Respiratory System (Acid) CO2 is a volatile acid

Change	•The respiratory system can effect a change in 15-30 minutes
ACIDOSIS	• **Decrease your respiratory rate (hypoventilation)** you **retain CO2** (acid) therefore increasing your CO2 (acid)
ALKLAOSIS	• **Increased respiratory rate (hyperventilation)** "blow off" CO2 (acid) therefore **decreasing CO2** acid

The Renal System (Base)

Renal System (Base)	• Kidneys rid the body of the nonvolatile acids H+ (hydrogen ions) and **maintain a constant bicarb (HCO3**). • Bicarbonate is the body's base
Acidosis	• **Kidneys** try to adjust for this by **excreting H+ and retaining HCO3- base**. • **Respiratory System** will try to **compensate by increasing ventilation to blow off CO2** (acid) and therefore decrease the Acidosis. • Have **excess H+ and decreased HCO3**- causing a decrease in pH.
Alkalosis	• **H+ decreases and you have excess (or increased) HCO3**- base. • The **kidneys excrete HCO3**- (base) and **retain H+ to compensate**. • The **respiratory** system tries to **compensates with hypoventilation** to retain CO2 (acid) to decrease the alkalosis
Change	• The renal system takes several hours to days to have an effect.

The Land of the ABG

The Last Name	• First, look at her pH (normal is 7.35 - 7.45) • If her pH is < 7.35; her name is ACIDOSIS • If her pH is > 7.45; her last name is ALKALOSIS • NOTE: To have an absolutely perfect last name; her pH needs to be 7.40. So, keep in mind that if her pH is 7.35 - 7.39 she's thinking about marrying into the ACIDOSIS family. If her pH is 7.41 - 7.45 she's thinking about marrying into the ALKALOSIS family
The First Name	• Look at her pH again. • If it is 7.35 - 7.45 (normal) then her first name is COMPENSATED. • If the pH is < 7.35 or > 7.45 then her first name is UNCOMPENSATED.
The Middle Name	• First you need to look at the CO2 and HCO3-. Remember : **normal CO2 35 - 45; and HCO3- 22 - 26**. 1. • The middle name will either be Respiratory or Metabolic. 2. • If the **CO2 is < 35 or > 45** her middle name is RESPIRATORY. 3. • If the **HCO3- is < 22 or > 26**; her middle name is METABOLIC.

The Land of the ABG (cont)

The Family Feud	• **pH and HCO3**- are "kissin' cousins" they like to **go in the same direction** • CO2 is the "black sheep" pH runs the **opposite direction** when it sees him Coming. THEREFORE: • Decreased pH with decreased HCO3-: ACIDOSIS • Increased pH with increased HCO3-: ALKALOSIS • **Decreased pH with increased CO2**-: ACIDOSIS • **Increased pH with decreased CO2**-: ALKALOSIS

Metabolic Acidosis

	• pH < 7.35 (Normal: 7.35 - 7.45) HCO3- < 22 (normal: 22 – 26)
Causes	• **Increased H+, excess loss of HCO3-** • Overproduction of organic acids (starvation, ketoacidosis, increased catabolism) • Impaired renal excretion of acid (renal failure) • Abnormal loss of HCO3- (diarrhea, biliary fistula, Diamox) • Ingestion of acid (salicylate overdose, oral anti-freeze)

Metabolic Acidosis (cont)

Signs and Symptoms	• CNS depression (confusion to coma) • Cardiac Dysrhythmias (elevated T wave, wide QRS to ventricular standstill) • Electrolyte abnormalities (**elevated K+, Cl-, Ca2+**) • Flushed skin (arteriolar dilitation) • Nausea
Treatment (treat the underlying cause)	• NaHCO3- (sodium bicarbonate) based on ABGs only and with caution • IV fluids and insulin for DKA • Dialysis for renal failure • Antibiotics, increased nutrition for tissue catabolism • Increased cardiac output and tissue perfusion for low CO states • Rehydrate, monitor I and O • Treat dysrhythmias, support hemodynamic and respiratory status

Metabolic Alkalosis

• pH > 7.45 (Normal: 7.35 - 7.45) HCO3- > 26

Metabolic Alkalosis (cont)

Causes	• Loss of H+ or increased HCO3- • Loss of K+ (diarrhea, vomiting) • Ingestion of large amounts of bicarbonate (antacids, resuscitation) • Prolonged use of diuretics (distal tubule lose ability to reabsorb Na+ and Cl- therefore NaCl); Ammonia is in the urine and then binds with H+
Signs and Symptoms	• Similar to the disease process • Diaphoresis • Nausea and Vomiting • Increase neuromuscular excitability (Ca2+ binds with protein) • Shallow breathing (respiratory compensation) • EKG changes (increased QT, sinus tachycardia) • May also see confusion progressing to lethargy to coma • Electrolyte abnormality (decreased Ca2+), normal or decreased K+, increased base excess on the ABG

Metabolic Alkalosis (cont)

Treatment (treat the underlying cause)	• Replace potassium (KCl) losses in 0.9% NaCl (rehydrates and increases HCO3- excretion) • Diamox (acetazolamide, increases HCO3-excretion) • Monitor neuro status, re-orient, seizure precaution, monitor I and O

RESPIRATORY ACIDOSIS

	• pH < 7.35 (Normal: 7.35 - 7.45) CO2 > 45 (Normal: 35 – 45)
Causes	• **Hypoventilation** • Depression of the Respiratory Center (sedatives, narcotics, drug overdose, CVA, cardiac arrest, MI). • Respiratory muscle paralysis (spinal cord injury, Guillian-Barre, paralytics). • Chest wall disorders (flail chest, pneumothorax). • Disorders of the lung parenchyma (CHF, COPD, pneumonia, aspiration, ARDS). • Alteration in the function of the abdominal system (distension)

RESPIRATORY ACIDOSIS (cont)	
Signs and Symptoms	•CNS depression **(decreased LOC)** •Muscle twitching which can progress to convulsions •Dysrhythmias, tachycardia, diaphoresis (related to hypoxia secondary to hypoventilation) •Palpitations •Flushed skin •Serum electrolyte abnormalities including elevated K+ (potassium leaves the cell to replace the H+ buffers leaving the cell)
Treatment	•Physically stimulate the patient to improve ventilation •Vigorous pulmonary toilet (chest PT, coughing and deep breathing, inspirometer, respiratory treatments with bronchodilators) •Mechanical ventilation (to **increase the respiratory rate and tidal volume**) •Reversal of sedatives and narcotics •Antibiotics for infections •Diuretics for fluid overload •NOTE: beware of NaHCO3- sodium bicarbonate—can compensate and cause metabolic alkalosis. Also, if patient has been hypoxic and this is a lactic acidosis; NaHCO3- can be dangerous)

Respiratory Alkalosis	
	pH > 7.45 (Normal: 7.35 - 7.45) CO2 < 35 (Normal: 35 – 45)
Causes	• **Alveolar Hyperventilation** •Psychogenic (fear, pain, anxiety) •CNS stimulation (brain injury, ETOH, early salicylate poisoning, brain tumor) •Hypermetabolic states (**fever**, thyrotoxicosis) •**Hypoxia** (high altitude, pneumonia, heart failure, pulmonary embolism) •Mechanical overventilation (**ventilator rate too fast**)
Signs and Symptoms	•Heachache •Vertigo •Paresthesias (numb fingers /toes, circumoral, carpal pedal spasms and tetany) •Tinnitus (ringing in the ears) •Electrolyte abnormalities (**decreased Ca+, K+**)

Respiratory Alkalosis (cont)	
Treatment (treat the underlying cause)	•Sedatives or analgesics •Correction of hypoxia (possible diuretics, mechanical ventilation to also **decrease respiratory rate and decrease the tidal volume**) •NOTE: patients with brain injury may need hyperventilation •Antipyretics for fever •Treat hyperthyroidism •Breathe into a paper bag for hyperventilation