



CANADIAN ASSOCIATION  
of GENERAL SURGEONS

**20**  
**18**

# Dynamic Practice Guidelines for Emergency General Surgery

Committee on Acute Care Surgery, Canadian Association of General Surgeons

# 3 | **DIAGNOSTIC LABORATORY TESTS**

Dynamic Practice Guidelines for Emergency General Surgery

**Melissa Hanson MD, and Jacinthe Lampron MD**

Committee on Acute Care Surgery, Canadian Association of General Surgeons

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### **CBC – Complete Blood Count**

Information on white and red cells and platelet numeration

General screening that can orient toward infection, bleeding, coagulopathy

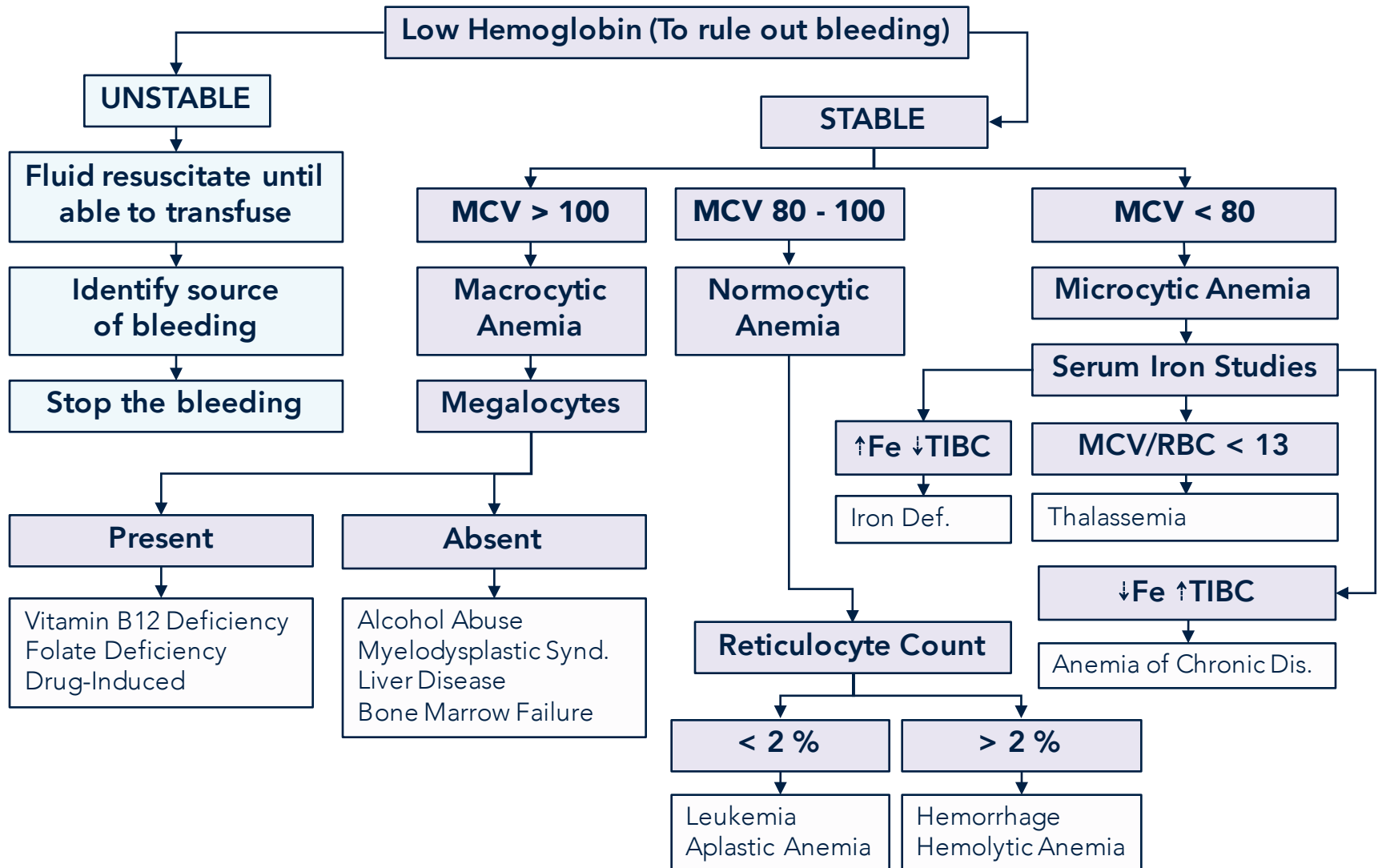
#### **Red blood cell count (RBC) – total number of cells**

- **Mean corpuscular volume (MCV):** average size of a single red blood cell
  - **Mean corpuscular hemoglobin (MCH):** average amount of hemoglobin inside a single red blood cell
  - **Red cell distribution width:** calculation of the variation in the size of the red blood cells
  - **Reticulocyte count:** absolute count or percentage of young red blood cells in the blood
  - **Hematocrit:** percentage of a person's blood volume is composed of red blood cells
  - **Hemoglobin:** amount of oxygen-carrying protein in the blood
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### **CBC – Complete Blood Count**

#### **White blood cell count (WBC)**

- **Differential:** differentiates type of white cell and the quantity (neutrophils, lymphocytes, basophils, eosinophils and monocytes)
  - Large amount of band usually marks acute infection
  - **High WBC**
    - Infection, Inflammation
    - Leukemia/ Myeloproliferative Disorders
    - Tissue death (trauma/ burns/ ischemia)
  - **Low WBC**
    - Bone marrow disorders, Lymphoma
    - Autoimmune conditions
    - Severe Infection/ Sepsis
    - Dietary deficiencies
    - HIV/AIDS
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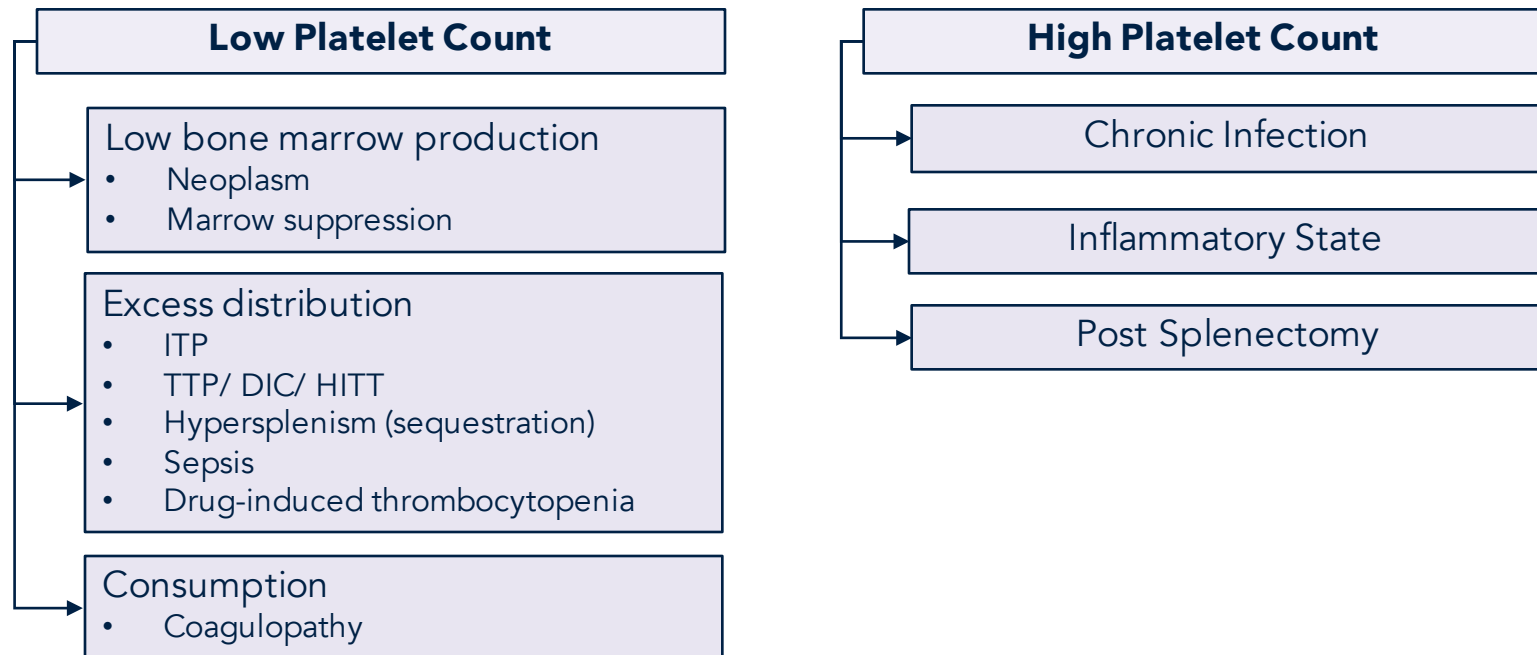
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## CBC – Complete Blood Count

### Platelet Count

- Mean Platelet Volume (MPV): average size of the platelets
- Platelet Distribution Width: reflects how uniform the platelets are in size



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### **Electrolytes**

When to order? General screening of metabolic state  
Evaluation of fatigue/weakness, confusion, dehydration/fluid status, nausea/vomiting, kidney/lung disease or heart conditions/arrhythmias

### **Components**

- Sodium
  - Potassium
  - Chloride
  - Bicarbonate
  - Extended Electrolytes:  $\text{Ca}^{+2}$ ,  $\text{Mg}^{+2}$ ,  $\text{PO}_4^{+3}$
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### HYPERNATREMIA (High Na<sup>+</sup>)

SYMPTOMS: seizures, coma, thirst, dry mucus membranes, oliguria, fever

CAUSES: [click here](#) to see approach to etiologies of Hyper Na<sup>+</sup>

#### MANAGEMENT

- This is a water deficit state. Therefore treat with saline to address the water deficit state before attempting to correct the sodium value.
- Oral water replacement preferred if possible.
- **Correct slowly**
  - Rapid correction can lead to cerebral edema
- Less common than hyponatremia but has a worse prognosis and is a predictor of mortality in critical illness

WATER  
DEFICIT

=

(Serum Na<sup>+</sup> - 140)/140

x

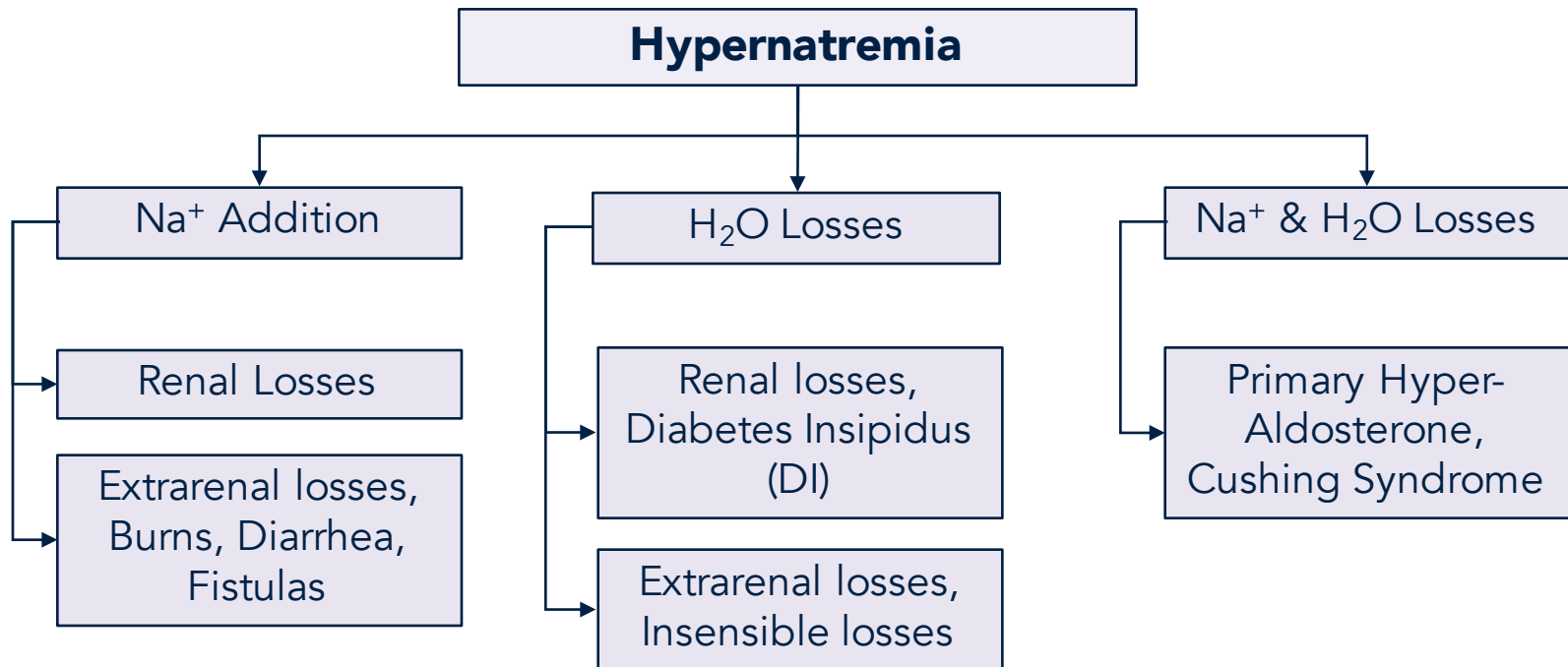
TBW = weight in kg x  
0.6 (males) or 0.5 (females)

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## HYPERNATREMIA (High Na<sup>+</sup>)



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## HYPONATREMIA (Low Na<sup>+</sup>)

**SYMPTOMS:** nausea/vomiting, headache, confusion, fatigue, muscle weakness/spasm/ cramps, seizures/coma

### CAUSES

- Volume status is the key to determine the etiology:
  - Hypovolemic
    - Urine Na < 10 = volume loss (sweating, diuretics, third spacing and water replacement without electrolytes)
    - Urine Na > 20 = salt wasting
  - Euvolemic – SIADH (malignancy i.e. SCLC or pancreatic cancer, pulmonary infection, CNS disorders, medications, post op), AI, or primary polydipsia.
  - Hypervolemic – CHF, nephrotic syndrome, cirrhosis

### MANAGEMENT

- **Correct slowly** as rapid correction can lead to pontine myelinolysis, permanent brain damage and even death
  - If Na < 120 or neurological symptoms treat with 3% saline but aim to increase by no more than 1 meq/hr
  - If asymptomatic then correct by 0.5 meq/hr to a max of 12meq/day if acute and even slower if chronic

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## HYPERKALEMIA (High K<sup>+</sup>)

**SYMPTOMS:** nausea/vomiting/diarrhea/abdominal pain, weakness leading to paralysis, respiratory failure, ECG changes, arrhythmias and eventually cardiac arrest.

### CAUSES:

- Potassium Supplement
- Renal Failure
- ACE Inhibitor, NSAID
- Massive tissue breakdown, trauma, burns, rhabdomyolysis

### DIAGNOSIS: ECG Changes

- Early shows peaked T waves
- Widened QRS
- Flattened P wave
- Prolonged PR interval (1st degree block)
- Eventually sine wave and ventricular fibrillation

### MANAGEMENT

- Calcium gluconate immediately (stabilizes cardiac membrane)
  - Bicarbonate OR insulin and dextrose (shift)
  - Dialysis if refractory to treatments
  - Kayexalate takes hours to days to correct potassium.
-

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## **HYPOKALEMIA (Low K<sup>+</sup>)**

**SYMPTOMS:** Ileus, decreased reflexes, fatigue, paralysis, cardiac arrest.

**CAUSES:**

- Increase excretion
  - Diarrhea
  - Renal losses, diuretics, NG drainage, hyperaldosteronism, Mg<sup>+</sup> depletion
- Shift of Potassium into cells
  - Medication: Beta-agonists, insulin
  - Delirium tremens

**DIAGNOSIS:** ECG Changes described as essentially stretching out of the ECG

- Broad flat T waves
- ST depression
- QT prolongation
- U waves

## **MANAGEMENT**

- Replace either IV (faster) 10mEq/100cc x 3 over 1h each or PO (safer) 40mEq TID
  - Replete magnesium level if not responding to treatment.
-

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## HYPERCALCEMIA (High Ca+)

**SYMPTOMS:** Anorexia, nausea/vomiting, abdominal pain, weakness/ confusion/ coma, bone pain, polydipsia, HTN, arrhythmias.

- "Painful bones, renal stones, abdominal groans, and psychiatric moans"

### CAUSES:

1. Hyperparathyroidism (parathyroid adenoma)
2. Malignancy (metastases) – osteolysis
3. Granulomatous disease, Sarcoidosis, Tuberculosis
4. Vitamin D Intoxication
5. Familial Hypocalciuric Hypercalcemia

### DIAGNOSIS: ECG Changes

- Shortened QT
- Prolonged PR and QRS
- Flat and wide T waves
- AV block progressive to complete heart block

### MANAGEMENT

- Forced diuresis (Normal Saline and Lasix)
  - Bisphosphonates/ PO<sub>4</sub>
  - Calcitonin (DO NOT GIVE THIAZIDES)
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## HYPOCALCEMIA (Low Ca<sup>+</sup>)

**SYMPTOMS:** Hyperreflexia, spasms, seizures

### CAUSES:

1. Renal Disease
2. Vitamin D deficiency
3. Pancreatitis
4. Massive transfusion
5. Post-op thyroidectomy

### DIAGNOSIS: ECG Changes

- Prolonged QT
- T wave inversion
- Eventually ventricular fibrillation and heart block

### MANAGEMENT

- **IV**
    - 10% Calcium gluconate contains 90mg/10ml of calcium, give 2 or 3
    - 10% calcium chloride contains 360mg/10ml, give 1, be careful to avoid extravasation, can cause skin slough
  - **PO:** Calcium carbonate 240mg of calcium per 600mg tablet
  - May be refractory to treatment if Mg<sup>+</sup> is low so ensure to also replace Mg<sup>+</sup>
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### **HYPERMAGNEMIA (High Mg+) – Very Rare**

**SYMPTOMS:** Nausea/vomiting, weakness, lethargy, hyporeflexia, hypotension, arrest

**CAUSES:** Could be seen in renal failure and magnesium containing antacid abuse.

**DIAGNOSIS:** ECG Changes similar to hyper K+

### **HYPOMAGNEMIA (Low Mg+)**

**SYMPTOMS:** Hyperreflexia, tremors, tetany, seizures, arrhythmias

**CAUSES:** Parallel the effect on calcium (i.e. diarrhea, aggressive diuresis, alcohol abuse, DM with persistent osmotic diuresis, pancreatitis)

**DIAGNOSIS:** ECG Changes

- Prolonged QT & PR with ST depression
- Flat or inverted T waves leading to Torsades de Pointe & other arrhythmias

### **MANAGEMENT**

- Needs aggressive replacement and requires potassium and calcium corrected to restore homeostasis
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### **BUN/ CREATININE**

- BUN and creatinine are the primary tests used to assess kidney function (through calculation of creatinine clearance can determine how well kidneys are functioning)
  - BUN levels increase with age
  - **Elevated BUN/Creatinine Ratio:**
    - Seen in situations where there is decreased flow of blood to the kidneys (i.e. CHF, dehydration, GI bleeding, increased protein in the diet, malnutrition)
    - Ratio more than 20 is usually a sign of dehydration
  - **Low levels of BUN and creatinine** are typically seen in very petite individuals or malnourished persons with decreased muscle mass
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### Lactate

When to order?

- Signs and symptoms of inadequate oxygenation/hypoxia (shortness of breath, increased respiratory rate, nausea, abdominal pain, decreased LOC, fatigue/paleness).
- Repeat to monitor resuscitation efforts or monitor progression of the condition. It is not diagnostic on its own.

*Conditions in which lactate can be elevated is lengthy and includes:*

- Sepsis
  - Bowel ischemia
  - Heart attack/CHF
  - Severe lung disease/ Resp. failure
  - Pulmonary edema
  - Anemia
  - Liver/kidney disease
  - Diabetes, Leukemia or AIDS
  - Strenuous exercise
  - Thiamine deficiency
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### **Blood Gas**

When to order?

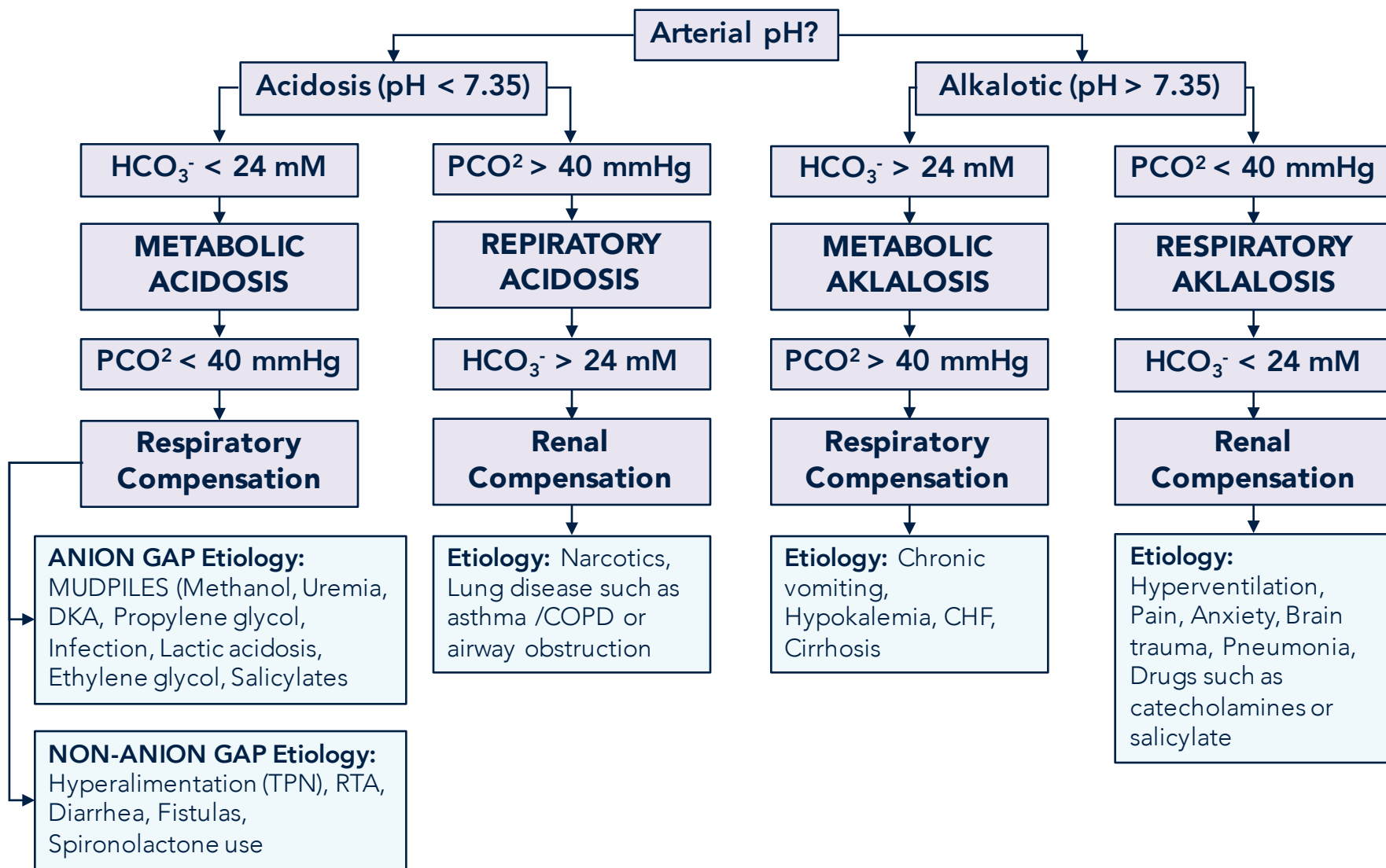
When a patient is experiencing:

- Shortness of breath
  - Decreased LOC
  - Shock
  - Requiring increasing amounts of supplemental oxygen
  - Nausea/vomiting
  - Known respiratory, metabolic or kidney disease and is experiencing some respiratory or metabolic distress.
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### Liver Panel (Enzymes and Function Tests)

Evaluation of jaundice, heavy alcohol use, pruritus, nausea/ vomiting/ diarrhea, abdominal swelling or pain, dark urine

#### Components:

- **Bilirubin**
    - Unconjugated – increased with hemolysis or dysfunction of the liver conjugation
    - Conjugated – increased with biliary obstruction
  - **ALT and AST = hepatocellular dysfunction**
    - Very high levels seen in acute hepatitis, moderately elevated or normal with biliary disease/cirrhosis/cancer, liver damage is due to alcohol the AST is often increased much more than the ALT
  - **ALP:** can be elevated in bone disease and in biliary obstruction
  - **GGT:** more specific to the biliary tree than ALP
  - **Albumin:** decreased in malnourished patients, it is often normal in liver disease but may be low due to decreased production
  - **INR:** prolonged with liver disease, Vitamin K deficiency, warfarin
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### Urinalysis

#### When to order?

Lower abdominal or back pain, urinary frequency/dysuria or hematuria, to determine the presence of urinary tract infection, assess electrolyte abnormalities and kidney function, liver abnormalities, diabetes and other metabolic conditions

#### Components:

- **Color:** i.e. red (can be blood, secondary to dietary or medication changes), brown/tea (jaundiced), feculent (?colovesicular fistula)
- **Clarity:** i.e. cloudy can mean infection vs colonization
- **pH:** normal range 4.8-8, can be altered in times of acidosis/alkalosis and this can predispose patients to forming stones
- **Protein:** elevation can be seen in kidney disease, diabetes, HTN
- **Glucose:** elevated in uncontrolled diabetes
- **Ketones:** produced when there is not enough carbohydrates available such as in DKA and can be an emergency
- **Myoglobin:** seen in muscle breakdown

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### Urinalysis (continued)

#### Components:

- **Blood:** can be vaginal bleeding, rectal bleeding, secondary, infection, physical injury to kidney/bladder, NSAIDs/blood thinners, stones, BPH, urethritis/prostatitis, exposure to toxins, or cancer (prostate, bladder, kidney)
  - **Leukocyte Esterase:** may indicate inflammation in the urinary tract or kidneys such as a UTI
  - **Nitrite:** many bacteria can convert nitrate into nitrite thus making this test positive in the presence of certain bacteria common to the urinary tract
  - **Urobilinogen:** presence may indicate liver diseases such as viral hepatitis, cirrhosis, liver damage such as from toxins/EtOH
  - **Bacteria/Yeast/Parasites:** may be contaminate from skin or vaginal flora or colonization from chronic catheterization but often points to infection depending on clinical context
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