COVID -19 part IV

Svetlana Plamadeala
MD, PhD, associate professor, Anesthesia and Intensive Care Department
Coordinator of training program in CUSIM
MEDPARK International Hospital, ICU and Anesthesia department
Member of examination subcommittee part I EDAIC, Republic of Moldova

sveta_plam@yahoo.com

Despre ce vorbim astazi

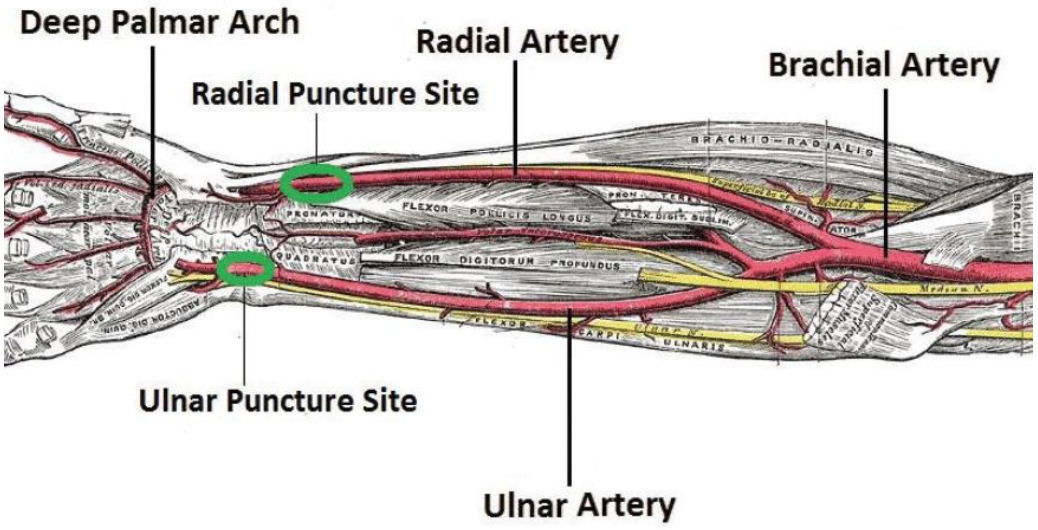
- Punctia si cateterizarea arteriala
- Analiza unui ABG – de unde incepe
- Oxigenarea
- Ce este pH-ul ?
- Cum interpretam valorile CO2
- Cum interpretam valorile HCO3

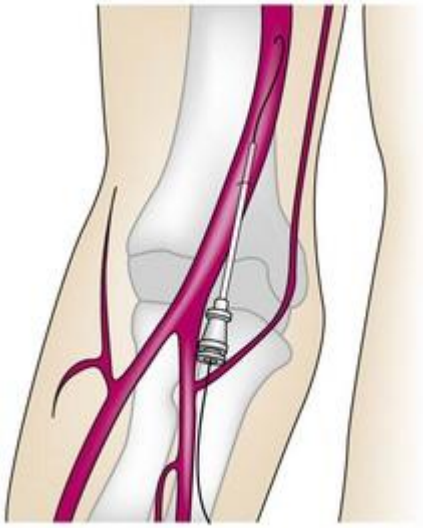
Cum interpretam cand sunt toate impreuna pH-ul, CO_2, HCO_3????

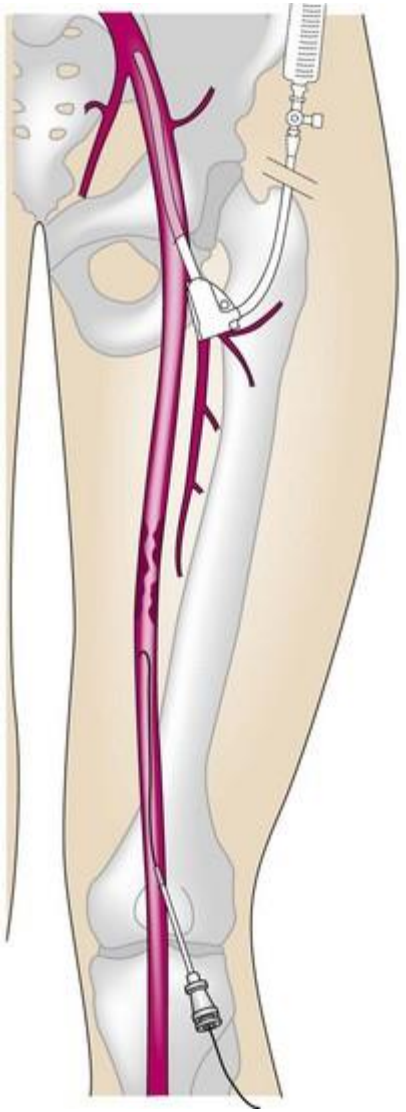
ABG
Arterial
Blood
Gas

Cele mai frecvente

- Radiala
- Ulnara
- Brahiala
- Femurala

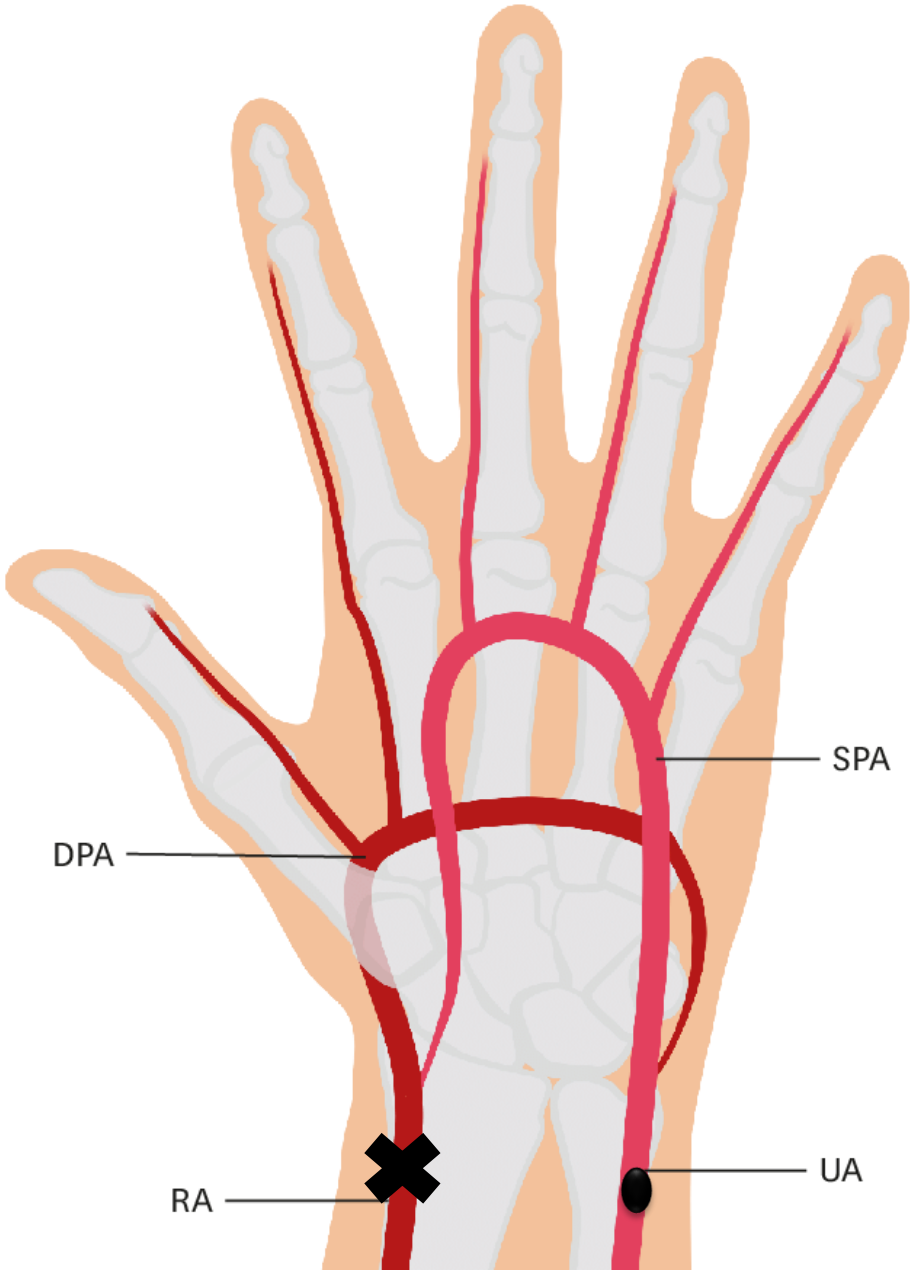

Deep Palmar Arch
Radial Artery
Brachial Artery
Radial Puncture Site
BRACHIO-RADIALIS
PRONATOR
FLEXOR POLLICIS LONGUS
QUADRATUS
FLEXOR DIGITORUM PROFUNDUS
Median N.
FLEXOR CARPI ULNARIS
Ulnar N.
Ulnar Puncture Site
Ulnar Artery



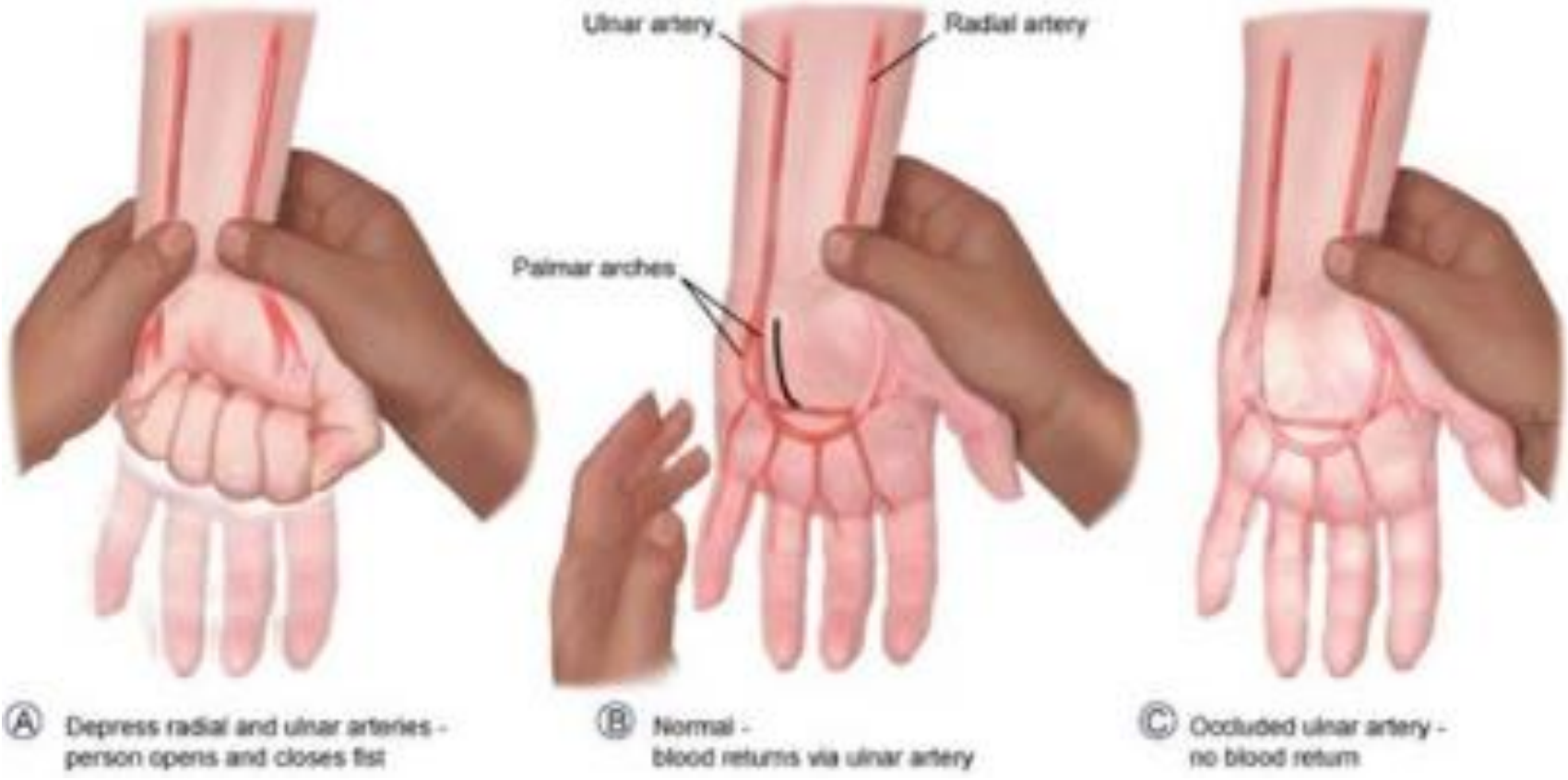


Cele mai frecvente

- **Radiala**
- Ulnara
- Brahiala
- Femurala

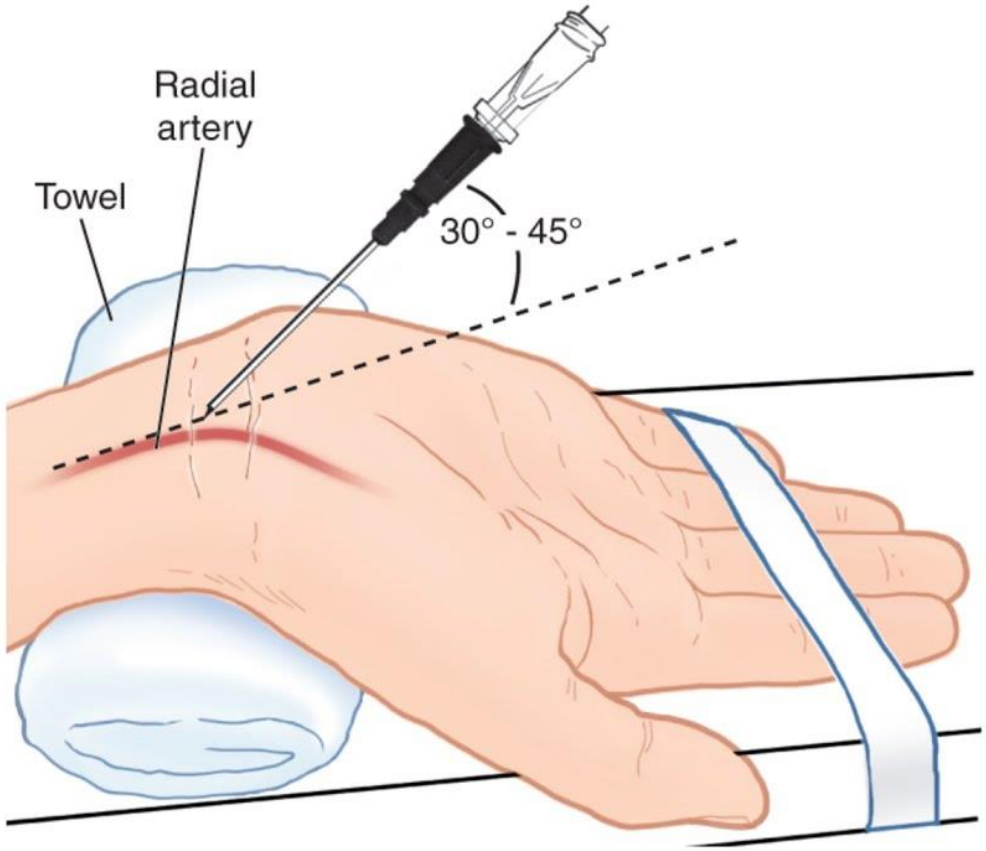

SPA
DPA
RA
UA

iStock
by Getty Images


Ulnar artery
Radial artery
Palmar arches
A Depress radial and ulnar arteries - person opens and closes fist
B Normal - blood returns via ulnar artery
C Occluded ulnar artery - no blood return

LEFT OR RIGHT

Arterial Puncture



Tehnica punctiei

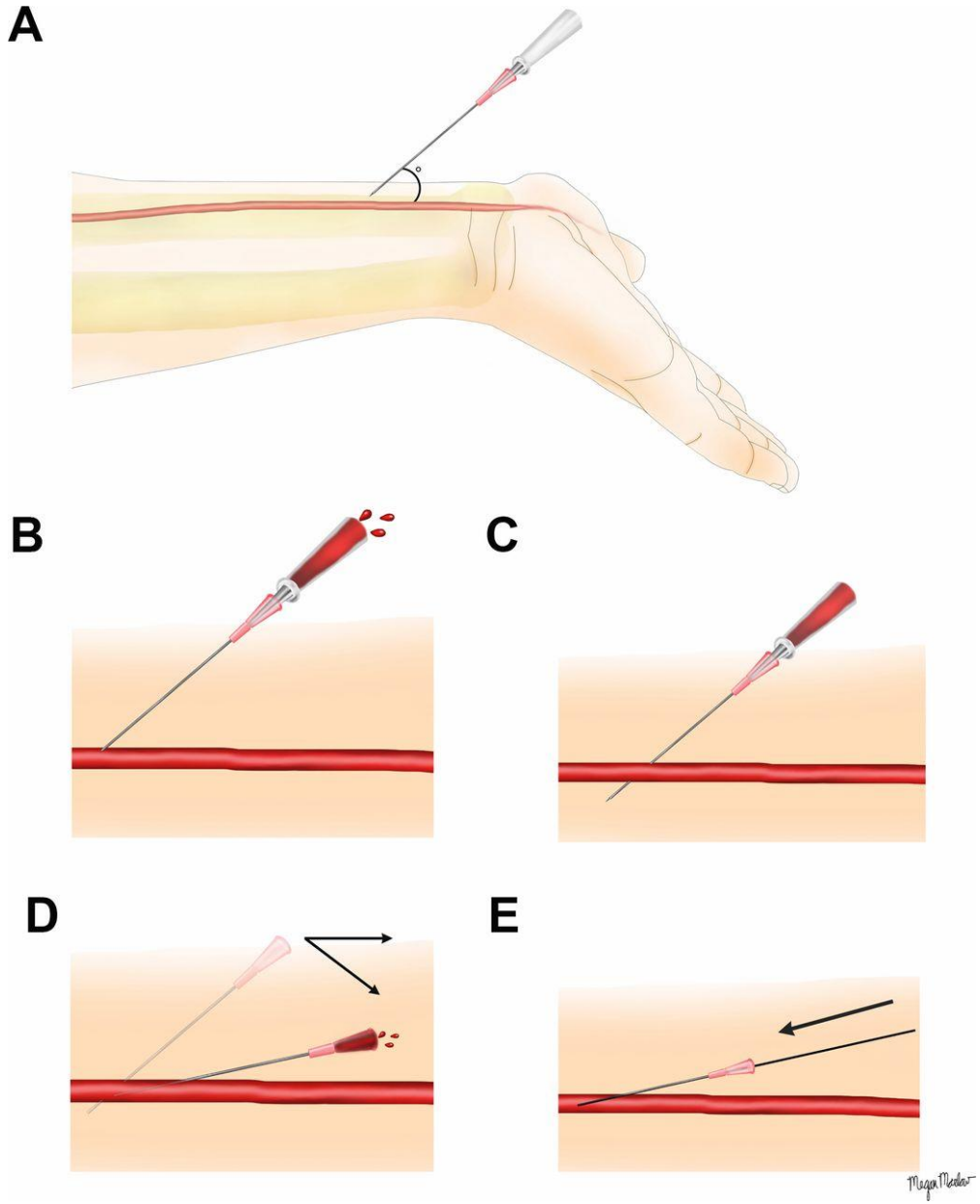
https://www.youtube.com/watch?v=0BSv4iN8T2E

Cateterizare arteriala

- Monitorizare invaziva TA
  - Pacient instabil
  - Suport vasoactiv
  - NIBP imposibil
- Pacient cu IR +/- VM care necesita AG (analiza gazometrica)

Riscurile

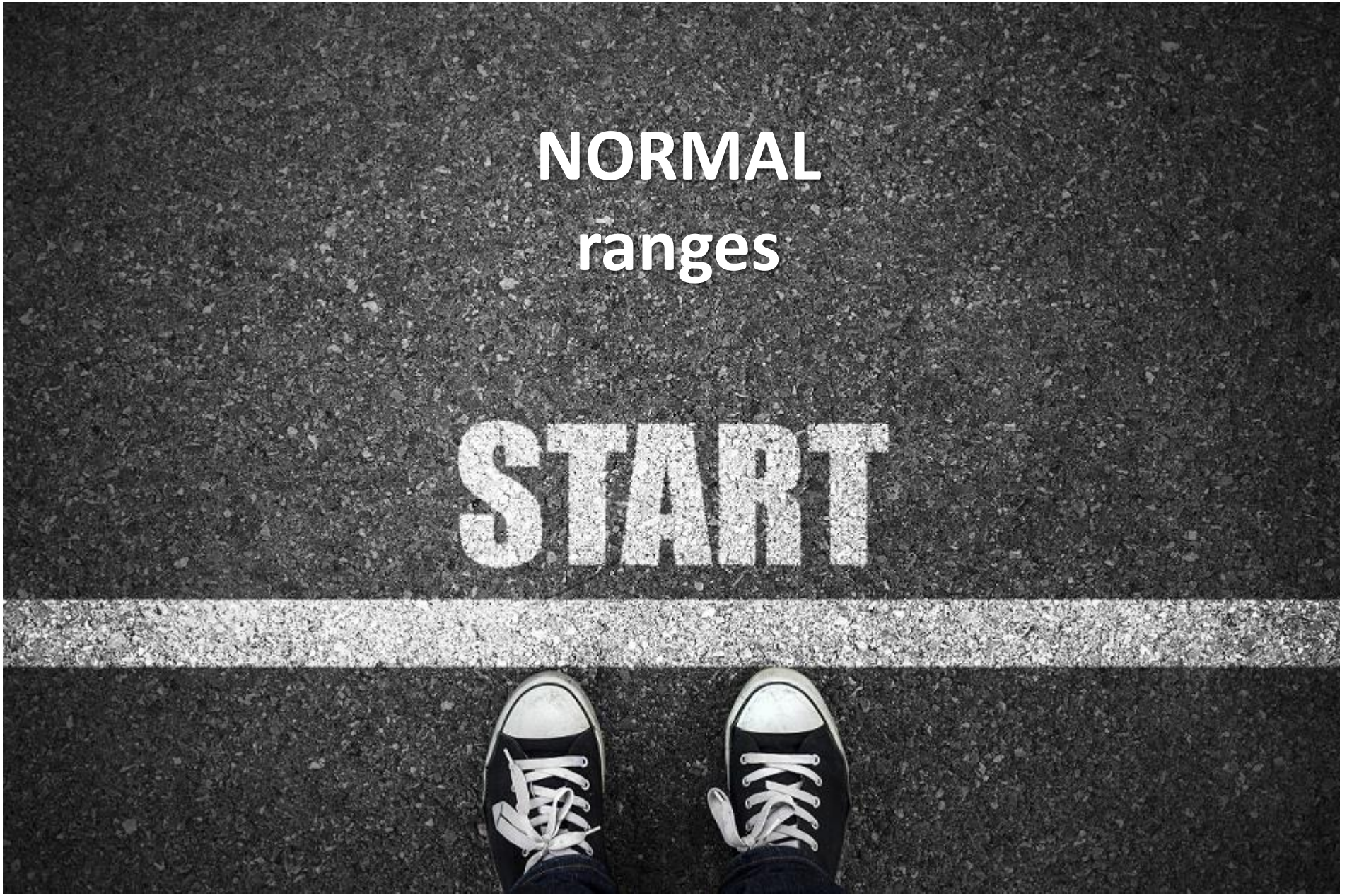
- Hematom
- Infectare
- Tromboza
- Tarume ale arterei (dissectie, ruptura)


A
B
C
D
E

Tehnica cateterizarii

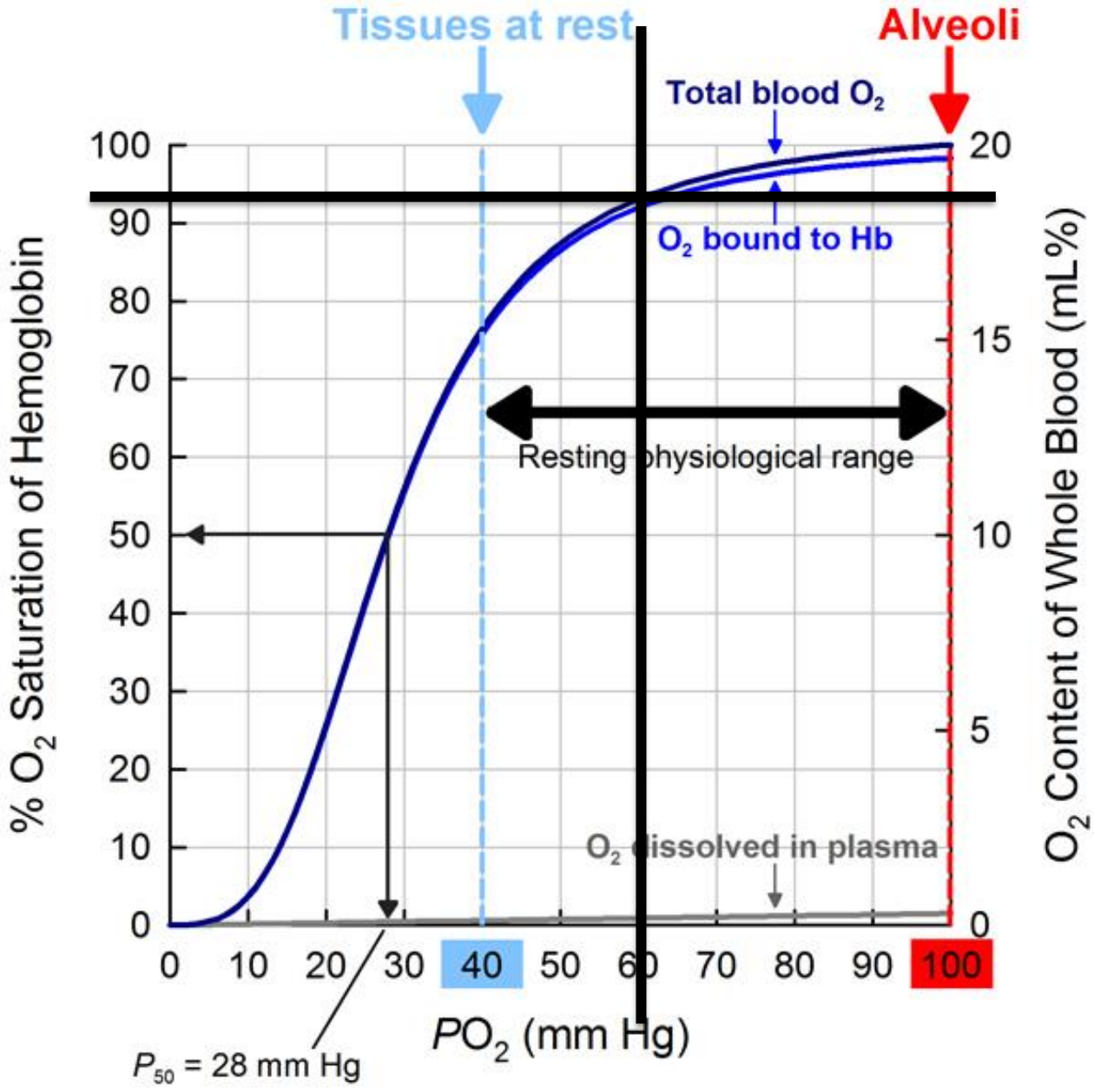
https://www.youtube.com/watch?v=dNEK4GYB0vM

ABG analysis

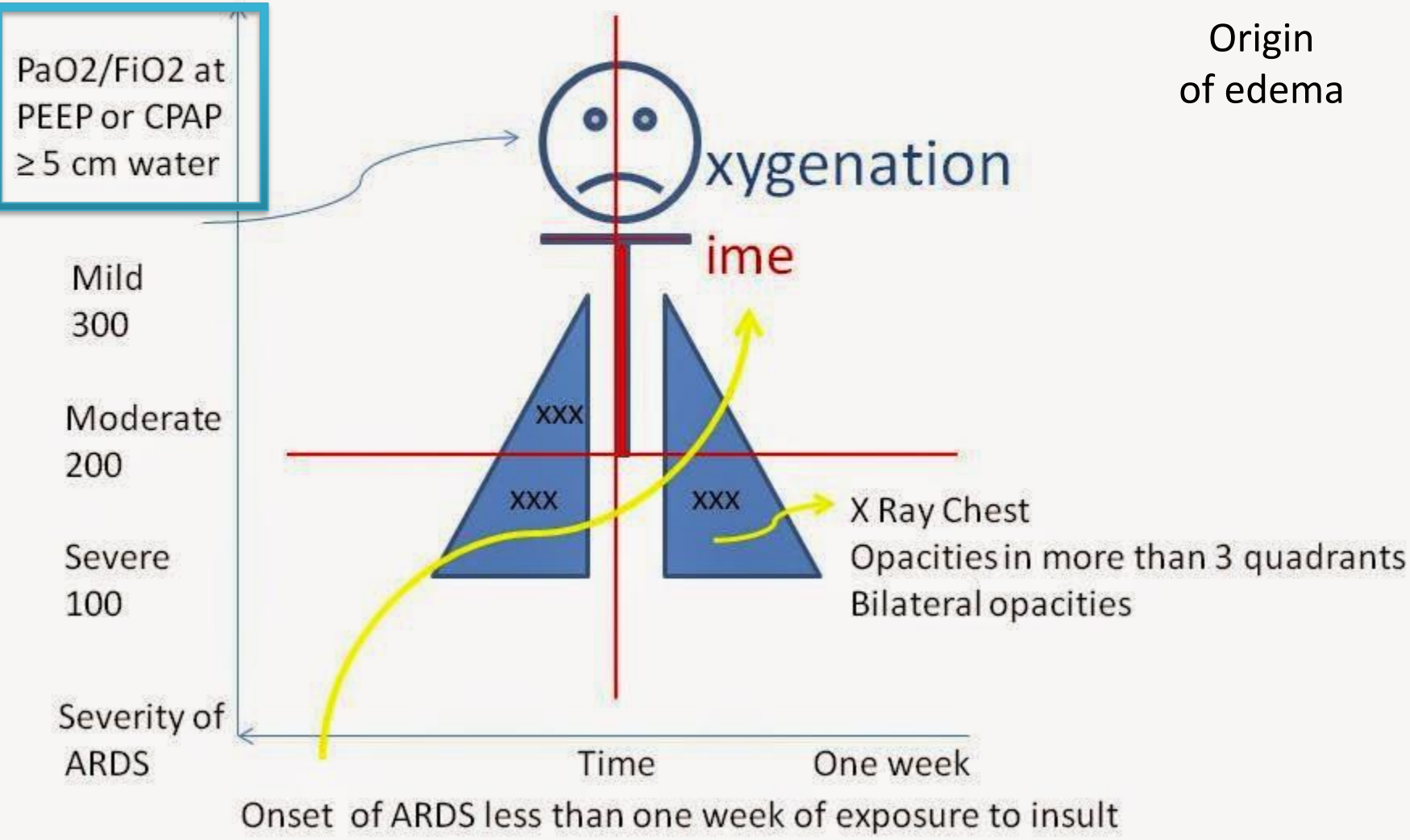

NORMAL
ranges
START

Limita de jos	Parametru	Limita de sus
7.35	pH	7.45
35	PaCo2	45
22	HCO3	26
60	PaO2	95

Limita de jos	Parametru	Limita de sus
7.35	pH	7.45
35	PaCo2	45
22	HCO3	26
60	**PaO2**	**95**


Tissues at rest
Alveoli
Total blood O_2
O_2 bound to Hb
Resting physiological range
O_2 dissolved in plasma
% O_2 Saturation of Hemoglobin
O_2 Content of Whole Blood (mL%)
PO_2 (mm Hg)
P_{50} = 28 mm Hg
0
10
20
30
40
50
60
70
80
90
100

The Berlin Definition of ARDS



Origin of edema

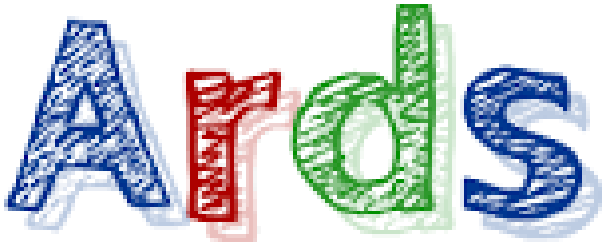
PaO2/FiO2

95/0,21= 452

60/0,21=285

300 > 285

+ CPAP 5 cm H2O
+ intervalul < 7 zile
+RÖ – infiltratii bilaterale (furtuna de zapada)



300 > 285

+ CPAP 5 cm H2O
+ intervalul < 7 zile
+RÖ – infiltratii bilaterale (furtuna de zapada)

Limita de jos	Parametru	Limita de sus
7.35	pH	7.45
35	PaCo2	45
22	HCO3	26

Limita de jos	Parametru	Limita de sus
7.35	**pH**	**7.45**
35	PaCo2	45
22	HCO3	26

pH

pH-ul este logaritmul negativ al concentrației ionului de H^+

Table 1. Correlation of pH values and Hydronium ion concentrations

pH	Hydronium ion concentration (moles/L)	
1	.1	(1×10^{-1})
2	.01	(1×10^{-2})
3	.001	(1×10^{-3})
4	.0001	(1×10^{-4})
5	.00001	(1×10^{-5})
6	.000001	(1×10^{-6})
7	.0000001	(1×10^{-7})
8	.00000001	(1×10^{-8})
9	.000000001	(1×10^{-9})
10	.0000000001	(1×10^{-10})
11	.00000000001	(1×10^{-11})
12	.000000000001	(1×10^{-12})
13	.0000000000001	(1×10^{-13})
14	.00000000000001	(1×10^{-14})

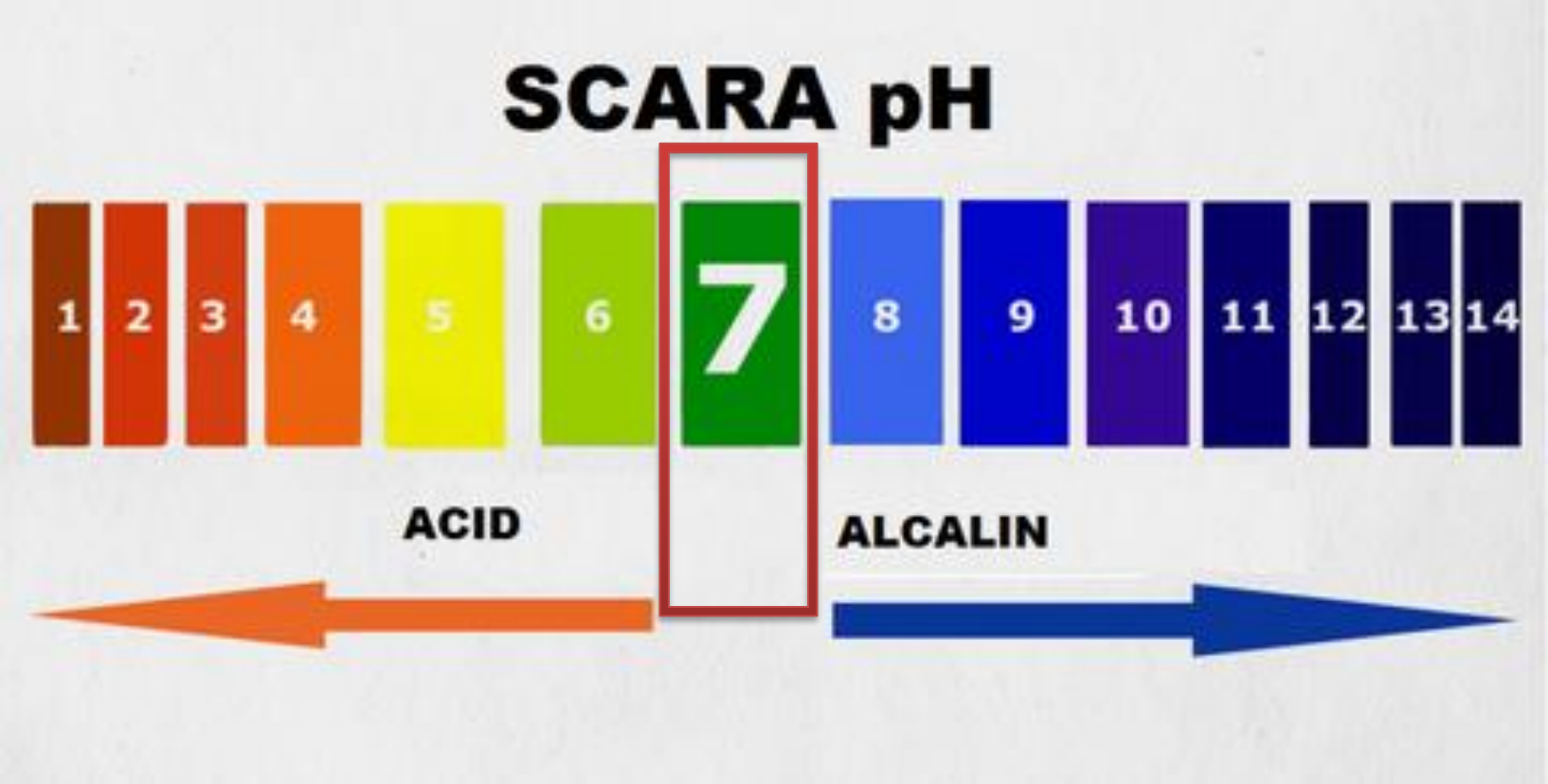
$$H^+ + OH^- = HOH$$

The relationship between H^+ , OH^- and pH

OH^- concentration(mol/l)		pH	H^+ concentration(mol/l)	
1×10^{-14}	0.00000000000001	0	1	1×100
1×10^{-13}	0.0000000000001	1	0.1	1×10^{-1}
1×10^{-12}	0.000000000001	2	0.01	1×10^{-2}
1×10^{-11}	0.00000000001	3	0.001	1×10^{-3}
1×10^{-10}	0.0000000001	4	0.0001	1×10^{-4}
1×10^{-9}	0.000000001	5	0.00001	1×10^{-5}
1×10^{-8}	0.00000001	6	0.000001	1×10^{-6}
1×10^{-7}	0.0000001	7	0.0000001	1×10^{-8}
1×10^{-5}	0.00001	9	0.000000001	1×10^{-9}
1×10^{-4}	0.0001	10	0.0000000001	1×10^{-10}
1×10^{-3}	0.001	11	0.00000000001	1×10^{-11}
1×10^{-2}	0.01	12	0.000000000001	1×10^{-12}
1×10^{-1}	0.1	13	0.0000000000001	1×10^{-13}
1×100	1	14	0.00000000000001	1×10^{-14}

Increasing basicity

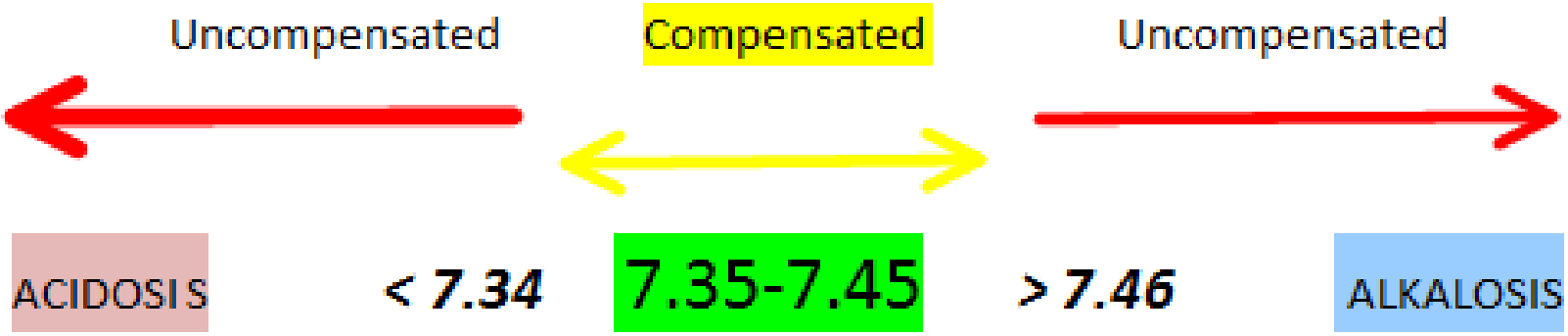
Increasing acidity


SCARA pH
1
2
3
4
5
6
7
8
9
10
11
12
13
14
ACID
ALCALIN

Nominal pH values of body fluids

Site	nominal pH	Site	nominal pH
aqueous humour	7.2	muscle, skeletal	6.0
blood, arterial	7.4	nasal secretions	6.0
blood, venous	7.4	prostatic fluid	6.5
blood, umbilical	7.3	saliva	6.4
cerebrospinal	7.4	semen	7.2
duodenum	5.5	stomach	1.5
faeces	7.2	sweat	5.4
illeum, distal	8.0	urine	5.7
intestine	5.3	vaginal, post-M	7.0
lacrimal	7.4	vaginal, pre-M	4.5
milk, breast	7.0	lyzosome	4.5

Limita de jos	Parametru	Limita de sus
7.35	**pH**	**7.45**
35	PaCo2	45
22	HCO3	26


Uncompensated
Compensated
Uncompensated
ACIDOSIS
< 7.34
7.35-7.45
> 7.46
ALKALOSIS

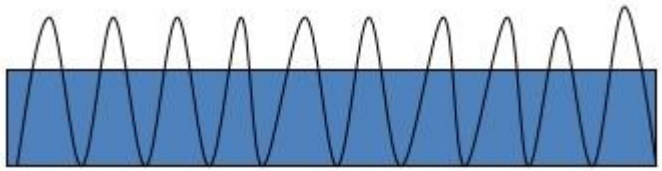
Limita de jos	Parametru	Limita de sus
7.35	pH	7.45
35	**PaCo2**	**45**
22	HCO3	26

PaCO2

Hipocapnie **Hipercapnie**

< 35 35-45 mmHg **> 45**

Hyperventilation
– ↑ depth & rate

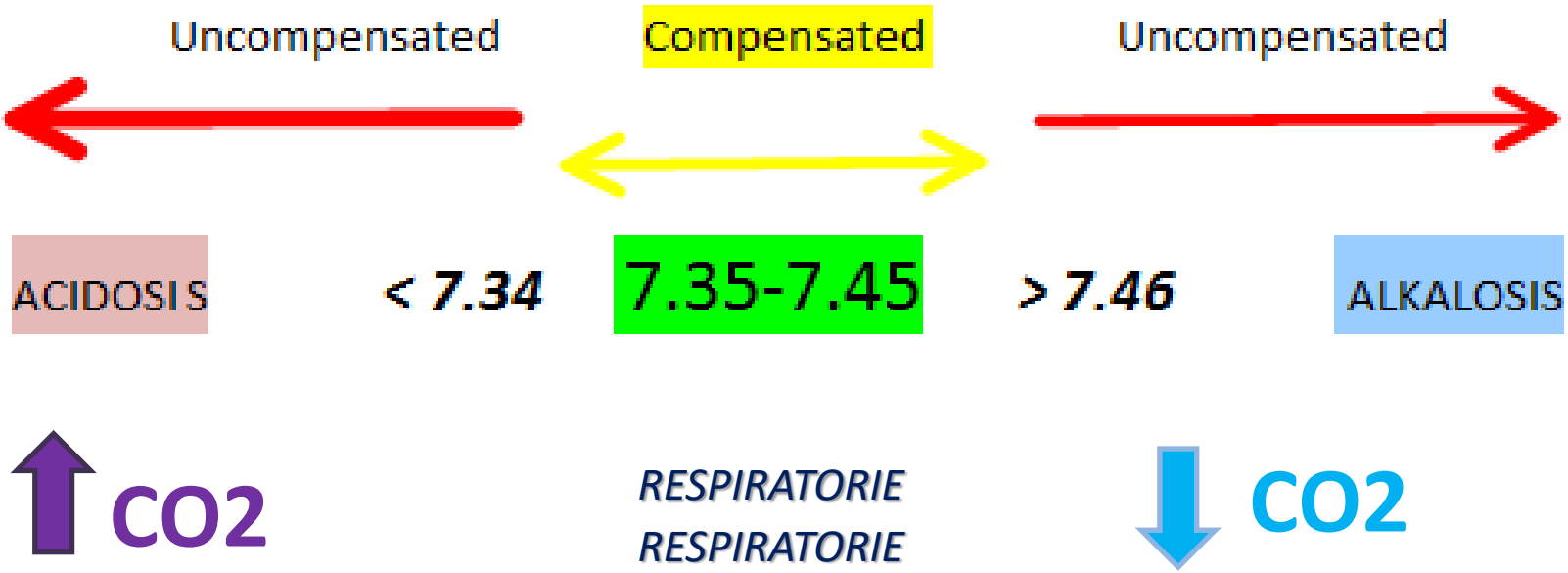


Hypoventilation
– ↓ depth & rate

PaCO2 & pH

=

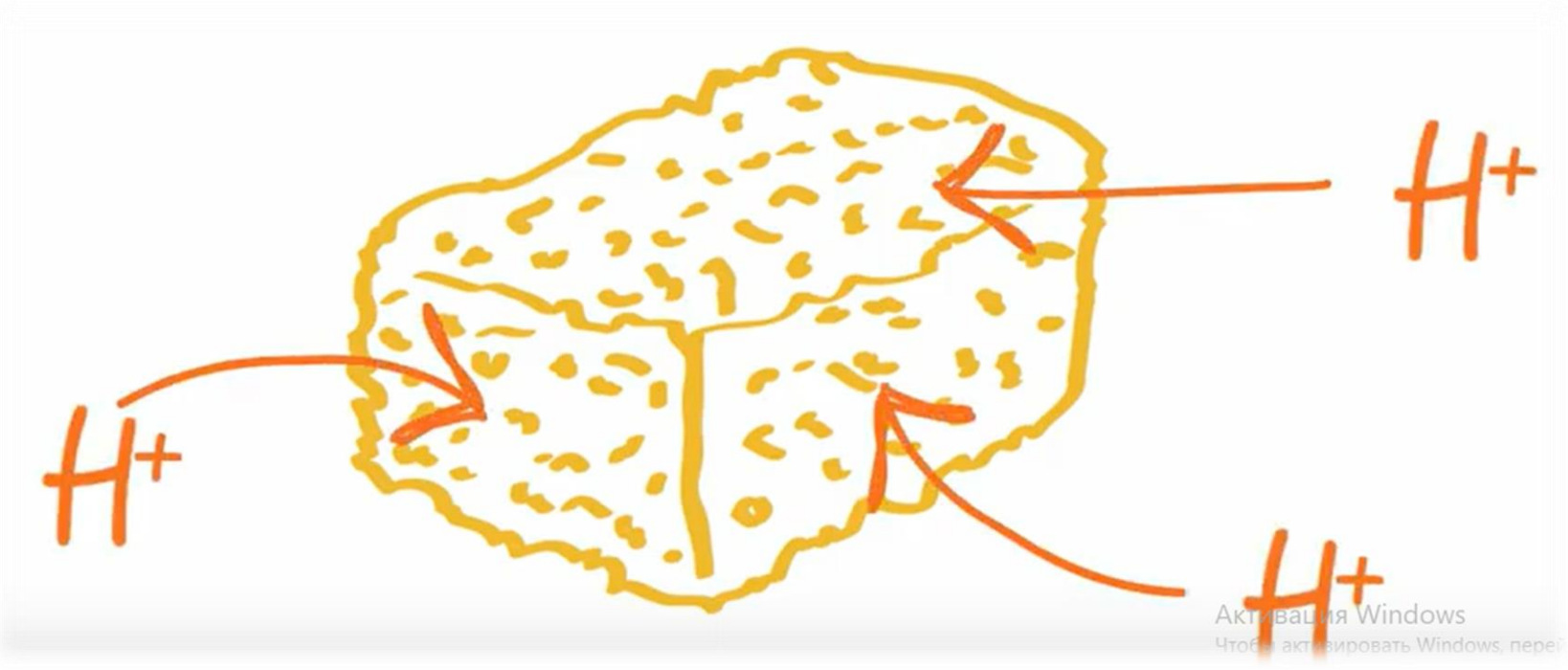
RESPIRATOR


Uncompensated
Compensated
Uncompensated
ACIDOSIS
< 7.34
7.35-7.45
> 7.46
ALKALOSIS
CO2
RESPIRATORIE
RESPIRATORIE
CO2

Limita de jos	Parametru	Limita de sus
7.35	pH	7.45
35	PaCo2	45
22	**HCO3**	**26**

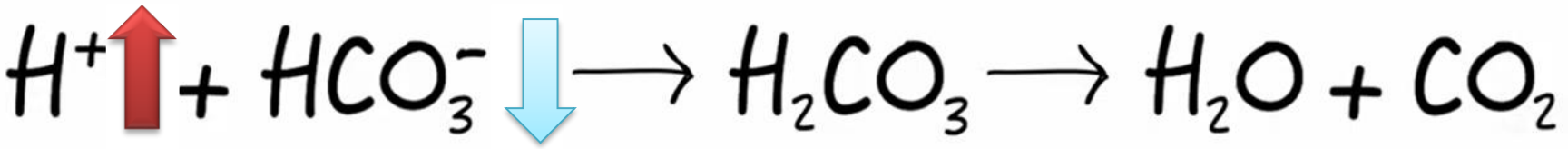
HCO3 cel mai important sistem tampon

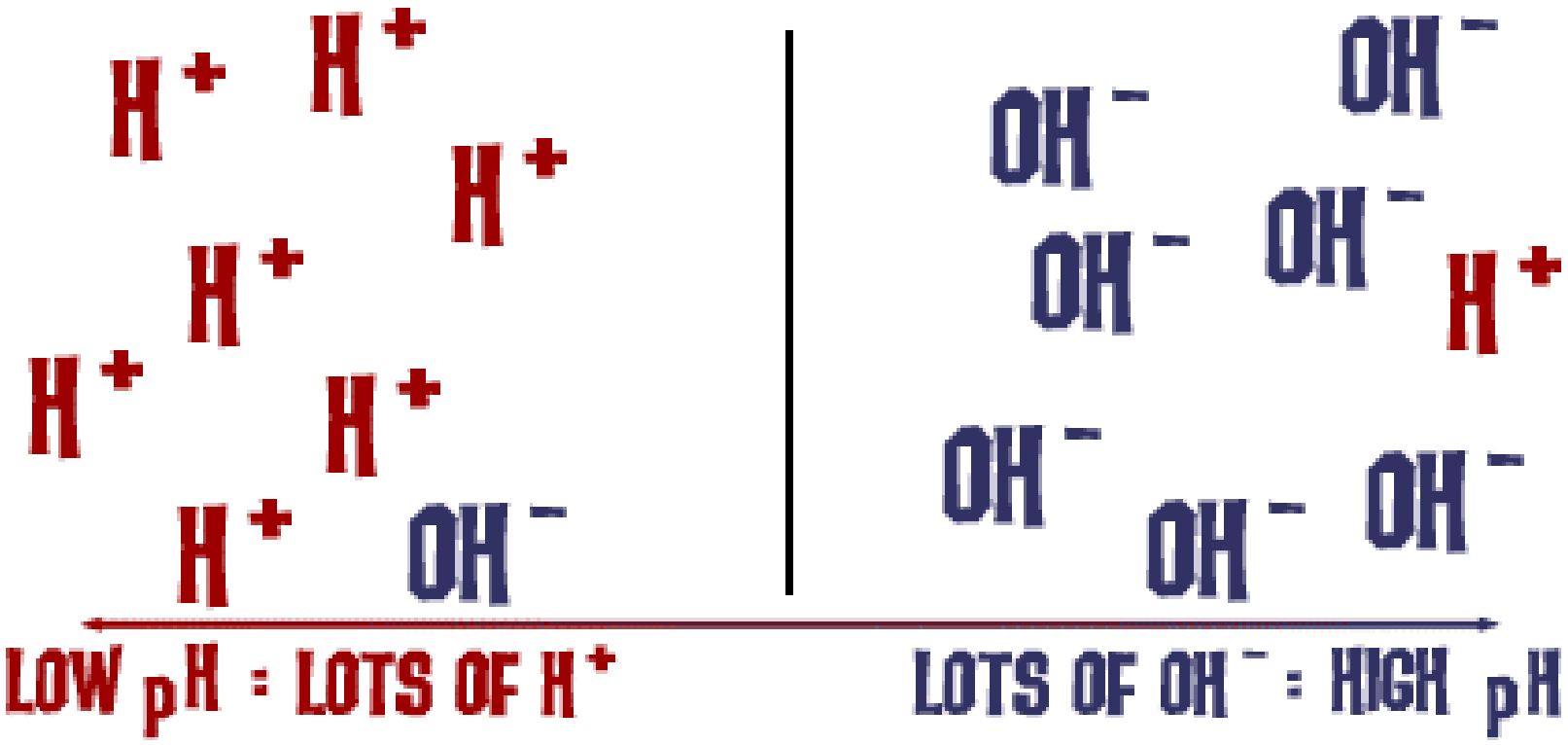
Sistem tampon



Sistem tampon

Активация Windows
Чтобы активировать Windows, пе
Смотреть (k)

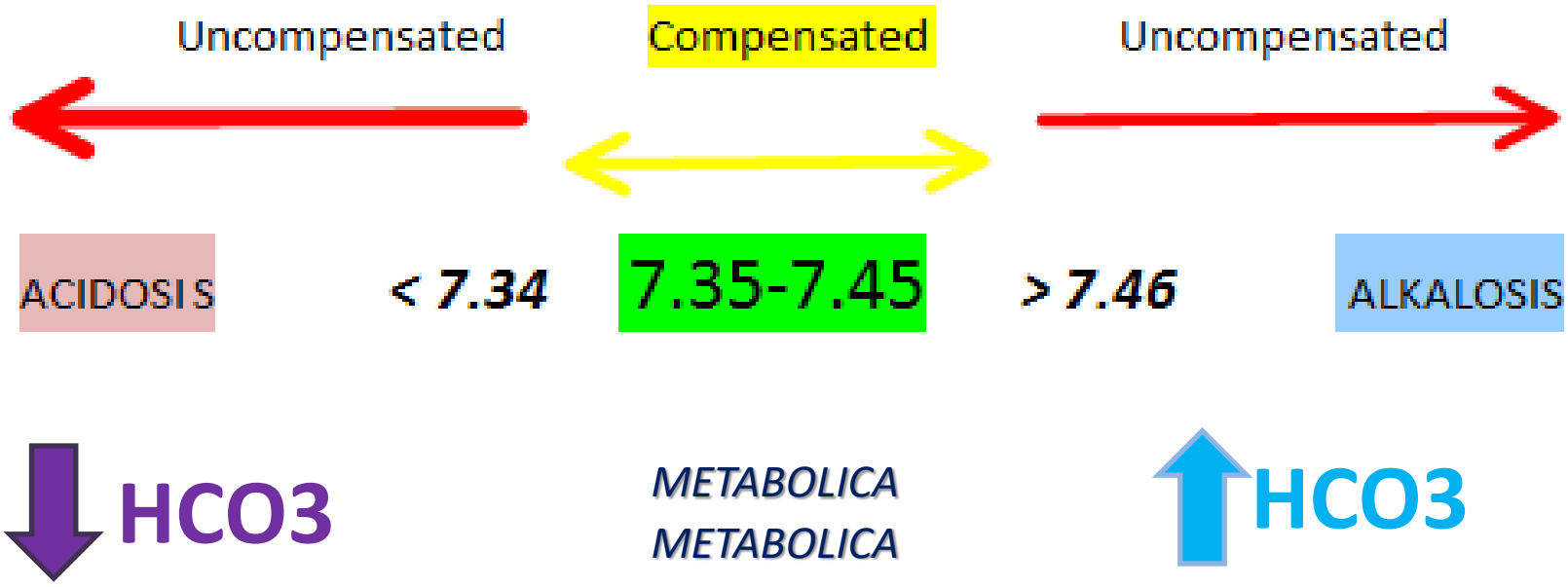

H+ + HCO3- → H2CO3 → H2O + CO2

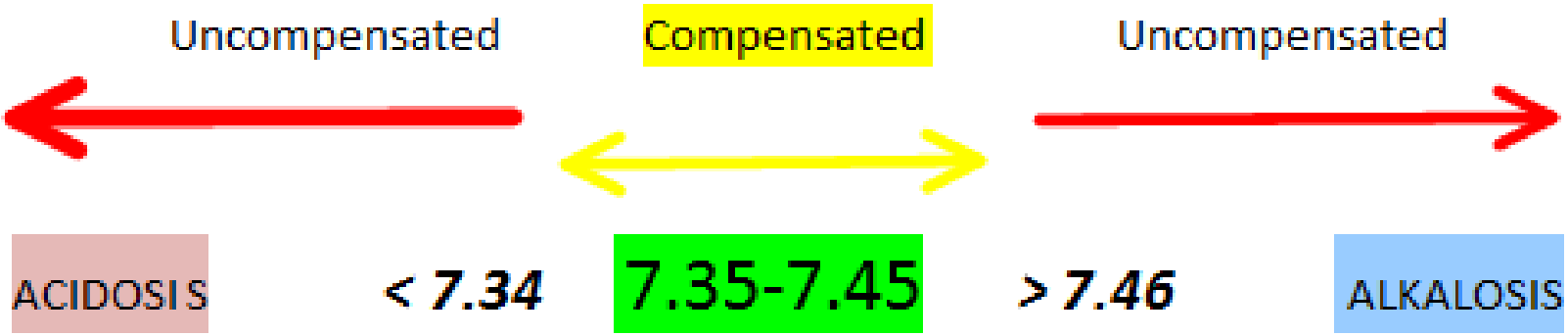

H+ H+
H+
H+
H+ H+
H+ OH−
OH− OH−
OH− OH− H+
OH−
OH− OH−
LOW pH : LOTS OF H+
LOTS OF OH− : HIGH pH

HCO3 & **pH**

=

METABOLIC

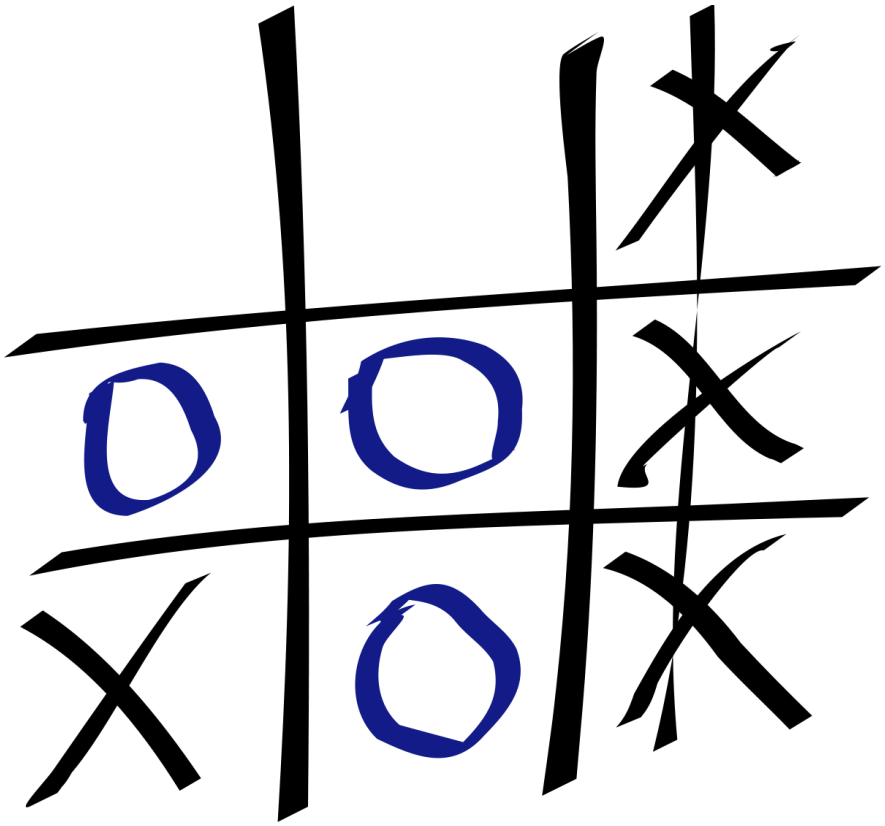

Uncompensated
Compensated
Uncompensated
ACIDOSIS
< 7.34
7.35-7.45
> 7.46
ALKALOSIS
HCO3
METABOLICA
METABOLICA
HCO3



CO2 ↑ — *RESPIRATORIE* — CO2 ↓

HCO3 ↓ — *METABOLICA* — HCO3 ↑

LETS
PLAY



pH: 7.15, **PaCO2:** 52, **HCO3:** 23

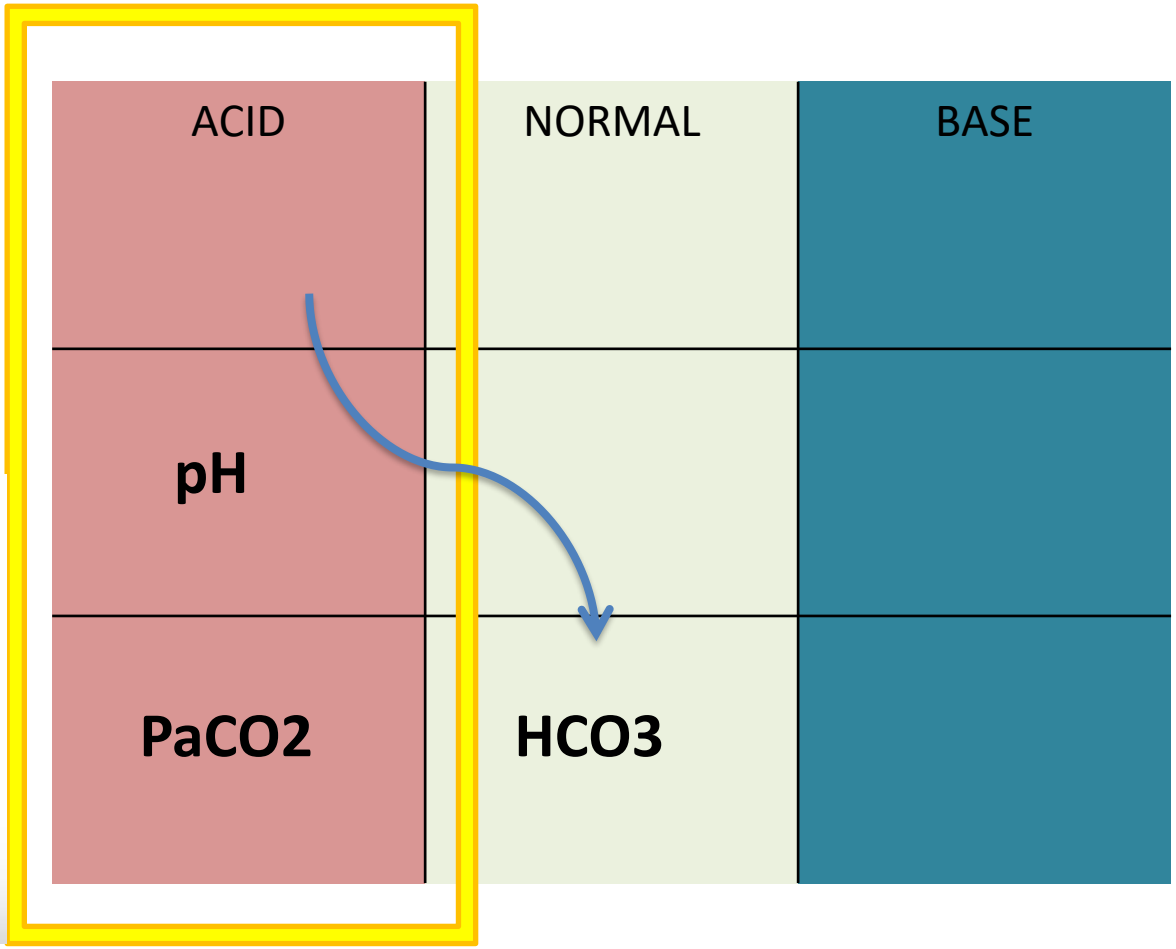
Acidoza respiratorie necompensata

Remember:

pH ACID< 7.35-7.45 <BASE

$PaCO_2$ BASE< 35-45 <ACID

HCO_3^- ACID< 22-26 <BASE



pH: 7.21, **PaCO2:** 54, **HCO3:** 24

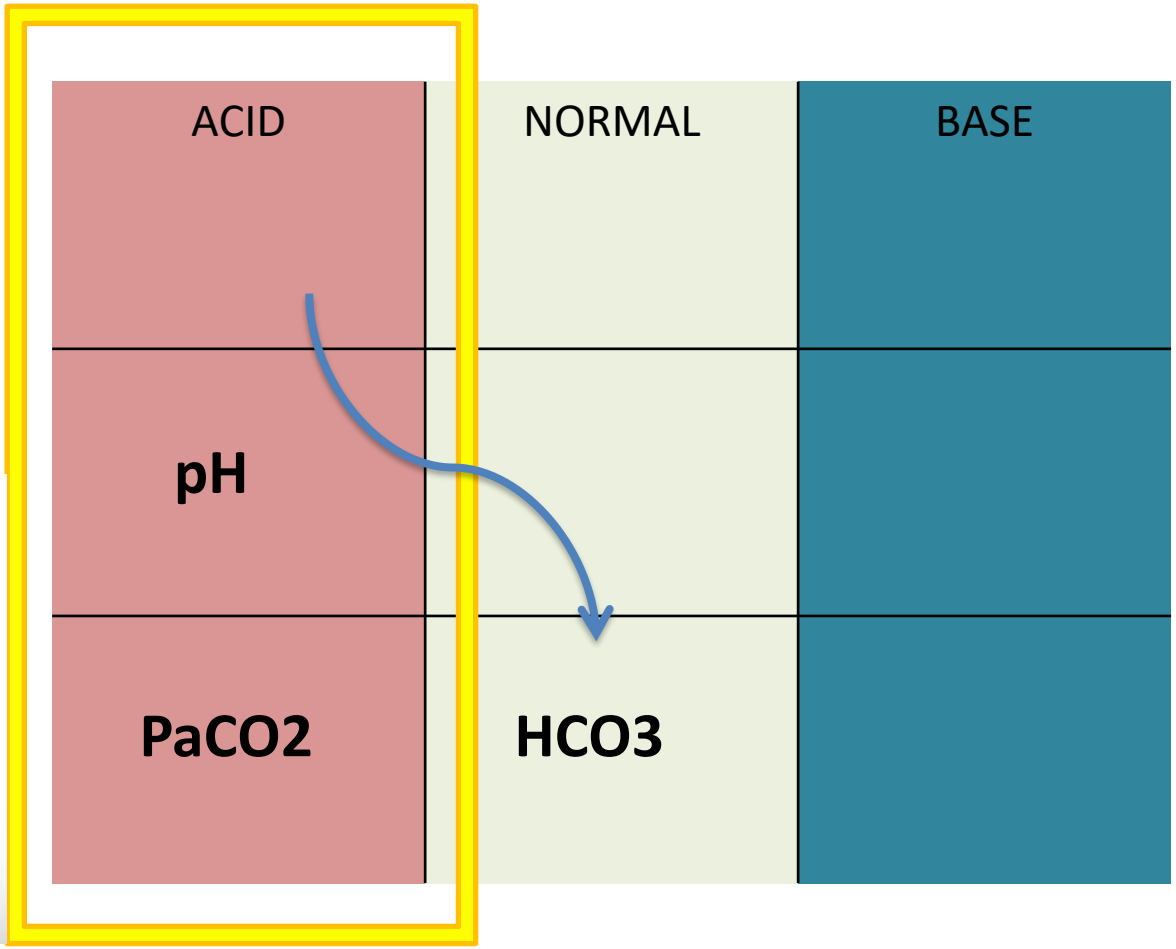
Acidoza respiratorie necompensata

Remember:

pH ACID< 7.35-7.45 <BASE

$PaCO_2$ BASE< 35-45 <ACID

HCO_3^- ACID< 22-26 <BASE



pH: 7.17, **PaCO2:** 36, **HCO3:** 17

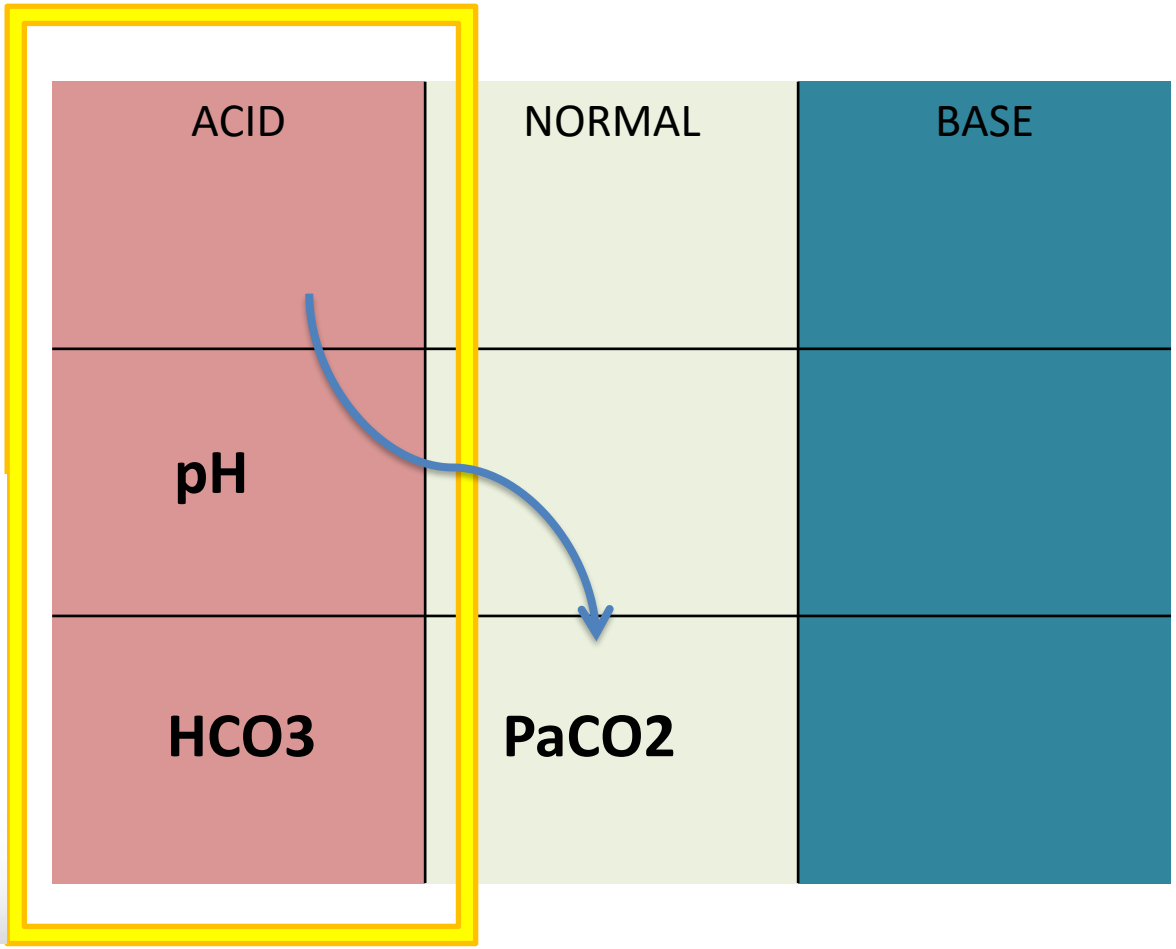
Acidoza metabolica necompensata

Remember:

pH ACID< 7.35-7.45 <BASE

$PaCO_2$ BASE< 35-45 <ACID

HCO_3^- ACID< 22-26 <BASE



pH: 7.6, **PaCO2:** 40, **HCO3:** 32

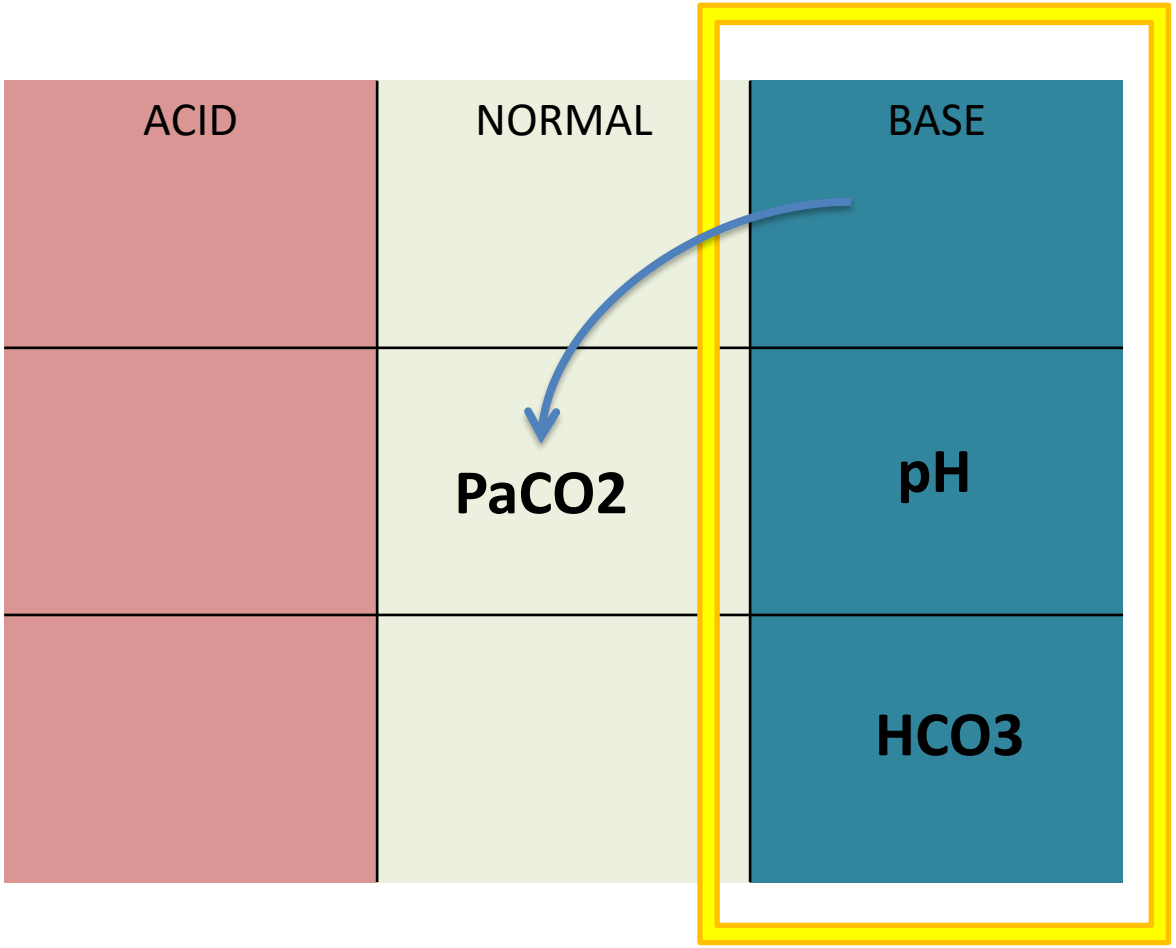
Alcaloza metabolica necompensata

Remember:

pH ACID< 7.35-7.45 <BASE

PaCO2 BASE< 35-45 <ACID

HCO3- ACID< 22-26 <BASE



pH: 7.78, **PaCO2:** 28, **HCO3:** 21

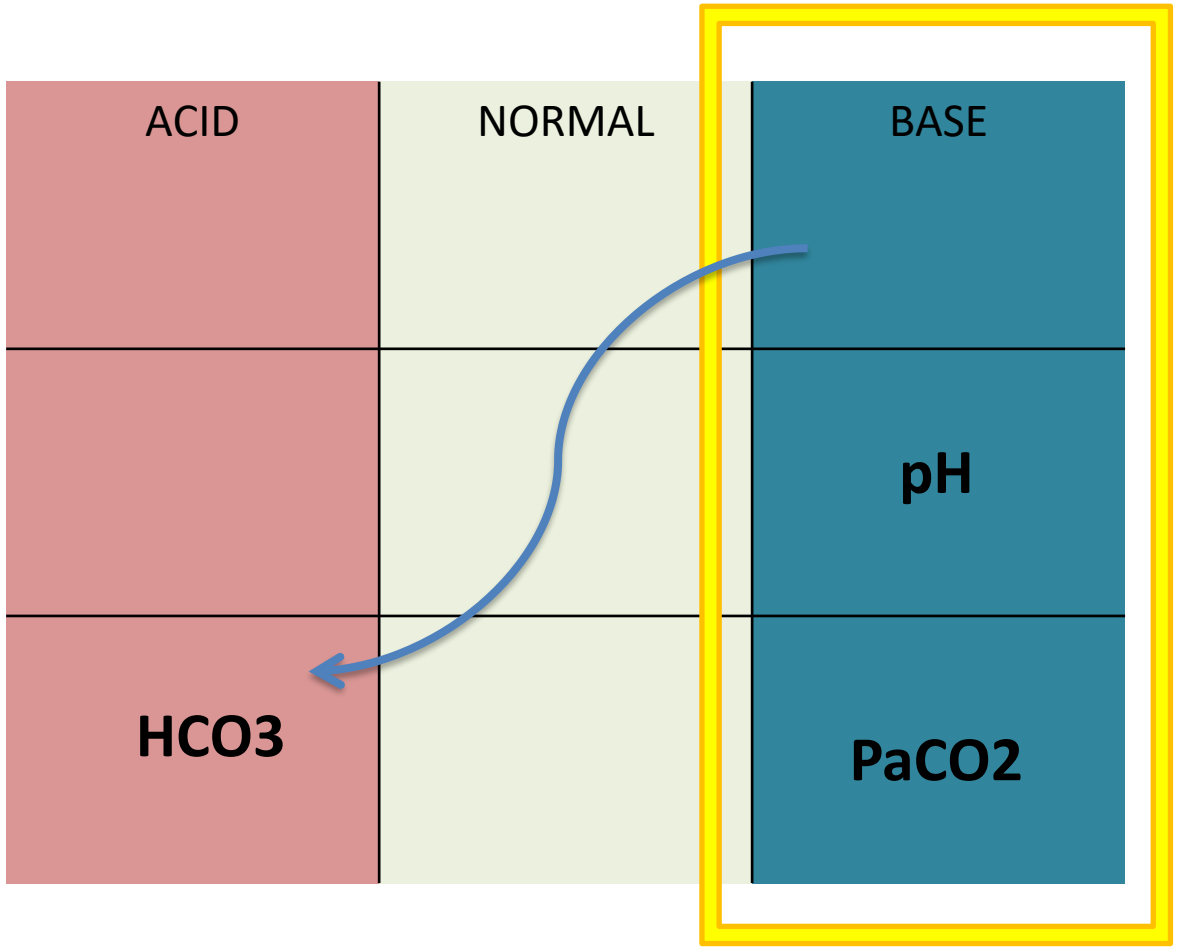
Alcaloza respiratorie partial compensata

Remember:

pH ACID< 7.35-7.45 <BASE

$PaCO_2$ BASE< 35-45 <ACID

HCO_3^- ACID< 22-26 <BASE



pH: 7.37, **CO2:** 50, **HCO3:** 33

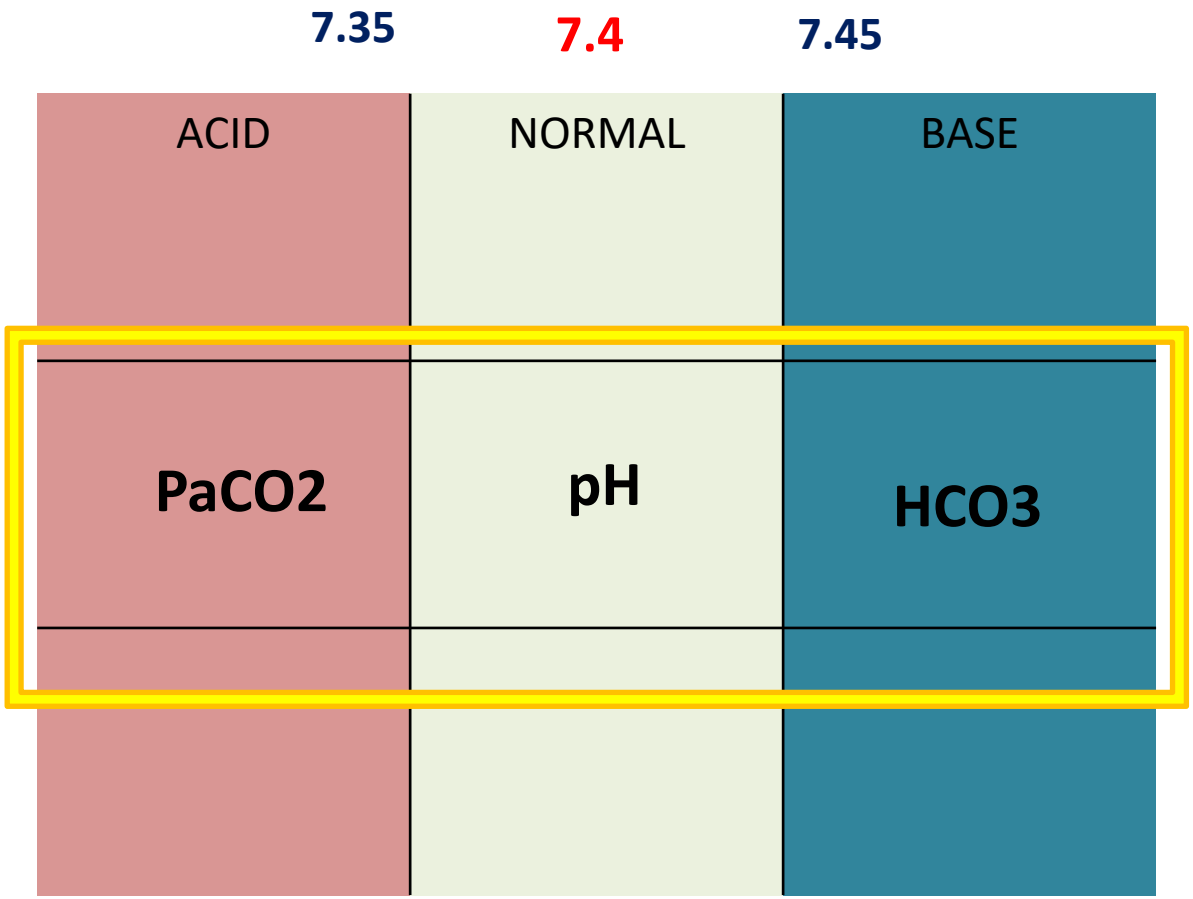
?

Remember:

pH ACID< 7.35-7.45 <BASE

PaCO2 BASE< 35-45 <ACID

HCO3- ACID< 22-26 <BASE



pH: 7.37, **CO2:** 50, **HCO3:** 33

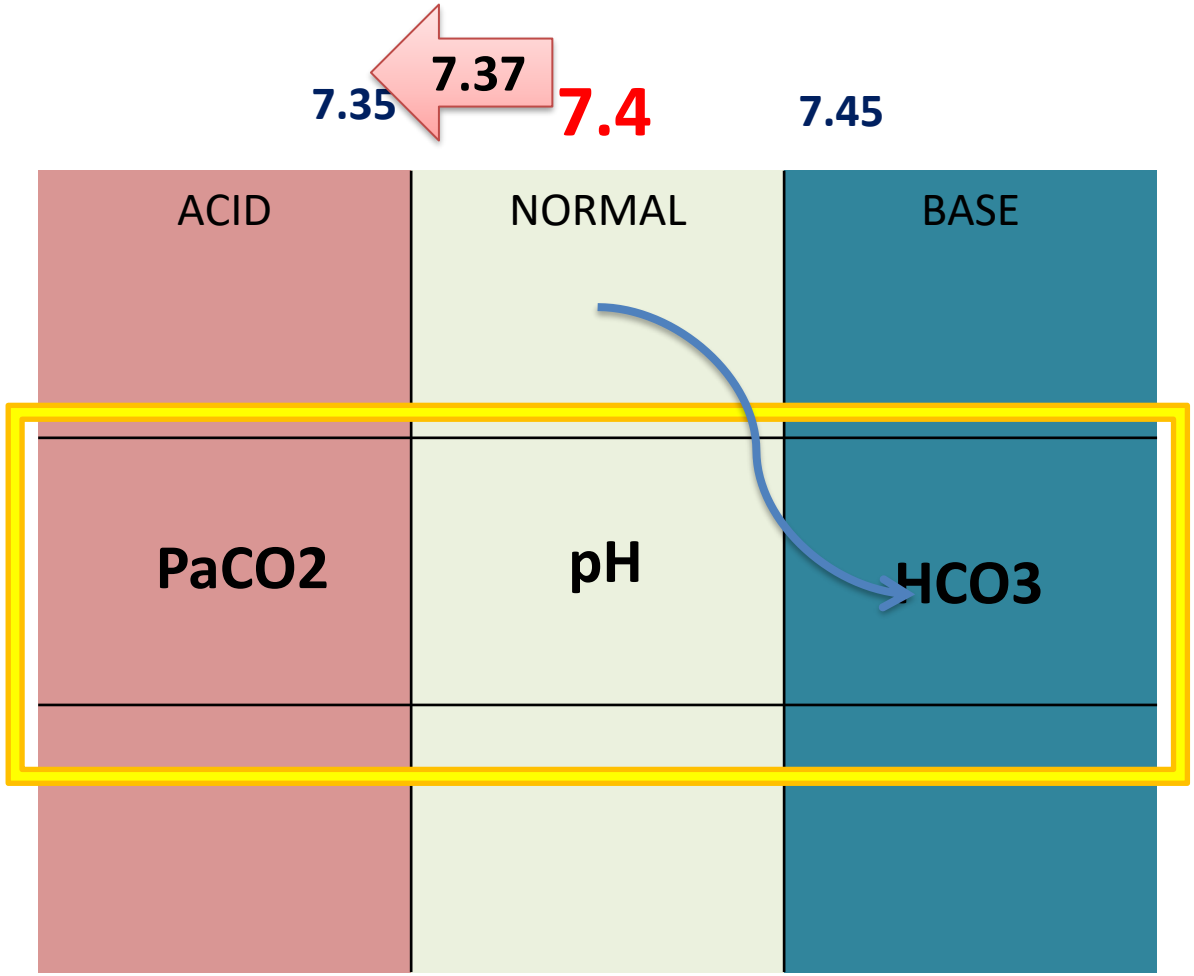
Acidoza respiratorie compensata

Remember:

pH ACID< 7.35-7.45 <BASE

PaCO2 BASE< 35-45 <ACID

HCO3- ACID< 22-26 <BASE



pH: 7.37, **PaCO2:** 28, **HCO3:** 12

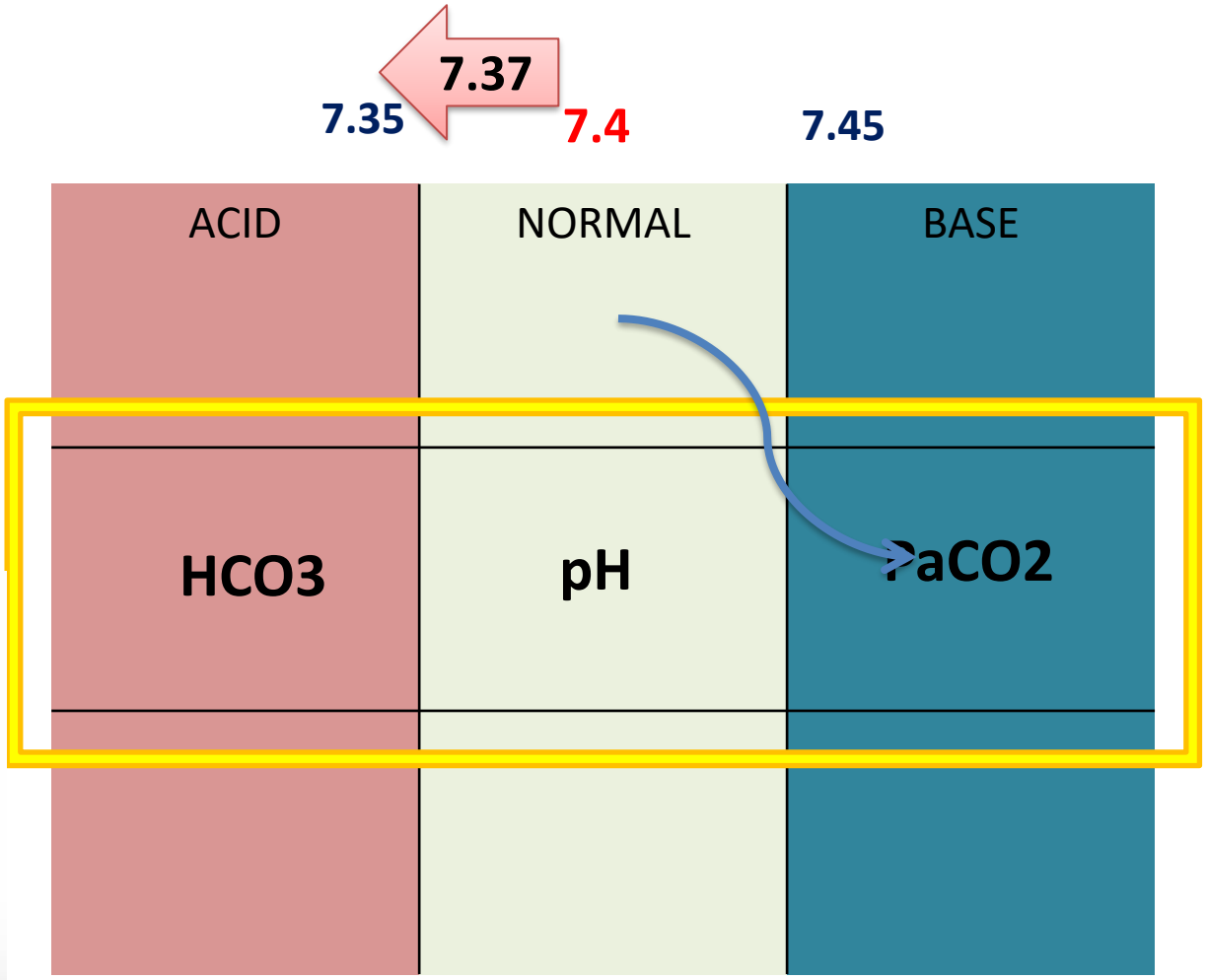
Acidoza metabolica compensata

Remember:

pH ACID< 7.35-7.45 <BASE

PaCO2 BASE< 35-45 <ACID

HCO3- ACID< 22-26 <BASE



pH: 7.65, **PaCO2:** 36, **HCO3:** 33

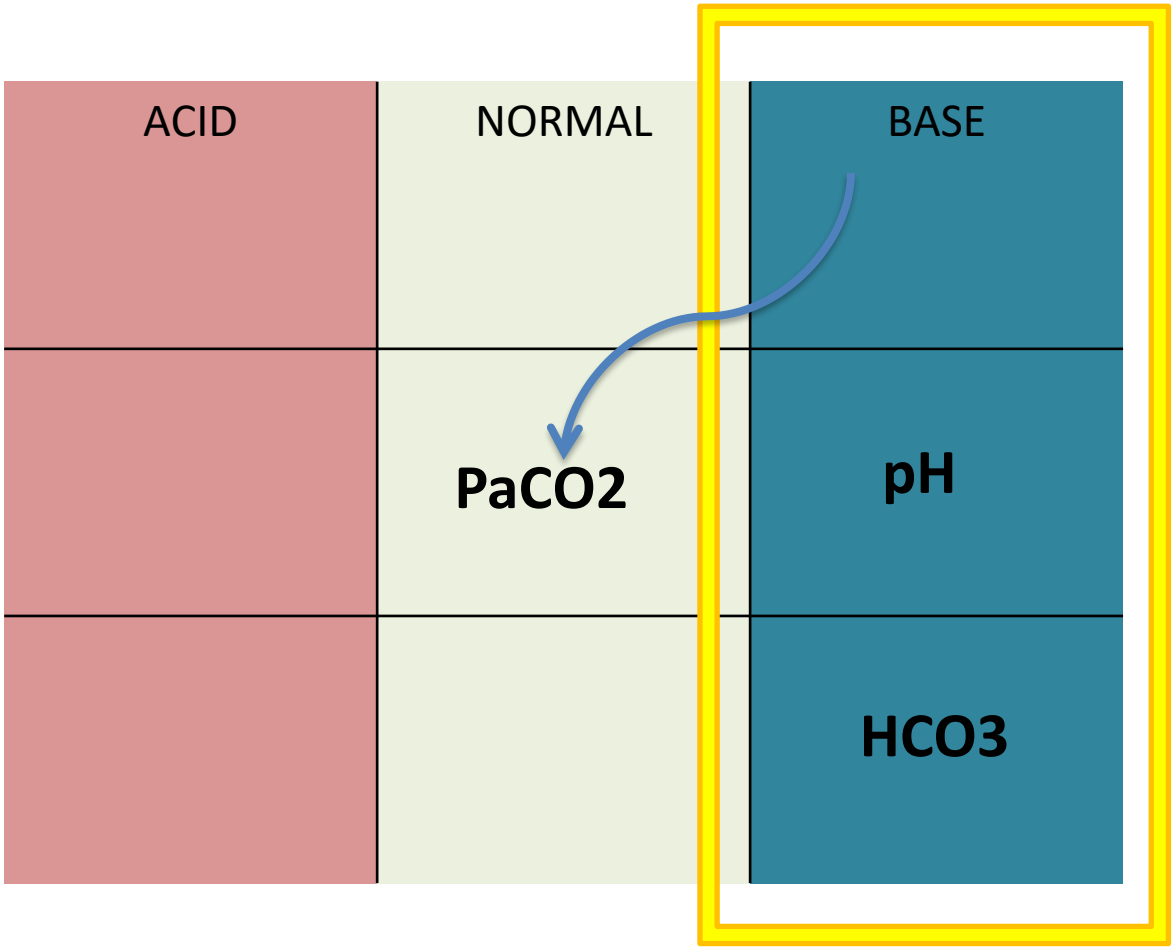
Alcaloza metabolica necompensata

Remember:

pH ACID< 7.35-7.45 <BASE

$PaCO_2$ BASE< 35-45 <ACID

HCO_3^- ACID< 22-26 <BASE



pH: 7.48, **PaCO2:** 53, **HCO3:** 29

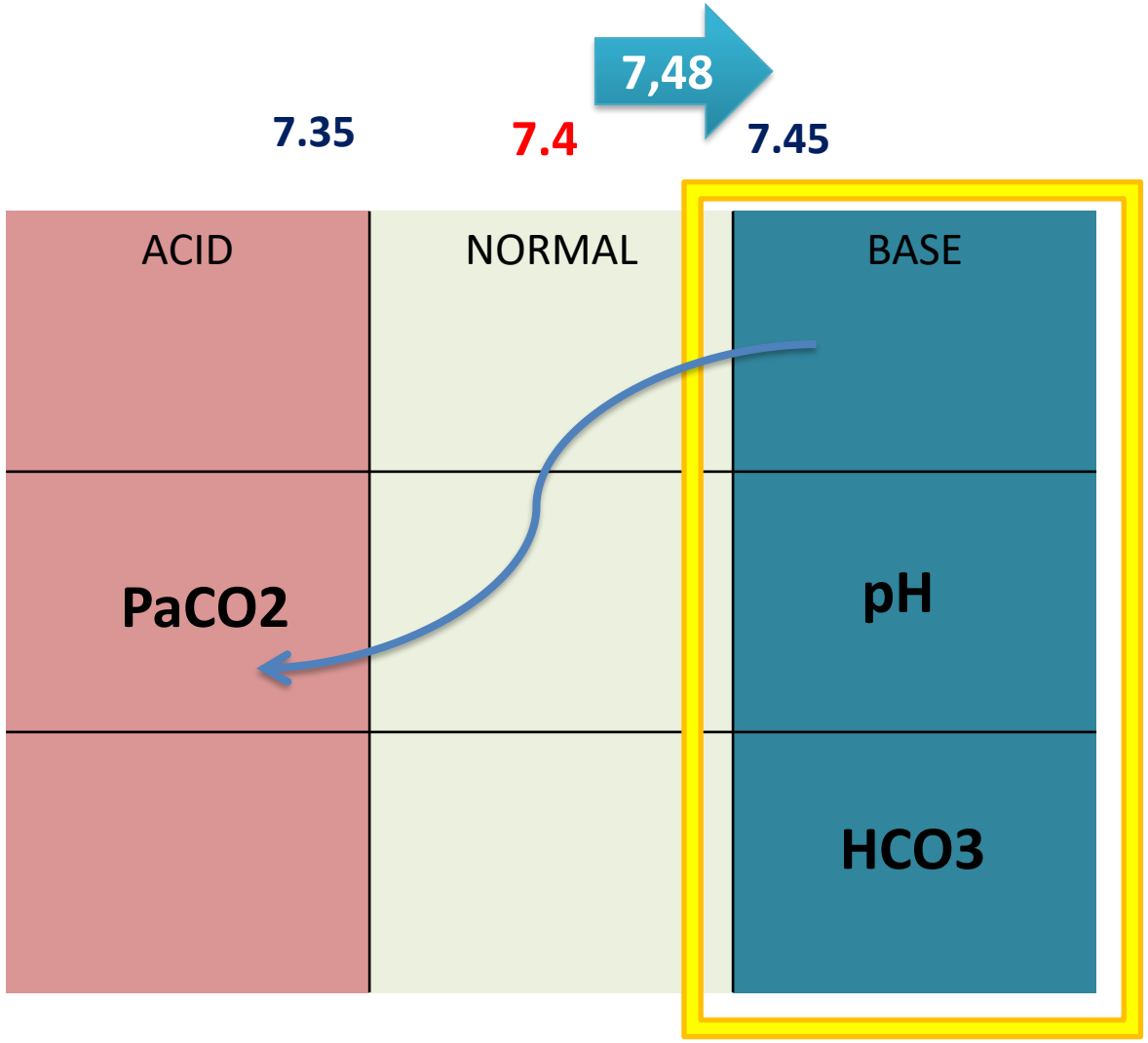
Alcaloza metabolica partial compensata

Remember:

pH ACID< 7.35-7.45 <BASE

PaCO2 BASE< 35-45 <ACID

HCO3- ACID< 22-26 <BASE



Take home messages

- ABG in ICU TREBUIE sa fie
- Prudenta la puctie/canulare arteriala
- ABG analiza – feed our brain

Let me pick your brain!
www.TaraBurner.com