ASLBA

OSPEDALE DI VENERE
U.O.C. di Terapia Intensiva Neonatale
Direttore: dr. Antonio Del Vecchio

MECHANICAL VENTILATION IN NICU

https://it.depositphotos.com/164621502/stock-photo-human-and-robot-arm-wrestling.html

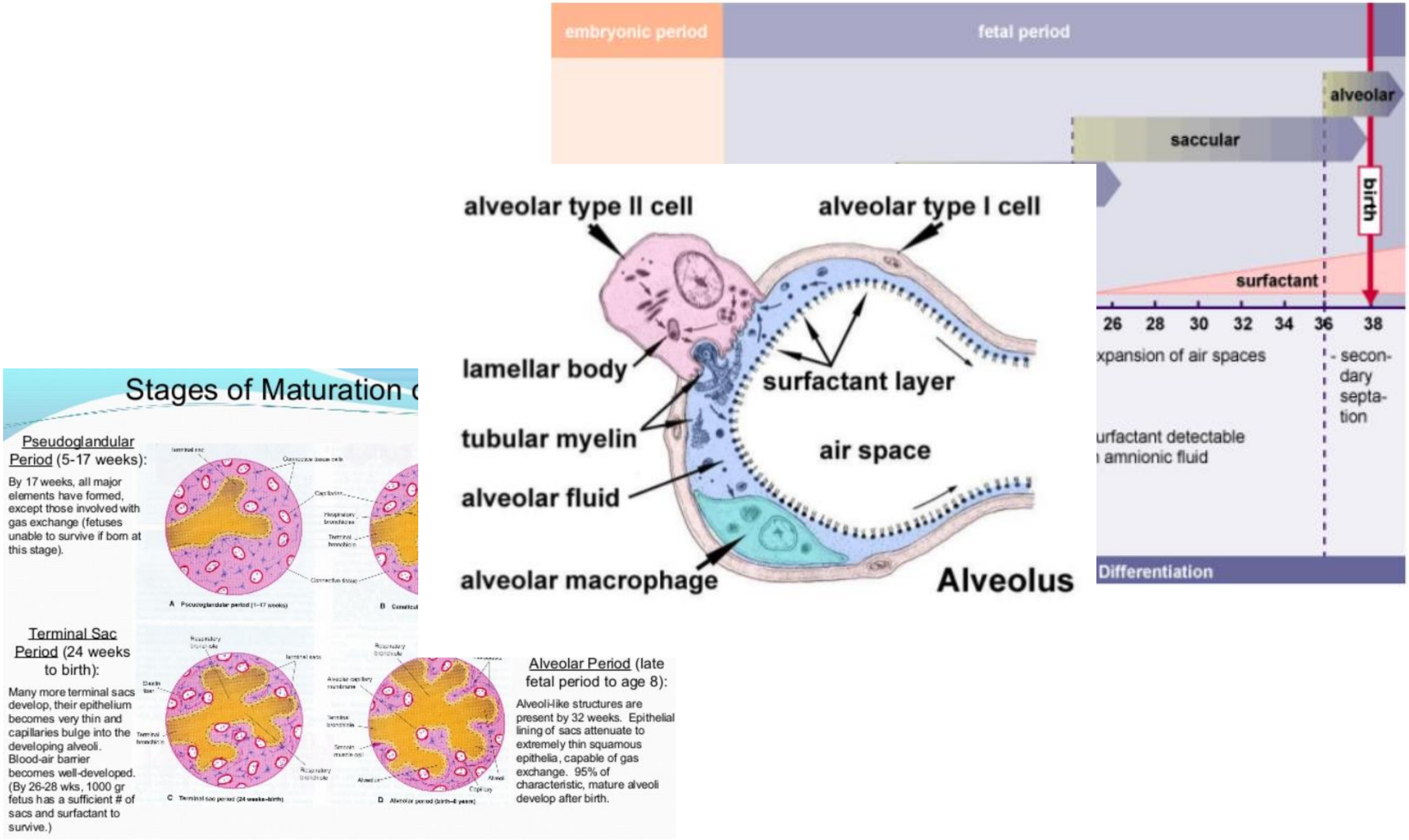
Dr.ssa Flavia Petrillo, inf Domenico Dentico

HIGHLIGHTS

- ✓Mechanical Ventilation in Intesive Care
- ✓Evolution of mechanical ventilation
- ✓The ventilator: structure and operation
- ✓Mechanical properties of respiratory system
- ✓Ventilation mode: taxonomy
- ✓Ventilation mode in Di Venere NICU
- ✓Non invasive ventilation
- ✓Partnership NICU/politecnico: the projects

Mechanical Ventilation in Intensive Care

Lung development



Stages of Maturation c

Pseudoglandular Period (5-17 weeks):

By 17 weeks, all major elements have formed, except those involved with gas exchange (fetuses unable to survive if born at this stage).

Terminal Sac Period (24 weeks to birth):

Many more terminal sacs develop, their epithelium becomes very thin and capillaries bulge into the developing alveoli. Blood-air barrier becomes well-developed. (By 26-28 wks, 1000 gr fetus has a sufficient # of sacs and surfactant to survive.)

Alveolar Period (late fetal period to age 8):

Alveoli-like structures are present by 32 weeks. Epithelial lining of sacs attenuate to extremely thin squamous epithelia, capable of gas exchange. 95% of characteristic, mature alveoli develop after birth.

Courtesy by M.L. Ventura

Evolution of mechanical ventilation

In the early 1800s interest in resuscitation and mechanical ventilation of the newborn infant flourished. In 1800, the first report describing nasotracheal intubation as an adjunct to mechanical ventilation was published by Fine in Geneva.[7] At about the same time, the principles for mechanical ventilation of adults were established; the rhythmic support of breathing was accomplished with mechanical devices, and on occasion, ventilatory support was carried out with tubes passed into the trachea.

In 1806, Vide Chaussier, professor of obstetrics in the French Academy of Science, described his experiments with the intubation and mouth-to-mouth resuscitation of asphyxiated and stillborn infants.[8] The work of his successors led to the development in 1879 of the Aerophore Pulmonaire (Fig. 1-1), the first device specifically designed for the resuscitation and short-term ventilation of newborn infants.[4] This device was a simple rubber bulb connected to a tube. The tube was inserted into the upper portion of the infant's airway, and the bulb was alternately compressed and released to produce inspiration and passive expiration. Subsequent investigators refined these early attempts by designing devices that were used to ventilate laboratory animals.

FIG 1-1 Aerophore pulmonaire of Gairal. (From DePaul. *Dictionnaire Encyclopédique*. XIII, 13…

O'Dwyer[11] in 1887 reported the first use of long-term positive-pressure ventilation in a series of 50 children with croup. Shortly thereafter, Egon Braun and Alexander Graham Bell independently developed intermittent body-enclosing devices for the negative-pressure/positive-pressure resuscitation of newborns (Fig. 1-2).[12,13] One might consider these seminal reports as the stimulus for the proliferation of work that followed and the growing interest in mechanically ventilating newborn infants with respiratory failure.

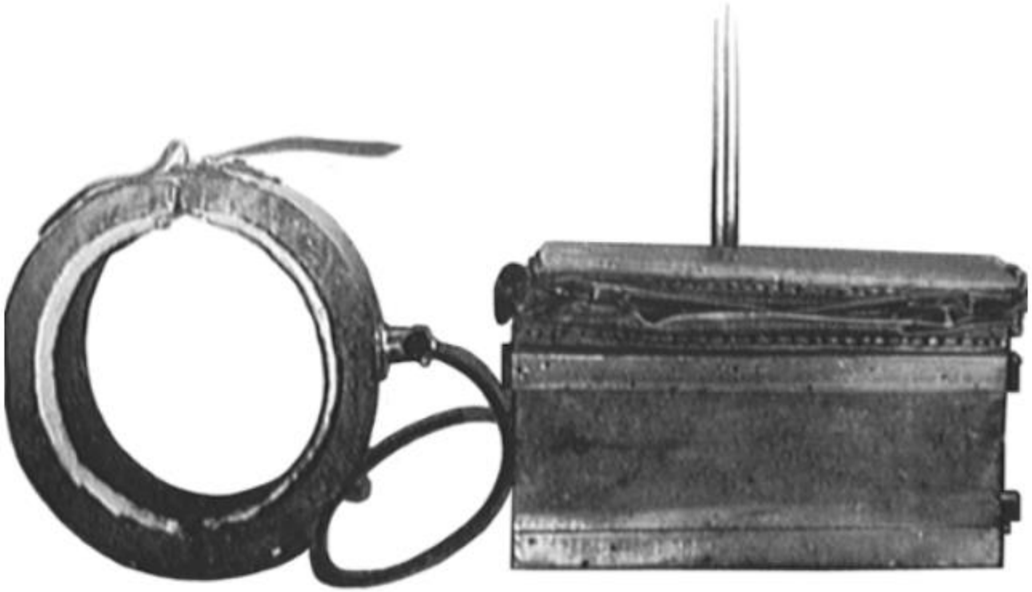


FIG 1-2 Alexander Graham Bell's negative-pressure ventilator, c. 1889. (From Stern L, e…

it alternately created positive and negative pressure of 1 to 3 psi at 1-min intervals in a tightly sealed cylindrical steel chamber that was infused with warmed humidified 60% oxygen.[18] Clear plastic versions of the air lock quickly became commercially available in the United States in the early 1950s (Fig. 1-3). However, a study by Apgar and Kreiselman in 1953[19] on apneic dogs and another study by Townsend involving 150 premature infants[20] demonstrated that the device could not adequately support the apneic newborn. The linkage of high oxygen administration to retinopathy of prematurity and a randomized controlled trial of the air lock versus care in an Isolette® incubator at Johns Hopkins University[21] revealed no advantage to either study group and heralded the hasty decline in the use of the Bloxsom device.[21]

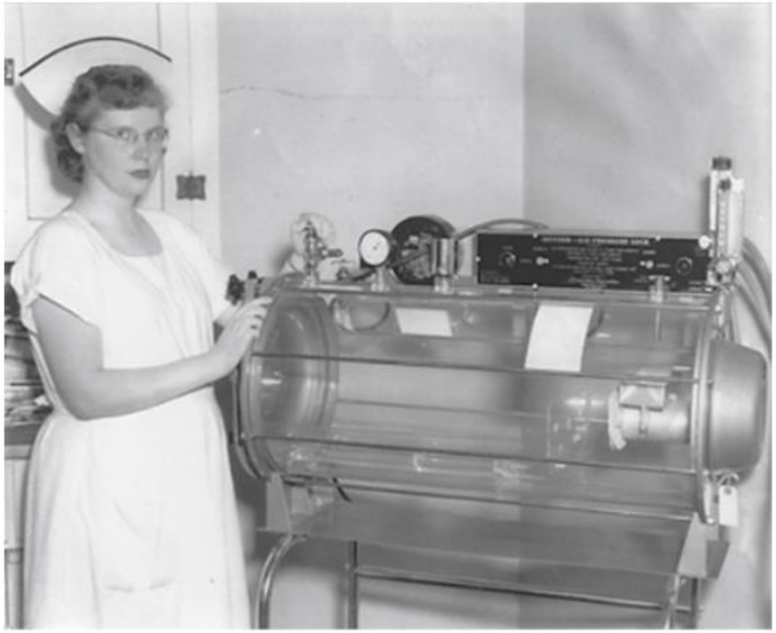


FIG 1-3 Commercial Plexiglas version of the positive-pressure oxygen air lock. Arriva…

The New York Times.

NEW YORK, THURSDAY, AUGUST 8, 1963.

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S. Is Hinted
alk in Warsaw

KENNEDY TO SEND TEST BAN TREATY TO SENATE TODAY

Message Will Explain Pact and Urge Ratification—Opposition Waning

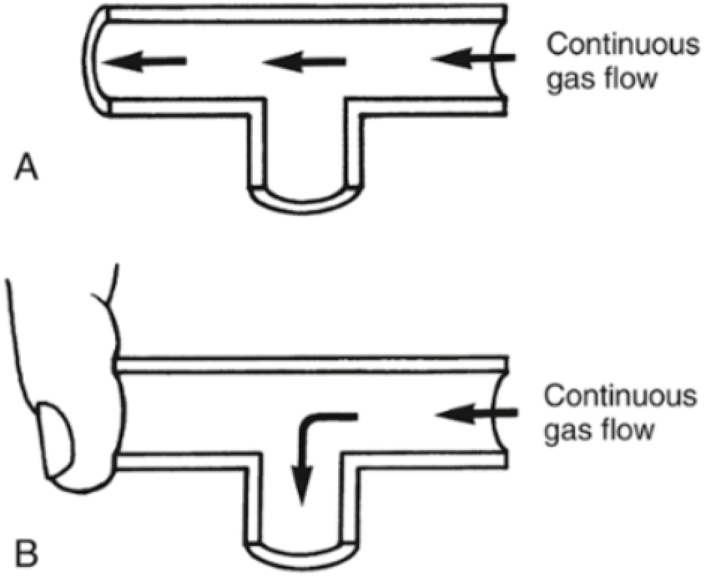
2d Son Born to Kennedys; Has Lung Illness

Child Transferred to Boston After Birth at Cape Hospital

By WILLIAM M. BLAIR

FIG 1-4 Front page of *The New York Times*. August 8, 1963. (Copyright 1963 by The New Y…

Until the early 1970s, ventilators used in neonatal intensive care units (NICUs) were modifications of adult devices; these devices delivered intermittent gas flows, thus generating IPPV. The ventilator initiated every mechanical breath, and clinicians tried to eliminate the infants' attempts to breathe between IPPV breaths ("fighting the ventilator"), which led to rebreathing of dead air. In 1971, a new prototype neonatal ventilator was developed by Kirby and colleagues.[38] This ventilator used continuous gas flow and a timing device to close the exhalation valve modeled after Ayre's T-piece used in anesthesia (Fig. 1-5).[24,36,38] Using the T-piece concept, the ventilator provided continuous gas flow and allowed the patient to breathe spontaneously between mechanical breaths. Occlusion of the distal end of the T-piece diverted gas flow under pressure to the infant. In addition, partial occlusion of the distal end generated positive end-expiratory pressure. This combination of mechanical and spontaneous breathing and continuous gas flow was called *intermittent mandatory ventilation* (IMV).



Il trigger: una svolta per la ventilazione

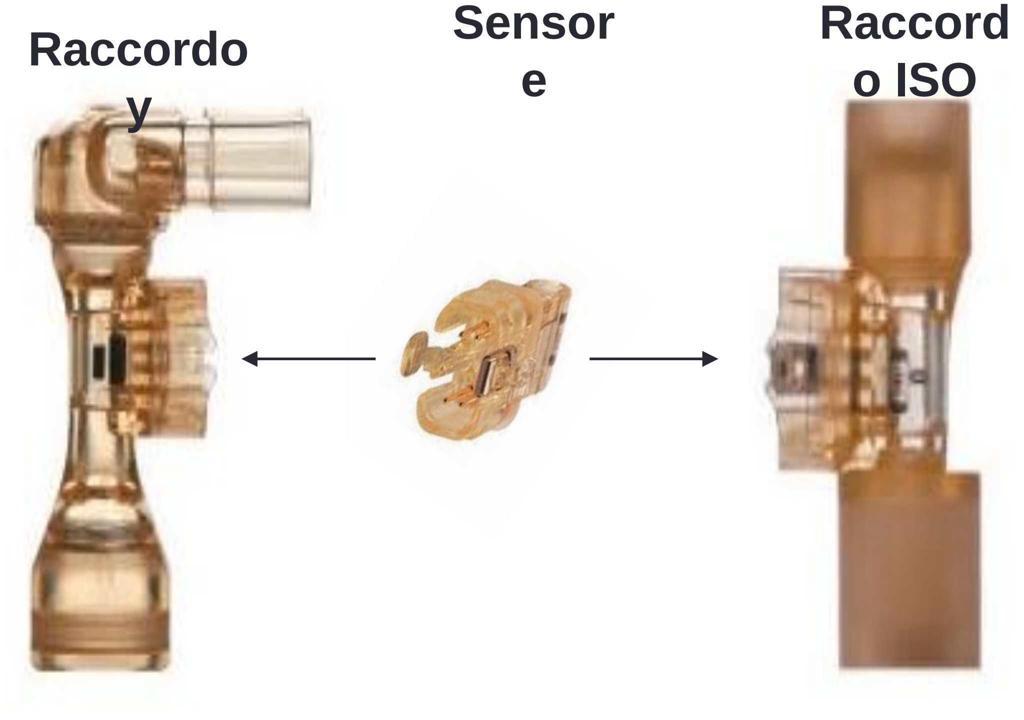
- Alta sensibilità e stabilità del trigger → precoce e costante rilevazione del segnale.
- Breve tempo di risposta (response time)→tempo intercorrente tra l'inizio del respiro spontaneo e l'inizio del ciclo meccanico (< 100 m/sec.).
- Eliminazione del fenomeno dell'auto attivazione → inappropriata attivazione del respiratore (per eccessiva sensibilità del trigger, eccessiva condensa nel circuito di ventilazione, presenza di perdita tra cannula tracheale e trachea).

Dispositivi di rilevamento segnale in NICU

- **Trigger di pressione** → viene attivato dalla deflessione negativa del segnale di pressione determinato dall'inspirazione spontanea del pz.
- **Capsula pneumatica addominale o di Graseby** → rileva l'aumento della pressione addominale conseguente alla contrazione del diaframma.
- **Trigger di impedenza toracica** → il segnale di inspirazione spontanea deriva dalle modificazioni di impedenza transtoracica valutate per mezzo di elettrodi applicati sul torace e un monitor cardiorespiratorio.
- **Trigger di flusso** → questo strumento rileva il flusso aereo a livello del raccordo tra crociera e cannula tracheale.

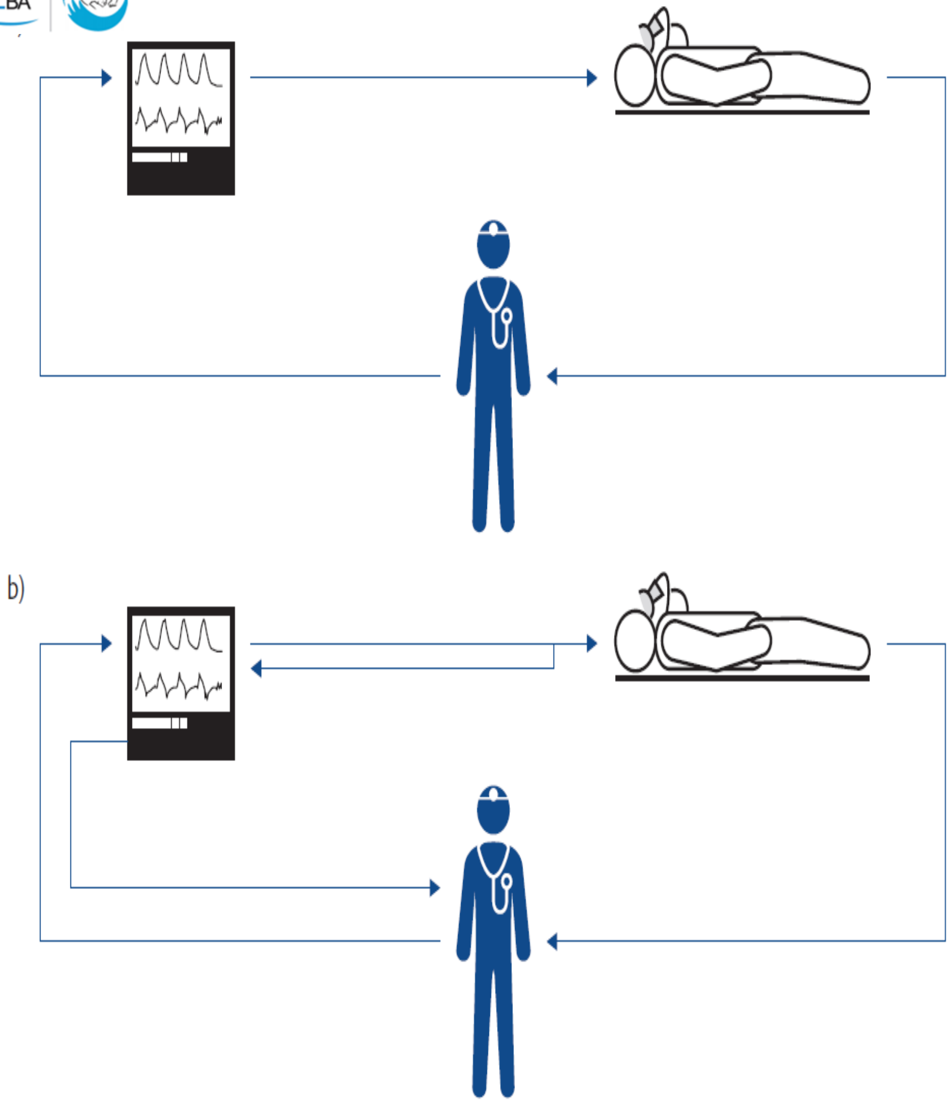
Trigger di flusso

Sembra essere ad oggi il sistema di trigger più idoneo a realizzare la ventilazione assistita in epoca neonatale, definita, per questo motivo, ventilazione assistita flusso-sincronizzata.



Funzionamento del sensore di flusso

Il sensore di flusso è formato da un anemometro a filo caldo e un adattatore. L'anemometro presenta un elemento riscaldatore posto tra 2 sensori di temperatura, fra i quali, al passaggio dei gas, si crea un gradiente termico registrato come differenza di potenziale proporzionale al flusso aereo che lo attraversa. Il minimo flusso a cui il rilevamento funziona in modo affidabile è 0,2 L/min. I valori di flusso minori vengono soppressi e visualizzati come zero.



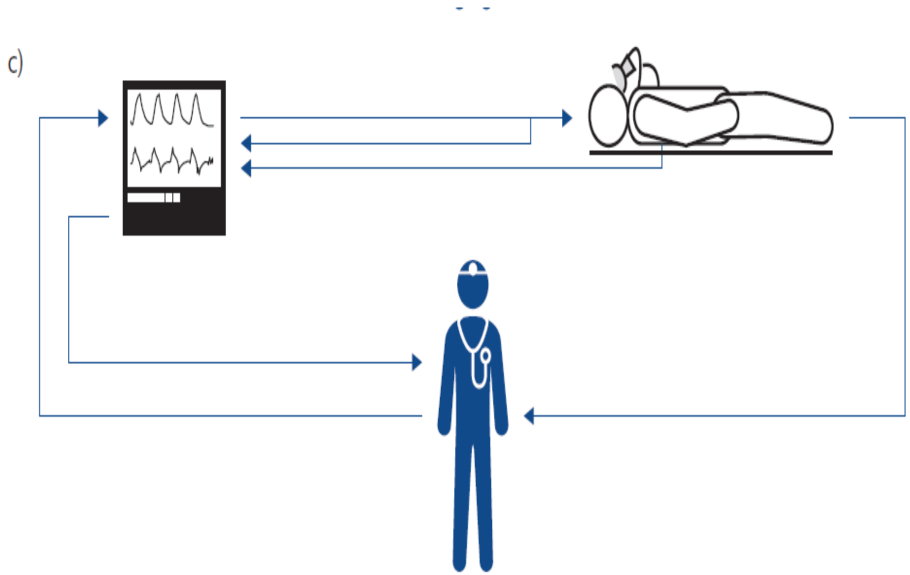
The use of mechanical tools to assist ventilation dates back to the late 19th century, when devices able to apply an alternating subatmospheric pressure around the body were used to restore ventilation by expanding the chest wall of patients [2]. However, it was only after the introduction of positive-pressure ventilation during the reappearance of poliomyelitis in the 1950s, when Bjorn Ibsen demonstrated a dramatic reduction of mortality in patients manually ventilated by tracheostomy, that mechanical ventilation started to be widespread [3].

Ashbaugh *et al.* [8] first described acute respiratory distress syndrome (ARDS) in 1967 and identified the positive end-expiratory pressure (PEEP) as "most helpful in combating atelectasis and hypoxæmia".

From the early 1970s, ventilators benefited from the progresses in electronics, and started incorporating more advanced monitoring of flow and pressure variables (figure 1b). Improvements in

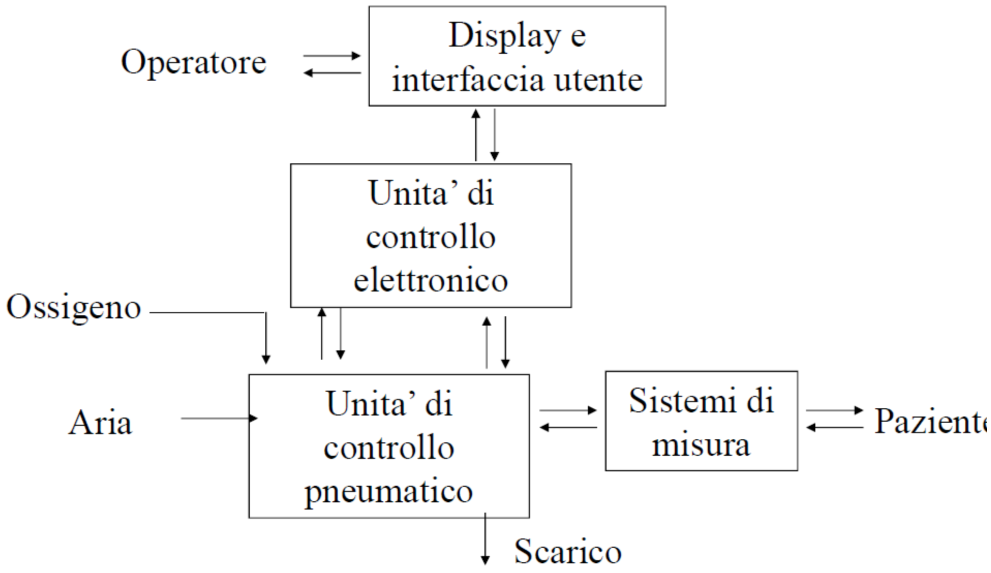
In 1974, Webb and Tierney [14] demonstrated in animal models that ventilation with high distending pressures was leading *per se* to severe or even fatal pulmonary oedema, marking the

This progress was also possible thanks to the introduction of microprocessors in mechanical ventilators, starting in the early 1980s.



the device). In addition, microprocessors allow the implementation of sophisticated signal processing of the measurements provided by sensors, leading not only to better measurement accuracy and better rejection of noise and artefacts, but also to the generation of new information by appropriately computing and integrating several variables. Moreover, this expanded information can be used by the ventilator itself to optimise the ventilation parameters on the basis of patient needs, creating the so-called “closed-loop” ventilation strategies or intelligent or smart ventilation modes (figure 1c).

Struttura di un ventilatore neonatale

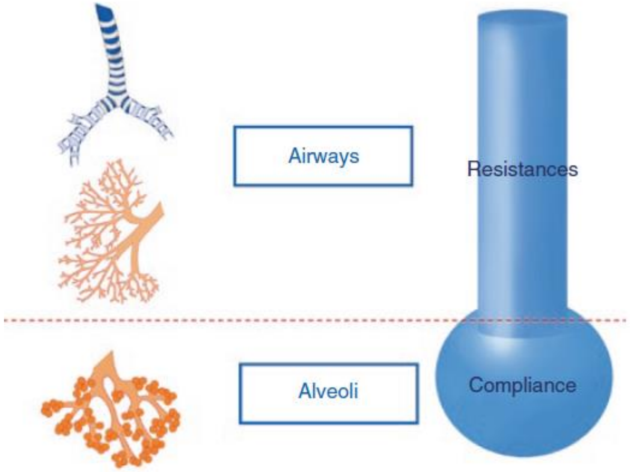


Mechanical properties of respiratory system

Resistance (R) R = P/V

Compliance (C) $C = \Delta P / \Delta V$

Inertia (I) I = P/V



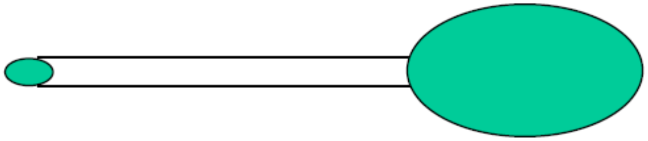
Equation of motion for the respiratory system

- Flow (laminar)

$$P = R\dot{V}$$

- If we connect the tube to an elastic balloon:

$$P = R\dot{V} + EV$$



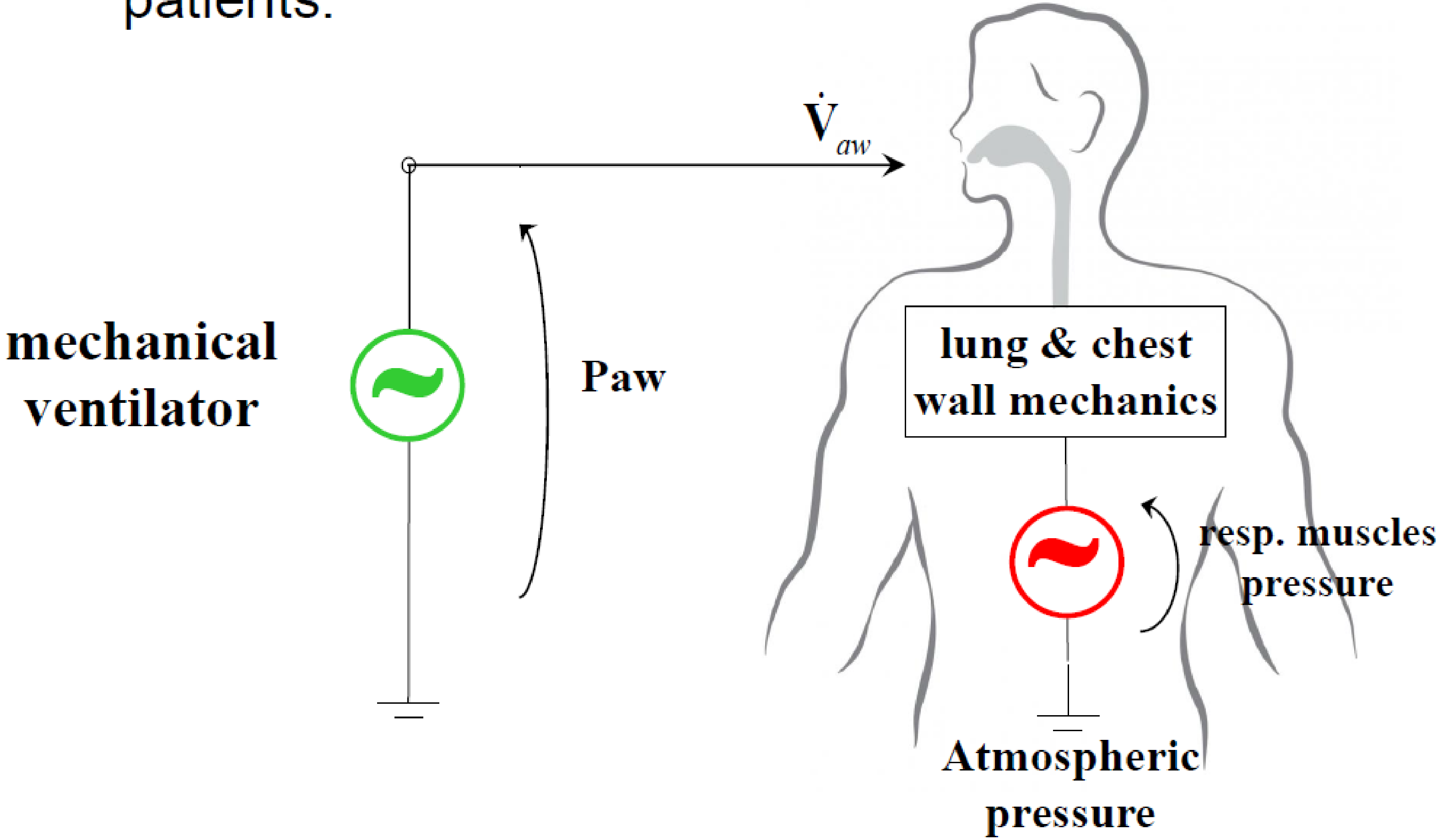
- If the flow is also accelerated:

$$P = R\dot{V} + EV + \boxed{I\ddot{V}}$$

- Equation of Motion of the Respiratory System

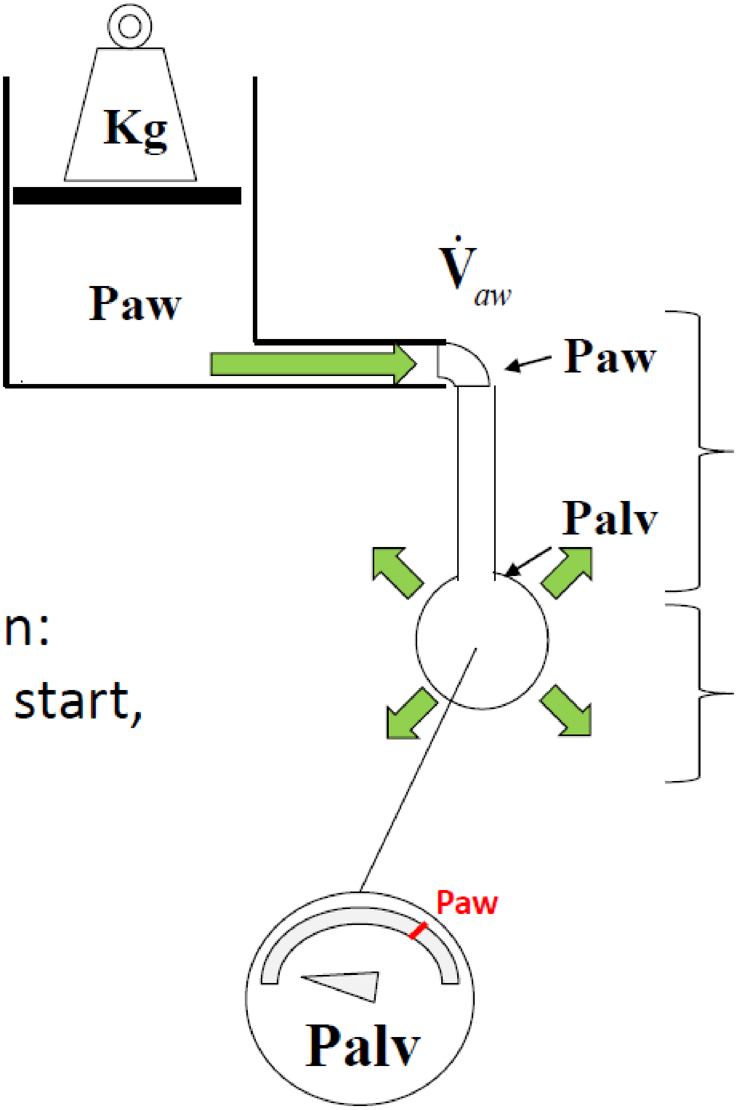
How ventilator works

Mechanical ventilation is a method where mechanical means is used to assist or replace spontaneous breathing of patients.



Beginning of inspiration

mechanical
ventilator
-
Pressure
generator



$$\Delta P = P_{aw} - P_{alv}$$

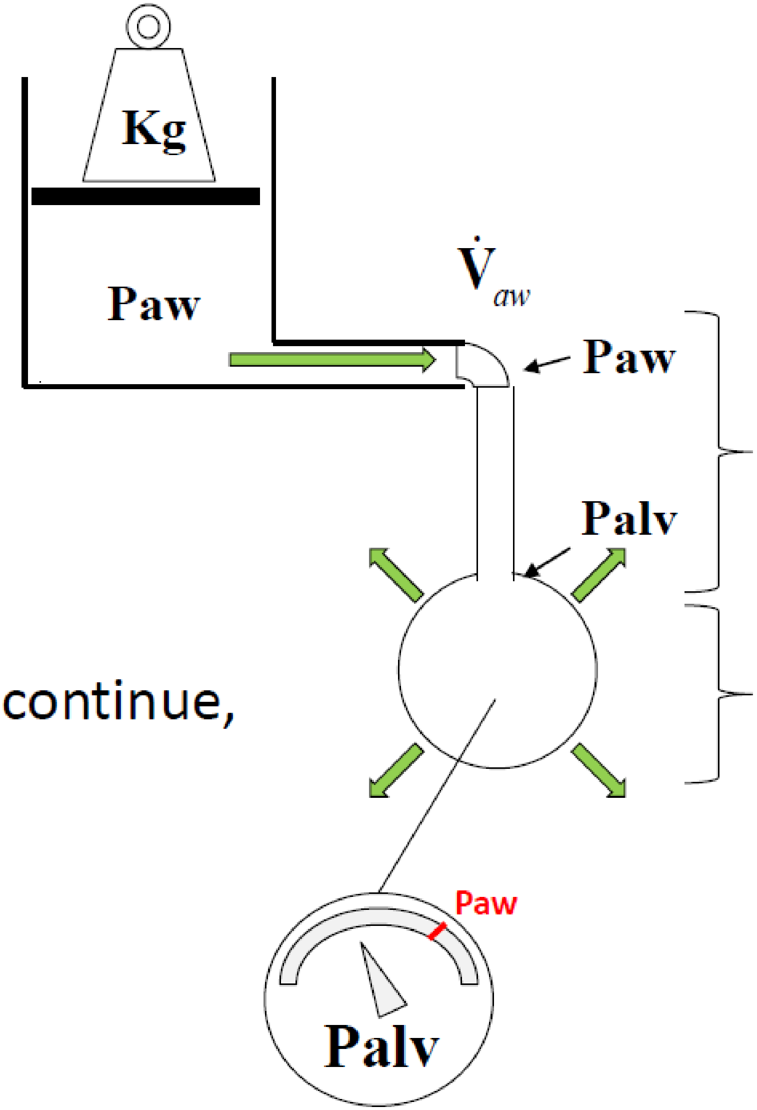
$$V'_{aw} = \frac{\Delta P}{Rrs}$$

$$P = \frac{1}{C_{rs}} V$$

Beginning of inspiration:
Paw>>Palv, inspiration start,
large Vaw’

Middle of inspiration

mechanical
ventilator
-
Pressure
generator



$$\Delta P = P_{aw} - P_{alv}$$

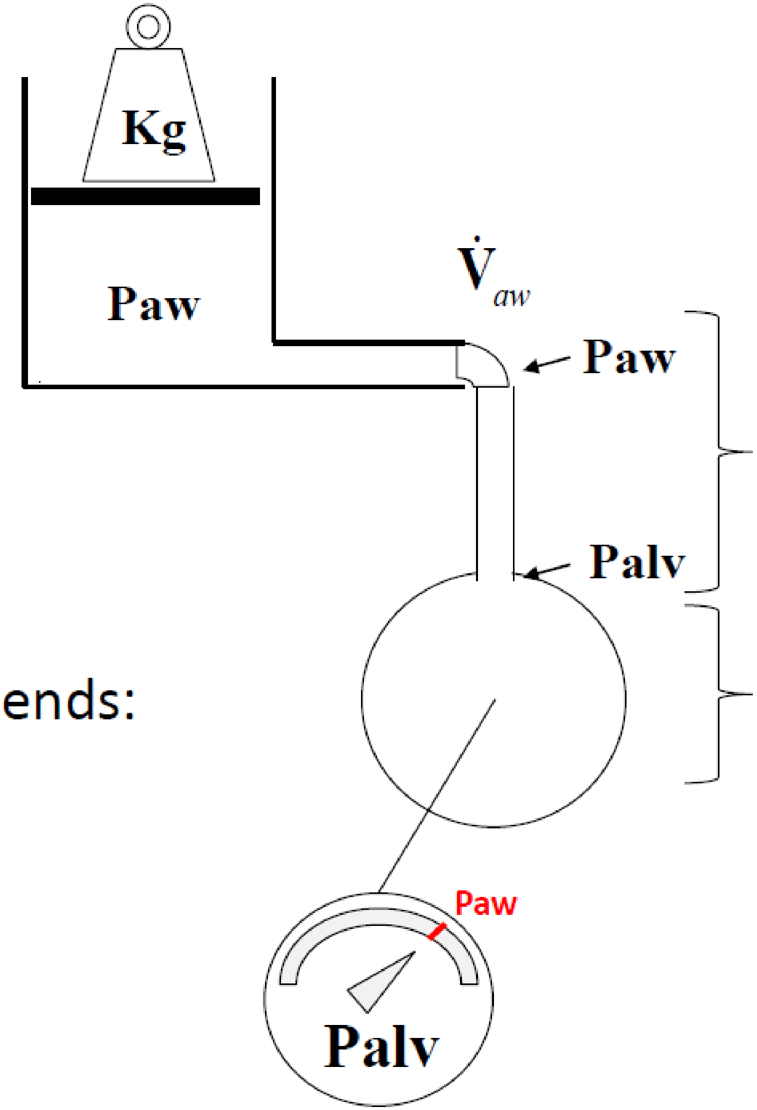
$$V'_{aw} = \frac{\Delta P}{Rrs}$$

$$P = \frac{1}{C_{rs}} V$$

Middle of inspiration:
Paw>Palv, inspiration continue,
reduced Vaw’

End of inspiration

mechanical
ventilator
-
Pressure
generator



$$\Delta P = P_{aw} - P_{alv}$$

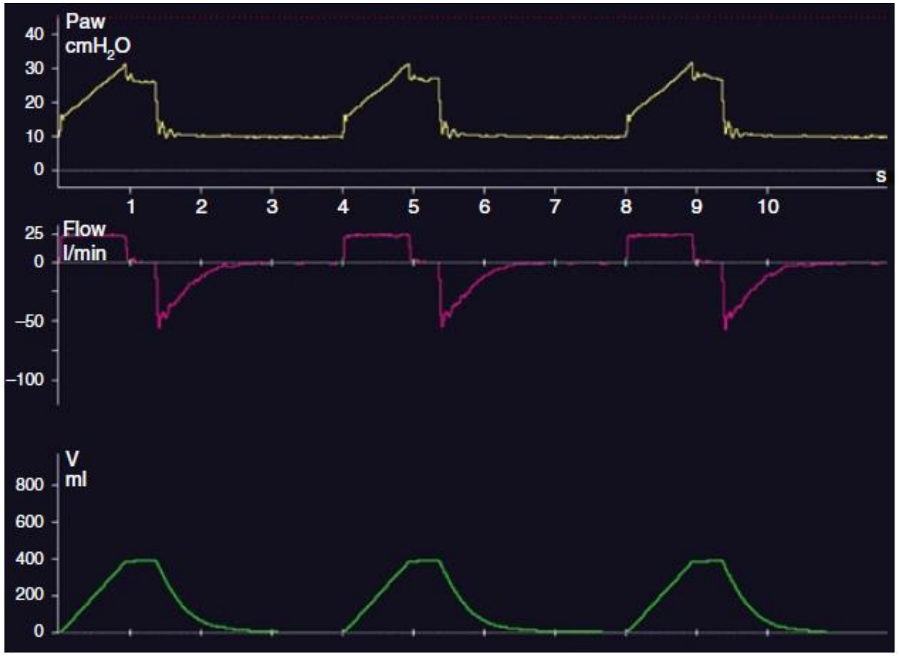
$$V'_{aw} = \frac{\Delta P}{Rrs}$$

$$P = \frac{1}{C_{rs}} V$$

End of inspiration:
Paw=Palv, inspiration ends:
Vaw’=0

Patient /Ventilator interaction

- Mechanical Features of Respiratory System
- Respiratory drive

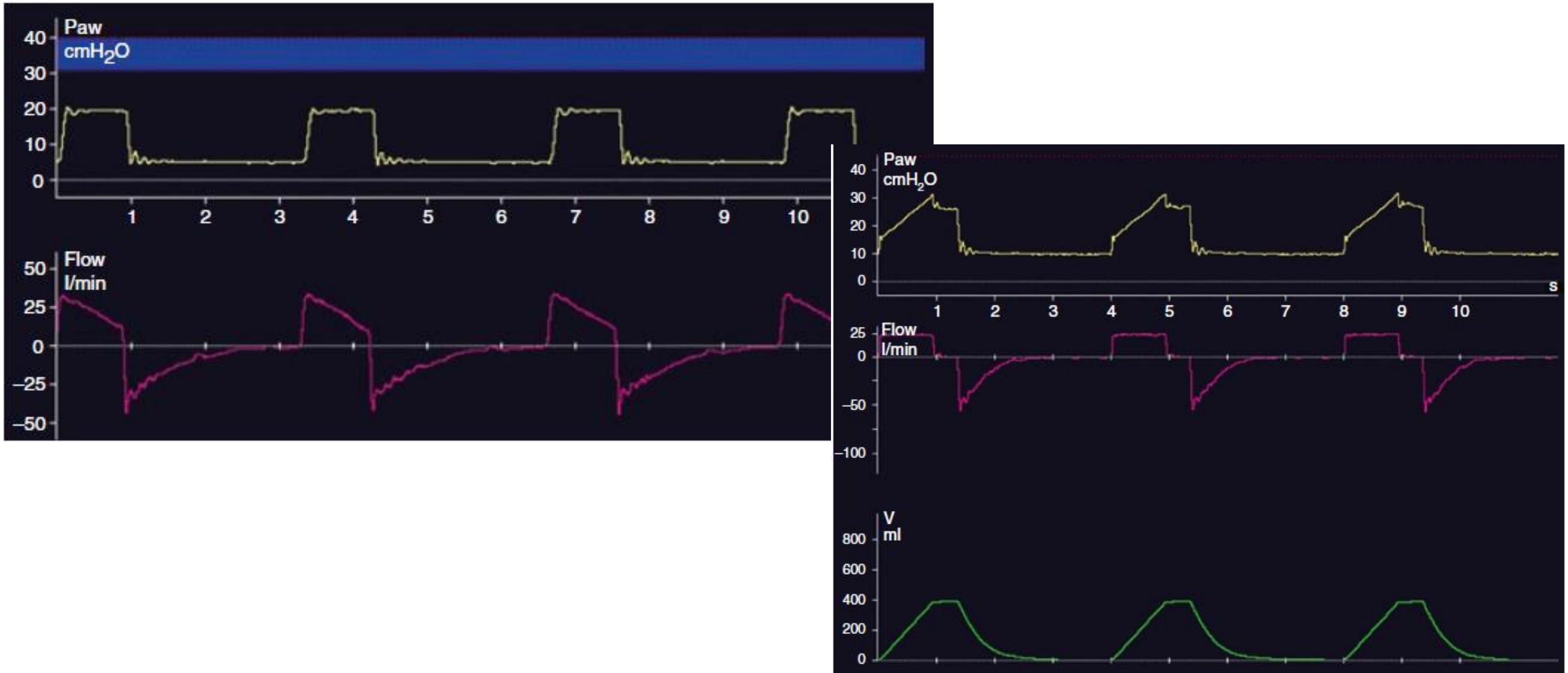


Curves are real-time graphical representation of a variable (presssure, flow or volume) according to time

Patient /Ventilator interaction

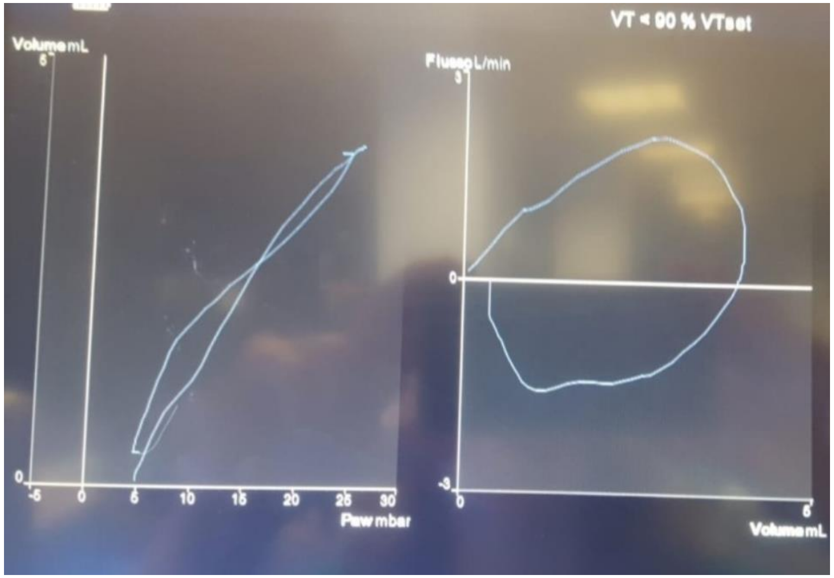
Which Curves Are Relevant?

Ventilators measure airway pressure and airway flow. Volume is derived from the flow measurement. *Pressure and flow* provide all the information necessary to explain the physical interaction between ventilator and patient.



Patient /Ventilator interaction: loops

A loop is a real-time graphical representation of two variables (pressure, flow or volume) plotted against one another



Ventilation mode taxonomy Chatburn's classification

Ventilator breath control variable

- Volume control
- Pressure control

+

Breath sequence

- CMV
- IMV
- CSV

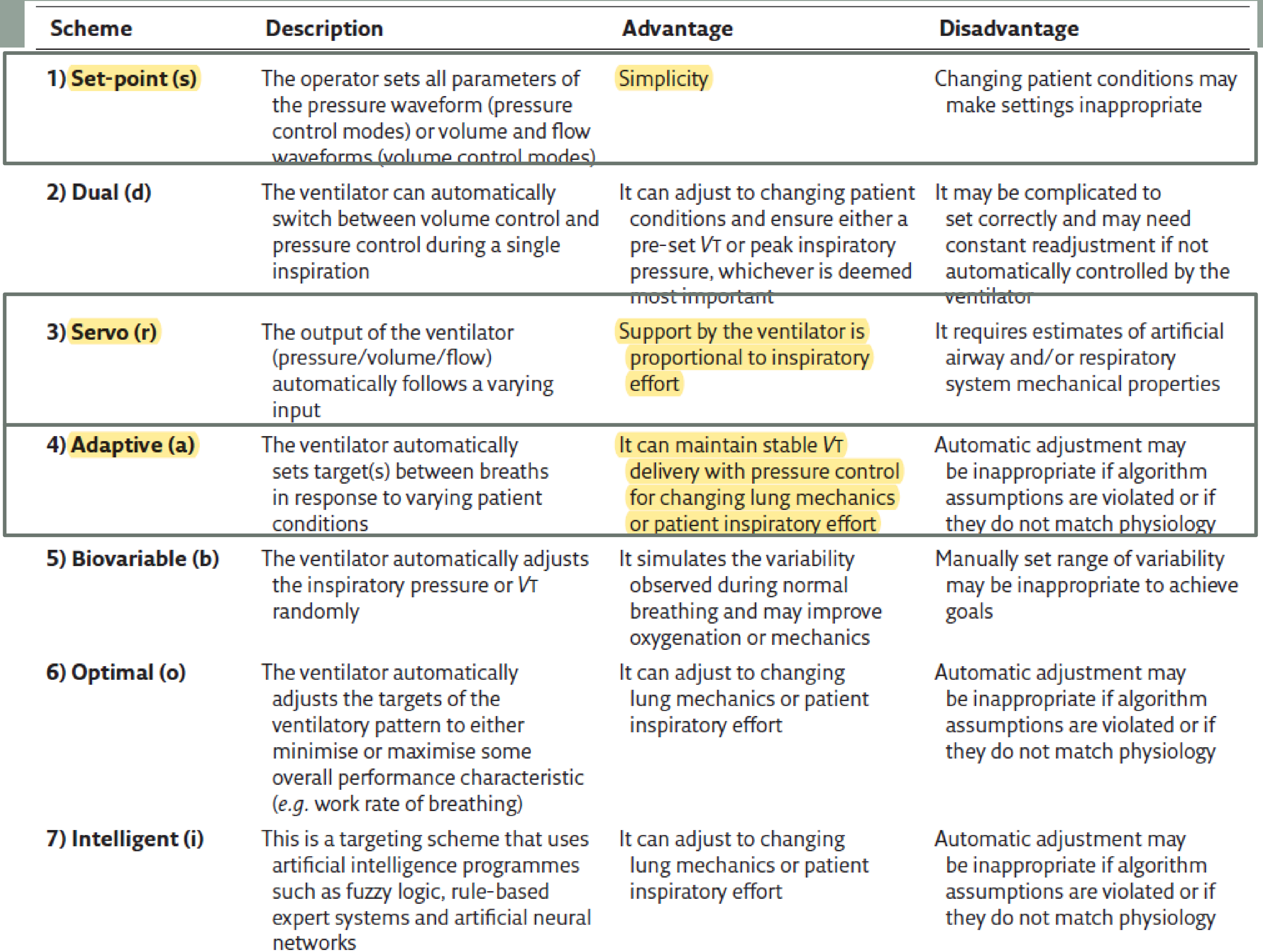
+

Targeting scheme

- Set point
- Dual
- Servo
- Adaptive
- Biovariable
- Optimal
- Intelligent

=

Mode



Scheme	Description	Advantage	Disadvantage
1) **Set-point (s)**	The operator sets all parameters of the pressure waveform (pressure control modes) or volume and flow waveforms (volume control modes)	Simplicity	Changing patient conditions may make settings inappropriate
2) **Dual (d)**	The ventilator can automatically switch between volume control and pressure control during a single inspiration	It can adjust to changing patient conditions and ensure either a pre-set V_T or peak inspiratory pressure, whichever is deemed most important	It may be complicated to set correctly and may need constant readjustment if not automatically controlled by the ventilator
3) **Servo (r)**	The output of the ventilator (pressure/volume/flow) automatically follows a varying input	Support by the ventilator is proportional to inspiratory effort	It requires estimates of artificial airway and/or respiratory system mechanical properties
4) **Adaptive (a)**	The ventilator automatically sets target(s) between breaths in response to varying patient conditions	It can maintain stable V_T delivery with pressure control for changing lung mechanics or patient inspiratory effort	Automatic adjustment may be inappropriate if algorithm assumptions are violated or if they do not match physiology
5) **Biovariable (b)**	The ventilator automatically adjusts the inspiratory pressure or V_T randomly	It simulates the variability observed during normal breathing and may improve oxygenation or mechanics	Manually set range of variability may be inappropriate to achieve goals
6) **Optimal (o)**	The ventilator automatically adjusts the targets of the ventilatory pattern to either minimise or maximise some overall performance characteristic (*e.g.* work rate of breathing)	It can adjust to changing lung mechanics or patient inspiratory effort	Automatic adjustment may be inappropriate if algorithm assumptions are violated or if they do not match physiology
7) **Intelligent (i)**	This is a targeting scheme that uses artificial intelligence programmes such as fuzzy logic, rule-based expert systems and artificial neural networks	It can adjust to changing lung mechanics or patient inspiratory effort	Automatic adjustment may be inappropriate if algorithm assumptions are violated or if they do not match physiology

Ventilation Mode in Di Venere NICU

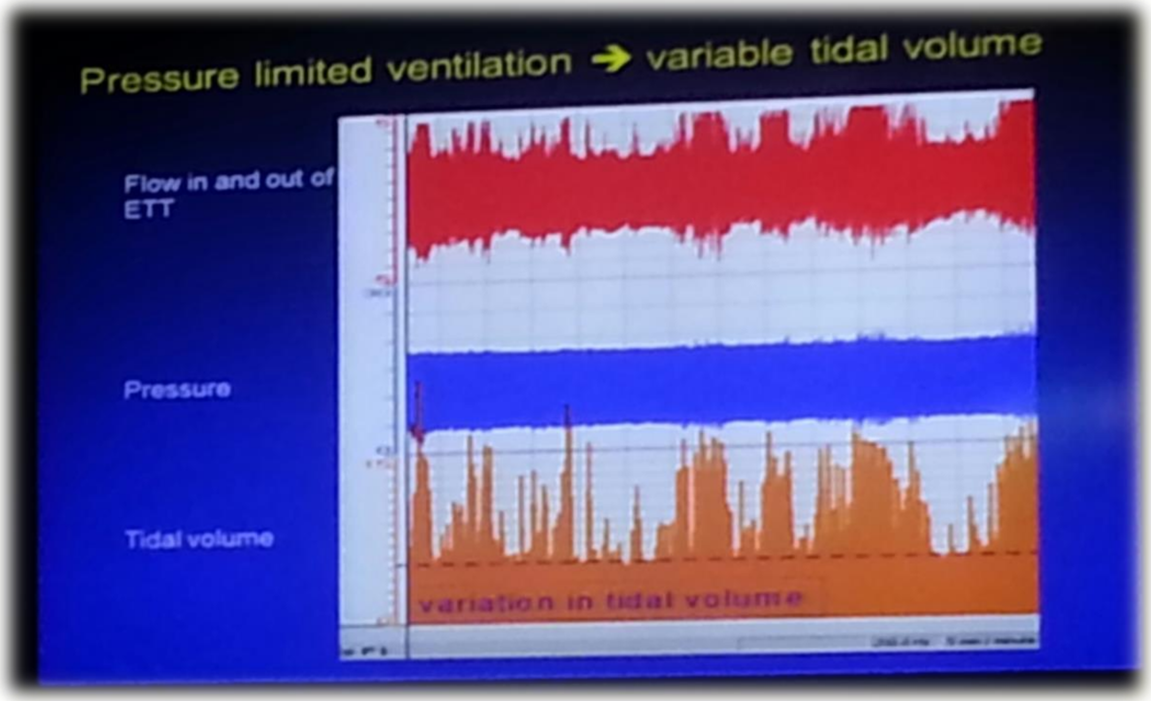
- Ventilator breath control ………..pressure (PC)
- Breath sequence……sCMV (AC)
- Targeting scheme: adaptative (VG)

PC/AC + VG

PC/AC

- Easy
- Works
- Good control of PIP

BUT….Great variability of the Vt



Pressure limited ventilation ➔ variable tidal volume

Vt and surfactant administration

Neonate 28 weeks, wheight 1 kg

Set

measured

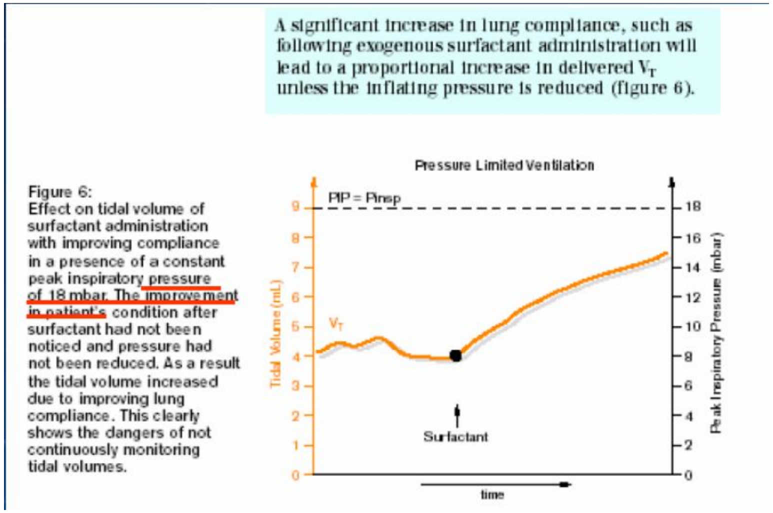
PIP 28 cm H2O

5 ml

surfactant

PIP 28 cm H2O

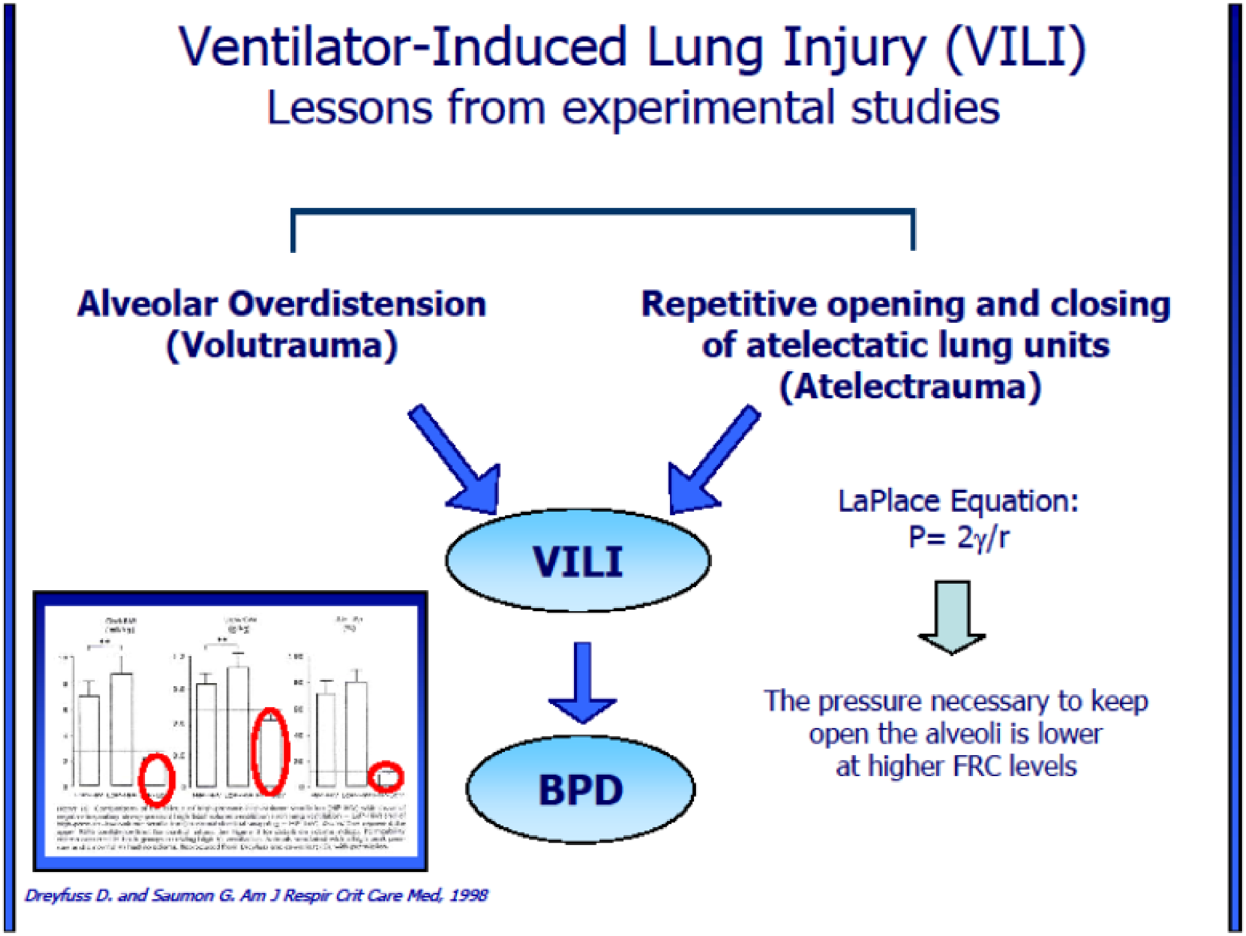
17 ml



A significant increase in lung compliance, such as following exogenous surfactant administration will lead to a proportional increase in delivered V_T unless the inflating pressure is reduced (figure 6).

Figure 6:
Effect on tidal volume of surfactant administration with improving compliance in a presence of a constant peak inspiratory pressure of 18 mbar. The improvement in patient's condition after surfactant had not been noticed and pressure had not been reduced. As a result the tidal volume increased due to improving lung compliance. This clearly shows the dangers of not continuously monitoring tidal volumes.

Ventilator-Induced Lung Injury (VILI)



Ventilator-Induced Lung Injury (VILI)

Lessons from experimental studies

Alveolar Overdistension (Volutrauma)

Repetitive opening and closing of atelectatic lung units (Atelectrauma)

VILI

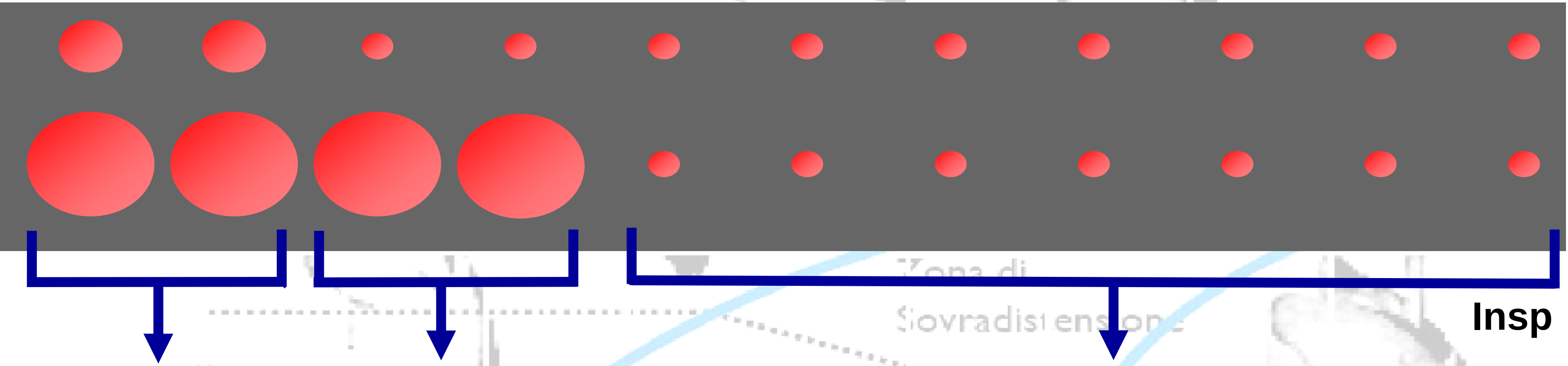
BPD

LaPlace Equation:
$P = 2\gamma/r$

The pressure necessary to keep open the alveoli is lower at higher FRC levels

Dreyfuss D. and Saumon G. Am J Respir Crit Care Med, 1998

VILI: Non homogenous aeration in RDS



Ventilated Stable

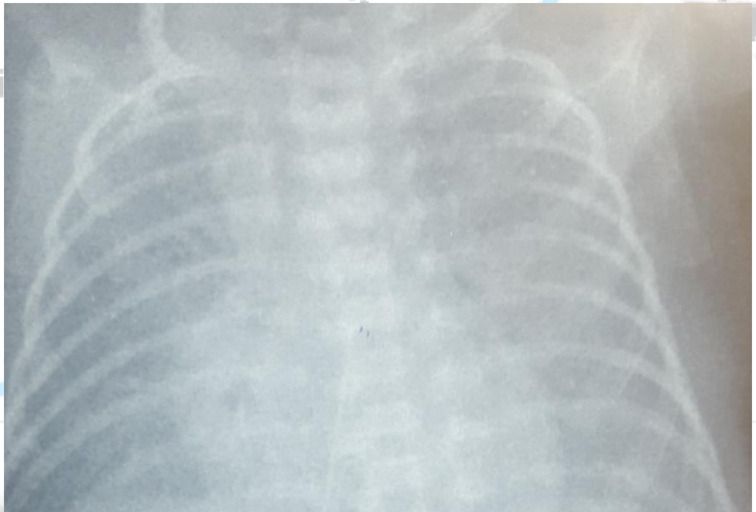
Healthy Baby Lung

Ventilated Unstable

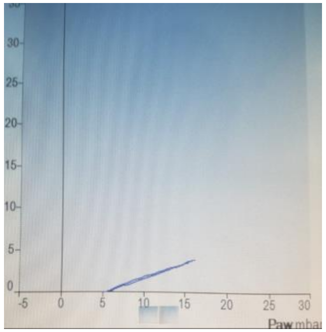
Recruitment/ de-recruitment injury!!!

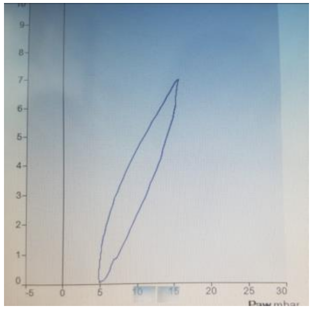
Unventilated

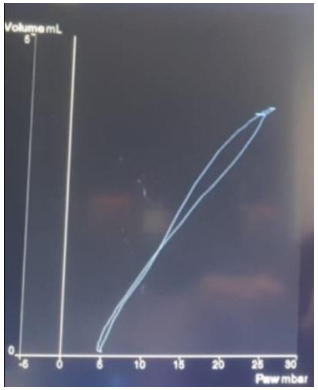
"Atelectotrauma"



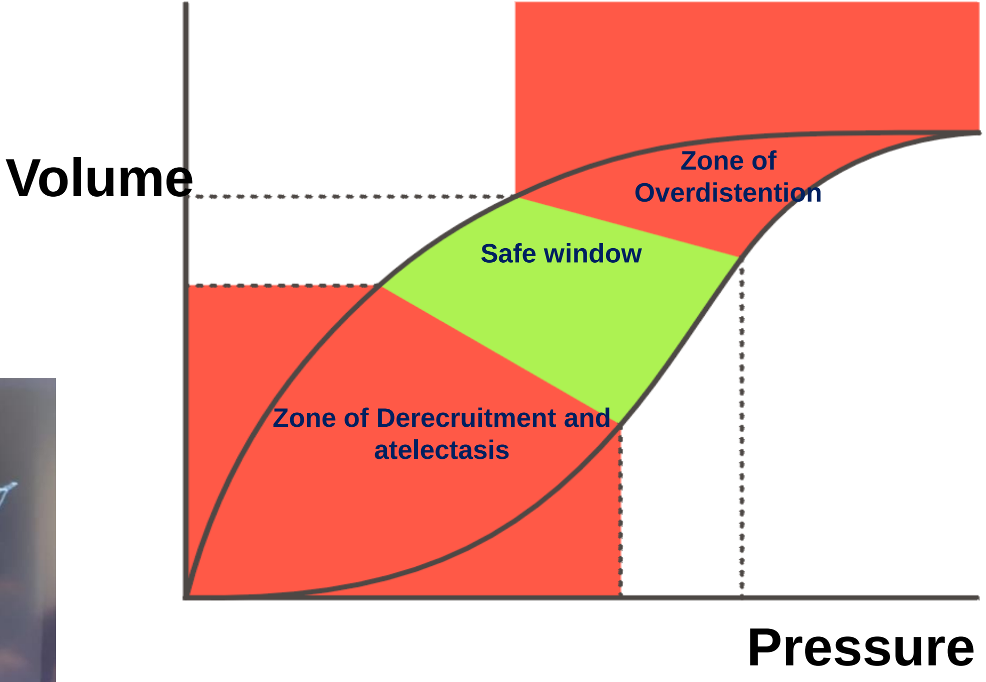
VILI: to avoid injury zones and operate in the safe window







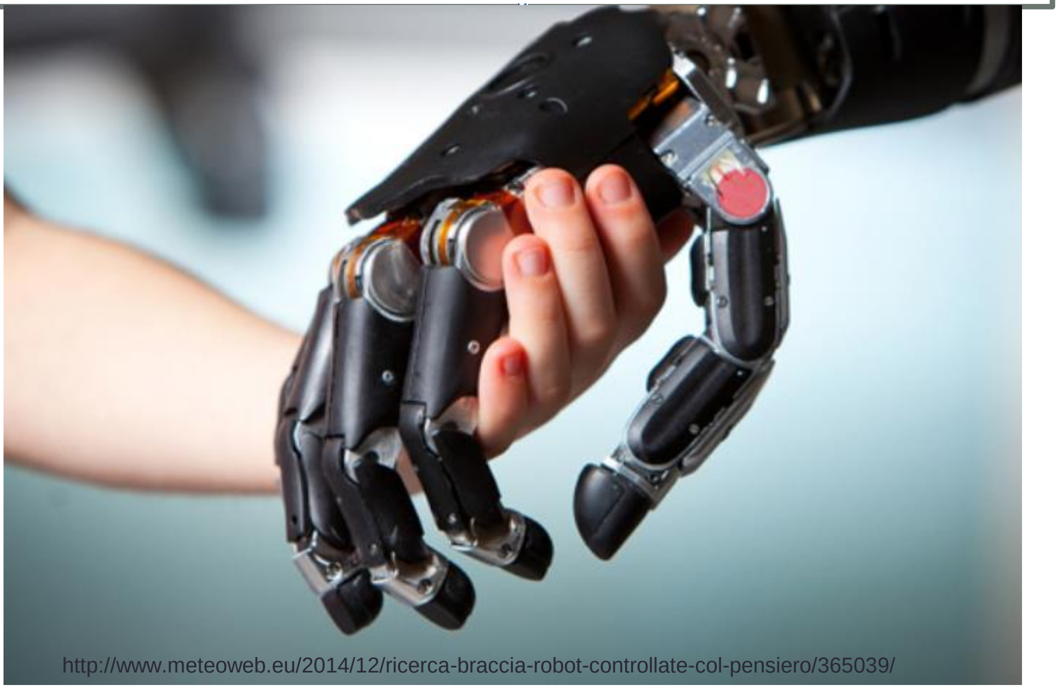
$C = \Delta V / \Delta P$



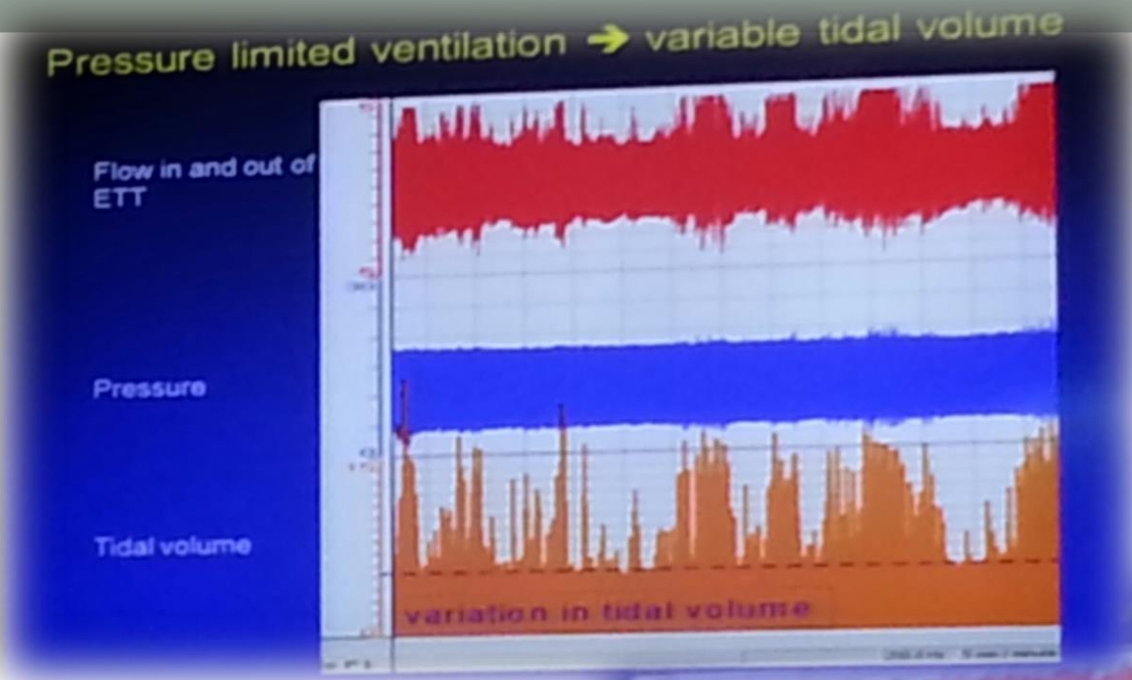
Froese, CCM, 1997

Ventilation mode in Di Venere NICU

PC/AC + VG



http://www.meteoweb.eu/2014/12/ricerca-braccia-robot-controllate-col-pensiero/365039/



Pressure limited ventilation → variable tidal volume

PC/AC

PC/AC + VG

entilation → stable tidal vo

Vt and surfactant administration

Neonate 28 weeks, wheight 1 kg

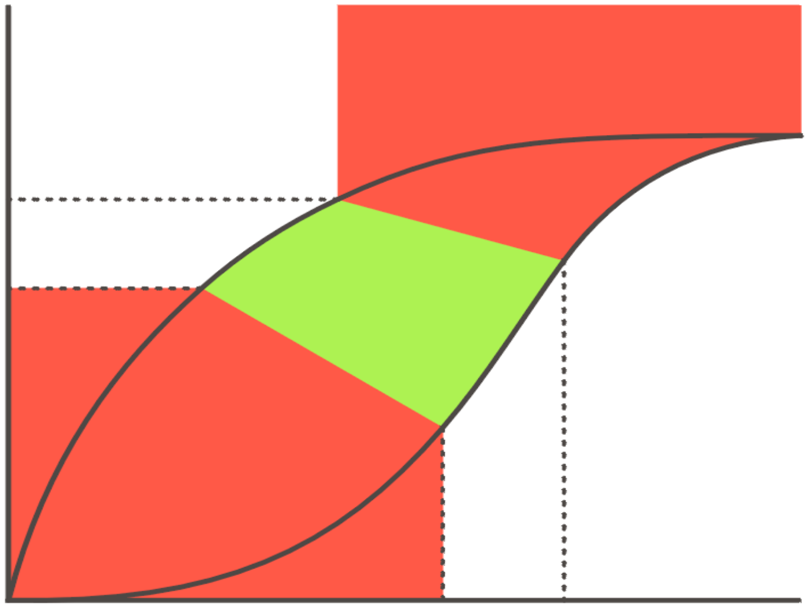
PIP 28 cm H2O

Vt 5 ml

surfactant

PIP 19 cm H2O

Vt 5 ml



Systematic review and meta-analysis on randomized controlled trials of neonatal VTV versus PLV

VTV significantly reduces

- ✓ rates of death
- ✓ bronchopulmonary dysplasia
- ✓ pneumothorax
- ✓ hypocarbia
- ✓ severe cranial ultrasound abnormalities

Wheeler K, Klingenberg C, McCallion N, Morley CJ, Davis PG. Volume-targeted versus pressure-limited ventilation in the neonate. Cochrane Database Syst Rev 2010

Wheeler K, Klingenberg C, Morley CJ, Davis PG. Volume-targeted versus pressurelimited ventilation for preterm infants: a systematic review and meta-analysis. Neonatology 2011

Vg ventilation

…as soon as possible…since the first breath…..

Keszler M. et al – Volume Guarantee Ventilation
Clin Perinatol 34 (2007) 107-116

Vg ventilation

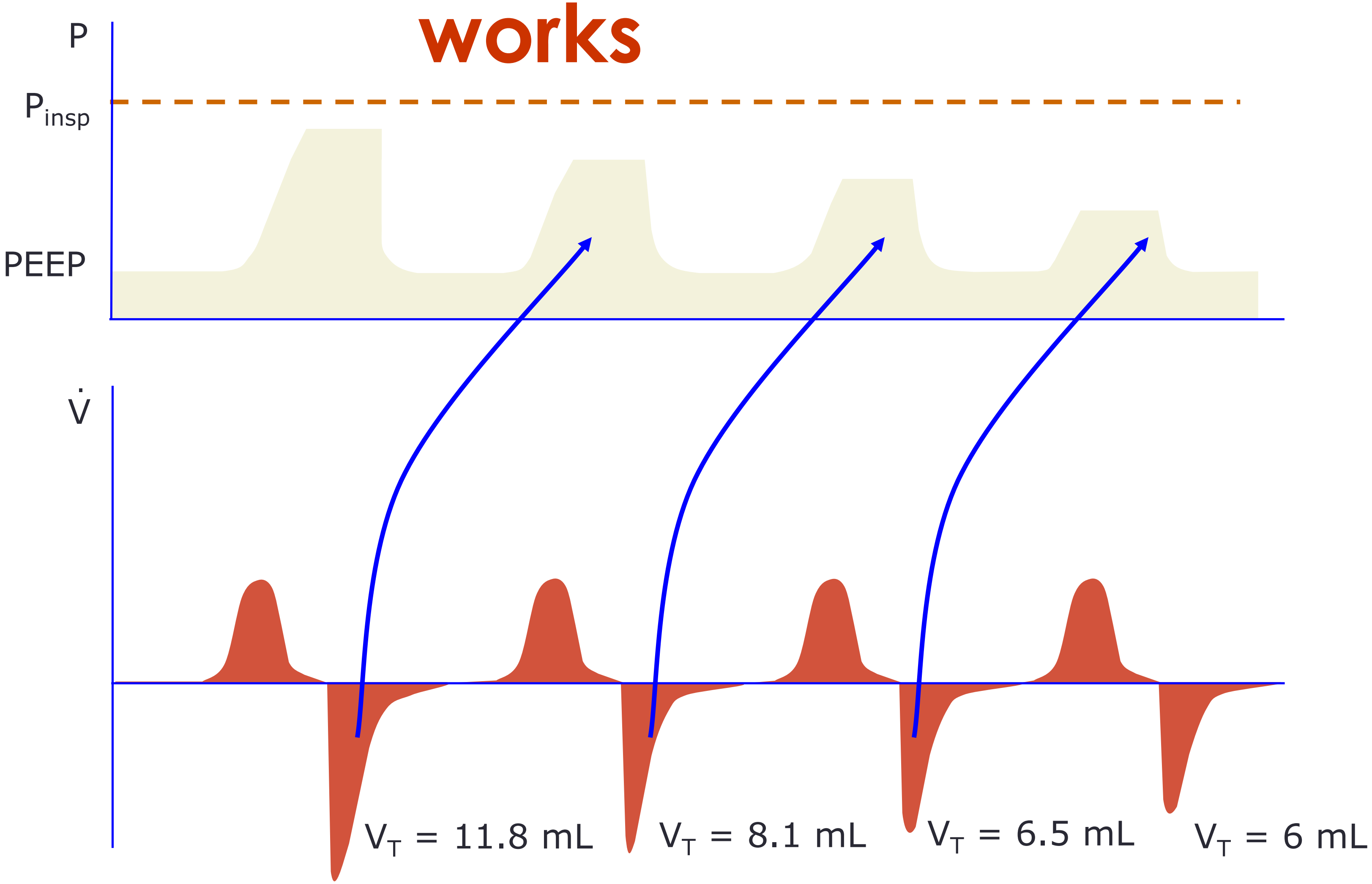
The operator

- ❑Chooses Target Vt, Ti, FR, flow, PEEP
- ❑Selects a pressure limit up to wich the ventilator operating pressure (working pressure) may be adjusted

The microprocessor

- ❑Compares the Vt of the previous breath and adjusts the working pressure up and down to achieve the set Vt

Volume Guarantee - How it works



$V_{T\ set}$ = 6 mL

VG: guidelines

Raccomandazioni sulla ventilazione meccanica convenzionale nel neonato (2014)

F. Scopesi, G. Lista, F. Petrillo, M.R. Colnaghi, P. Biban, F. Mosca

Cinical Guideline for the use of Volume Guarantee: practice guidelines for the bedside

M. Keszler - 2007

A practical guide to neonatal volume guarantee ventilation

CJ MorleyJournal of Perinatology (2011)

Mechanical Ventilation

Close System

Trigger

Flow measures

Curves and loops

Analgesia

Non invasive ventilation

https://bluemoonandart.wordpress.com/2016/09/24/1029/

Spontaneous respiratory drive

Clinical evaluation

en System

No trigger

Fl es conditioned by

We can know only about: FR, SatO2, breath-impedence curve, PIP, PEEP, MAP??

No analgesia

Non invasive ventilation (NIV)

One le

- NCPA
- High

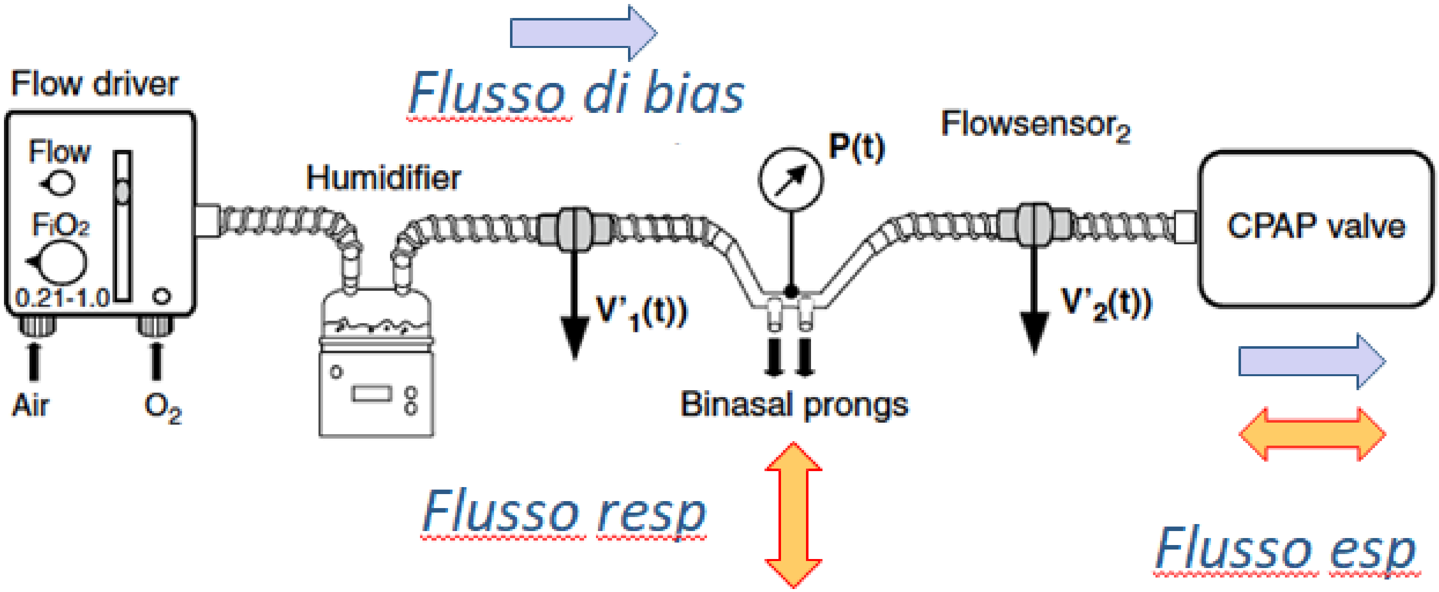
non invasive support

Two levels of pression

- NIPP
- NBile
- NHF

non invasive ventilation

NIPPV with espiratory valve



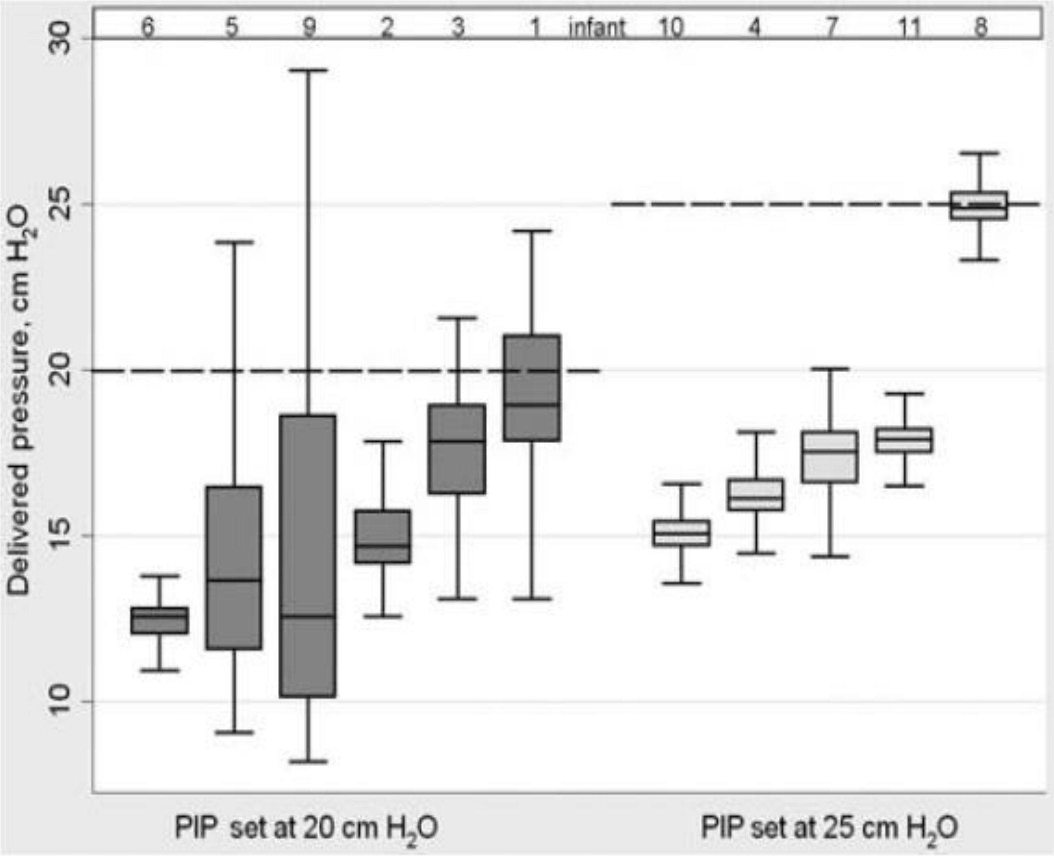
Flusso di bias

Flusso resp

Flusso esp

Pressure variation during ventilator generated nasal intermittent positive pressure ventilation in preterm infants

L S Owen,[1–3] C J Morley,[1,3,4] P G Davis[1,3,4]



CONCLUSION: During ventilator-generated non-synchronised NIPPV delivered PIP was variable and frequently lower than set PIP. Delivered PIP was occasionally greater than set PIP.

NIPPV: performance

Target: to transmitte pressure to the airways

- Airways shunt
- Resistance
- Leaks
- Spontaneous respiratory drive

NIPPV: performance

Resistence

- Glottis
- Interfaces
- Secretions
- Water Vapor and condensation

INTERFACES

- Lenght
- Diameter
- Configuration
- Type of material

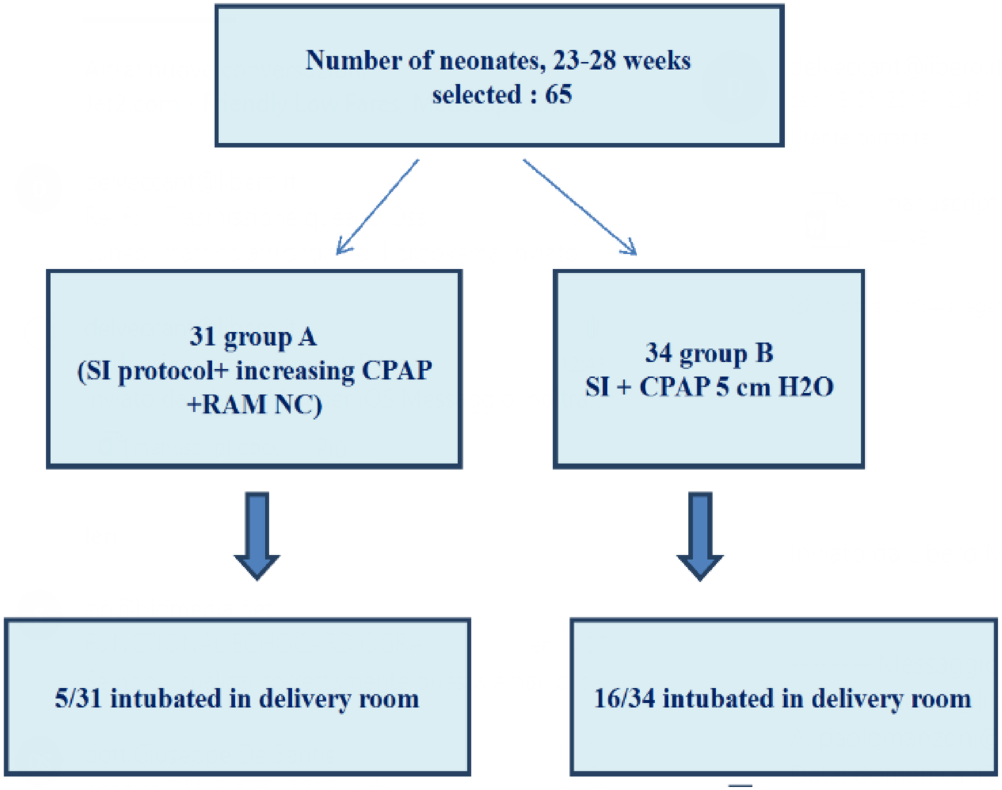
$$R = \frac{8 \cdot \eta \cdot L}{\pi \cdot r^4}.$$

Pulmonary recruitment strategy in preterm neonates < 29 weeks gestation age to reduce the need for intubation in the delivery room

F. Petrillo[1], L. Valenzano[1], C. Franco[1], G. Calò[2], D. Dentico[1], P. Manzoni[3], G. D'Amato[1], and A. Del Vecchio[1]

[1] Department of Women's and Children's Health ASL Bari, Neonatal Intensive Care Unit, Ospe

[2] Department of Electrical Engineering and Information, Polytechnic University of Bari, Italy



Number of neonates, 23-28 weeks selected : 65

31 group A (SI protocol+ increasing CPAP +RAM NC)

34 group B SI + CPAP 5 cm H2O

5/31 intubated in delivery room

16/34 intubated in delivery room

Delivery room intubation, n (%)	5 (16.1)	16 (47)	**0.008**

Conclusion: SI with RAM NC followed by NCPAP ranging 6 to 8 cmH2O, administered with RAM NC, resulted in a significant reduction of intubation in the delivery room.

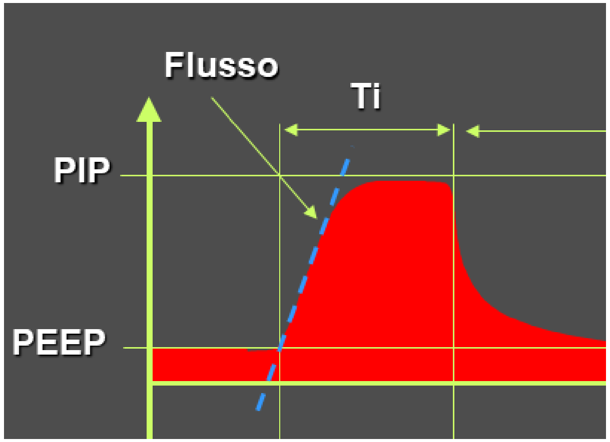
- **NO NASAL INJURIES**
- **COMFORTABLE**
- **EASY TO WEAR**
- **MOTHER BABY VISUAL INTERACTION**
- **EASY KANGAROO MOTHER CARE**

NIPPV: resistence

We can set parameters to win resistance

$$P = R \bullet \dot{V} + \frac{1}{C_{rs}} \bullet V$$

Equation of motion of the respiratory system



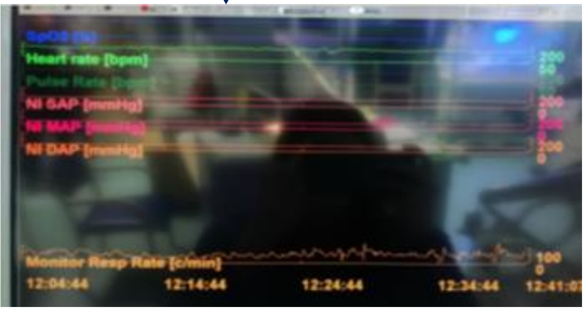
$$R = \frac{P}{\dot{V}}$$

Convenzione UTIN – Politecnico tirocinio studenti

Acquisizione dei dati di ventilazione (pressioni) e di monitoraggio tramite il monitor C700

Dati acquisibili da infinity delta

- Saturazione O2 transcutanea
- Frequenza cardiaca
- Frequenza respiratoria spontanea
- Pressione arteriosa



Dati acquisibili da VN500

- PEEP
- PIP
- FR MECCANICA

I dati vengono esportati dal C700 (software DATARECAN) tramite chiavetta USB e visualizzati in formato CSV su foglio excel.

Scopo del tirocinio

Analizzare i dati (numerici) mettendoli a confronto con le condizioni respiratorie del neonato con l'obiettivo di capire l'impatto di differenti tipi di ventilazione sul neonato prematuro. Il dato più importante per seguire l'andamento della ventilazione non invasiva sarà la FR spontanea che può essere un alert importante per predire la necessità di un approccio terapeutico più intensivo

Monitoraggio pz: il monitor INFINITY DELTA

Caratteristiche del monitor Infinity Delta

Rilevazione e visualizzazione di una gamma di parametri :

- Frequenza cardiaca
- Saturazione O2 transcutanea
- ECG a 3-5-6—12 derivazioni
- Frequenza respiratoria
- Traccia impedenzometrica del respiro
- Pressione sanguigna non invasiva

Trend

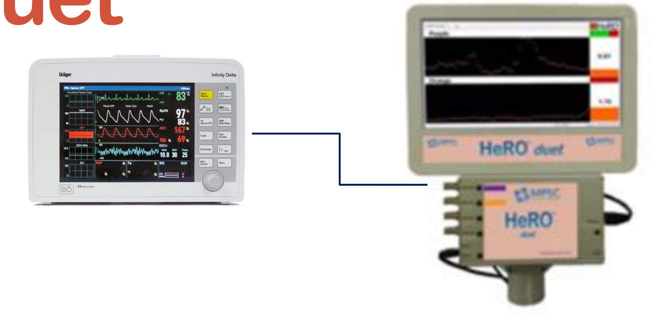
- Il dispositivo memorizza dati di trend di tutti i segnali collegati
- E’ possibile marcare gli eventi
- È possibile esportare i dati tramite il monitor C700
- L’uso dei grafici di trend permette di visualizzare dei dati memorizzati in grafici individuali per ciascun parametro
- I grafici mostrano il comportamento dei dati nel corso di un periodo di tempo significativo, tre canali per volta, permettendo al personale di monitorare in tempo reale l’evoluzione dei parametri vitali del paziente

Scopo del tirocinio

Approfondire la conoscenza del monitor Infinity Delta e analizzare l’impatto sul personale infermieristico della TIN di un corso di formazione finalizzato a ottimizzare l’utilizzo del monitor attraverso una conoscenza approfondita dello stesso

Monitoraggio sepsi: Hero duet

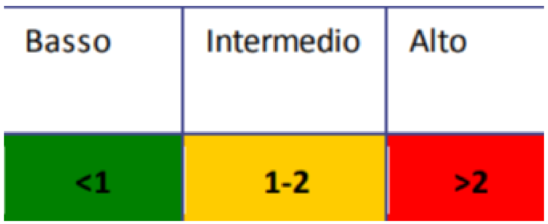
- Metodo automatico e non invasivo per rilevare le decelerazioni momentanee e la riduzione della ***variabilità della frequenza cardiaca***
- Acquisisce, registra, misura e analizza ininterrottamente la variazione degli ***intervalli RR dell'elettrocardiogramma***.
- Il dispositivo acquisizione dati (**AD2-DAD**) è collegato a un segnale analogico del monitor fisiologico e a Hero duet
- Può essere connesso al massimo a due monitor paziente da cui acquisisce i dati e per ogni ora elabora e stampa a video il **PUNTEGGIO HeRO** utile a predire il rischio di sepsi nel neonato pretermine di basso peso



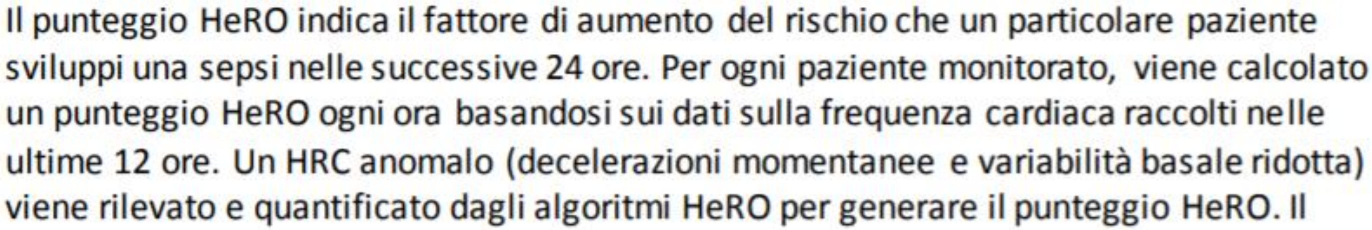
Scopo del tirocinio

Valutare l'effettiva capacità di HeRO di predire anticipatamente il rischio di sepsi incrociando il punteggio con i dati clinici dei pazienti

Punteggio HeRO



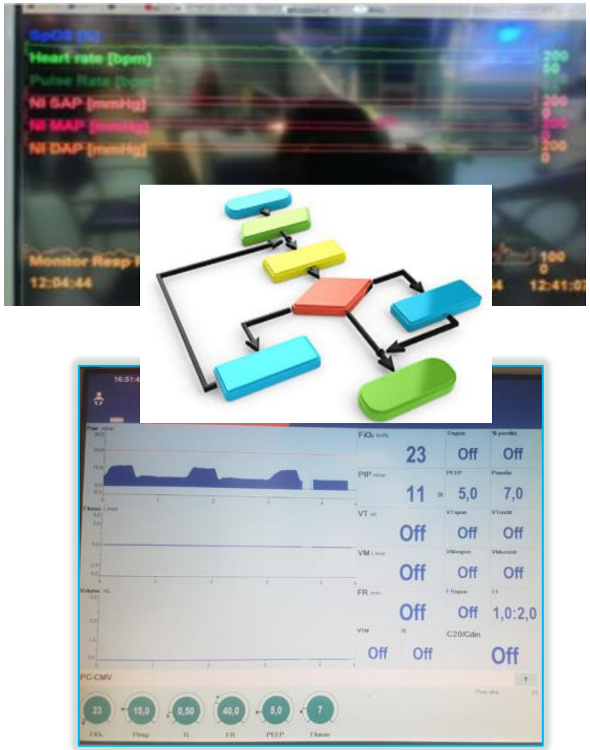
Basso	Intermedio	Alto
<1	1-2	>2



Il punteggio HeRO indica il fattore di aumento del rischio che un particolare paziente sviluppi una sepsi nelle successive 24 ore. Per ogni paziente monitorato, viene calcolato un punteggio HeRO ogni ora basandosi sui dati sulla frequenza cardiaca raccolti nelle ultime 12 ore. Un HRC anomalo (decelerazioni momentanee e variabilità basale ridotta) viene rilevato e quantificato dagli algoritmi HeRO per generare il punteggio HeRO. Il

algorithm

lisatronic



ASLBA

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