# Understanding Acid-Base Data from the VitalPath™ Analyzer

## Acid-Base Analysis

Imbalances in patient acid-base status will disrupt normal metabolic processes and can lead to organ system failure. Severe derangements can ultimately lead to irreparable damage and loss of the patient.

Knowledge of acid-base status is useful for generating a differential diagnosis, monitoring patient response to treatment and better defining patient prognosis.

## Sample Handling

To ensure accurate results, proper sample handing is required. Using a balanced heparin syringe, commercially heparinized non-vacuum collection tube, or heparinized capillary tube, a sample should be collected and analyzed immediately. Any delay can lead to changes in pH, ***P***$CO_2$ and $HCO_3$. The VitalPath™ Analyzer has the ability to provide immediate and accurate results.

## Interpretation of pH, *P*$CO_2$ and $HCO_3$ (acid-base)

### Step 1: Evaluate the pH

Determine if the pH is below (acidemia) or above (alkalemia) the normal range for the tested species.

### Step 2: Evaluate the *P*$CO_2$

Determine if the ***P***$CO_2$ is below (alkalosis) or above (acidosis) the normal range for the species and sample being tested.

### Step 3: Evaluate the $HCO_3$

Determine if the $HCO_3$ is below (acidosis) or above (alkalosis) the normal range for the species being tested.

### Step 4: Evaluate the interaction of pH, *P*$CO_2$ and $HCO_3$

The process that gives the same indication as the pH is the primary disturbance. Use dog normal values for pH (7.31–7.42), ***P***$CO_2$ (29–42), $HCO_3$ (17–24) for the following examples:

pH 7.21 (acidemia), ***P***$CO_2$ 50 (acidosis), $HCO_3$ 20 (normal). Interpreted as primary respiratory acidosis without compensation.

pH 7.51 (alkalemia), ***P***$CO_2$ 48 (acidosis), $HCO_3$ 30 (alkalosis). Interpreted as a primary metabolic alkalosis with respiratory compensation.

## Interaction Scenarios

| **Condition** | pH | ***P***$CO_2$ | $HCO_3$ |
|---|---|---|---|
| Metabolic acidosis | ↓ | N | ↓ |
| Metabolic acidosis – some compensation | ↓ | ↓ | ↓ |
| Metabolic alkalosis | ↑ | N | ↑ |
| Metabolic alkalosis – some compensation | ↑ | ↑ | ↑ |
| Respiratory acidosis | ↓ | ↑ | N |
| Respiratory acidosis – some compensation | ↓ | ↑ | ↑ |
| Respiratory alkalosis | ↑ | ↓ | N |
| Respiratory alkalosis – some compensation | ↑ | ↓ | ↓ |

N=normal

(cont'd)

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## Common Examples

| Metabolic Acidosis | Respiratory Acidosis |
|---|---|
| • Renal failure<br>• Ketoacidosis<br>• Lactic acidosis<br>• Ethylene glycol toxicity<br>• Obstructive uropathy<br>• Hypoadrenocorticism (Addison's disease)<br>• Diarrhea | • Pulmonary edema<br>• Thoracic trauma<br>• Bronchial obstruction<br>• CNS trauma<br>• Pneumothorax<br>• Pyothorax |
| **Metabolic Alkalosis** | **Respiratory Alkalosis** |
| • Vomiting<br>• Excessive diuretic therapy<br>• Exogenous $HCO_3$<br>• Excessive cortisol and mineralocorticoid: hyperadrenocorticism (Cushing's syndrome) | • Excessive positive pressure ventilation<br>• Anxiety<br>• CNS trauma |

## Calculations for Advanced Users

### Anion Gap (AG)

Anion gap is defined as the difference between normally measured anions and normally measured cations:

**Anion Gap = $(Na^+ + K^+) - (HCO_3^- + Cl^-)$**

Abnormalities in AG may be helpful in determining the cause of metabolic acidosis. An increased AG is typically caused by an increase in unmeasured anions such as ketoacids, sulfates, salicylate, lactate, and ethylene glycol metabolites. Decreases in anion gap are seldom clinically significant.

### Base Excess (BE)*

**BE = $(HCO_3^- - 24.8) + 16.2\ (pH - 7.4)$**

Base excess is a calculated parameter from blood gas analysis. BE can be used for base deficit correction calculations in fluid therapy, and in conjunction with $HCO_3^-$, can be used to assess the metabolic component of acid-base balance in patients with mixed responses. BE > reference range indicates metabolic alkalosis and BE < reference range indicates metabolic acidosis.

* For background information refer to M.A. Thrall, Veterinary Hematology and Clinical Chemistry (Baltimore: Lippincott Williams & Wilkins, 349, 2004).

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