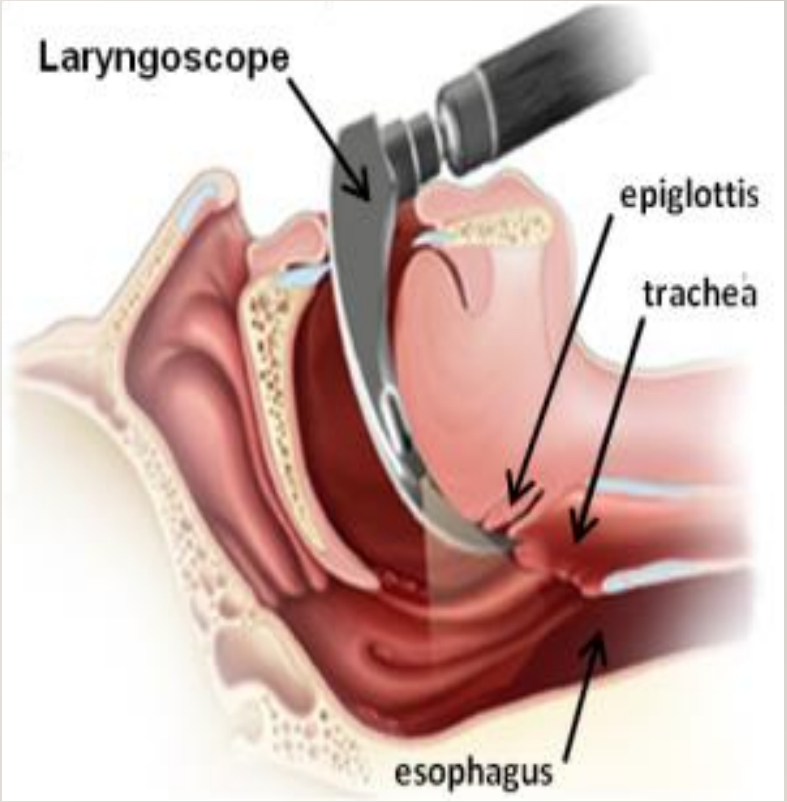
INTUBATION AND MECHANICAL VENTILATION

OBJECTIVES

- Intubation preparation
- Equipment's for intubation
- Why do patients go on ventilators ?
- Common terminology associated with mechanical ventilation
- Modes of ventilation
- Difference between pressure and volume ventilation
- Ventilator monitoring, alarms and intervention

INTUBATION

- Intubation is a procedure in which an Endotracheal tube is put into the trachea to provide gas exchange.
- It can be Nasal intubation or Oral intubation
- A Minimum of 3 staff members are needed
  - One intubating
  - Medication delivery
  - Assisting with intubation



INTUBATION EQUIPMENTS

- Laryngoscope with blade
- The two most common blade use in intubation are Macintosh(mac) and Miller blades.
- Endotracheal tube
- Hemodynamic monitoring
- Stethoscope
- CO2 detector

ENDOTRACHEAL TUBES

DIFFERENT KINDS OF ET TUBE

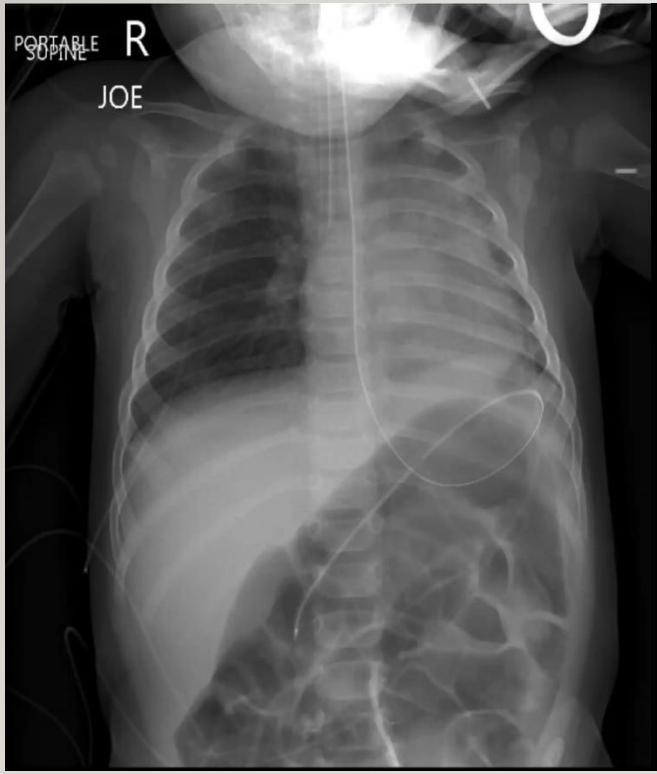
ET TUBE FORMULA IN PEDIATRIC

- [(Age/4)+4] for Uncuffed tubes
- [(Age/4)+3.5] for Cuffed ET tubes

INTUBATION PROCESS

- Tilt patient head back and insert laryngoscope into mouth
- Move laryngoscope to back of mouth avoiding teeth
- Raise/lift the epiglottis,
- Insert ET tube in-between vocal cord
- Verify insertion of ET tube

CHEST XRAY



A

B

C

HISTORY OF MECHANICAL VENTILATION

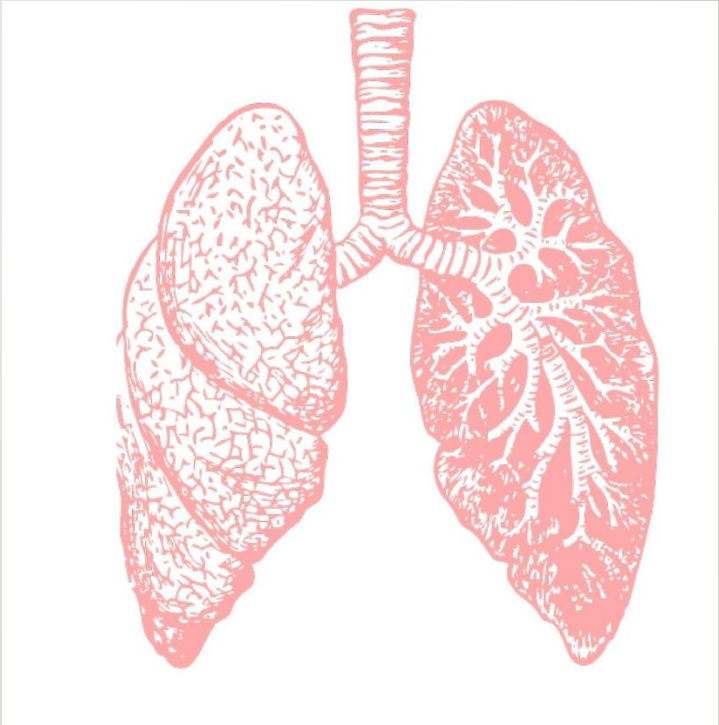
1920's - first positive pressure mechanical ventilator associated with anesthesia

1920's - negative pressure ventilators for polio victims

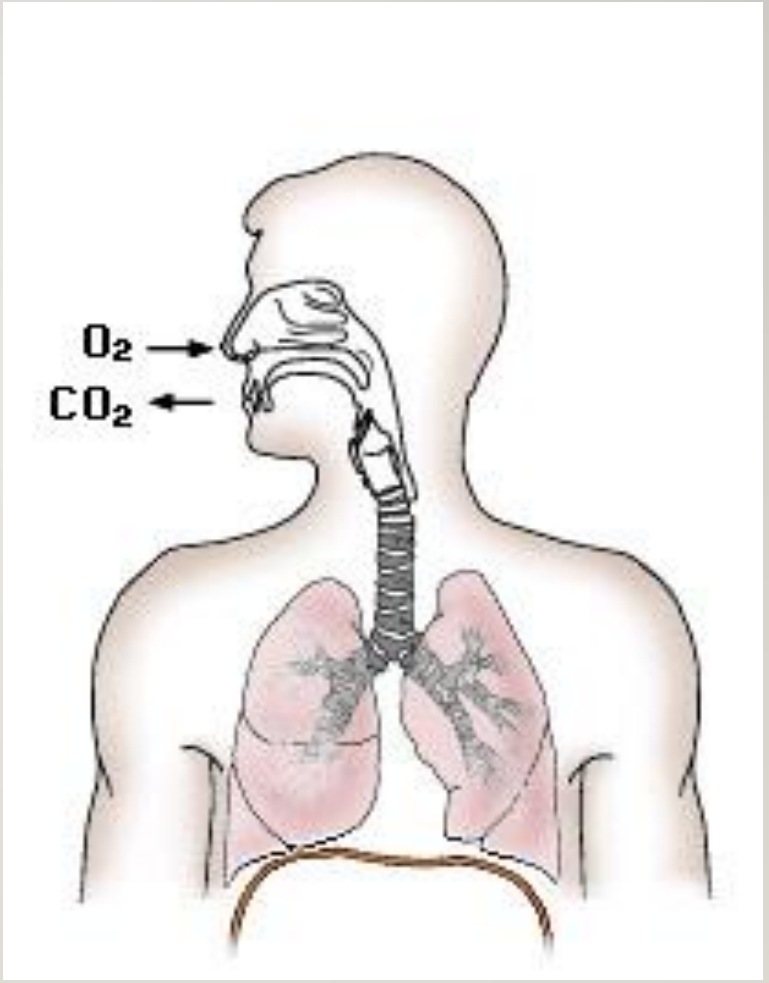
1960's - wide application of positive-pressure ventilation in ICU'S

WHY VENTILATE ?

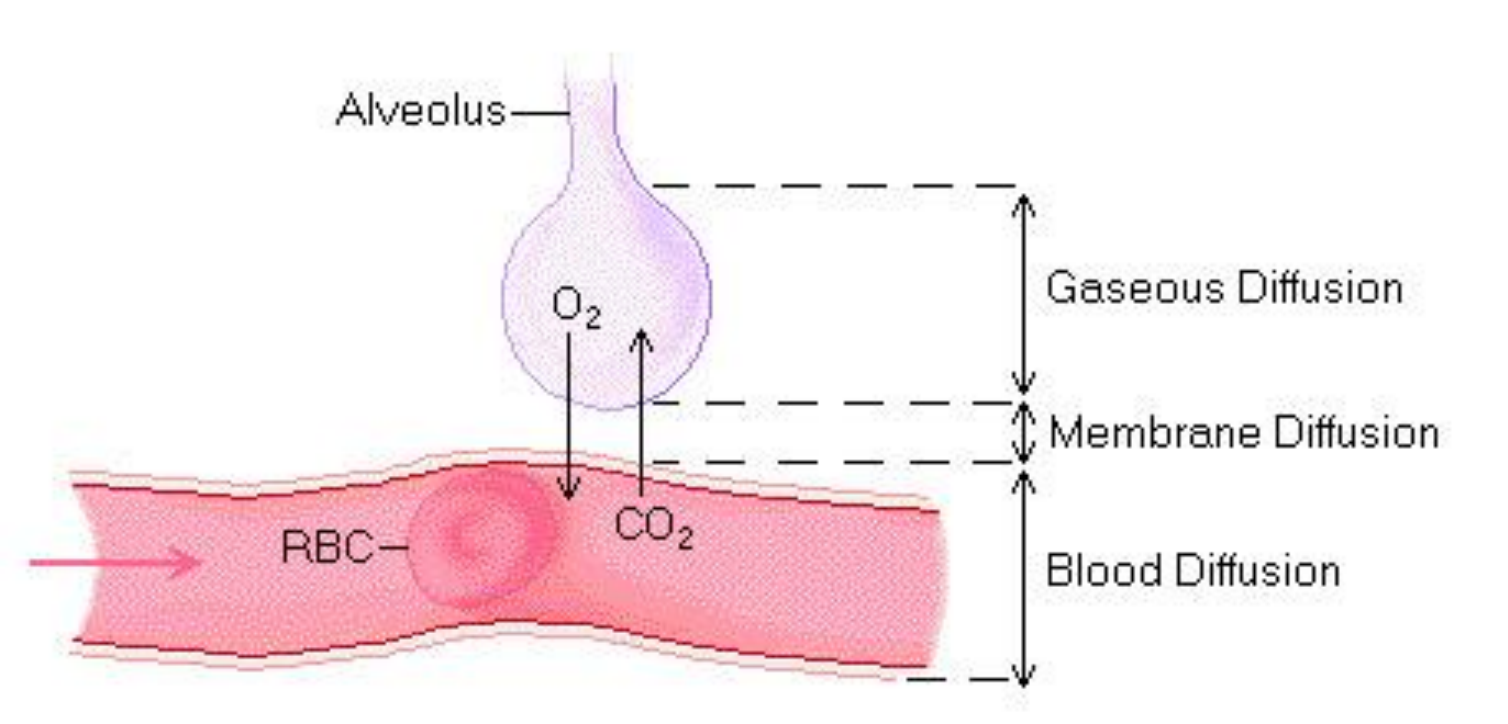
- **Respiratory failure (hypercarbia)**
- **Respiratory failure (hypoxic)**
- **Unstable airway – trauma**
- **Control ICP – head injury**
- **Cardiac insufficiency - ECMO**
- **Post-Op Surgery**



PURPOSE OF VENTILATION



DIFFUSION


Alveolus
O_2
CO_2
RBC
Gaseous Diffusion
Membrane Diffusion
Blood Diffusion

FACTORS AFFECTING O_2 DELIVERY

- **Blood flow rate to tissue**
- **Number of capillaries perfused**
- **PaO_2 or $PaCO_2$ Gradient between capillaries and cells**
- **Shifts in the Oxy-hgb dissociation curve**
- **Hgb as reflected by hematocrit or RBC count**

FACTORS…….


Factors Affecting
Chest Cage Compliance
diameter/shape of chest
height of individuual
respiratory muscle integrity
respiratory muscle innervatio
obesity

IN CASE YOU WERE WONDERING?

Why do I need to know this?

The use of a mechanical ventilator DOES NOT guarantee that the child is actually being ventilated.

How is this applicable to my job?

Nursing assessment of ventilatory status, therefore, is essential.

IN CASE YOU WERE WONDERING?

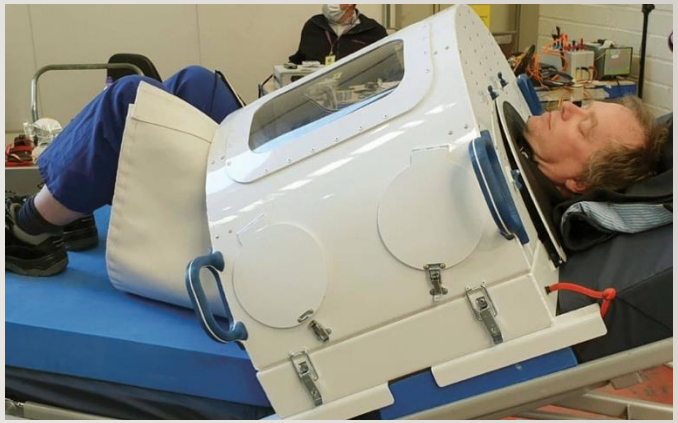
Why do I need to know this?

Factors that interfere with compliance and recoil increase the work of breathing.

How is this applicable to my job?

If respiratory muscle fatigue develops, respiratory failure can occur.

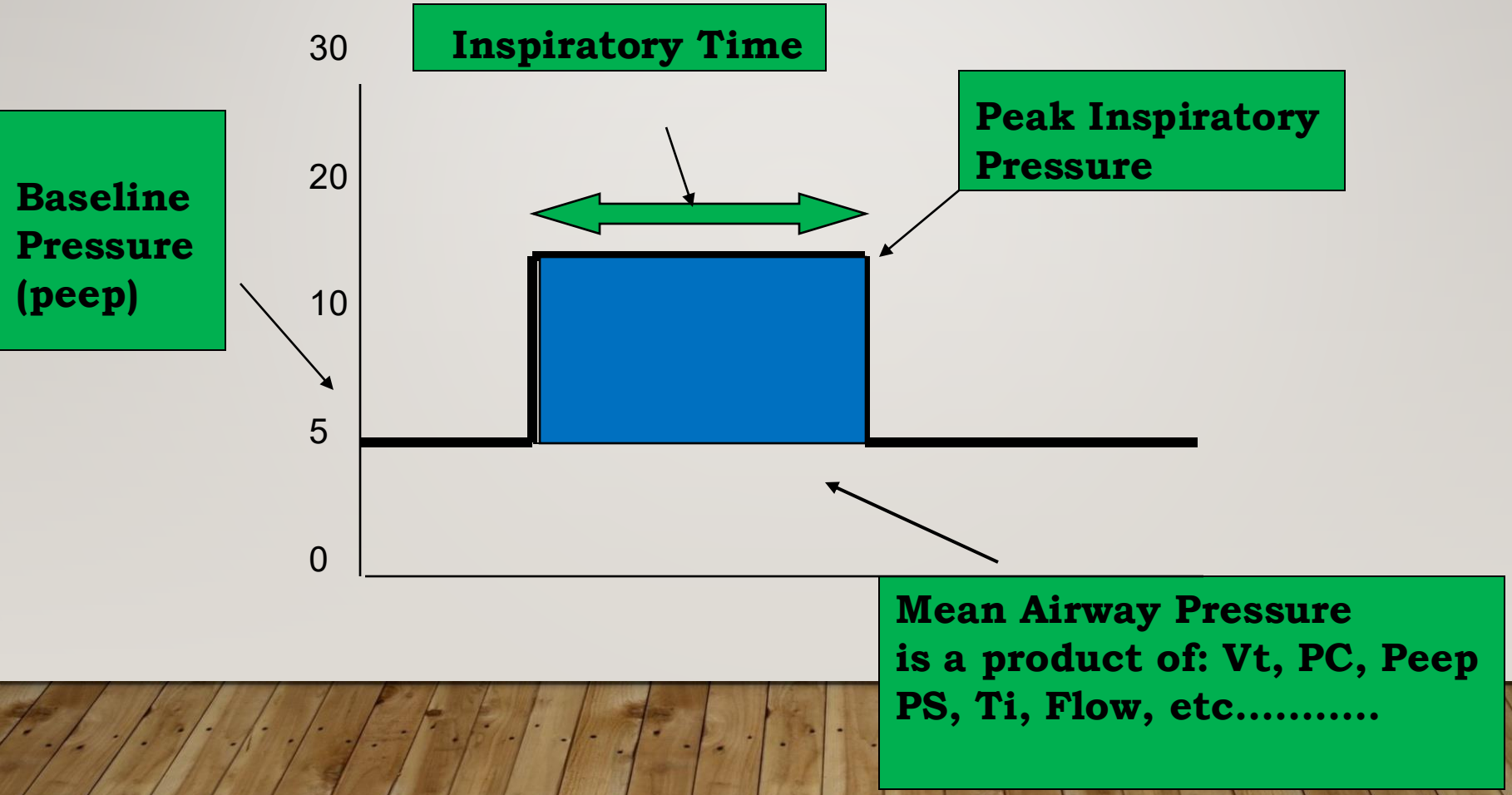
NEGATIVE PRESSURE VENTILATIONS
(YOU)



NEGATIVE PRESSURE VENTILATION

POSITIVE PRESSURE VENTILATORS

CONVENTIONAL MECHANICAL VENTILATION



VENTILATOR TERMINOLOGY

- **PEEP** positive end expiratory pressure
- **Vt** tidal volume
- **PC** pressure control
- **PS** pressure support
- **PIP** peak inspiratory pressure
- **VS** volume support
- **PRVC** pressure regulated volume control
- **SIMV** synchronized IMV

COMMON MODES OF VENTILATION

- V-A/C
- P-A/C
- CPAP/PSV
- V-SIMV
- P-SIMV
- PRVC
- DuoLevel
- APRV

Apnea Ventilation

- CPAP/PSV
- V-SIMV
- P-SIMV
- DuoLevel
- APRV

PRESSURE CONTROL

Breaths are delivered with a preset pressure during the set time and frequency.

Volumes will vary from breath to breath

VOLUME CONTROL

The ventilator delivers a set volume during a preset time and frequency.

Pressures will vary from breath to breath.

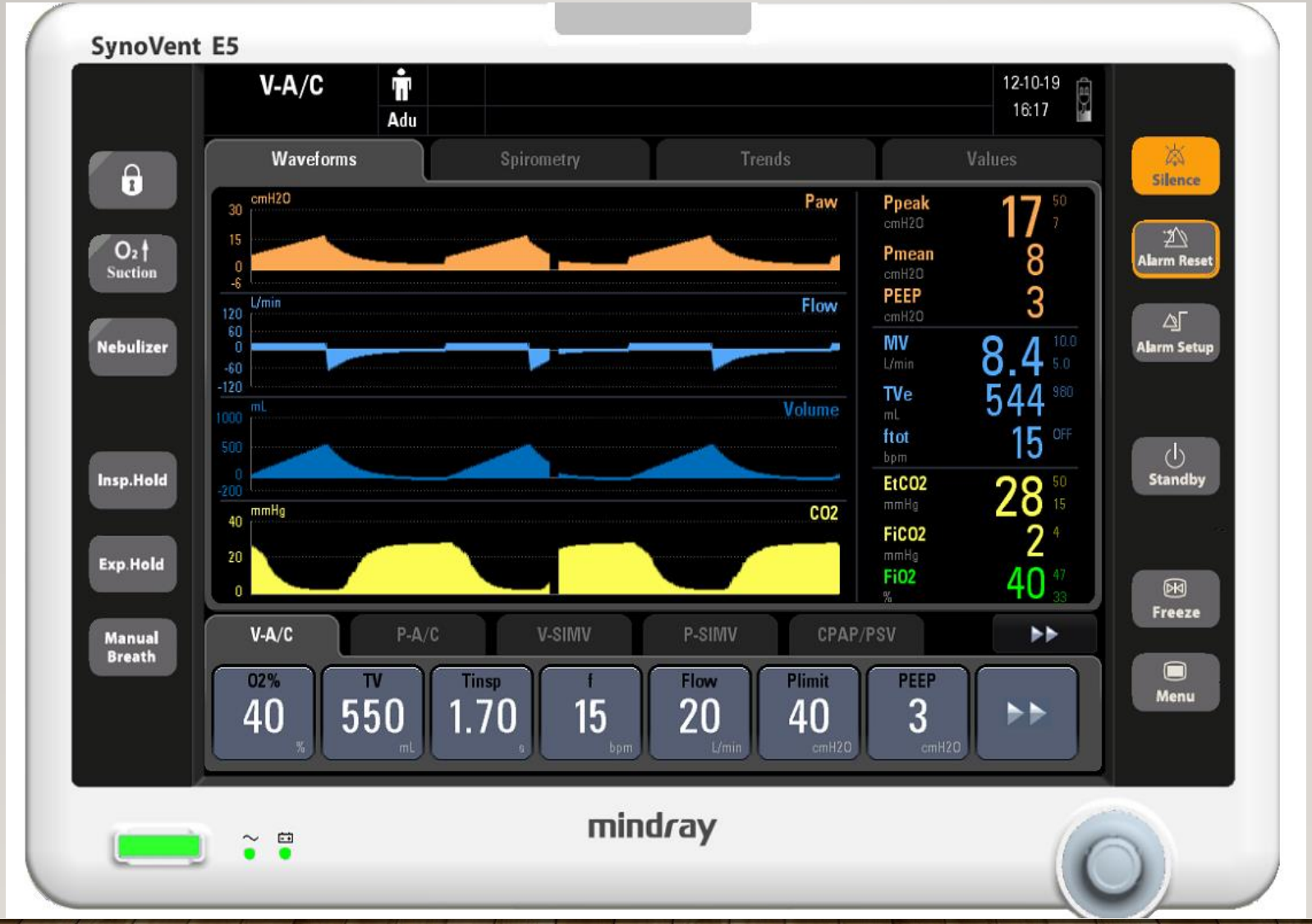
PRVC (PRESSURE REGULATED VOLUME CONTROL)

- **Targets a set tidal volume while regulating the pressure.**
- **Pressures "may" vary from breath to breath**

CPAP/PSV

- Patient must trigger every breath
- Tidal volume may vary from breath to breath
- Vent "support" is set on specific pressure (CPAP).
- Patient must be spontaneously breathing.

VOLUME CONTROL VENTILATION



SIMV PC/PS (SYNCHRONIZED INTERMITTENT MANDATORY VENTILATION)

Combination of "pressure control" with pressure support.

Ventilator synchronizes "control" breaths with the patient's "spontaneous" breaths.

Very patient friendly mode

SIMV VC/PS (SYNCHRONIZED INTERMITTENT MANDATORY VENTILATION)

Combination of "volume control" with pressure support.

Ventilator synchronizes "control" breaths with the patient's "spontaneous" breaths.

Very patient friendly mode

THE VENTILATOR IS ALARMING !!

- **CHECK YOUR PATIENT FIRST**

  Is your patient connected to the vent!

If so what alarm is going off

Start Bagging if any patient deterioration occurs!!

HIGH PRESSURE ALARM

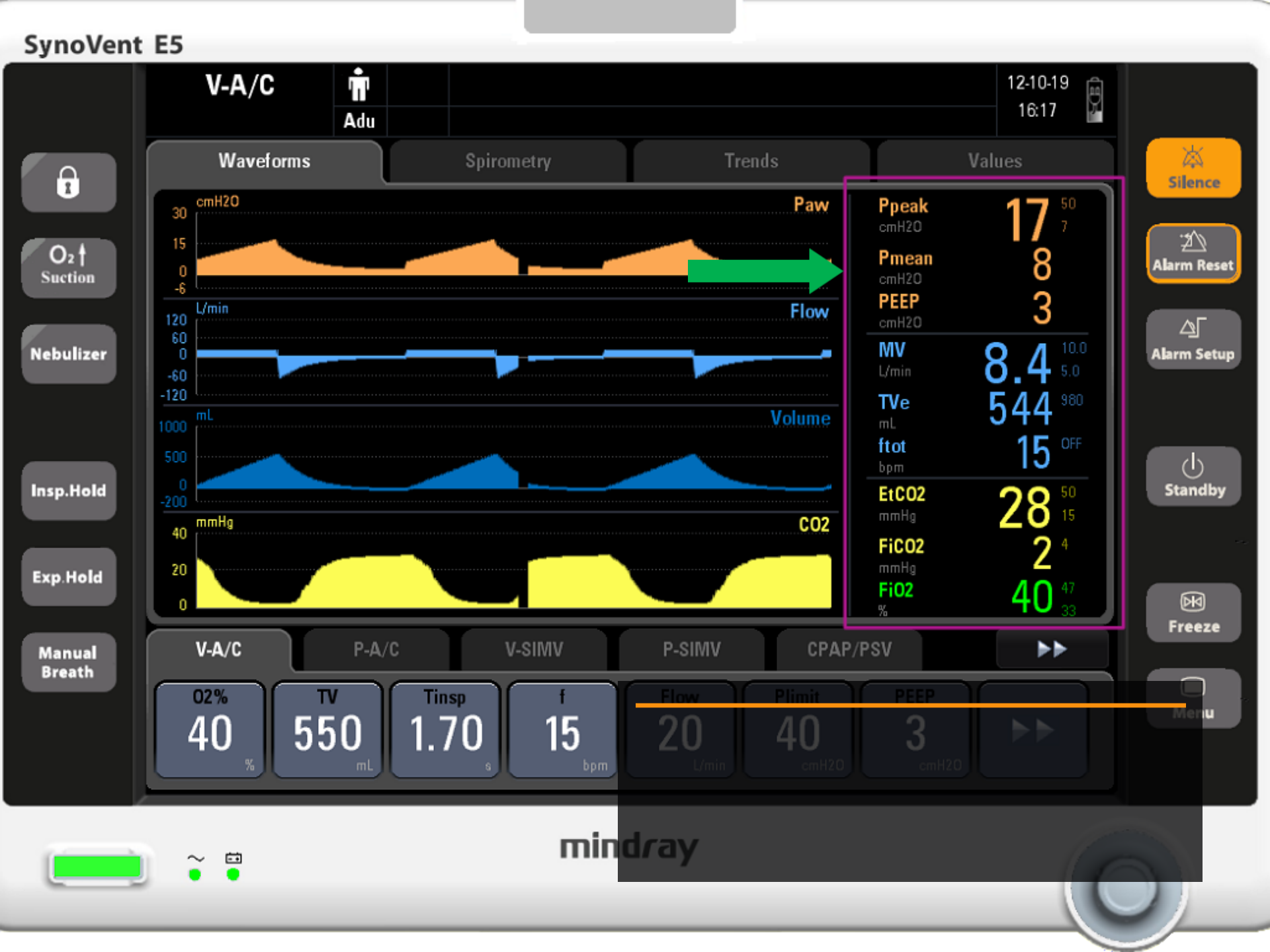
- Regulation Pressure Limited (PRVC name for High Pressure Alarm)
  - Tube kinked
  - Secretions (Suction)
  - Decreased compliance

LOW PRESSURE ALARM

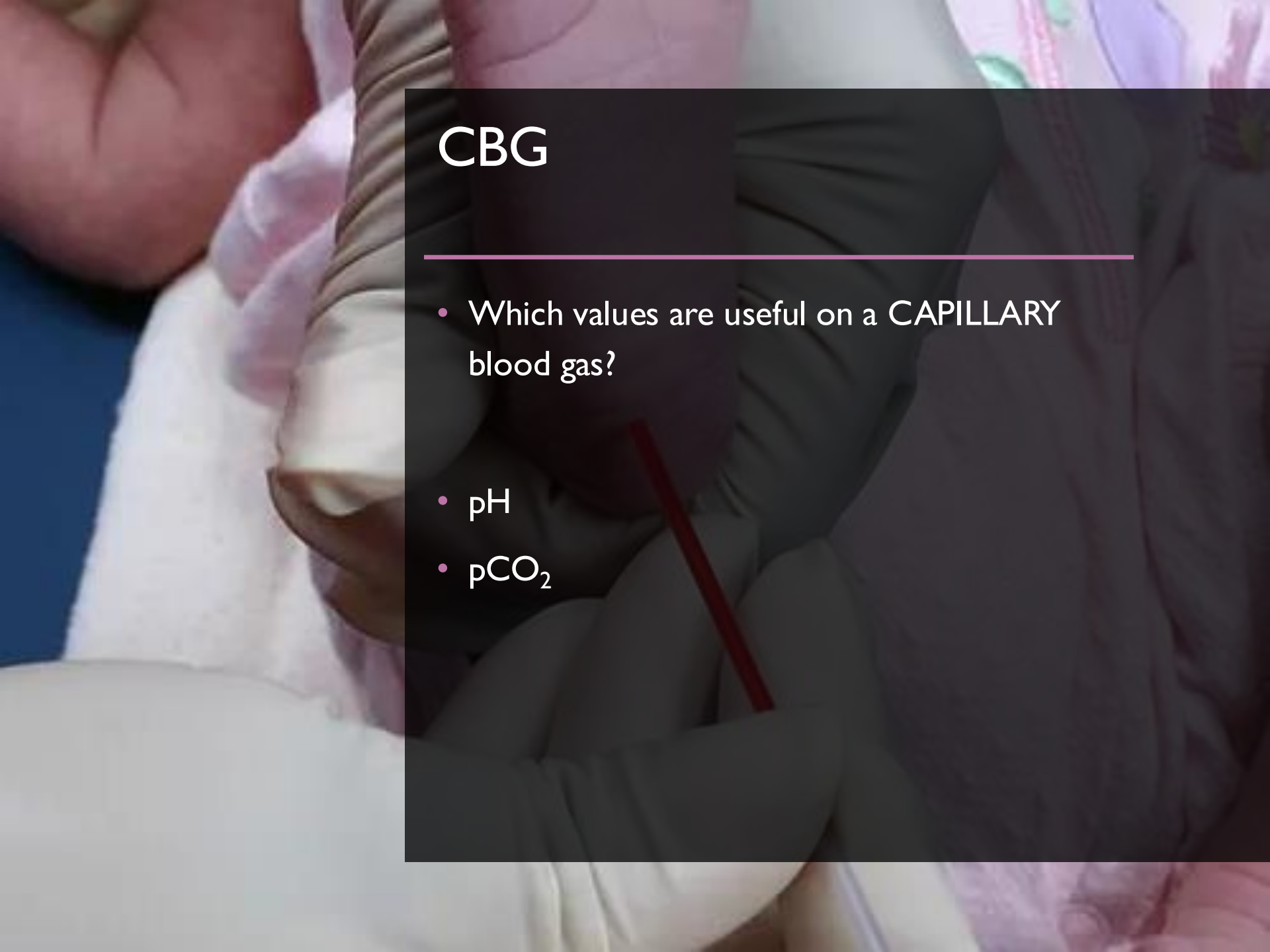
- Check for patient disconnection
- Look for source of leaks quickly (often saline port to ballard is open or insp/exp limb is disconnected from vent)
- Patient will require bagging if alarm continues (somewhere the pressure is venting to ambient not to the lungs)

LOW RESPIRATORY RATE

- Patient has ceased spontaneous respirations
- If the patient is in a control/SIMV mode the set RR may be adequate (Monitor ETCO2)
- In a support mode (PS/VS) the apnea alarm will sound and backup ventilation will begin


SynoVent E5
V-A/C
Adu
12-10-19
16:17
Waveforms
Spirometry
Trends
Values
cmH2O
Paw
30
15
0
-6
L/min
Flow
120
60
0
-60
-120
mL
Volume
1000
500
0
-200
mmHg
CO2
40
20
0
Ppeak
cmH2O
17
50
7
Pmean
cmH2O
8
PEEP
cmH2O
3
MV
L/min
8.4
10.0
5.0
TVe
mL
544
980
ftot
bpm
15
OFF
EtCO2
mmHg
28
50
15
FiCO2
mmHg
2
4
FiO2
%
40
47
33
Silence
Alarm Reset
Alarm Setup
Standby
Freeze
Menu
O2 Suction
Nebulizer
Insp.Hold
Exp.Hold
Manual Breath
V-A/C
P-A/C
V-SIMV
P-SIMV
CPAP/PSV
O2%
40
%
TV
550
mL
Tinsp
1.70
s
f
15
bpm
Flow
20
L/min
Plimit
40
cmH2O
PEEP
3
cmH2O
mindray

SETTINGS AND MODE CHANGE



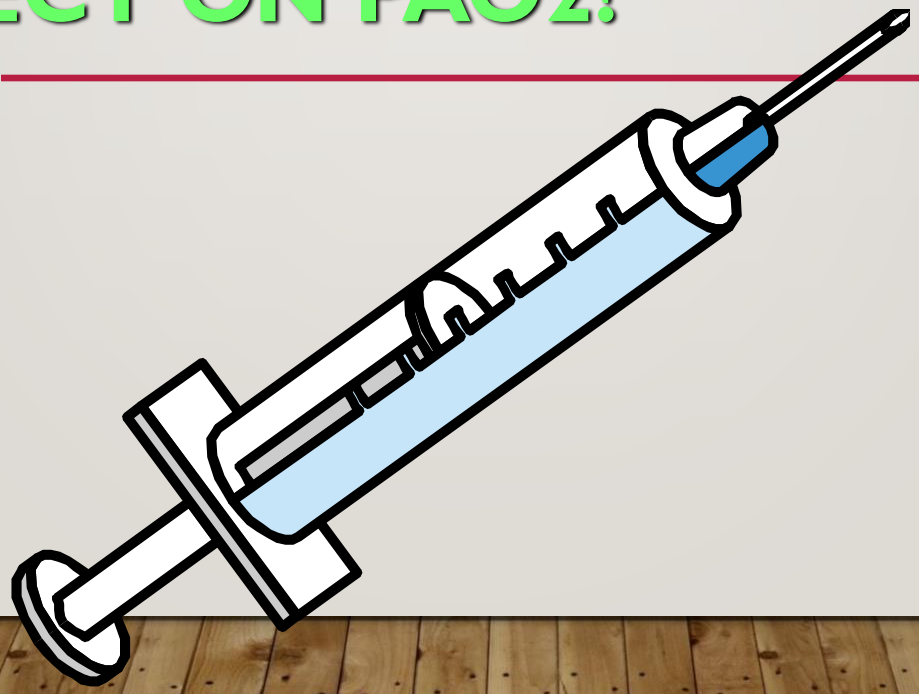
CBG

- Which values are useful on a CAPILLARY blood gas?

- pH
- pCO_2

BLOOD GASES & VENT MANAGEMENT

WHAT VENT PARAMETERS HAVE THE GREATEST EFFECT ON PAO2?



GREATEST EFFECT ON PAO2

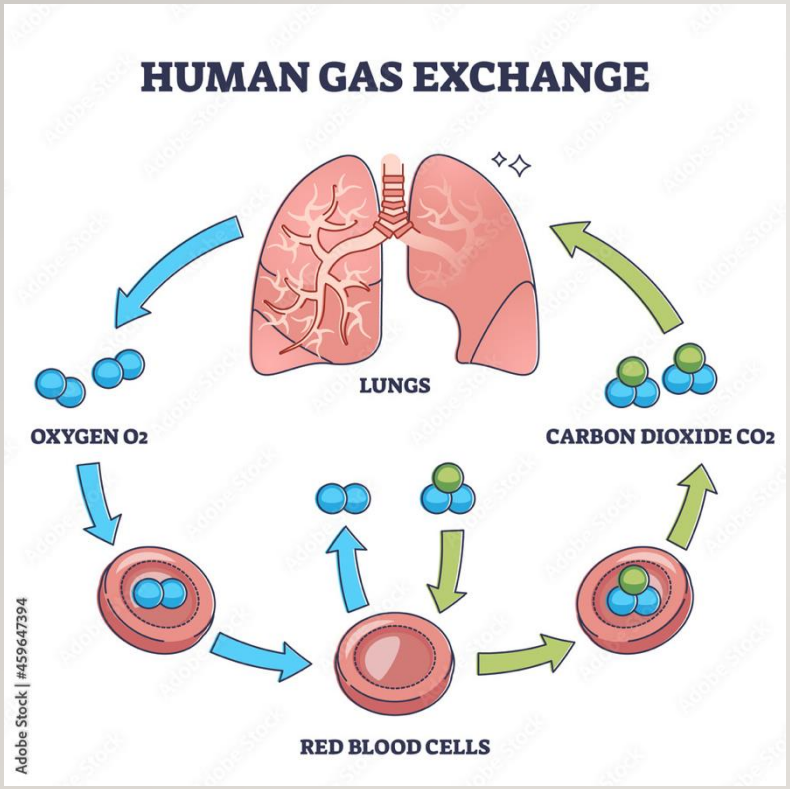
- FiO2
- PEEP
- MAP

VENTILATOR CHANGES

- My patient's $PaCO_2$ is now 100mmHg! What do I do?
  - Adjust minute ventilation
  - First assess tidal volumes, then rate
- My patient's PaO_2 is only 55! What do I do?
  - Adjust oxygenation parameters
  - PEEP and/or FiO_2
- My patient is freaking out and "fighting the vent"! What do I do?
  - Consider mode - most comfortable for patient?
  - Sedation
  - PARALYSIS ONLY AS A LAST RESORT!!!

OXYGENATION

- Mean airway pressure (Paw)
- Improves the number of alveoli available for gas exchange ("recruitment")
- Decreases "shunt"
- Paw = PEEP + (T_i/T_i+T_e) x PIP
  - PEEP (positive end expiratory pressure) is the major determinant of Paw in nearly all cases
- So, PEEP determines oxygenation!
  - In general, more PEEP = better oxygenation
  - (MAJOR OVERSIMPLIFICATION ALERT)



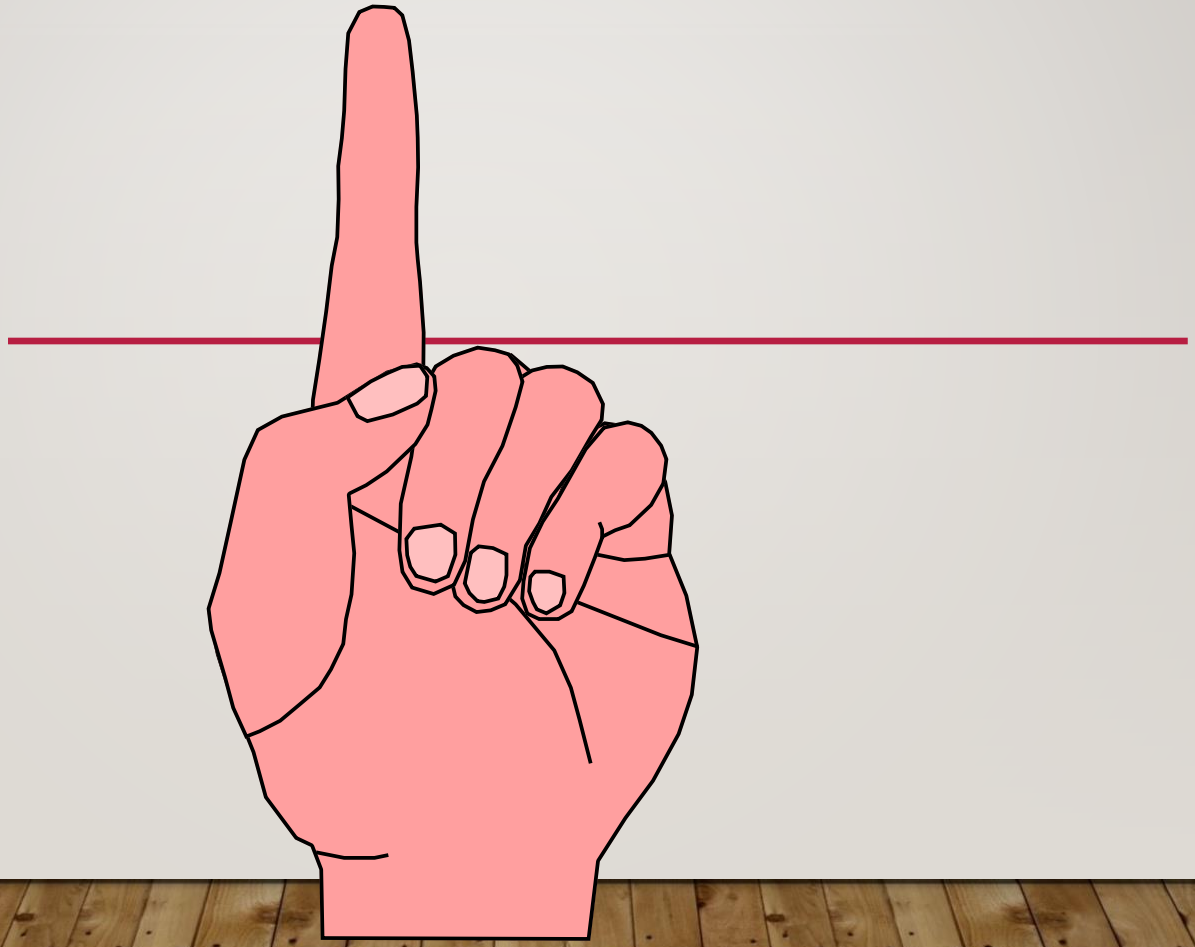
BLOOD GASES & VENTILATOR MANAGEMENT

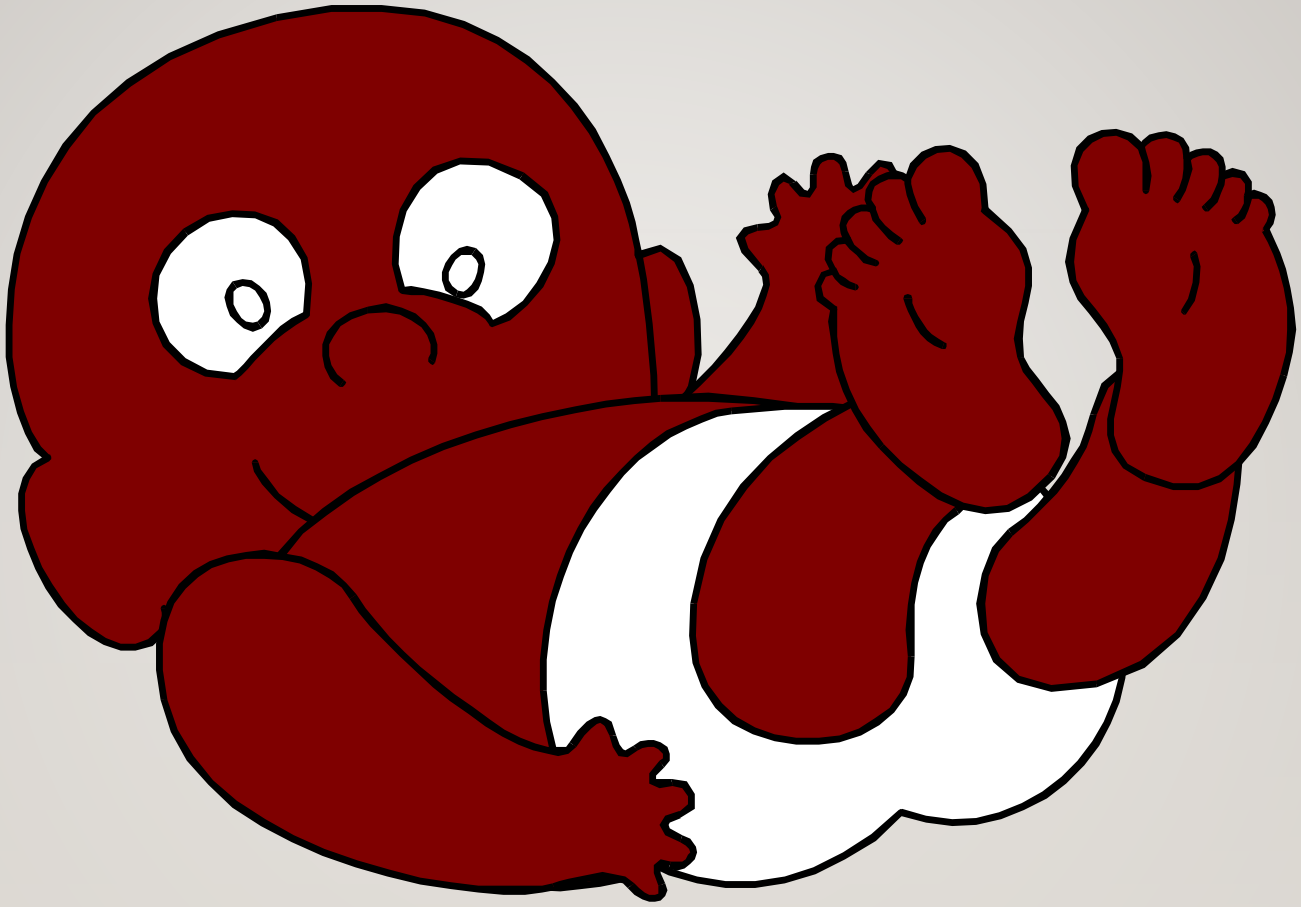
WHAT VENTILATOR PARAMETERS WILL HAVE THE GREATEST EFFECT ON CO2 (PH)?

GREATEST AFFECT ON CO_2

- Ventilator Rate
- Tidal Volume
- Pressures

WHAT IS THE FIRST THING YOU CHECK IF A VENTILATOR ALARM SOUNDS?





Your Patient!

POST-TEST

- **What is the basic difference between volume ventilation and pressure ventilation?**
- **Name the two modes that are totally patient dependent.**
- **If your patient is in Volume Control what will vary from breath to breath?**
- **If your patient is in Pressure Control what will vary from breath to breath?**

POST-TEST 2

- When a ventilator alarms, what is the first thing you should check?
- What can you check next?
- What does the following stand for?
- PIP PCAP
- CPAP PSAP
- PEEP SIMV

REFERENCES

- *Essentials of Respiratory Care*, Kacmarek.
- *Nursing Care of Infants and Children*, Whaley & Wong's, 6th Edition.
- *Mindray Manual SynoVent E5*