



Lab Values Course

Lab Values by AHRQ Most Common Diagnosis

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Sepsis Labs

“Patients are given a diagnosis of sepsis when they develop clinical signs of infections or systemic inflammation; sepsis is not diagnosed based on the location of the infection or by the name of the causative microbe. Physicians draw from a list of signs and symptoms in order to make a diagnosis of sepsis, including abnormalities of body temperature, heart rate, respiratory rate, and white blood cell count. Sepsis may be diagnosed in a 72-year-old man with pneumonia, fever, and an increased WBC, and in a 3-month old with appendicitis, low body temp, and low WBC’s.” – Sepsis Alliance

1. SIRS

- Temp > 38C or <36C
- HR > 90 BPM
- RR > 20, PaCo2 < 32 mmHg
- WBC > 12 or < 4, or >10% immune cells

2. **Sepsis:** 2 or greater than the above + suspected infection

3. **Severe Sepsis:** sepsis with organ dysfunction (for example, hypotension)

4. **Septic Shock:** hypotension + impaired end organ function despite IVF resuscitation

LABS!

- CMP w/ anion gap, Magnesium, Phosphate
 - Checking for electrolyte disturbances so we can correct them
 - Anion gap, less than 11 = normal
 - Cation/anions should be equal and are measured in other values. The presence of a large gap indicates an issue with acid/base balance
- CBC w/ diff
 - H/H – anemia assessment.. may need to give blood
 - Bands – assess level of immature neutrophils.. can be an indicator of how severe sepsis is (less than 3% is normal, greater than 10% is cause for concern)
- Type and screen
 - Preparing to give blood products
- ABG (pH, ScvO2/SvO2)
 - Assess degree of compensation

- Dictates treatment during progression so we can maximize O₂ consumption
- PT / INR, PTT
 - Must assess coagulation to see if bleeding is occurring, DIC, etc.
- CK Isoenzymes, Troponin
 - Assess level to identify cardiac compromise; many times sepsis patients will have elevated cardiac markers
- Lactic acid (venous or arterial)
 - Marker for cellular hypoxia; not enough O₂ to the tissues!
 - Normal is less than 1 mmol/L.
 - 4 or greater is bad new bears
 - Serial lactates must be drawn, as they assess the response to therapy
 - Half-life is 20 minutes, so if it's consistently high that means that the body keeps making it (not that it's building up)
 - Typically wanting to see the level decrease 10% by the next draw
 - Decreasing lactate = increasing chance of survival
 - Serial schedule is first draw, then in 3, 5, 9, and 24 hours
- Cultures
 - Blood cultures x 2 sets
 - Absolutely vital these are drawn in a timely manner, BEFORE antibiotics are started
 - UA with reflexive culture test
 - Sputum culture
 - Wound cultures (only if wounds are present)

Acute Renal Failure (ARF)

Acute renal failure (ARF) is when the kidneys cannot filter waste from the blood. It can develop in a matter of hours or days.

MANY things can cause the kidney to begin to fail

Run tests to determine the phase, then the cause, then decide on treatment

Creatinine is a breakdown product of creatine phosphate in muscle, and is usually produced at a relatively consistent rate and is excreted in the urine. A normal creatinine is 0.5-1.2 mg/dL

BUN (blood urea nitrogen) is the amount of nitrogen in your blood that comes from the urea (a waste product), which is produced when protein is broken down in the body. While it's made in the liver, it's excreted via urine. A normal BUN is 8-21 mg/DL.

The **BUN to creatinine ratio** is important – used to determine the cause of the renal failure. Normal is between 10:1 and 20:1.

- Increased ratio (>20:1) can = increased BUN re-absorption. Decreased flow to the kidney (hypoperfusion).
- Decreased ratio (<10:1) can = reduction in re-absorption of BUN... therefore lowering the ration. Problem within the kidneys

Many different urine labs can be ordered for various reasons

- Urine culture
- UA (looking at white and red blood cells, protein, etc.)
- Creatinine clearance

Other labs

- Glomerular filtration rate (GFR): estimates how much blood passes through the glomeruli each minute.
- Coagulation studies
- CMP/BMP
- Therapeutic drug levels
- Blood cultures
- TSH, T3, T4
- Uric acid

Congestive Heart Failure Labs

What is CHF?

In congestive heart failure (CHF), the heart is not as efficient as it should be. In a healthy heart, increased filling of the ventricle results in increased contraction force (by the Frank–Starling law of the heart) and thus a rise in cardiac output. In heart failure this mechanism fails, as the ventricle is loaded with blood to the point where heart muscle contraction becomes less efficient.

No specific gold standard related to diagnostics; various methods are helpful but not definitive

Labs

- CBC
- •MP
- Cardiac enzymes
- T3, T4, TSH
- C-reactive protein (if infection suspected)
- B-type natrietic peptide (BNP)
- N-terminal pro b-type natiuretic peptide (NT-proBNP)

Thyroid and the Heart (T3, T4, TSH)

Hyper/hypothyroidism can cause cardiac changes. Changes in contractcility, SVF, CO, BP, and myocardial O2 consumption. Hyper can cause afib; hypo can cause ventricular dysrhythmias.

C-reactive protein

- CRP = inflammation marker 5-10 mg/L
- Elevated with infectious processes

BNP and pro BNP

Amino acid polypeptide secreted by the ventricles in response to excessive stretching of the heart.. so the heart is stretching/working harder to attempt to meet the body's demands. These will decrease with treatment over time

- Less than 100pg/mL
- ProBNP (N-terminal)
 - Male: less than or equal to 60 pg/mL
 - Female: 12-150 pg/mL

COPD Labs

What is COPD?

COPD is a group of irreversible lung diseases that block airflow, making it very difficult to breathe. Emphysema and chronic bronchitis are most common conditions that cause COPD.

Diagnostics

- PFT
- Chest x-ray
- Pulse oximetry

Labs

- ABG's
 - Assess level of CO2 retention, oxygen utilization
- CMP/BMP
 - Electrolytes, kidney, liver
- CBC
 - H/H for anemia
- Glucose monitoring (if on steroids)
- Blood and respiratory cultures (if signs of infection present)

Dysrhythmias

Abnormal heart rhythm – can be stable or unstable, acute or chronic
ECG and stabilize first

CBC

- H/H, looking for anemia
- WBC, looking for infection

CMP/BMP, Mag, Phos

- Electrolyte disturbances
- Kidney or liver issues

Cardiac markers

- Is there an active MI or did they have one that's causing this abnormality?

BNP

- Identify any congestive heart failure that may be occurring

D-dimer

- Is enough going on to merit a PE work up?

Thyroid function (T3, T4, TSH)

- Hyper and hypothyroidism can cause dysrhythmias
- Hyper can cause afib, hypo can predispose one to ventricular dysrhythmias

Digoxin level (if on dig)

- Therapeutic, subtherapeutic, dig toxicity present?

Tox screen

- Various drugs can cause dysrhythmias

Ischemic Stroke Labs

“**Ischemic stroke** occurs as a result of an obstruction within a blood vessel supplying blood to the brain. It accounts for 87 percent of all **stroke** cases. Hemorrhagic **stroke** occurs when a weakened blood vessel ruptures.”

- American Stroke Association

LABS!

Glucose

- Assess for hypoglycemia
- FSBS or from CMP/BMP

CMP

- Assess electrolytes
 - Hyponatremia can cause cerebral edema
- Assess liver function
 - Preparing to initiate statins
 - Statins block a substances that the body requires to produce cholesterol as well as helps to reabsorb the cholesterol that's on the walls of the vessels
 - Can reduce stroke risk up to 25%

Lipid Panel

- Assess level of cholesterol to prepare for statin initiation
- Not a clear association between cholesterol and all of the causes of strokes, but statins are shown to decrease incidence notably enough to justify starting the med

CBC

- All important, but mainly assessing platelets
 - Platelets less than 100,000 will exclude someone from tPA administration
 - Less than 50,000 is critical result

PT/INR, PTT

- Assess coagulation studies prior to tPA administration and potentially rule out
- aPTT or PTT (activated prothrombin plasmin time) normal is 25-35 seconds

- Assess therapeutic level of INR for patients on anticoagulation for various reasons
 - Less than 2.00 is normal
 - 2.0-3.0 is therapeutic for PE, DVT, valvular heart disease, venous thrombus
 - 2.5-3.5 is therapeutic for a mechanical heart valve and systemic embolism

Laboring Patient

These are labs for a healthy patient and normal delivery

Labor is the most common reason for a hospital admission

- **CBC**
 - Platelets – cannot get epidural if platelets are less than 100,000
 - H/H – hemorrhage is a potential complication, helpful to know where hemoglobin was prior to delivery
- **Type and screen**
 - To prepare for potential hemorrhage complication
 - Also to test for Rh antigen (although hopefully done on outpatient basis)
- RPR or rapid plasma reagin
 - Screening test for syphilis
- If suspected high blood pressures
 - UA
 - Protein
 - CMP
 - Liver enzymes

Pediatrics: Respiratory Admission

Very common, normal occurrence

- Per Cleveland Clinic, up to 6 respiratory infections/year is normal!
- Some can overlap
- More common with kids in daycare, school, or kids with siblings

Bronchiolitis

- Wheezing
- Probably from a respiratory virus (like RSV)
- Spread by direct contact with respiratory secretions
- Less labs the better
- Suspected patients should get a pulse oximetry, then further evaluation if pulse ox is abnormal... then chest x-ray, then additional labs

Labs to anticipate

- CBC with diff
 - White count (typically 8,000-15,000) with a left shift due to stress, however white count is highly variable
 - 50-75% lymphocytes
- CRP, elevated but also highly variable
- Cultures
 - Blood cultures: low potential for sepsis, but good to identify microbe before antibiotics are introduced at some point during admission
 - Trach tube culture,
- Viral testing – if severe enough to justify it
 - Rapid flu to rule out if needed
 - RSV: wash gets better sample than swab, but swab is better than nothing

Pneumonia Labs

Pneumonia is an infection that inflames air sacs in the lungs. These may become filled with fluid or pus and become solid, therefore not allowing appropriate oxygenation to occur. This can be caused by a bacterial or viral infection and affect one lung, both, or only specific lobes.

CBC with or without differential

- WBC and differential; assess for elevation

CMP or BMP

- Electrolyte assessment and replacement PRN

ABG's

- Assesses degree of compensation

Cultures

- Important! Must draw before starting on antibiotics!
- This is essential because we want to know what kind of microbe we are treating. If we draw cultures after antibiotics, we may not be able to ID it and therefore risk not being able to target and treat it appropriately

Therapeutic drug levels

- Therapeutic levels of antibiotics are routinely assessed so dose can be adjusted and maximized
- Time and frequency depends on med
- Typically, you will draw the "trough" 30 minutes before the next dose is due
- Depending on your hospital's policies, you will most likely still administer that next dose (the one in 30 minutes) and then they (the pharmacist or the MD) will adjust the net dose