Acid base disorders

Read in this order ↓

ABG and BMP Normal values	
pH	7.35-7.45
PaCO2	35-45 mmHg
PaO2	80-100 mmHg
HCO3 (on BMP)	22-26 mmol/L

Steps for interpretation:

1. Acidemia or Alkalemia?
2. Respiratory or Metabolic?
3. Compensated? Acute or chronic?
4. Anion gap? Delta-delta?
5. Differentials?

Step 1: pH <7.35= Acidemia
>7.45=Alkalemia

Step 2:

pH	pCO2	
↓	↓	Metabolic Acidosis
↑	↑	Metabolic alkalosis
↓	↑	Resp Acidosis
↑	↓	Resp Alkalosis

Step 3:

Metabolic compensation	Respiratory acidosis		Respiratory alkalosis	
	Acute	Chronic	Acute	Chronic
Expected HCO3 (BMP)	$24+\left(\frac{PCO2-40}{10}\right)\times 1$	$24+\left(\frac{PCO2-40}{10}\right)\times 4$	$24-\left(\frac{40-PCO2}{10}\right)\times 2$	$24-\left(\frac{40-PCO2}{10}\right)\times 5$
Expected pH	$7.4-(PCO2-40)\times 0.008$	$7.4-(PCO2-40)\times 0.003$	$7.4+(40-PCO2)\times 0.008$	$7.4+(40-PCO2)\times 0.003$

Respiratory compensation	Metabolic acidosis	Metabolic alkalosis
Expected PCO2 (ABG)	1.5(HCO3) + 8 (+/-2)	40 + (HCO3-24)X0.7 (+/-5)
Additional disorder	If PCO2 is **greater** than expected = additional **respiratory acidosis** If PCO2 is **lower** than expected = additional **respiratory alkalosis**	

Step 4: Anion Gap (AG) = {Na – (Cl + HCO3)} Normal = 12 +/- 2

Corrected Anion Gap = AG + 2.5(4-albumin)

Delta: Delta = $\frac{AG-12}{24-HCO3}$

Delta: Delta	Interpretation for metabolic acidosis
<0.4	Pure Normal AG metabolic acidosis
0.4-0.8	Normal + High AG metabolic acidosis
0.8-2.0	Pure High AG metabolic acidosis
>2.0	Metabolic acidosis with superimposed Metabolic alkalosis/Resp acidosis

Step 5:

Causes of High Anion Gap Metabolic acidosis	
G	Glycols - ethylene glycol "antifreeze" and propylene glycol (present in IV benzodiazepines)
O	Oxoproline (associated with acetaminophen dosing)
L	L-lactate (common form of lactate)
D	D-lactate (short bowel syndrome, intestinal bacterial overgrowth, propylene glycol)
M	Methanol
A	Aspirin (salicylates)
R	Renal failure (uremia)
K	Ketoacidosis (starvation, diabetic)

Causes of Normal Anion Gap Metabolic acidosis
Diarrhea
Renal tubular acidosis/Chronic renal failure
Adrenal insufficiency
Rapid saline infusion
Acetazolamide

Causes of Metabolic Alkalosis
Vomiting, NG suction
Volume depletion (diuresis)
Mineralocorticoid excess

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Causes of Respiratory alkalosis
Hyperventilation (Anxiety, pain, fever, hypoxia)
"Classically" noted with pulmonary embolism (with associated hypoxia)
Salicylates

Causes of Respiratory acidosis
CNS depression (sedation, narcotics, CVA)
Neuromuscular weakness (GBS, Myasthenia gravis)
Obstructive or restrictive lung disease (COPD, OSA, Asthma, Obesity hypoventilation)
Airway obstruction (foreign body, aspiration)