# BLOOD GAS VARIATIONS

**BLOOD pH Normal range 7.35 – 7.45**

**Think of 7.40 as your new 0 or neutral**
**If the reading is below 7.4 it is acid. Below 7.35 it is acid out of range or Acidosis**
**If the reading is above 7.4 it is alkaline. Above 7.45 it is alkaline out of range or Alkalosis**

## Respiratory Values PCO2 : 35-45 mmHg Normal range

**Where the CO2 is where the H+ are, is where the acid is, so if there is more CO2 in the blood the blood is more acidic, if the CO2 is low in the blood the blood is more alkaline.**

**Hypoventilation increases PCO2 levels above 45mmHg so the CO2 is in the blood and the acid levels are increasing in the blood. This leads to a drop in pH, which leads to Respiratory Acidosis**

**Think Sleeping pills, which decrease Respiratory rates:**

**PCO2 ( > 45) pH ( < 7.35) Respiratory Acidosis**

**Hyperventilation decreases PCO2 levels below 35mmHg so the CO2 is out of the blood out of the body, the acid levels are decreasing so the pH is increasing and the blood is becoming more alkaline which leads to Respiratory Alkalosis**

**Think Cocaine Psychosis, which increases respiratory rates:**

**PCO2 ( < 35) pH ( > 7. 45) Respiratory Alkalosis**

## Metabolic Values HCO3: 22-26 mEq/L Normal range

**HCO3- is bicarbonate and bicarbonate is alkaline. Think Tums or baking soda.**
**The kidneys, liver and pancreas make HCO3- to buffer the acid of the stomach.**
**The kidneys secrete acid (H+) in the urine.**
**If one is not urinating such as in Kidney failure they can be retaining H+ and become acid**

**Think vomiting they are losing acid (H+) and becoming alkaline:**

**HCO3- in the body ( > 26) pH ( > 7. 45) Metabolic Alkalosis**

**Think diarrhea they are losing HCO3- and becoming acid:**

**HCO3 - in the body ( < 22) pH ( < 7.35) Metabolic Acidosis**

**Steps to figuring out what is going on with the lab values. If one follows these steps and asks the same questions each time then they should have no trouble interpreting ABGs**

# EXAMPLE ONE

# DATA

**pH = 7.31 PCO2 = 52 HCO3- = 24**

**Step one: Is the pH Normal , Acid, or Alkaline?**

**The pH is out range and it is below 7.35 so it is Acid**
**The person is in some form of acidosis**

**Step two: Is the PCO2 out of range, if so would it make the blood acid or alkaline?**

**Yes the PCO2 is out of range, it is high**
**If the PCO2 is high there is more acid in the blood and the pH would be low**

**Step three: Is the HCO3- out of range, if so would it make the blood acid or alkaline?**

**No the HCO3- is within range therefore it is normal**

**What do I now know?**

**Person is in Acidosis**
**PCO2 is high (acid) and PCO2 is the respiratory component**
**HCO3- is normal and HCO3- is the metabolic component**

**So these data represents a person in <u>Respiratory Acidosis</u>**

# EXAMPLE TWO

# DATA

**pH = 7.53 PCO2 = 42 HCO3- = 32**

**Step one: Is the pH Normal , Acid, or Alkaline?**

**The pH is out range and it is above 7.45 so it is Alkaline**
**The person is in some form of alkalosis**

**Step two: Is the PCO2 out of range, if so would it make the blood acid or alkaline?**

**No the PCO2 is within range therefore it is normal**

**Step three: Is the HCO3- out of range, if so would it make the blood acid or alkaline?**

**Yes the HCO3- is out of range, it is high**
**If the HCO3- is high there is more alkaline in the blood and the pH would be high**

**What do I now know?**

**Person is in Alkalosis**
**PCO2 is normal and PCO2 is the respiratory component**
**HCO3- is high (alkalosis) and HCO3- is the metabolic component**

**So these data represent a person in <u>Metabolic Alkalosis</u>**

## Work sheet

**Using the method described in this handout interpret the following lab values, and remember a lab value can indicate normal as well as a problem**

**# 1. pH = 7.47 PCO2 = 42 HCO3- = 32**

**Answer:_____**

**# 2. pH = 7.37 PCO2 = 42 HCO3- = 25**

**Answer:_____**

**# 3. pH = 7.51 PCO2 = 28 HCO3- = 22**

**Answer:_____**

**# 4. pH = 7.48 PCO2 = 39 HCO3- = 31**

**Answer:_____**

**# 5 . pH = 7.28 PCO2 = 62 HCO3- = 23**

**Answer:_____**

**# 6. pH = 7.43 PCO2 = 39 HCO3- = 26**

**Answer:_____**

**# 7. pH = 7.30 PCO2 = 44 HCO3- = 17**

**Answer:_____**

# COMPENSATION: PARTIAL OR FULLY

**In the examples you have worked up to now only one lab value has been off, thus representing a client whose body has not started to compensate for the problem. When the blood pH goes out of range the body will try to compensate with the opposite action to bring the blood pH back into balance. For example if a client were in a state of respiratory acidosis the body would react with several physiological processes that would produce a state of metabolic alkalosis. If one were in a state of metabolic acidosis the body would counter with respiratory alkalosis. Now for a more concrete example to set this idea. My daughter had a very bad UTI and vomited about six times in an hour, she was in a state of metabolic alkalosis (vomit is acid). So to compensated her body went into a state of respiratory acidosis and her breathing became long and deep (if one keeps the CO2 in the body they will increase the acid in the blood) and she fell into a profound sleep.**

# PARTIAL COMPENSATION

**Using the same steps as before to figure out what is going on with the lab values just ask a few more questions. The main difference in problems where compensation is taking place is that both the PCO2 and HCO3- will both be out of range. If the compensation is partial the pH will still be out of range, if it is fully compensated the PCO2 and HCO3- will both be out of range but the pH will within range.**

## EXAMPLE ONE

## DATA

**pH = 7.31 PCO2 = 52 HCO3- =28**

**Step one: Is the pH Normal, Acid, or Alkaline?**

**The pH is out range and it is below 7.35 so it is Acid**
**The person is in some form of acidosis**

**Step two: Is the PCO2 out of range, if so would it make the blood acid or alkaline?**

**Yes the PCO2 is out of range, it is high**
**If the PCO2 is high there is more acid in the blood and the pH would be low**

**Step three: Is the HCO3- out of range, if so would it make the blood acid or alkaline?**

**Yes the HCO3- is out of range, it is high**
**If the HCO3- is high there is more alkaline in the blood and the pH would be high**

**What do I now know?**

**Person is in Acidosis**
**PCO2 is high (acid) and PCO2 is the respiratory component**
**HCO3- is high (alkalosis) and HCO3- is the metabolic component**

**When both the PCO2 and HCO3- are out of range the body is compensating. If the pH is out of range it is a partial compensation.**

**So these data represent a person in <u>Respiratory Acidosis Partially Compensated</u>**

## FULL COMPENSATION

## EXAMPLE TWO
## DATA

**pH = 7.43 PCO2 = 54 HCO3- = 35**

**Step one: Is the pH Normal, Acid, or Alkaline?**

**The pH is in range**
**The person is normal (so far)**

**Step two: Is the PCO2 out of range, if so would it make the blood acid or alkaline?**

**Yes the PCO2 is out of range it is high**
**If the PCO2 is high there is more acid in the blood and the pH would be low**

**Step three: Is the HCO3- out of range, if so would it make the blood acid or alkaline?**

**Yes the HCO3- is out of range, it is high**
**If the HCO3- is high there is more alkaline in the blood and the pH would be high**

**What do I now know?**
**Client's pH is in normal range**
**PCO2 is high (acid) and PCO2 is the respiratory component**
**HCO3- is high (alkalosis) and HCO3- is the metabolic component**

**When the PCO2 and HCO3- are both out of range but the pH is within range the person had a problem but has fully compensated for it. Now what I must decide is was this person in acidosis or alkalosis. Remember, think of pH 7.4 as the new neutral and the body cannot over compensate. So if the pH is above 7.4 the person was in some form of alkalosis, if it is below 7.4 they were in some form of acidosis.**

**Go back to pH. It is above 7.4 so this person was in a form of alkalosis**

**So these data represent a person in <u>Metabolic Alkalosis</u> who fully compensated by retaining CO2 (remember when the body goes into an abnormal acidocis or alkalosis; the body compensates by trying to go to the opposite state.**

**Finally once you have the skill to read these labs values to really set these concepts you must be able to visualize what these clients look like when they are experiencing these metabolic states. I have attached four tables from an exam review book, which summarize the causes, symptoms and responses to these metabolic states. As you are reading them really think about what a client would look and feel like as their blood pH changes. If you get lost, to very much simplify the concept you can hold on to these statements:**

**If one is in Acidosis they go down to death**
**Lethargy Weakness Headache Diaphoresis Coma Death**

**If one is in Alkalosis they go up to death**
**Apprehension Irritability Twitching Tetany Convulsion Death**

## Work sheet

**Using the method describe in this handout interpret the following lab values.**

**# 1. pH = 7.33 PCO2 = 52 HCO3- = 28**

**Answer:_____**

**# 2. pH = 7.43 PCO2 = 49 HCO3- = 29**

**Answer:_____**

**# 3. pH = 7.29 PCO2 = 31 HCO3- = 16**

**Answer:_____**

**# 4. pH = 7.36 PCO2 = 49 HCO3- = 30**

**Answer:_____**

**# 5. pH = 7.33 PCO2 = 54 HCO3- = 31**

**Answer:_____**

**# 6. pH = 7.43 PCO2 = 23 HCO3- = 21**

**Answer:_____**

**# 7. pH = 7.38 PCO2 = 50 HCO3- = 31**

**Answer:_____**

**# 8. pH = 7.47 PCO2 = 48 HCO3- = 28**

**Answer:_____**

**Answers to worksheet #1**

**1 = Metabolic Alkalosis**

**2 = Normal**

**3 = Respiratory Alkalosis**

**4 = Metabolic Alkalosis**

**5 = Respiratory Acidosis**

**6 = Normal**

**7= Metabolic Acidosis**

**Answers to worksheet # 2**

**1 = Respiratory Acidosis Partial Comp.**

**2= Metabolic Alkalosis Fully Comp.**

**3 = Metabolic Acidosis Partial Comp.**

**4 = Respiratory Acidosis Fully Comp**

**5 = Respiratory Acidosis Partial Comp**

**6 = Respiratory Alkalosis Fully Comp**

**7 = Respiratory Acidosis Fully Comp.**

**8 = Metabolic Alkalosis Partial Comp.**