that digests carbohydrates (CHO) | Pancreatitis |  |
| Lipase | <60 U/L | Pancreatic enzyme that help digests fat | Pancreatitis |  |
| Protein, total (TP) | 6–8 g/d | Protein is essential to all physiologic functions. |  | Malnutrition |
| Albumin (ALB) | 4–6 g/dL | The type of protein with the highest concentration in the body. Evaluate nutritional status and edema. |  | AlcoholismMalnutritionCirrhosis |
| **Hepatic** | **Normal Levels** | **What it Does** | **High Level** | **Low Level** |
| Aspartate aminotransferase (AST)Alanine aminotransferase (ALT)Alkaline phosphatase (ALP) | 8–46 U/L10–30 IU/mL20–90 U/L | Enzymes are analyzed in conjunction to monitor or assist with the diagnosis of hepatic disease and other disorders | Liver Disease |  |
| Total bilirubin | 0.3–1.2 mg/dL | Bilirubin is a pigment produced by the liver that is stored in RBCs and released during cell breakdown, most commonly causing Jaundice. | Hemolysis of bloodcellsHyperbilurubina of Prematurity |  |
| **Renal** | **Normal Levels** | **What it Does** | **High Level** | **Low Level** |
| BUN | 6–20 mg/dL | Metabolic waste product. Evaluated in kidney function and hydration status | DehydrationKidney Failure | Overhydration |
| Creatinine (Cr) | 0.6–1.3 mg/dL | Metabolic waste product. **Determines Renal function**. **Small increases are significant**. | Kidney FailureMajor trauma/muscle damage  |  |
| Uric acid | 4.0–8.5 mg/dL | Metabolic waste product | Gout |  |
| **General Muscle Breakdown Markers** | **Normal Levels** | **What it Does** | **High Level** | **Low Level** |
| Creatine Kinase (CK), Total | <150 U/L | Enzyme found in the body, has 3 “isoenzymes”, CK-BB (Brain), CK-MS (Skeletal Muscle) and CK- MB (Heart) | Increased with any cell damage |  |
| Lactic dehydrogenase (LDH) | 50-150 U/L | To assess heart or skeletal muscle damage. | Increased with any cell damage |  |
| **Heart** | **Normal Levels** | **What it Does** | **High Level** | **Low Level** |
| Troponin T and Troponin I |  < 0.1 ng/mL < 0.03 ng/mL | Cardiac specific enzyme that is released from damaged cardiac muscle.Peaks 12-14 hours after an MITaken in a series for diagnosis (Q8 hours x 3) |  |  |
| Creatine kinase isoenzymes, CK-MB | >5 ng/mL | Elevated levels diagnose MIPeaks in 24 hoursTaken in a series for diagnosis (Q8 hours x 3) |  |  |
| B-Type natriuretic Peptide (BNP) | 0.5-3.0 pg/mL | Assists in diagnosis of heart failure especially when patients present with SOB and fluid retention | Heart Failure |  |
| **Lipid Panels** | **Normal Levels** | **What it Does** | **High Level** | **Low Level** |
| Total Cholesterol | <200 mg/dL (normal)200-240 (borderline high)>240 (high) | High lipid levels put a person at higher risk for Cardiovascular diseases. | obesity, sedentary, smoking, diet high in refined CHO |  |
| Low Density Lipoprotein (LDL) | <100 mg/dL | **BAD** Cholesterol**“L – lose the low”** | obesity, sedentary, smoking, diet high in refined CHO |  |
| High Density Lipoprotein (HDL) | >50 mg/dL | **GOOD** Cholesterol**“G- for GO”**Have protective CV benefitsPre-menopausal women typically have higher levels. |  |  |
| Triglycerides | <150 | Risk factor for metabolic syndrome (HTN, High Cholesterol, Truncal obesity) | obesity, sedentary, smoking, diet high in refined CHO |  |
| **Thyroid** | **Normal Levels** | **What it Does** | **High Level** | **Low Level** |
| Triiodothyronine (T3) | 2.3-4.2 pg/mL | One of two thyroid hormones. Test used to detect amount of free T3 in blood. Evaluated with TSH |  |  |
| Thyroxine (T4) | 0.8-1.8 ng/L | One of two thyroid hormones. Test used to detect amount of free T4 in blood. Evaluated with TSH |  |  |
| Thyroid Stimulating Hormone (TSH) | 0.4-4.2 U/L | To diagnosis Thyroid conditions, ie. Hypothyroidism. Analysis made in conjunction with T3 and T4 levels. | High TSH and Low T3 and T4 = Hypothyroidism | Low TSH with High T3 and T4 = Hyperthyroidism |
| **Arterial Blood Gases (ABG’s)** | **Normal Levels** | **What it Does** | **High Level** | **Low Level** |
| pH | 7.35–7.45 | The number of free Hydrogen (H+) in the body | **<7.35 = Acidosis** | **>7.45 = Alkalosis** |
| Po2 | 80–100 mm Hg | Partial pressure of Oxygen (O2) in the blood |  |  |
| Pco2 | 35–45 mm Hg | Indicator of ventilation | When high, carbonic acid (H+ ions) stay in the body**. Pt increases respirations to “blow off” the excess CO2** | When low, carbonic acid leaves the body.  |
| O2 saturation | 95–97% | Saturation of O2 in the blood |  |  |
| Bicarbonate (HCO3-) | 22–26 mEq/L | Buffer from kidneys is either absorbing or getting rid of bicarbonate. Whichever is need to maintain acid-base balance |  |  |
| **URINE TESTS** | **Normal Levels** | **What it Does** | **High Level** | **Low Level** |
| pH | 4.5-8.0 | Measures the acidity or alkalinity of urine | Alkaline | Acidic |
| Specific Gravity | 1.010-1.025 | Evaluates fluid status r/t hydration status | Over-hydration | Dehydration |
| Osmolality, Urine |  | Evaluate the kidneys ability to concentrate urine. | Renal Failure/AzotemiaCHFSIADH | DIHypernatremiaHypokalemia |
| **MICROBIOLOGY** | **Normal Levels** | **What it Does** | **High Level** | **Low Level** |
| Cultures and Sensitivity(C & S) | Normal = Negative for bacterial growth | Any body fluid can be cultured. Specimen is obtained using **STERILE PROCEDURE.** Specimen is placed on a petri dish and monitored for 72 hours. Reports on any bacterial growth is typically reported every 24 hours. If there is bacterial growth, small antibiotic disks are put in the petri dish to see which antibiotic kills the bacteria (Sensitivity-bacteria is “sensitive” to such and such antibiotic).**Nursing: Do not administer antibiotics until after cultures are obtained.** |  |  |

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| **TEST** | **INDICATION** | **NURSING ACTION** |
| **RADIOLOGY** |  |  |
| Plain X-Rays | Used to diagnose skeletal (bone) disorders | * Remove any metal from body part to be imaged, ie for CXR, remove bra
 |
| Barium Enema or Barium Swallow | Diagnose bowel disorders. Procedure requires the patient to drink barium to enhance the image. | * Hydrate well until all barium (white) passes in stool
* Consume foods high in fiber to help clear barium
* Allow 2-4 days before scheduling other GI tests.
 |
| Mammography | To diagnose breast disorders | * Remove deodorant and powder from axilla and breasts
 |
| Computed Tomography (CT) General | Used to diagnose soft tissue and bone disorders. Imaging may be enhanced by administering a PO or IV radiopaque dye (iodine contrast medium) | * Check allergy to iodine and shellfish
* Check renal function
* Hydrate pre and post procedure
 |
| CT Angiography (CTA) | To visualize and access vascular structures. Procedure requires a radiopaque dye (iodine contrast medium). | * Check allergy to iodine and shellfish
* Check renal function
* Hydrate pre and post procedure
 |
| Magnetic Resonance Imaging (MRI) | Evaluates organ for disease. Used to diagnose soft tissue and bone disorders. Imaging may be enhanced by administering a PO or IV radiopaque dye (iodine contrast medium) | * No metal allowed in MRI room.
* Patient for implanted metals, ie…pacemaker
* Patient for claustrophobia
* Patient may wear earphones to block out noise caused by machine.
* If contrast used:
	+ Check allergy to iodine and shellfish
	+ Check renal function
	+ Hydrate pre and post procedure
 |
| Magnetic Resonance Angiography/Venography (MRA/MRV) | Visualize and assess blood flow in blood vessels to diagnose vascular disorders. Imaging may be enhanced by administering a PO or IV radiopaque dye (iodine contrast medium). | * No metal allowed in MRI room.
* Patient for implanted metals, ie…pacemaker
* Patient for claustrophobia
* Patient may wear earphones to block out noise caused by machine.
* If contrast used:
	+ Check allergy to iodine and shellfish
	+ Check renal function
	+ Hydrate pre and post procedure
 |
| Positron Emission Tomography (PET) | Assess blood flow and metabolic processes. The procedure requires administration of an IV administered **radioactive** material. | * Check allergy to iodine and shellfish
* Check renal function
* Hydrate pre and post procedure
* Post procedure:
* Wear gloves when discarding urine for 24 hours
* Instruct patient to flush toilet and wash hands with soap and water after each void for 24 hours.
 |
| Nuclear Medicine | Diagnose and evaluate body systems by using an IV administered **radioactive** substance to enhance the image. | * Follow post procedure orders dealing with clearance of the radioactive substance.
* Check allergy to iodine and shellfish
* Check renal function
* Hydrate pre and post procedure
* Post procedure:
	+ Wear gloves when discarding urine for 24 hours
	+ Instruct patient to flush toilet and wash hands with soap and water after each void for 24 hours.
 |
| Ultrasound (US) | Evaluates an organ for disease. A topical gel is placed on the site to be imaged to decrease friction between probe and skin and to improve conduction of the image.  | * Dependent upon organ tested, ie Bladder US - requires full bladder.
* Remove residual gel from skin.
 |
| Coronary Angiography (Cardiac Cath) | Detect narrowing or blockage of coronary vessels. Evaluates cardiac muscle function, detects aneurysms and therapeutic procedures can be done, angioplasty (PTCA) and stent placement. Procedure requires a radiopaque dye (iodine contrast medium). | * Check allergy to iodine and shellfish
* Check renal function
* Hydrate pre and post procedure
* Follow post-procedure activity orders
* Check site for bleeding
 |
| Intravenous Pyleogram (IVP) | Assess urinary tract function and/or renal disease. Procedure requires a radiopaque dye (iodine contrast medium). | * Check allergy to iodine and shellfish
* Check renal function
* Hydrate pre and post procedure
 |
| **MISC TESTS** |  |  |
| Electrocardiogram (ECG or EKG) | Evaluate the electric impulses generated by the heart to diagnose heart rhythm disorders, infection and/or enlargement |  |
| Electroencephalography (EEG) | Evaluate electrical activity in the brain to diagnose brain disorders. Electrodes may or may not have needles. | * If sleeping to be evaluated, patient may be given sedative pre ECG.
* Post procedure, remove electrodes, wash hair
 |
| Colonoscopy and Endoscopy | Fiber optic scope inserted in mouth (endoscopy) or rectum (colonoscopy) to directly visualize GI tract. | * Follow pre-procedure orders concerning bowel prep and/or dietary restriction, NPO…
* Twilight anesthesia is used, so patient needs to be treated as post-op, VS taken frequently, NPO until GAG reflex returns.
* Inform patient that burping and flatulence is normal
 |