# ABG Interpretations

Collected by

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# Why Order an ABG?

- Aids in establishing a **diagnosis**
- Helps **guide treatment** plan
- Aids in **ventilator management**
- Improvement in acid/base management allows for **optimal function of medications**
- Acid/base status **may alter electrolyte levels** critical to patient status/care

| | PH | $PaO_2$ mmHg | $PaCO_2$ mmHg | HCO3 mEq/L |
|---|---|---|---|---|
| Cord blood | 7.28 +- 0.05 | 18 +- 6.2 | 49.2+- 8.4 | 14-22 |
| At birth | 7.11 – 7.36 | 8-24 | 27-40 | 13-22 |
| 5-10 min | 7.09- 7.3 | 33-75 | 27-40 | 13-22 |
| 30 min | 7.21- 7.38 | 31-85 | 27-40 | 13-22 |
| 60 min | 7.26- 7.49 | 55-80 | 27-40 | 13-22 |
| 1 day | 7.29-7.45 | 54-95 | 27-40 | 13-22 |
| Thereafter | 7.35-7.45 | 83-108 | 32-48 | 20-28 |

**Table 1.**

**Comparison of blood gas analysis at different sites**

| Variables | Arterial | Venous |
|---|---|---|
| pH | Same | Lower |
| $PaCO_2$ | Lower | Higher |
| $PaO_2$ | Higher | Lower |
| $HCO_3$ | Same | Same |

# Base Excess(BE) / Base Deficit (BD)

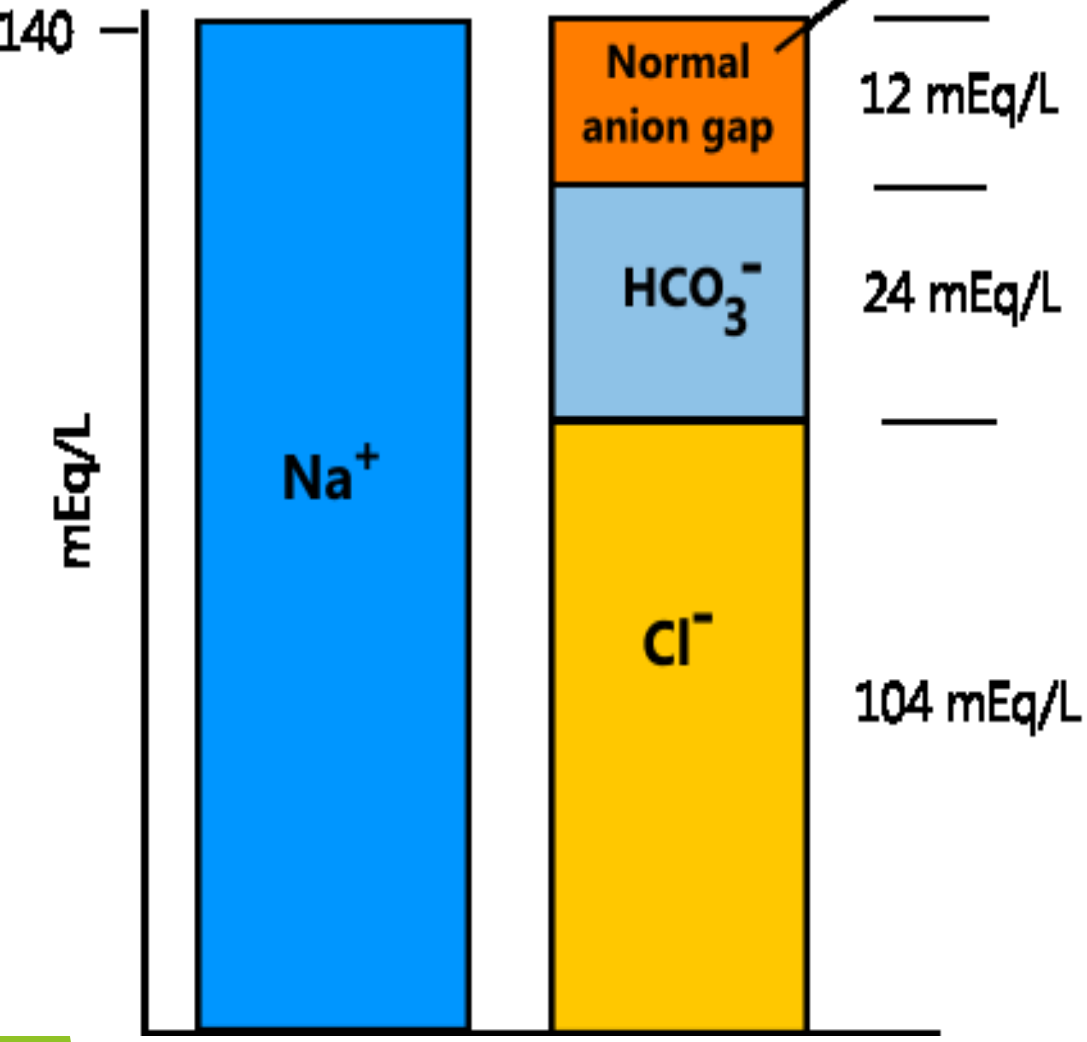
- Normal range -2-2
- Positive (excess) (> +2mmol/L) indicates that there is a higher than normal amount of $HCO_{3-}$ in the blood, which may be due to a primary metabolic alkalosis or a compensated respiratory acidosis.
- Negative(deficit (< -2mmol/L) indicates that there is a lower than normal amount of $HCO_{3-}$ in the blood, suggesting either a primary metabolic acidosis or a compensated respiratory alkalosis.
- **Predicted PH:**

-If $PaCO_2$<40= $7.4[(40- PaCO_2)/100] \times 0.5$

- If $PaCO_2$>40= $7.4[(40+ PaCO_2)/100]$

**- BD or BE= ( PH - predicted PH) ×67**

- primarily composed of albumin
- also contains phosphate, sulfate, and other anions

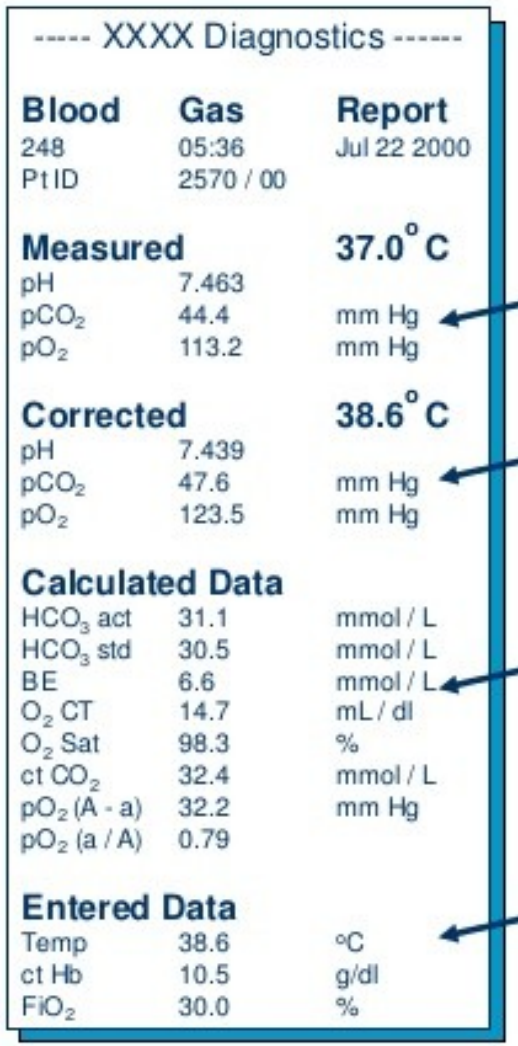



$$\text{Anion gap} = Na^+ - (Cl^- + HCO_3^-)$$

**Corrected anion gap for hypoalbuminemia =**
**(4 - serum albumin concentration) X 2.5 + calculated anion gap**

Reference [1,2,5]

# The Anatomy of a Blood Gas Report




**Measured Values**

**Temperature Correction:**
Is there any value to it?

**Calculated Data:**
Which are the useful ones?

**Entered Data:**
Derived from other sources

# STEP 1

- Acidosis or alkalosis.
- see PH

**TABLE 26-3**

**Interpretation of ABG Test**

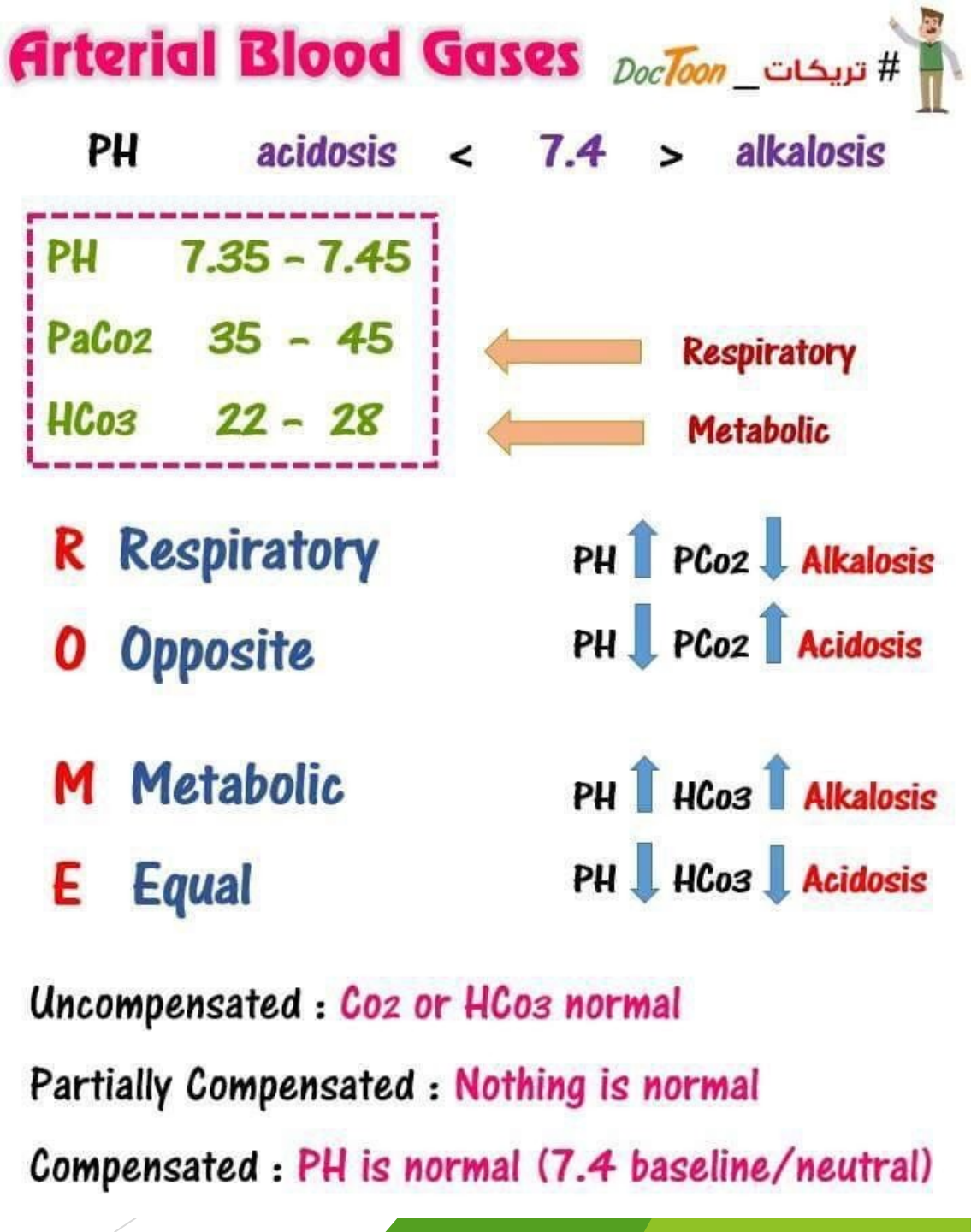
| | |
|---|---|
| 1. Look at pH | ⇑ = alkalosis<br>⇓ = acidosis |
| 2. Look at $Paco_2$ | = respiratory parameter |
| 3. Look at $HCO_3$ | = metabolic parameter |

| DISORDER | pH | $Paco_2$ | $HCO_3$ |
|---|---|---|---|
| Respiratory acidosis | ⇓ | ⇑ | — |
| Respiratory alkalosis | ⇑ | ⇓ | — |
| Metabolic acidosis | ⇓ | — | ⇓ |
| Metabolic alkalosis | ⇑ | — | ⇑ |

pH normal = fully compensated
All values abnormal = partially compensated
Two abnormal values = uncompensated

# STEP 2

- Respiratory or metabolic
- (primary pathology).



# ACID BASE MNEMONIC (ROME)

**R** Respiratory

**O** Opposite

pH ↑ $PCO_2$ ↓ Alkalosis

pH ↓ $PCO_2$ ↑ Acidosis

**M** Metabolic

**E** Equal

pH ↑ $HCO_3$ ↑ Alkalosis

pH ↓ $HCO_3$ ↓ Acidosis

# Arterial Blood Gases

| | pH | $PaCO_2$ | $HCO_3$ |
|---|---|---|---|
| Respiratory Alkalosis | ↑ | ↓ | Normal |
| Respiratory Acidosis | ↓ | ↑ | Normal |
| Metabolic Alkalosis | ↑ | Normal | ↑ |
| Metabolic Acidosis | ↓ | Normal | ↓ |

# STEP 3

- Is there is compensation

| Compensatory changes (Metabolic disorders). | | | | |
|---|---|---|---|---|
| **Primary disorder** | **Primary defect** | **Compensatory response** | **Expected Compensation** | **Limits of compensation** |
| Metabolic acidosis | ↓ HCO3 | ↓ PCO2 | PCO2=1.5[HCO3] + 8 ± 2<br>PCO2= last 2 digits of pH X 100<br>PCO2= 15+ [HCO3] | PCO2=15mmHg |
| Metabolic Alkalosis | ↑ HCO3 | ↑ PCO2 | PCO2= + 0.6 mmHg for Δ [HCO3] of 1 mEq/L<br>PCO2=15+ [HCO3] | PCO2=55mmHg |

**Remember.....**

✓ *Respiratory compensation is always FAST ...12-24 hrs*

✓ *Metabolic compensation is always SLOW ...5 -7 days*

# STEP 3

- Is there is

compensation

## Compensatory changes (Respiratory disorders).

| Primary disorder | Primary defect | Compensatory response | Expected Compensation | Limits of compensation |
|---|---|---|---|---|
| Respiratory acidosis | ↑ PCO2 | ↑ HCO3 | ***Acute:*** + 1 Meq/L ↑ HCO3 for each ↑ PCO2 of 10mmHg | [HCO3]=38 Meq/L |
| | | | ***Chronic:*** +4 Meq/L ↑ HCO3 for each ↑ PCO2 of 10mmHg | [HCO3]=45 Meq/L |
| Respiratory Alkalosis | ↓ PCO2 | ↓ HCO3 | ***Acute:*** -2Meq/l ↓ in HCO3 for each ↓ in PCO2 of 10mmHg | [HCO3]=18 Meq/L |
| | | | ***Chronic:*** -5 Meq/L ↓ in HCO3 for each ↓ in PCO2 of 10mmHg | [HCO3]=15 mEq/L |

## Table 52-9 APPROPRIATE COMPENSATION DURING SIMPLE ACID-BASE DISORDERS

RCA 101
RKA102
RCC103
RKC104

| DISORDER | EXPECTED COMPENSATION |
|---|---|
| Metabolic acidosis | $Pco_2 = 1.5 \times [HCO_3^-] + 8 \pm 2$ |
| Metabolic alkalosis | $Pco_2$ increases by 7 mm Hg for each 10-mEq/L increase in serum $[HCO_3^-]$ |
| Respiratory acidosis | |
| Acute | $[HCO_3^-]$ increases by 1 for each 10–mm Hg increase in $Pco_2$ |
| Chronic | $[HCO_3^-]$ increases by 3.5 for each 10–mm Hg increase in $Pco_2$ |
| Respiratory alkalosis | |
| Acute | $[HCO_3^-]$ falls by 2 for each 10–mm Hg decrease in $Pco_2$ |
| Chronic | $[HCO_3^-]$ falls by 4 for each 10–mm Hg decrease in $Pco_2$ |

**Summary of ABG findings in simple acid-base disturbances**

| Acid-base disturbance | pH | $pCO_2$ | $HCO_3^-$ | Compensatory response |
|---|---|---|---|---|
| Metabolic acidosis | ↓ | ↓ | ↓ | *Immediate*: respiratory compensation with hyperventilation and decreased $pCO_2$ |
| Respiratory acidosis | ↓ | ↑ | ↑ or ↔ | *Delayed*: kidneys compensate by retaining $HCO_3^-$ (concentrations generally > 30) |
| Metabolic alkalosis | ↑ | ↑ | ↑ | *Immediate*: respiratory compensation with hypoventilation and increased $pCO_2$ |
| Respiratory alkalosis | ↑ | ↓ | ↓ or ↔ | *Delayed*: kidneys compensate through $HCO_3^-$ loss (concentrations generally < 18) |

Correction always in same direction

| | Metabolic | respiratory |
|---|---|---|
| Acidosis | ↓ Hco3 | Pco2 ↑ |
| Alkalosis | ↑ Hco3 | pco2 ↓ |

# STEP 4

- If metabolic acidosis -

## High AG or normal AG

**MUD-PIELS**

M ethanol
U remia
D iabetic Ketoacidosis
P araldehyde
I nfection (lactic acid)
E thylene Glycol
S alicylate

**HARD-UPP**

Hyper Alimentation
Acetazolamide
Renal Tubular Acidosis
Diarrhea
Ureterosibmoidostomy
Pancreatic Fistula
Primary Hyperparathyroidism

# 1

A child with pneumonia on ventilator has following ABG report.

- pH : 7.29
- PCO2 : 60 mmHg
- PaO2 : 68 mmHg
- HCO3 : 30 mMol/L
- SpO2 : 92%

1. What is the acid base disorder?
2. Is it a simple disorder or mixed?
3. Is it a compensated disorder?

# ABG in OSCE EXAM

# 1

- pH 7.28
- $PaCO_2$ 54mmHg
- $PaO_2$ 45mmHg
- $HCO_3$ 29mEq/L
- Base excess +7

What are the-

- Abnormalities?
- Diagnosis?
- Likely causes?

- Low pH, high $PaCO_2$, low $PaO_2$, high $HCO_3$
- Uncompensated respiratory acidosis with hypoxemia
- RESPIRATORY FAILURE (pneumonia, RDS)

# 2

- pH 7.57
- PaCO2 22mmHg
- PaO2 156mmHg
- HCO3 18mEq/L
- Base excess -8

What are the-

Abnormalities?

Diagnosis?

Likely cause?

- High pH, low $PaCO_2$, high $PaO_2$, low $HCO_3$
- UNCOMPENSATED RESPIRATORY ALKALOSIS WITH HYPEROXIA
- Hyperventilation with high $FiO_2$

# 3

- pH 7.32
- $PaCO_2$ 30mmHg
- $PaO_2$ 70mmHg
- $HCO_3$ 12mEq/L
- Base excess-8

# QUESTIONS

- ABNORMALITIES
- DIAGNOSIS
- LIKELY CAUSES

- Low pH, low $PaCO_2$, normal $PaO_2$, low $HCO_3$

- UNCOMPENSATED METABOLIC ACIDOSIS
- SHOCK, RENAL FAILURE

# 4

- pH 7.60
- $PaCO_2$ 21mmHg
- $PaO_2$ 65mmHg
- $HCO_3$ 24mEq/L
- Base excess+2

# QUESTIONS

- ABNORMALITIES
- DIAGNOSIS
- LIKELY CAUSES

- High pH, low $PaCO_2$,  normal $PaO_2$, normal $HCO_3$
- UNCOMPENSATED RESPIRATORY ALKALOSIS

- HYPERVENTILATION (BRONCHIAL ASTHMA)

# 5

- pH 7.36
- $PaCO_2$ 70mmHg
- $PaO_2$ 75mmHg
- $HCO_3$ 35mEq/L
- Base excess+14

# QUESTIONS

- ABNORMALITIES
- DIAGNOSIS
- LIKELY CAUSES

- Low pH, high $PaCO_2$, normal $PaO_2$, high $HCO_3$
- COMPENSATED RESPIRATORY ACIDOSIS
- VENTILATED INFANT WITH TUBE BLOCK

# 6

- pH 7.52
- $PaCO_2$ 47mmHg
- $PaO_2$ 80mmHg
- $HCO_3$ 30mEq/L
- Base excess+3

# QUESTIONS

- ABNORMALITIES
- DIAGNOSIS
- LIKELY CAUSES

- High pH, high $PaCO_2$,  normal $PaO_2$, high $HCO_3$
- UNCOMPENSATED METABOLIC ALKALOSIS
- VOMITING, PYLORIC STENOSIS

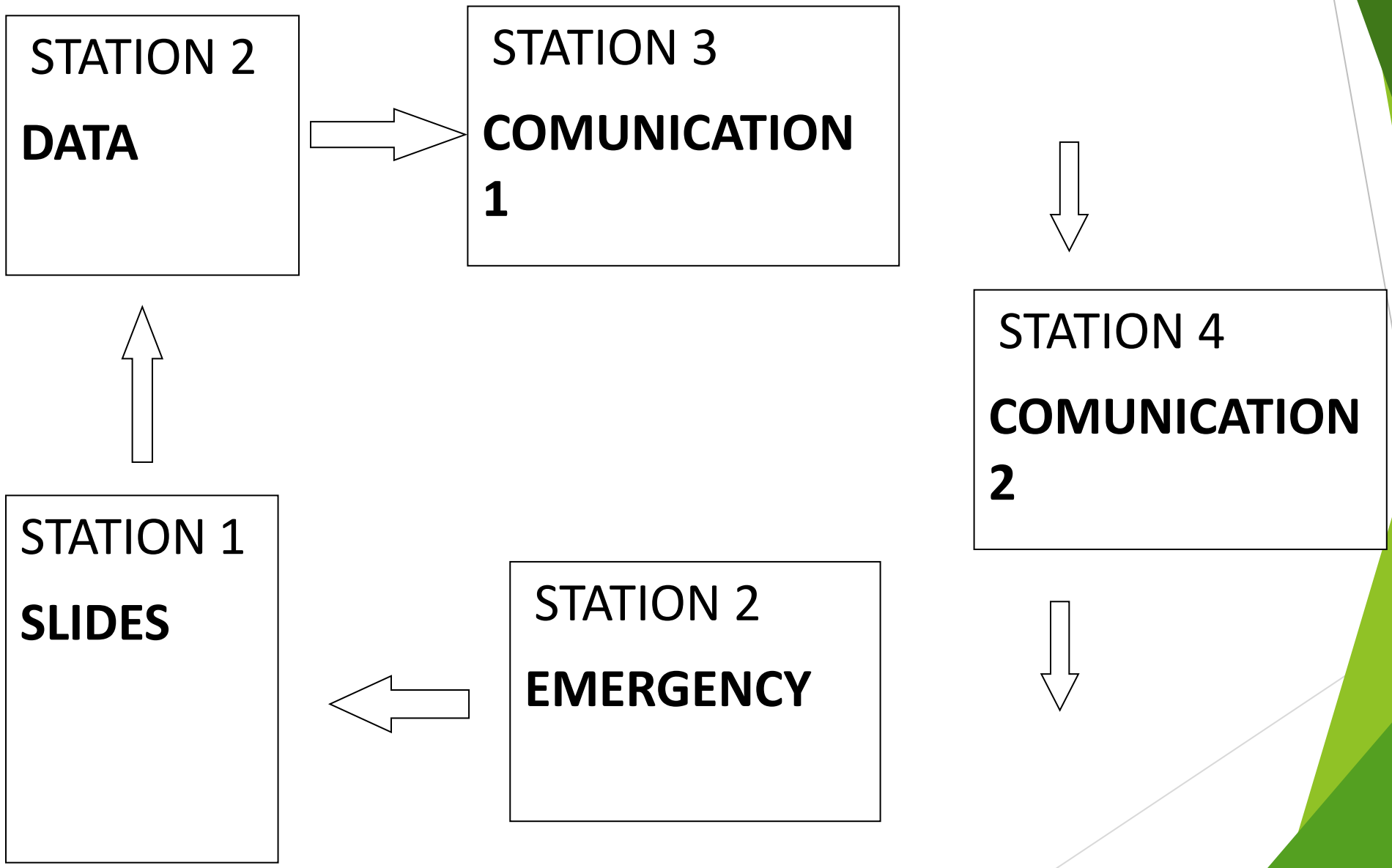
# 7

- pH 7.14
- $PaCO_2$ 54mmHg
- $PaO_2$ 55mmHg
- $HCO_3$ 14 mEq/L
- Base excess-7

# QUESTIONS

- ABNORMALITIES
- DIAGNOSIS
- LIKELY CAUSES

- Low pH, high $PaCO_2$, normal $PaO_2$, low $HCO_3$
- UNCOMPENSATED RESPIRATORY AND METABOLIC ACIDOSIS
- INFANT ON VENTILATOR WITH TUBE BLOCK & SHOCK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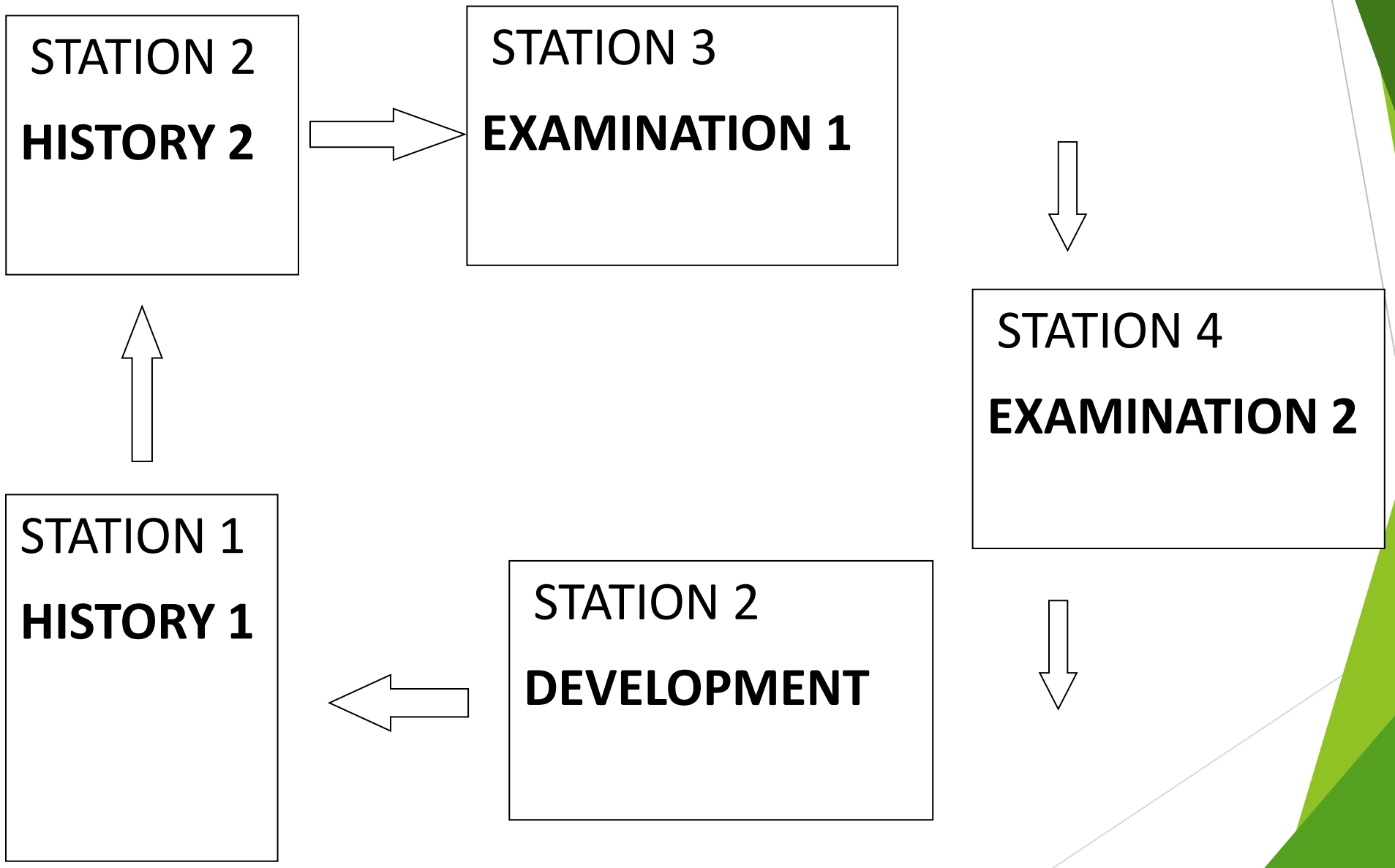
DATA
STATION 3
COMUNICATION 1
STATION 4
COMUNICATION 2
STATION 2
EMERGENCY
STATION 1
SLIDES


STATION 2
HISTORY 2
STATION 3
EXAMINATION 1
STATION 4
EXAMINATION 2
STATION 2
DEVELOPMENT
STATION 1
HISTORY 1

# Thank You