Using Blood Values to Determine the Cause of Acidosis or Alkalosis:

Students, particularly nursing students, are often provided with blood values and ask to determine (1) whether the patient is in acidosis or alkalosis, (2) the cause of the condition (respiratory or metabolic), and (3) whether or not the condition is being compensated by another body system. Such determinations are not as difficult as they may appear if they are approached systematically. When attempting to analyze a person's acid-base balance, scrutinize the blood values in the following order:

1. Note the pH. This tells you whether the person is in acidosis (pH< 7.35) or alkalosis (pH > 7.45), but it does *not* tell you the cause.

2. Next, check the pCO_2 to see if this is the cause of the acid-base imbalance. Because the respiratory system is a fast-acting system, an excessively high or low pCO_2 may indicate either that the condition is respiratory system caused or that the respiratory system is compensating. For example, if the pH indicates acidosis and
   a. the pCO_2 is over 45 mm Hg, the respiratory system *is the cause* of the problem and the condition is a respiratory acidosis;
   b. the pCO_2 is below normal limits (below 35 mm Hg), the respiratory system is *not the cause but is compensating* ;
   c. the pCO_2 is within normal limits, the condition is *neither caused nor compensated* by the respiratory system.

3. Check the bicarbonate level (HCO_3^-). If step 2 proves that the respiratory is not responsible for the imbalance, then the condition is metabolic and should be reflected in increased or decreased bicarbonate level: Metabolic acidosis is indicated by HCO_3^- values below 22 mEq/L, and metabolic alkalosis by values over 26 mEq/L. Notice that whereas pCO_2 levels vary inversely with blood pH (pCO_2 rises as blood pH falls), HCO_3^- levels vary directly with blood pH (increased HCO_3^- results in increased pH).

Consider the following example using the above approach:

Problem 1

Blood values given: pH 7.5; pCO_2 24 mm Hg; HCO_3^- 24 mEq/L.

Analysis:

1. The pH is elevated = alkalosis.
2. The pCO_2 is very low = the cause of the alkalosis.
3. The HCO_3^- value is within normal limits.

Conclusion: This is respiratory alkalosis not compensated by renal mechanisms (kidney), as might occur during short-term hyperventilation.

Normal range in plasma	pH 7.35–7.45	P_{CO_2} 35–45 mm Hg	HCO_3^- 22–26 mEq/L
Acid-base disturbance			
Respiratory acidosis	↓	↑	↑ if compensating
Respiratory alkalosis	↑	↓	↓ if compensating
Metabolic acidosis	↓	↓ if compensating	↓
Metabolic alkalosis	↑	↑ if compensating	↑

Problem 2
Blood values given: pH 7.48; pCO_2 46 mmHg; HCO_3^- 32 mEq/L

Analysis: Use the values for the following to draw conclusions about the patient.

1. The pH
2. The pCO_2
3. The HCO_3^-

Questions: Using the space provided below, please state the following: Be specific!
1. Whether the patient is in acidosis or alkalosis. (how do you know?)
1. The cause of the condition: respiratory or metabolic. (how do you know?)
2. Whether or not the condition is being compensated by another body system.
(how do you know?)

Conclusions: Rewrite your findings in a coherent paragraph below. ie. Make a diagnosis, what is a possible cause of the condition? see lecture notes!

Answer to Problem #2:

Blood values given:
1. pH 7.48
2. pCO_2 = 46 mm Hg
2. HCO_3^- = 32 mEq/L

Analysis:
1. **The pH is elevated = alkalosis**
2. **The pCO_2 is elevated = the cause of *acidosis*, not alkalosis; thus the respiratory system is compensating and is NOT the cause.**
3. **The HCO_3^- is elevated = the cause of the alkalosis.**

Conclusion:
This is a metabolic alkalosis caused by many disorders such as: constipation, taking too many ant-acids, excessive vomiting, or bicarbonate retention. (see lecture notes).
The condition is being compensated by the respiratory system, i.e. <u>retention of CO_2</u> by slow breathing in order to restore blood pH to normal range.