Blood Gases Made Easy

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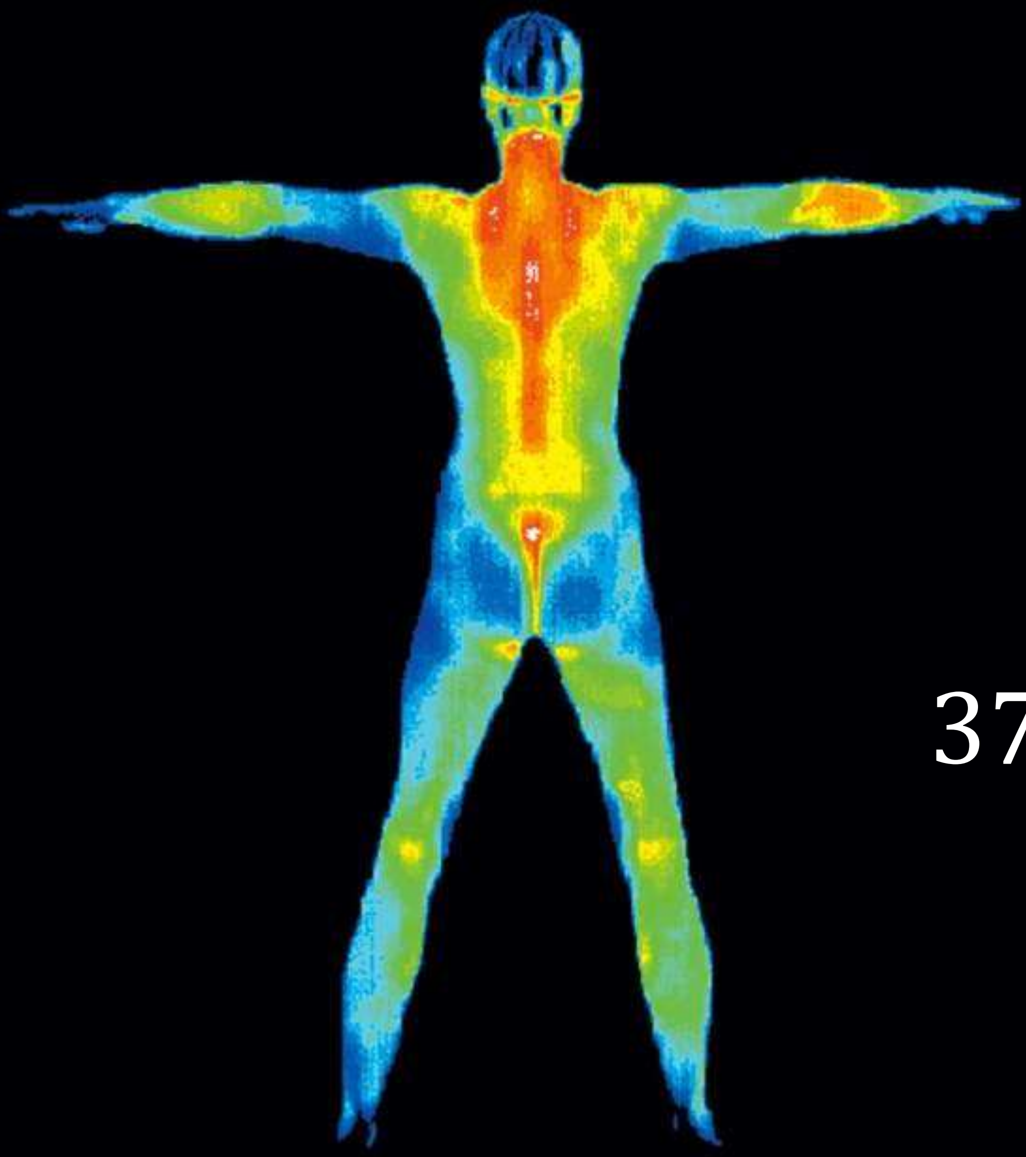
Life is all about balance…

-94º C

+56º C



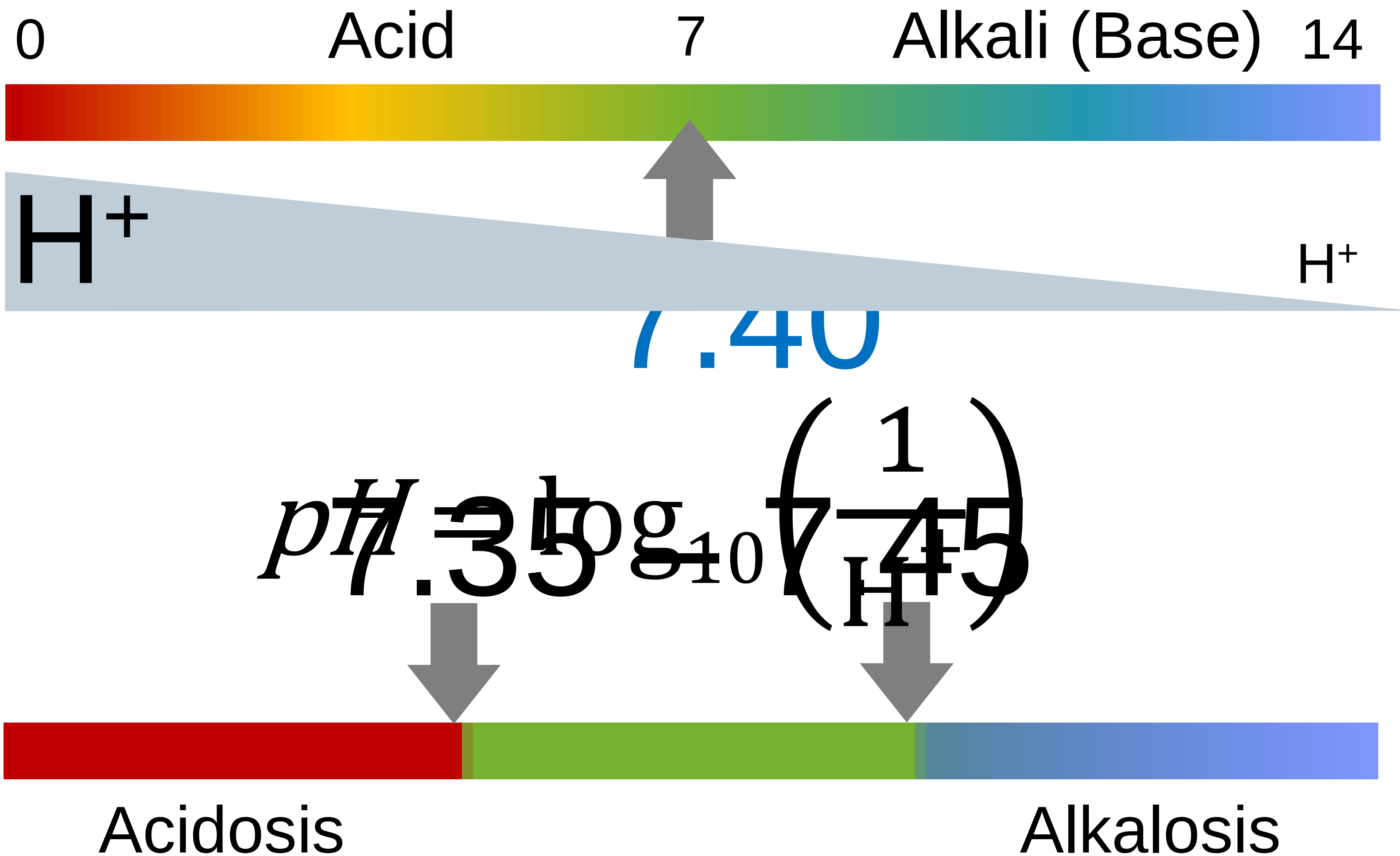
$37 \pm 0.5℃$


arter's

Acid – Base Balance

Similarly, the pH of body fluids is optimized, in particular blood pH…

Acid – Base Balance



Acid – Base Balance

7.35 – 7.45

Acidosis Normal Alkalosis

Arterial blood pH

Patient A	7.28	Acidosis
Patient B	7.51	Alkalosis
Patient C	7.34	Acidosis
Patient D	7.46	Alkalosis

Acid – Base Balance

Henderson – Hasselbach equation

$$\mathrm{pH} = 6.1 + \log_{10}\left(\frac{[\mathbf{HCO^{-}{}_{3}}]}{0.03\ x\ \mathbf{pCO_2}}\right)$$

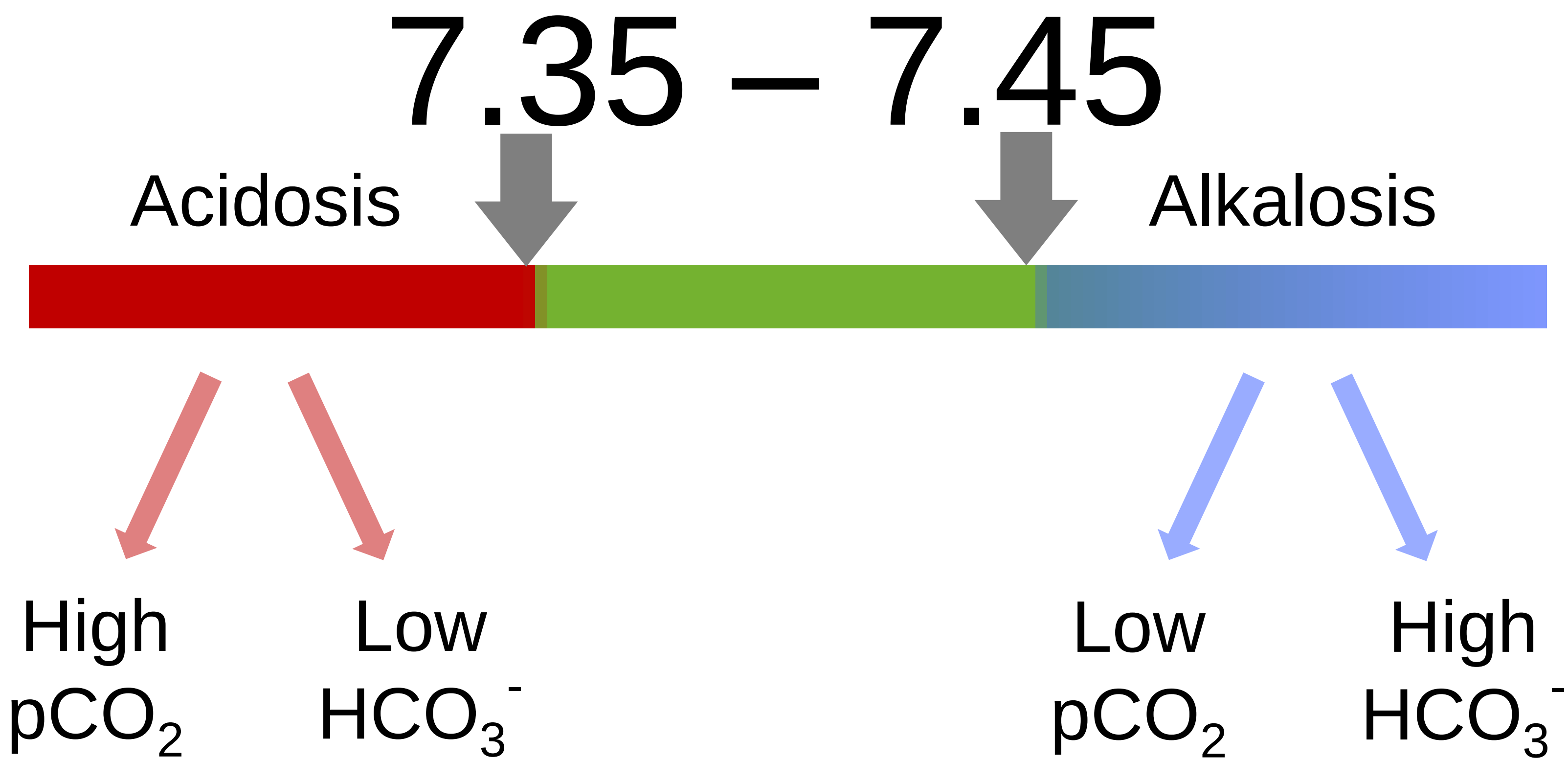
Acid – Base Balance

	Normal range		
pH	7.35		7.45
pCO_2	35	40	45 mmHg
HCO_3^-	22	24	26 mmol/L

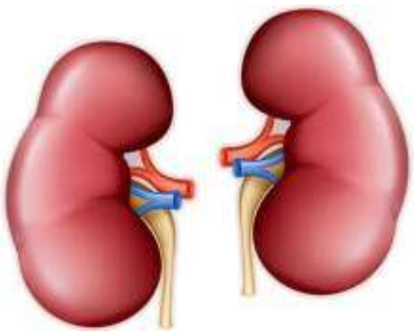
$$pH = 6.1 + \log_{10}\left(\frac{[\mathbf{HCO^-_3}]}{0.03\ x\ \mathbf{pCO_2}}\right)$$

$$pH = 7.40$$

Acid – Base Balance

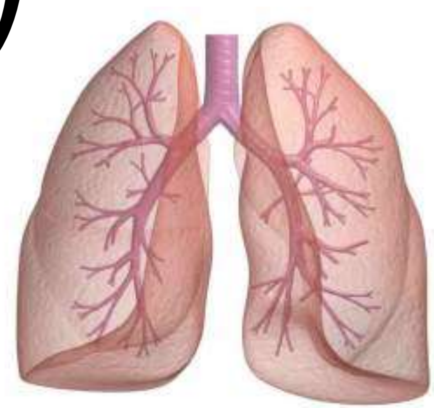


Acid – Base Balance



Metabolic

$$pH \propto \left(\frac{HCO_3^-}{pCO_2} \right)$$



Respiratory

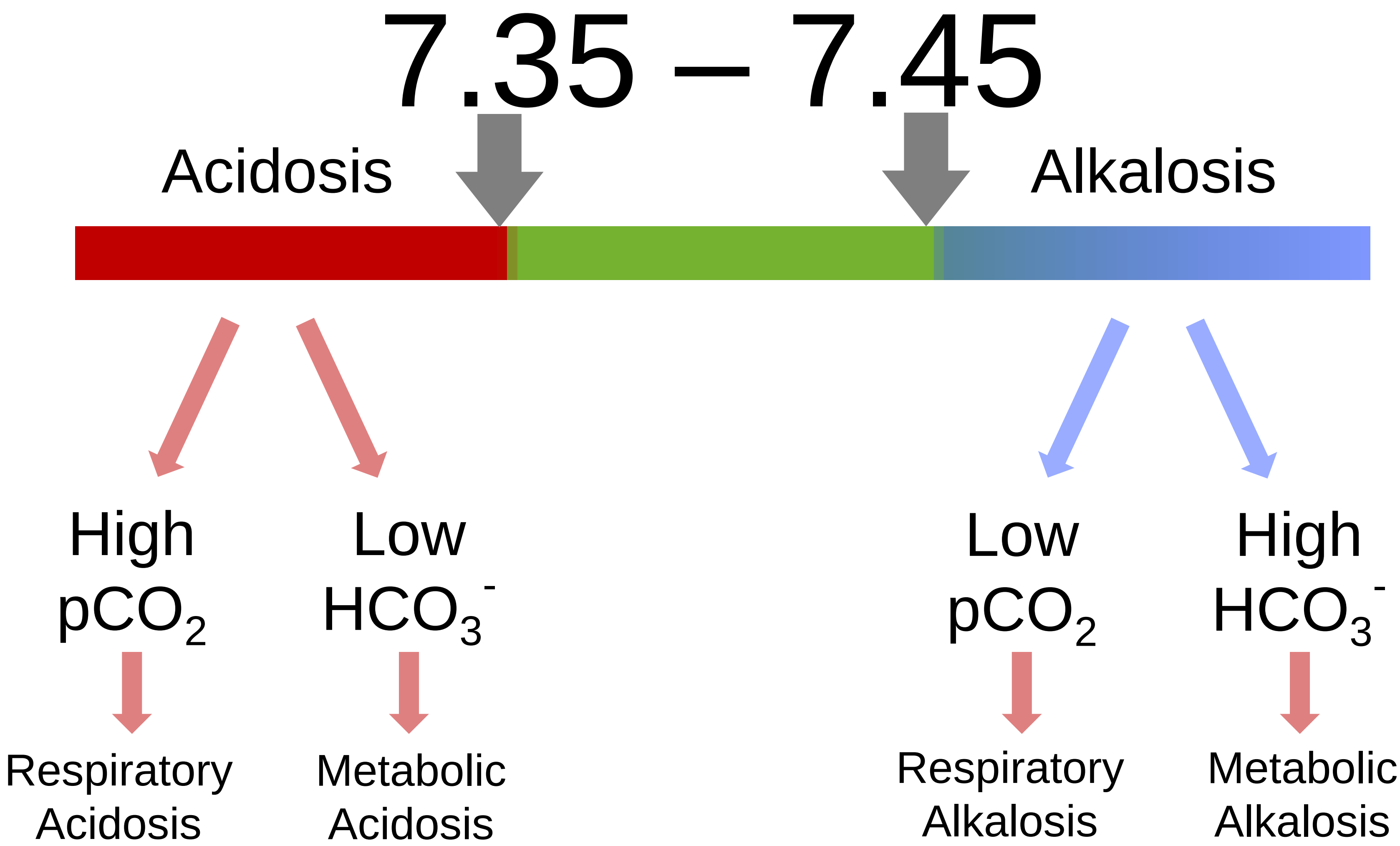
Acid – Base Balance

Le Chatelier's principle

Carbonic Anhydrase

$$CO_2 + H_20 \longleftrightarrow H_2CO_3 \longleftrightarrow H^+ + HCO_3^-$$

Acid – Base Balance



Trevor Allison IFCC POCT Meeting Cancun Nov 2015

Acid – Base Balance

Normal range

pH	7.35	7.45
pCO_2	35	45 mmHg
HCO_3^-	22	26 mmol/L

High pCO_2	Low HCO_3^-	Low pCO_2	High HCO_3^-
Respiratory Acidosis	Metabolic Acidosis	Respiratory Alkalosis	Metabolic Alkalosis

	pH	pCO_2	HCO_3^-	
Patient A	7.28	51	23	Respiratory Acidosis
Patient B	7.51	32	25	Respiratory Alkalosis
Patient C	7.30	40	19	Metabolic Acidosis
Patient D	7.55	35	30	Metabolic Alkalosis

Acid – Base Balance Compensation

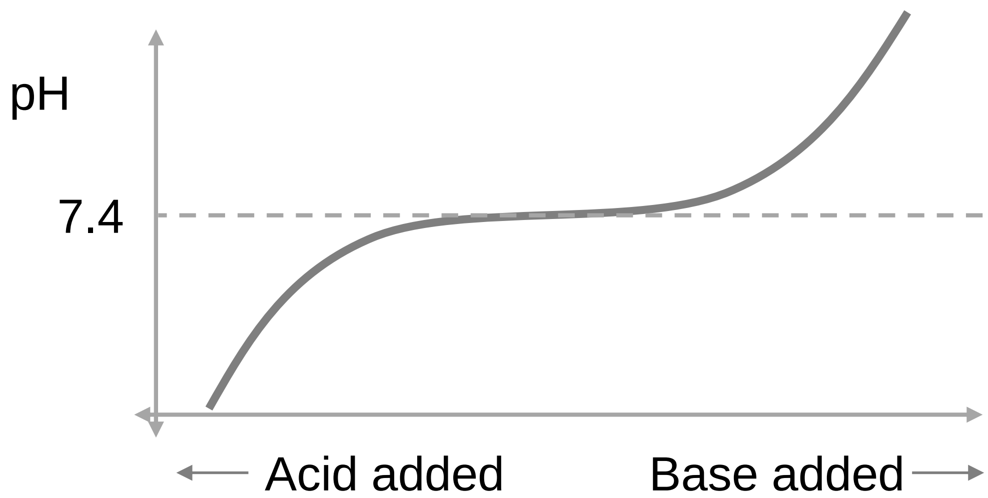
	pH	pCO_2	HCO_3^-	
Patient A	7.28	51	23	Respiratory Acidosis

3 responses to the change in equilibrium	Response time
1. Buffers in the blood	Quickly
2. Respiratory	Fairly quickly
3. Metabolic	Slowly

Acid – Base Balance Compensation

3 responses to the change in equilibrium

1. Buffers in the blood

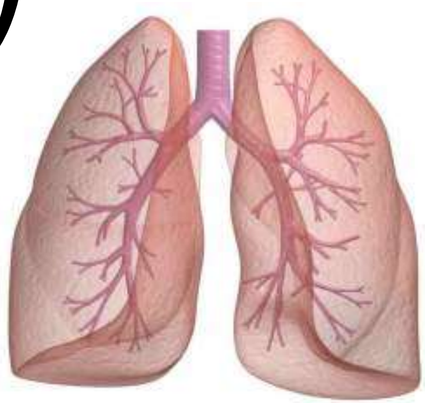


Acid – Base Balance Compensation

3 responses to the change in equilibrium

1. Buffers in the blood
2. Respiratory

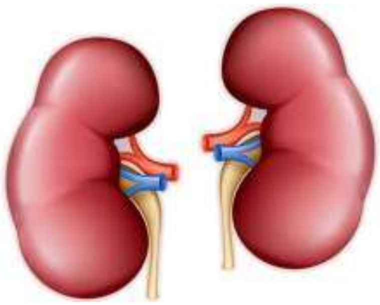
$$pH \propto \left(\frac{\mathrm{HCO_3}^-}{p\mathrm{CO_2}} \right)$$



Acid – Base Balance Compensation

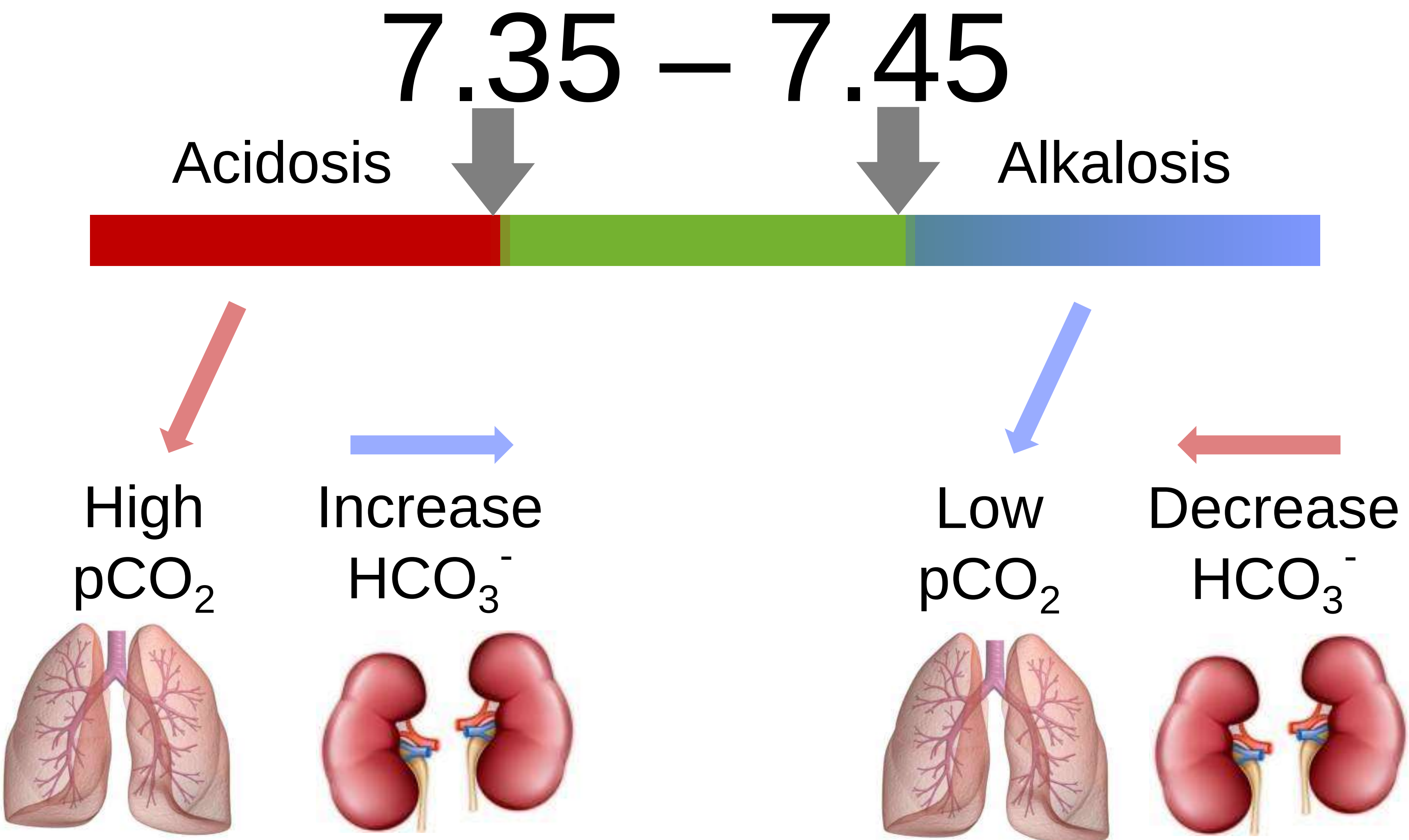
3 responses to the change in equilibrium

1. Buffers in the blood
2. Respiratory
3. Metabolic



$$pH \propto \left(\frac{\mathrm{HCO_3}^-}{p\mathrm{CO_2}}\right)$$

Acid – Base Balance Compensation



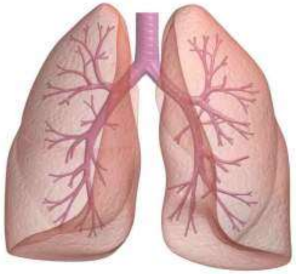
Acid – Base Balance Compensation

7.35 – 7.45

Acidosis

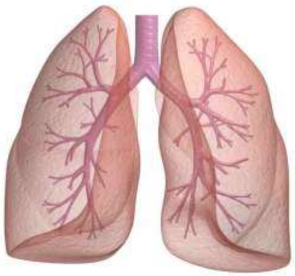
Alkalosis

Decrease pCO_2



Low HCO_3^-

Increase pCO_2



High HCO_3^-

Arterial blood pH

pH	7.35	7.45
pCO_2	35	45
HCO_3^-	22	26

Arterial blood pH

pH	7.35	7.45
pCO_2	45	35
HCO_3^-	22	26

Acid	Normal	Base
pH		
pCO_2	HCO_3^-	

Patient A

pH	7.28
pCO_2	51
HCO_3^-	23

Uncompensated
Respiratory Acidosis

Arterial blood pH

pH	7.35	7.45
pCO_2	45	35
HCO_3^-	22	26

Acid	Normal	Base
HCO_3^-		pH
		pCO_2

Patient B

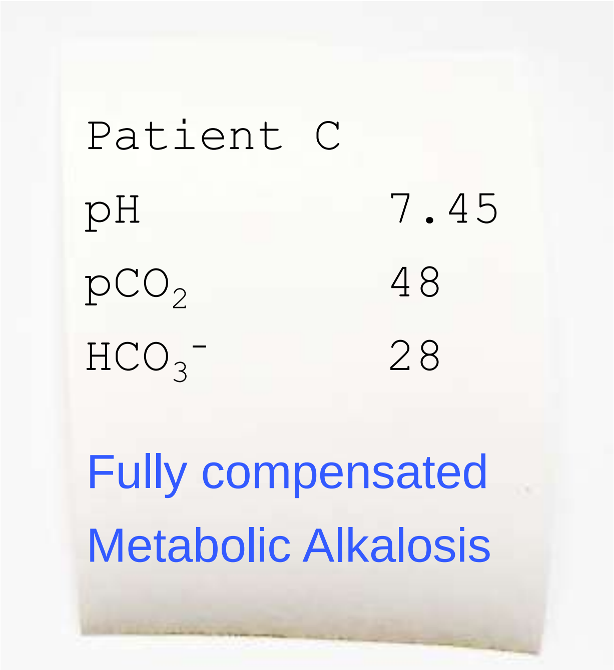
pH	7.70
pCO_2	24
HCO_3^-	21

Partially compensated
Respiratory Alkalosis

Arterial blood pH

pH	7.35	7.45
pCO_2	45	35
HCO_3^-	22	26

Acid	Normal	Base
pCO_2	pH	HCO_3^-



Arterial blood pO_2

Normal range for pO2 in arterial blood is 80 – 100 mmHg

(assuming room air at sea level of circa 160 mmHg)

Mexico City

Altitude 2240 metres, BP 585mmHg

Room air pO_2 circa 123 mmHg

Normal range 62 to 77 mmHg

60 - 79 mmHg	mild hypoxia
40 - 59 mmHg	moderate hypoxia
< 40 mmHg	severe hypoxia

Arterial blood pO_2

For a patient on oxygen therapy the FiO_2 has to considered…

FiO_2	Expected pO2 mmHg
30%	150
40%	200
50%	250

Rule of 5X

Blood Gas Interpretation

This is a basic guide to ABG result interpretation

Real life situations are often more complex

Acid	Normal	Base
pH		
pCO_2 HCO_3^-		

Additional calculated parameters such as Anion Gap, tHb & SaO_2 can help diagnose root cause

Thank you for your attention