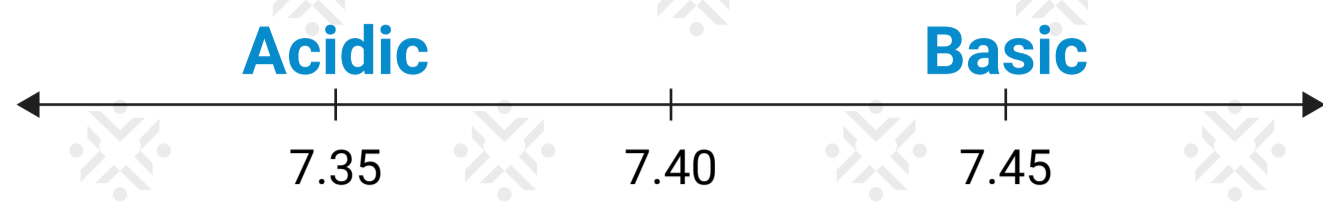


# Arterial Blood Gases

## Normal pH 7.35 - 7.45

Amount of free hydrogen ions (H<sup>+</sup>) in the blood



## Normal PaCO<sub>2</sub> 35-45

Partial pressure of carbon dioxide (CO<sub>2</sub>) in arterial blood

## Normal HCO<sub>3</sub> 22-26

Concentration of bicarbonate in arterial blood

## Normal PaO<sub>2</sub> 75-100

Partial pressure of oxygen

### Acidosis

< 7.35

Causes:

High CO<sub>2</sub> (>45)  
Low HCO<sub>3</sub> (<22)

### Alkalosis

> 7.45

Causes:

Low CO<sub>2</sub> (<35)  
High HCO<sub>3</sub> (>26)

## Interpretation of uncompensated imbalances

(pH is out of normal range)

### Respiratory ACIDOSIS

Low pH and High CO<sub>2</sub>

← Caused by CO<sub>2</sub>

### Respiratory ALKALOSIS

High pH and Low CO<sub>2</sub>

Low pH and Low HCO<sub>3</sub>

← Caused by HCO<sub>3</sub>

High pH and High HCO<sub>3</sub>

## Compensated Imbalances

When an ABG has a normal pH, but the CO<sub>2</sub> and HCO<sub>3</sub> is abnormal, it is considered fully compensated.

### Fully Compensated

pH is within normal limits, but CO<sub>2</sub> and HCO<sub>3</sub> will both be abnormal, the compensator is always opposite the pH.

### Partially Compensated

pH is abnormal, as well as CO<sub>2</sub> and HCO<sub>3</sub>, the compensation is not enough to normalize pH.

### Fully Compensated Metabolic Acidosis

Low pH 7.35-7.39 **Acidic**  
Low CO<sub>2</sub> (<35) **Basic**  
Low HCO<sub>3</sub> (<22) **Acidic**

### Fully Compensated Metabolic Alkalosis

High pH 7.41-7.45 **Basic**  
High CO<sub>2</sub> (>45) **Acidic**  
High HCO<sub>3</sub> (>26) **Basic**

(In partial compensation, pH is further out of range)

### Fully Compensated Respiratory Acidosis

Low pH 7.35-7.39 **Acidic**  
High CO<sub>2</sub> (>45) **Acidic**  
High HCO<sub>3</sub> (>26) **Basic**

### Fully Compensated Respiratory Alkalosis

High pH 7.41-7.45 **Basic**  
Low CO<sub>2</sub> (<35) **Basic**  
Low HCO<sub>3</sub> (<22) **Acidic**

Mixed acid-base disorders can also occur when multiple disorders are present

### Respiratory Acidosis

#### Causes

- asthma
- COPD
- pulmonary edema
- respiratory failure
- obstructed airway
- overdose
- atelectasis

#### Pathophysiology

Increased CO<sub>2</sub> retention from hypoventilation. Kidneys retain HCO<sub>3</sub> to compensate.

#### Signs & Symptoms

- respiratory distress
- altered mental status
- sleepiness or fatigue
- hypotension
- headache
- seizures
- warm, flushed skin

### Metabolic Acidosis

#### Causes

- diabetic ketoacidosis
- lactic acidosis
- diarrhea
- starvation
- shock
- renal failure

#### Pathophysiology

Acid increases due to metabolic or endocrine causes or the body is unable to excrete acid. Lungs compensate by high CO<sub>2</sub> excretion.

#### Signs & Symptoms

- headache
- coma
- nausea
- vomiting
- diarrhea
- muscle weakness
- deep, rapid respirations (Kussmaul respirations)

### Respiratory Alkalosis

#### Causes

- hyperventilation
- liver failure
- mechanical hyperventilation
- stimulated respiratory center d/t septicemia, stroke, meningitis

#### Pathophysiology

Increased CO<sub>2</sub> excretion from hyperventilation. Kidneys excrete HCO<sub>3</sub> to compensate.

#### Signs & Symptoms

- tachypnea
- dizziness
- confusion
- tachycardia
- cramps
- syncope
- paresthesias
- hyperreflexia

### Metabolic Alkalosis

#### Causes

- vomiting
- excess NaHCO<sub>3</sub> intake
- nasogastric suctioning
- diuretic therapy
- hypokalemia
- mineralocorticoid use

#### Pathophysiology

Loss of acid from prolonged vomiting or NB suction. Lungs compensate by retaining CO<sub>2</sub>.

#### Signs & Symptoms

- irritability
- lethargy
- dysrhythmias r/t hypokalemia
- nausea and vomiting
- seizures
- hypertonic muscles