Clinical Application of Lab Values for Patients in Acute Care

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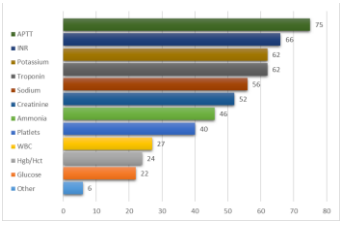
Objectives

1. The learner will be able to locate references for lab value resources for therapy services.
2. The learner will be able to identify what constitutes an abnormal lab value and how it pertains to therapy assessment and interventions.
3. The learner will be able to provide clinical rationale for medically holding therapy interventions in acute care for patients with abnormal lab values.
4. The learner will be able to provide clinical rationale for providing therapy assessment/interventions in acute care for patients with abnormal lab values.

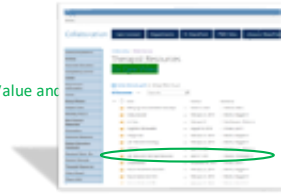


Which lab values

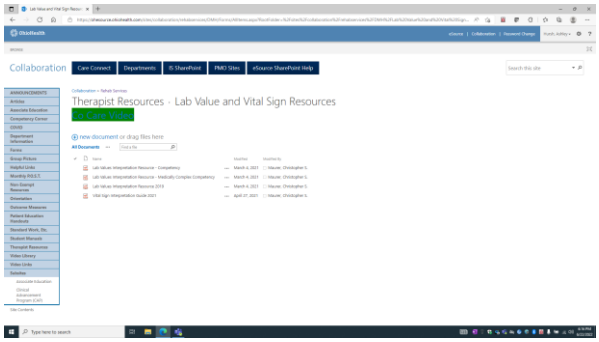
- Survey of all acute care therapists in the system:
- 123 respondents

OH resources available

- eSource: Therapist Resources: Lab Value and Vital Sign Resources (APTA)



- OHIOHEALTH Rehab Clinical Practice Guideline for VTE
  - Referenced from APTA VTE CPG
  - eSource: Standard work: Clinical Practice Guidelines



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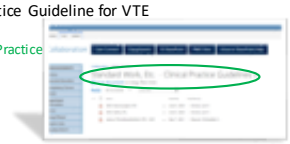
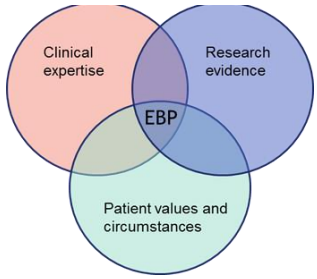
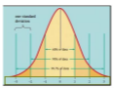


Clinical standardization



*Reference Ranges

- Depicts homeostasis
  - Changes with age, sex, weight, fluid status, physiologic changes
  - Individuals can have different tolerances
- Not meant to be memorized
- Depends on the lab and what reagent kit or diagnostic instrument is used (why ranges will change between hospitals and literature)
- Look at TRENDS!



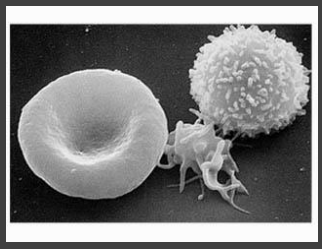
Symptoms based approach

- We shouldn't just look at one specific number in time
- Along with monitoring lab values we should be looking at vitals and symptoms
  - Monitor vitals
    - HR, BP, RR, SpO2, EKG
      - HR <60 or >120
      - SBP <90 or >180
      - SpO2 <90%
      - Dysrhythmia
    - Pt symptomology
      - New onset or worsening
      - Trend (vitals or lab)
  - Collaborate with health care team

Let's get started

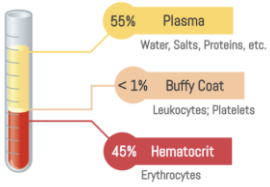
Complete Blood Count- CBC

Red blood cells (RBC), hemoglobin (Hb), hematocrit (Hct), platelet count (PLT), white blood cells (WBC)



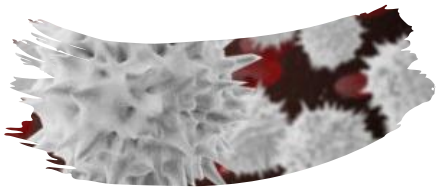
CBC

- Screens for
  - Anemia
  - Infection
  - Issues with coagulation



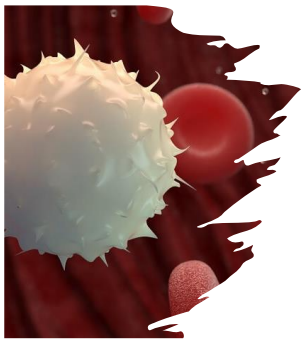
CBC reference ranges

	WBC	Hgb	Hct	Platelets
Males	4.5-11 K/mcL	13.5-17.5 g/dL	41%-53%	150-400 K/mcL
Females	4.5-11 K/mcL	12.0-16.0 g/dL	36%-46%	150-400 K/mcL



White Blood Cells (WBCs)

4.5-11K/mcL



WBCs

- Routine test to identify the presence of infection, inflammation or allergens
- 5 different types of WBCs
  - Neutrophil
  - Basophil
  - Eosinophil
  - Monocyte
  - Lymphocyte

Leukocytosis (>11 K/mcL)

- Infection
- Leukemia
- Neoplasm
- Sickle-cell disease
- Stress/pain
- Chronic inflammation
- Trauma
- Surgery
- Smoking
- Connective tissue disease

- Signs/Symptoms
  - Fever, malaise, lethargy, dizziness, bleeding, bruising, painful inflamed joints, lymphadenopathy
- Rehab implications:
  - Consider timing of therapy: WBC are at lowest levels early in AM and peak in late afternoon

Leukopenia (<4 K/mcL)

- Viral infection
- Chemotherapy/Radiation
- Aplastic anemia
- Autoimmune disease
- Hepatitis
- Leukemia
- Malignant cancer

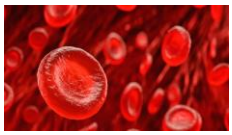
- Signs/Symptoms
  - Anemia, weakness, fatigue, fever, HA, SOB,
- Rehab implications:
  - Questionable tolerance to therapy due to possible presentation of fever, fatigue, weakness and/or SOB

Neutropenia (<1.5 K/mcL)

- Stem cell disorder
- Bacterial or viral infection
- Radiation

- Signs/Symptoms
  - Low-grade fever, skin abscesses, sore mouth
- Rehab implications:
  - Questionable tolerance to therapy due to possible presentation of fever, fatigue, weakness and/or SOB

Red Blood Cells



Hemoglobin (Hb)
Hematocrit (Hct)

	Hgb	Hct
Males	13.5-17.5 g/dL	41%-53%
Females	12.0-16.0 g/dL	36%-46%

Polycythemia

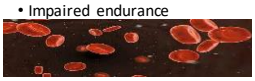
- Congenital heart disease
- Severe dehydration
- COPD
- CHF
- Severe Burns
- High altitude
- Myeloproliferative Neoplasm

- Signs/Symptoms:
  - Orthostasis, presyncope, dizziness, arrhythmias, seizure, CHF onset/exacerbation, angina, symptoms of TIA or MI, headache

Anemia- down-trending Hgb/Hct

- Hemorrhage
- Neoplasia
- Lymphoma
- Systemic lupus erythematosus
- Sarcoidosis
- Renal disease
- Sickle cell anemia
- Splenomegaly
- RBC destruction

- Signs/Symptoms:
  - Decreased endurance, decreased activity tolerance, pallor, tachycardia, orthostatic hypotension, SOB, dizziness, chest pain, arrhythmia, HA, cold hands/feet
- Rehab implications:
  - Impaired endurance



Impact of Low Hgb during PT

"Patients should not be refused treatment because of hemoglobin numbers alone."

"Mobilization of low hemoglobin levels can be safely conducted with the appropriate monitoring of adverse responses."

"By increasing a patient's activity, we improve respiratory function, increase level of consciousness, reduce adverse effects of immobility, and ultimately maximize a patient's functional return and psychological well-being."

Anemia clinical implications

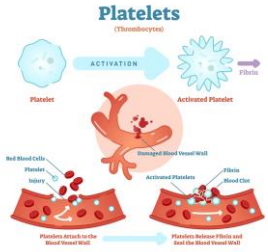
- Monitor vitals including SpO2
  - Assist with predicting tissue perfusion
  - Watch for clinical desaturations (SpO2 <88% during exercise or greater than 4% decrease from rest)
- Consult with medical interprofessional team along with monitoring for signs and symptoms since Hgb levels and blood transfusions are individualized.

Platelets

150-400k/mcL
>450 thrombocytosis/thrombocythemia
<150 thrombocytopenia

Platelets

- Essential component of hemostasis and initiating the clotting cascade



Thrombocytosis (PLT >400K/mcL)

- Response to stress
- Infection/inflammation
- Trauma
- Exercise
- Ovulation
- Splenectomy
- Cancer
- Iron deficiency
- Hemolysis

- Rehab implications:
  - Increases risk for thrombosis formation and increased risk for bleeding, impaired tolerance
- Signs/Symptoms:
  - Weakness, headaches, dizziness, chest pain, tingling hands/feet

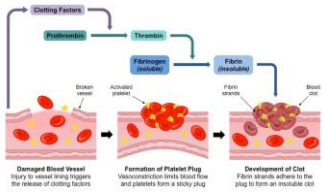
Thrombocytopenia (<140 K/mcL)

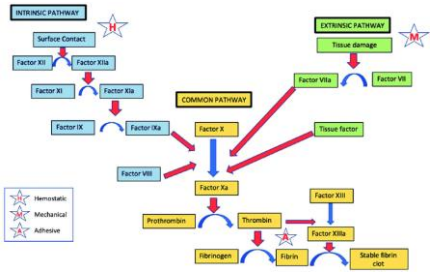
- Leukemia
- Chemotherapy
- DIC
- HIT
- TTP

- Rehab implications:
  - Avoid activities that could cause bruising or falls
  - Avoid resistive exercises to avoid intramuscular bleeding
  - Avoid Valsalva maneuver (blood vessels in eyes/nose)
  - Avoid brushing teeth
- Signs/Symptoms:
  - Petechiae, ecchymosis, fatigue, jaundice

aPTT/INR

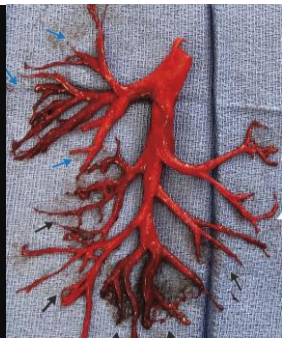
Clotting cascade





Blood viscosity

- Sticky or thickness of blood
- Factors affecting bleeding viscosity
  - Hematocrit
  - Hydration
  - Malabsorption
  - Vitamin K deficiencies
  - Hepatitis/cirrhosis/liver disease



aPTT- activated partial thromboplastin time

- Evaluates the intrinsic pathway of the clotting cascade
- Reference range is variable due to reagents at each lab
  - 23-34 seconds normal range
  - 68-104 seconds therapeutic range
- Utilized in measuring dosage of Heparin
- Review chart to determine reason for use of heparin

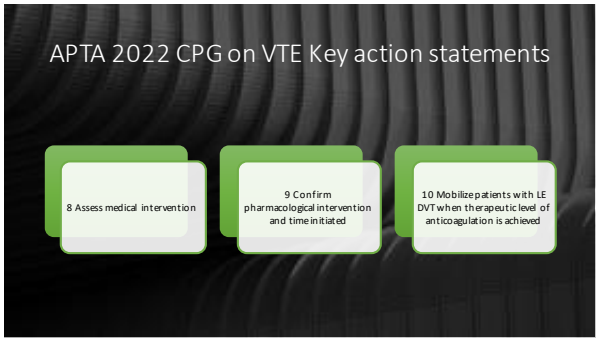
INR- International Normalization Ratio

- Assesses the extrinsic coagulation pathway
- Calculated from the PT (prothrombin time) result to minimize variations between labs
- Monitors dosage/effectiveness of Coumadin (Warfarin)
- Normal 0.8-1.2
- Therapeutic Ranges
  - Most clinical situations: INR 2.0-3.0
  - Mechanical Prosthetic Valve: INR 2.5-3.5
  - Critical: INR >5.0
- Review chart to determine reason for use of Coumadin

INR

- Expert opinion
  - 4-5 resistive exercises should be held and participation in light exercise (RPE ≤11) should be performed
    - Assess for falls and restrict ambulation if gait is unsteady
  - >5.0 Discussions with medical team should be held regarding the patient safety
  - >6.0 Discussion with the medical team to consider bedrest until INR is corrected (usually within 48 hours)

APTA 2022 CPG on VTE Key action statements



APTA 2022 CPG on VTE Key action statements

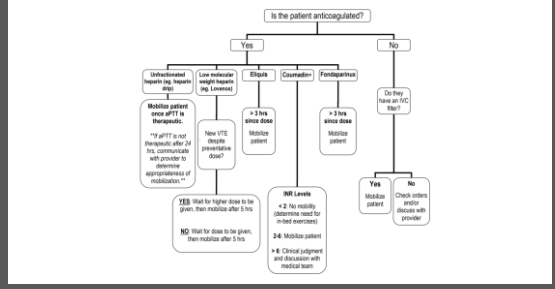
13 Mobilize individuals with an IVC filter

14 Consult the medical team to initiate mobility with a pt with distal LE DVT not treated with anticoagulant or IVC

APTA 2022 CPG on VTE Key action statements

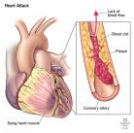
15 Mobilize patients with non-massive (low risk) PE when therapeutic level of anticoagulant achieved

16 Do not mobilize massive PE or sub-massive/intermediate high-risk PE until low risk and hemodynamically stable



Troponin

cTnT ≤ 22ng/L male
cTnT ≤ 14ng/L female



Troponin- cTn

Biomarker that is sensitive and specific to the myocardium of the heart

- Released when cardiac injury occurs (can be detected as early as 3 hours and can elevated up to 3 days after insult)
- Assist in diagnosing myocardial infarction
  - Can be elevated due to stress of myocardium without evidence of MI
- Will see a trend in elevation of cTn with MI
  - Typically peak around 48 hours
  - Important to look at the change over time to indicate MI
    - OH <20% delta from baseline cTnT
- Pts who have PCI revascularization, there may be a protracted elevation of troponin levels

Other clinical scenarios that increase Troponin

- Rhabdomyolysis with cardiac damage
- Renal failure
- Inflammatory disease
  - Myocarditis
  - Endocarditis
- Hypertrophic cardiomyopathy
- Drug toxicity
- Critical illness
- CHF
- Sepsis
- HTN emergency
- Cardiac surgery
- Large body surface area burns
- PE
- Pulm HTN
- Aortic valve disease
- Aortic disection
- COPD
- Blunt throacic damage
- Acute neuro disease
  - CVA
  - SAH

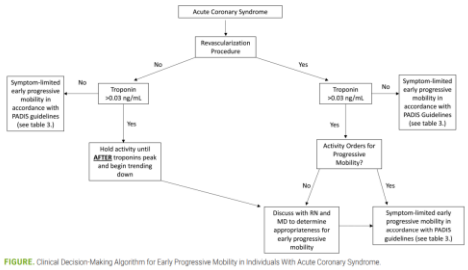
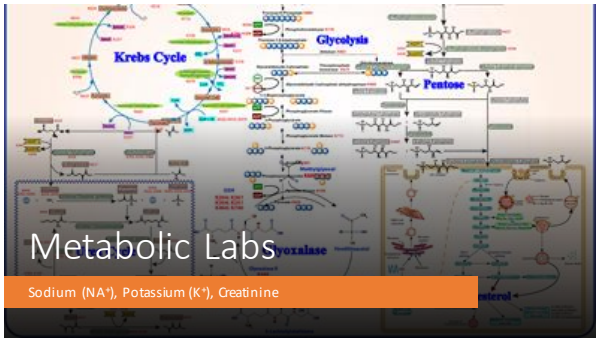


FIGURE. Clinical Decision-Making Algorithm for Early Progressive Mobility in Individuals With Acute Coronary Syndrome.

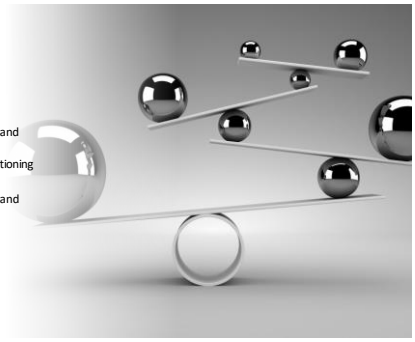


Metabolic Labs

Sodium (NA^+), Potassium (K^+), Creatinine

Electrolyte balance

- Looking at fluid balance and electrolyte balance
- Important for basic functioning
  - Nerve conduction
  - Muscle contraction and relaxation
  - Cardiac rhythm and conduction
  - Bone health



Hypervolemia

- Excessive IV fluids
- Hypertonic fluids
- Inadequate output
  - CHF
  - Cirrhosis
  - Renal insufficiency/failure

Signs
- Pitting edema
- SOB
- Anasarca
- JVD
- HTN
- Tachycardia
- Crackles

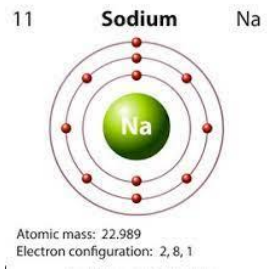
Hypovolemia

- Limited oral intake
- Excess fluid loss

Signs
- Dry mucous membranes
- Poor skin turgor
- Hypotensive
- Tachypneic
- Tachycardic
- Altered mental status

Sodium (Na^+)

135-145 mmol/L



Hyponatremia (<135 mEq/L)

- Diuretic use
- Burns/wounds
- Hypotonic IV use
- Cirrhosis
- GI impairment

Signs/Symptoms:
- Headache
- Lethargy
- Confusion
- Absent/diminished reflexes
- Seizures
- Coma
- Nausea/vomiting/diarrhea
- Hypovolemic hyponatremia
  - Poor skin tugor
  - Orthostatic hypotension/tachycardia
- Hypervolemia hyponatremia
  - HTN, tachycardia
  - Pitting edema

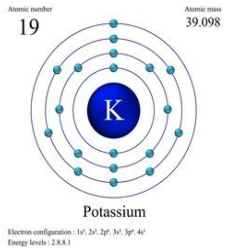
Hypernatremia (>145 mEq/L)

- Hypovolemia
- Increased Na intake
- Severe vomiting
- CHF
- Cushing's syndrome
- Diabetes

Signs/Symptoms:
- Irritability/agitation
- Seizure
- Coma
- Hypotension
- Tachycardia
- Decreased urine output

Potassium (K^+)

3.5-5.1mmol/L



Hyperkalemia(>5.1 mmol/L)

- Renal failure
- Metabolic acidosis
- DKA
- Addison's disease
- Excess K+ supplements
- Blood transfusions

Signs and Symptoms
- Muscle weakness, flaccid paralysis
- Paresthesia
- Bradycardia
- Heart block
- V-fib
- Cardiac arrest

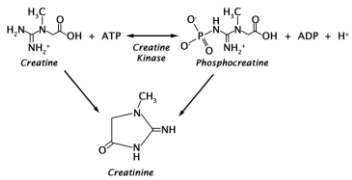
Hypokalemia (<3.5 mmol/L)

- Diarrhea/vomiting
- GI impairment
- Diuretics
- Cushing syndrome
- Malnutrition
- ETOH abuse
- Restrictive diets

Signs and Symptoms
- Extremity weakness
- Hyporeflexia
- Paresthesia
- Leg cramps
- ECG changes (ST depression, T wave inversion), dysrhythmias, cardiac arrest
- Hypotension
- Diminished bowel function, constipation, abdominal distension, paralytic ileus

Creatinine

Males: 0.5-1.3mg/dL
Female: o.4-1.1mg/dL



Up-trending Creatinine

- Renal disease
- Muscular dystrophy
- Rhabdomyolysis
- Dehydration

- Signs/Symptoms:
  - Reduced urine output
  - Dark colored urine
  - Edema
  - Back pain
  - Low fever
  - Fatigue
  - Headache
  - Confusion
  - Dyspnea

Ammonia

11-35 mmol/L

Up-trending Ammonia

- Cirrhosis
- Severe hepatitis
- Reye's syndrome
- Severe heart disease
- Kidney failure
- Severe GI bleeding

Signs and Symptoms
- Hepatic encephalopathy
- Confusion
- Lethargy
- Daytime sleepiness
- Tremors
- Decreased fine motor skills
- Speech impairment
- Numbness and tingling

Case Studies

Case #1

- A 65-year-old male underwent bowel resection for mesenteric intestinal ischemia and currently has an open abdominal incision due to compartment syndrome. He is being treated for septic shock and is on a low dose of Levophed (norepinephrine bitartrate) support.
- The patient's INR is 3.6; hemoglobin is 8.7 g/dL
- What further information would be helpful?

Case #2

- A 31-year-old female with no significant PMH was emergently intubated and admitted to the ICU with respiratory failure after a diagnosis of H1N1 influenza.
- While reviewing the chart, the therapist notes an elevated troponin cTnT of 25ng/mL. The EKG interpretation states no T wave or ST segment abnormality.
- Thoughts?

Case #2

In this case, which of the following conditions would most likely be the reason for the elevated troponin level?

A. Drug toxicity
B. End stage renal failure
C. Myocardial infarction
D. Severe critical illness

Case #3

- 57-year-old female presents with a subarachnoid hemorrhage (SAH) and underwent an aneurysm coiling one week ago. The therapist notes a downward trending sodium of 120mEq/L in the chart.
- What might the therapists anticipate as signs or symptoms during their session?

Case #4

67-year-old male with a PMH of ETOH abuse, HTN, DM2 and active smoker presents with acute GI bleed with a Hgb 5.4 g/dL. The patient undergoes an EGD with 2 bands placed for esophageal variceal. The patient receives 2 units of pRBCs.

PT and OT are consulted the following day. Hgb 7.2 g/dL.

What further information is needed?

Case #4

- 2 days have passed since the initial evaluation from PT and OT.
- On eval
  - Pt ambulated 75 ft with CGA
  - Modified Borg 4/10.
- Repeat Hgb shows a 6.9 g/dL
- What now?

Case #4

His last PT session, pt was complaining of calf pain and noted to have redness and swelling. RN and MD were notified

- Doppler U/S completed and pt with acute RLE DVT

What now?

Case #5

- 48-year-old female patient with leukemia is admitted for chemotherapy treatment. Which lab values will most likely help direct therapy intervention?
- WBC remaining stable at 0.5 K/mcL for the past 2 lab draws
- Platelets up-trending from 10K/mcL to 17K/mcL

- Should you proceed with your therapy evaluation?

Questions

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