CURSO DE VMNI

NIPPON 2026

Modos ventilatórios e ajuste de parâmetros de VMNI

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Professor Catedrático Convidado
FMUP

NIPPON GASES
Healthcare

Introduction

AIMS

Introduction

To distinguish the different modes of mechanical ventilation

To identify the different phases of mechanical ventilation and asynchronies

To choose the ideal ventilator for Longterm Mechanical Ventilation

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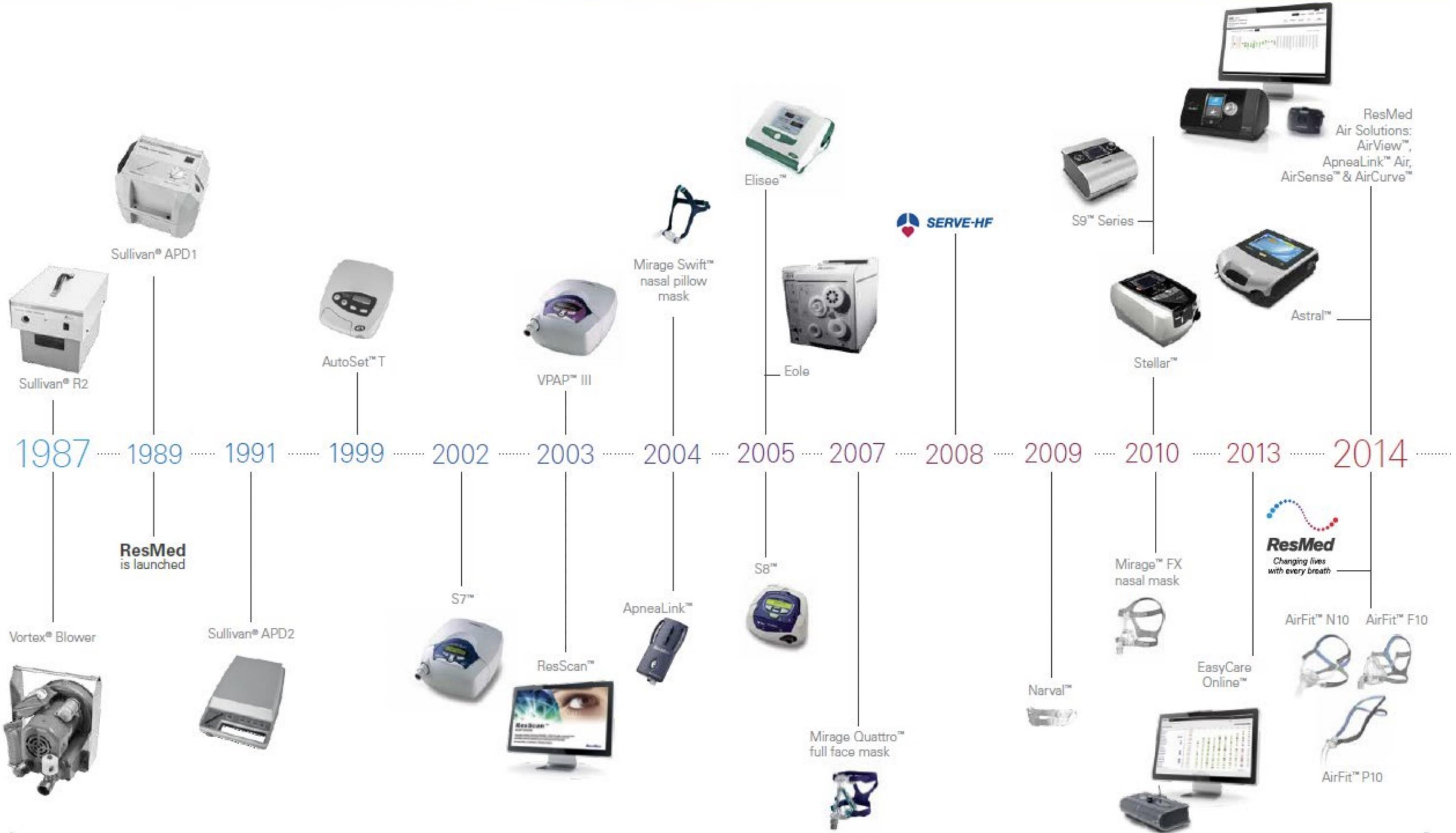
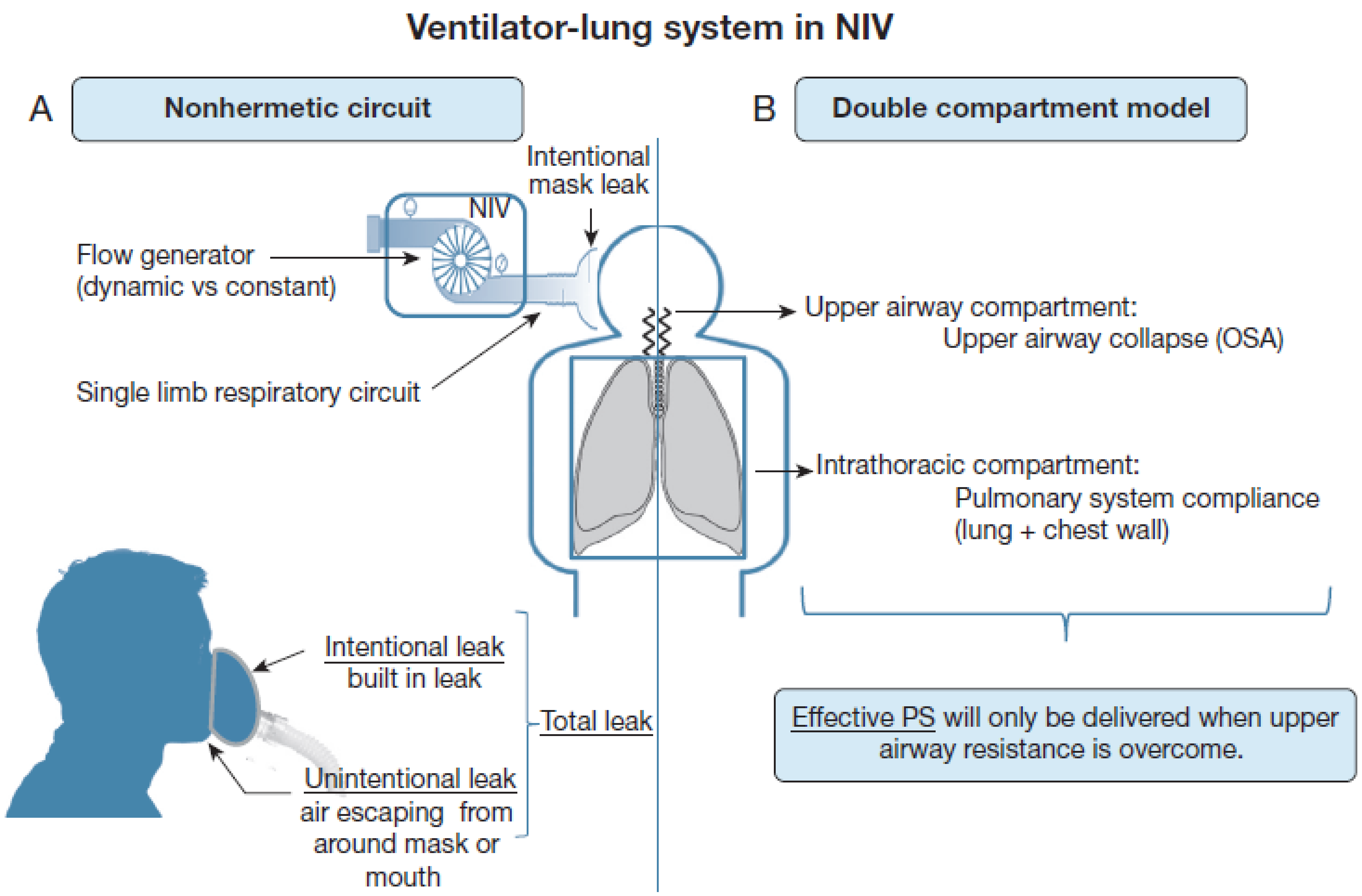
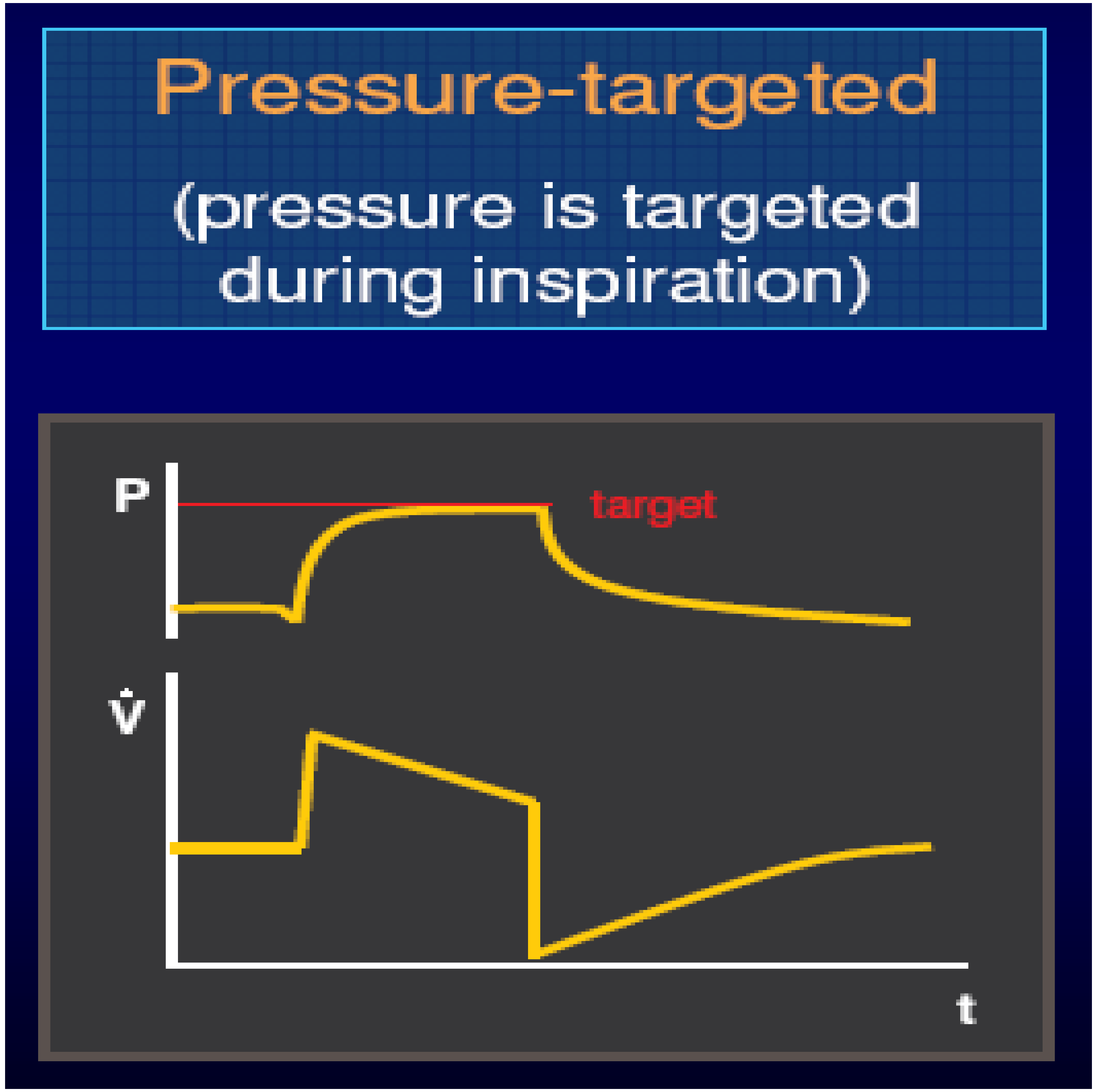
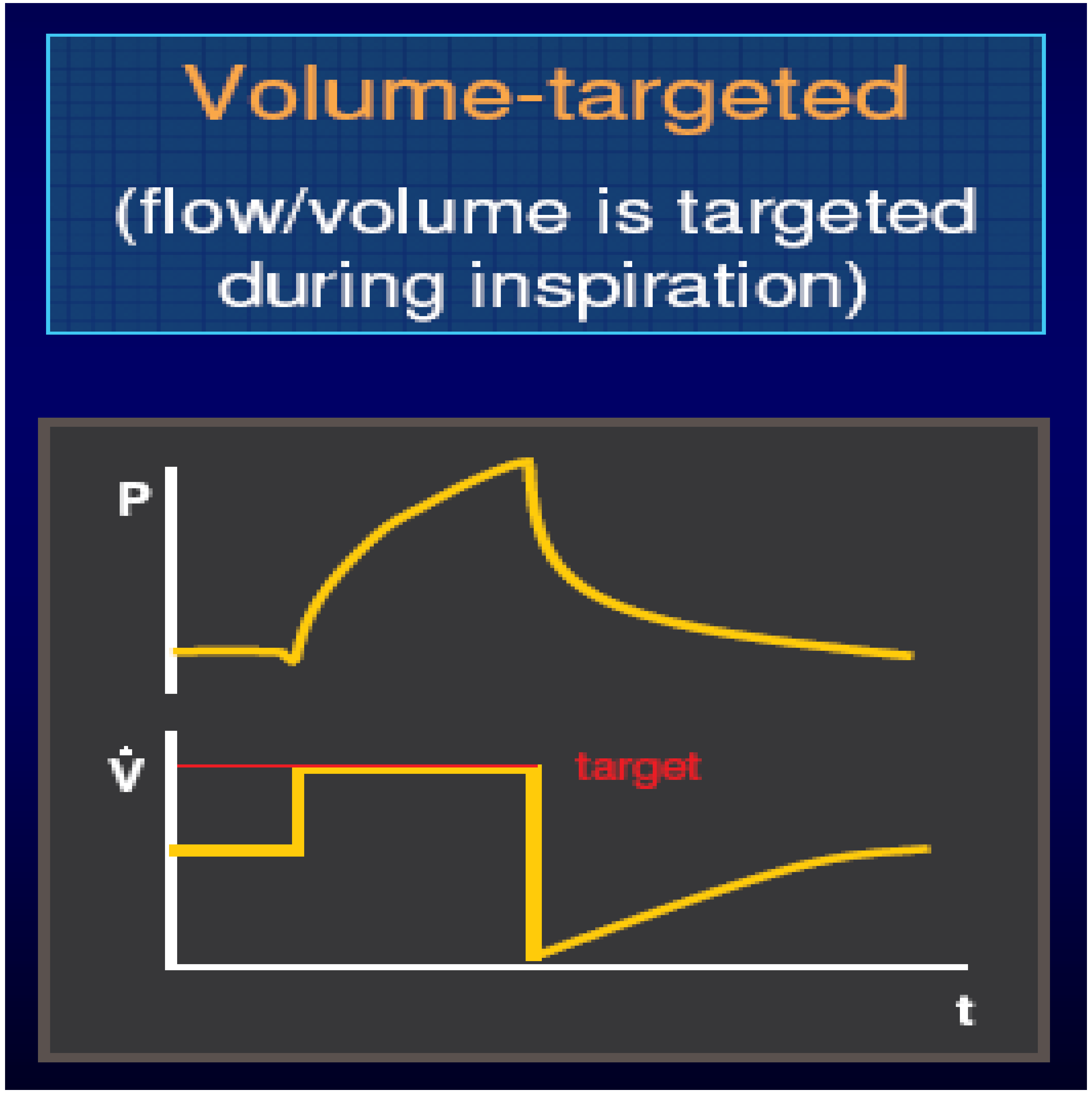

1987
Sullivan® R2
Vortex® Blower
1989
Sullivan® APD1
ResMed
is launched
1991
Sullivan® APD2
1999
AutoSet™ T
2002
S7™
2003
VPAP™ III
ResScan™
2004
Mirage Swift™
nasal pillow
mask
ApneaLink™
2005
Elisee™
Eole
S8™
2007
Mirage Quattro™
full face mask
2008
SERVE-HF
2009
Narval™
2010
S9™ Series
Stellar™
Mirage™ FX
nasal mask
2013
EasyCare
Online™
2014
ResMed
Air Solutions:
AirView™,
ApneaLink™ Air,
AirSense™ & AirCurve™
Astral™
ResMed
Changing lives
with every breath
AirFit™ N10
AirFit™ F10
AirFit™ P10

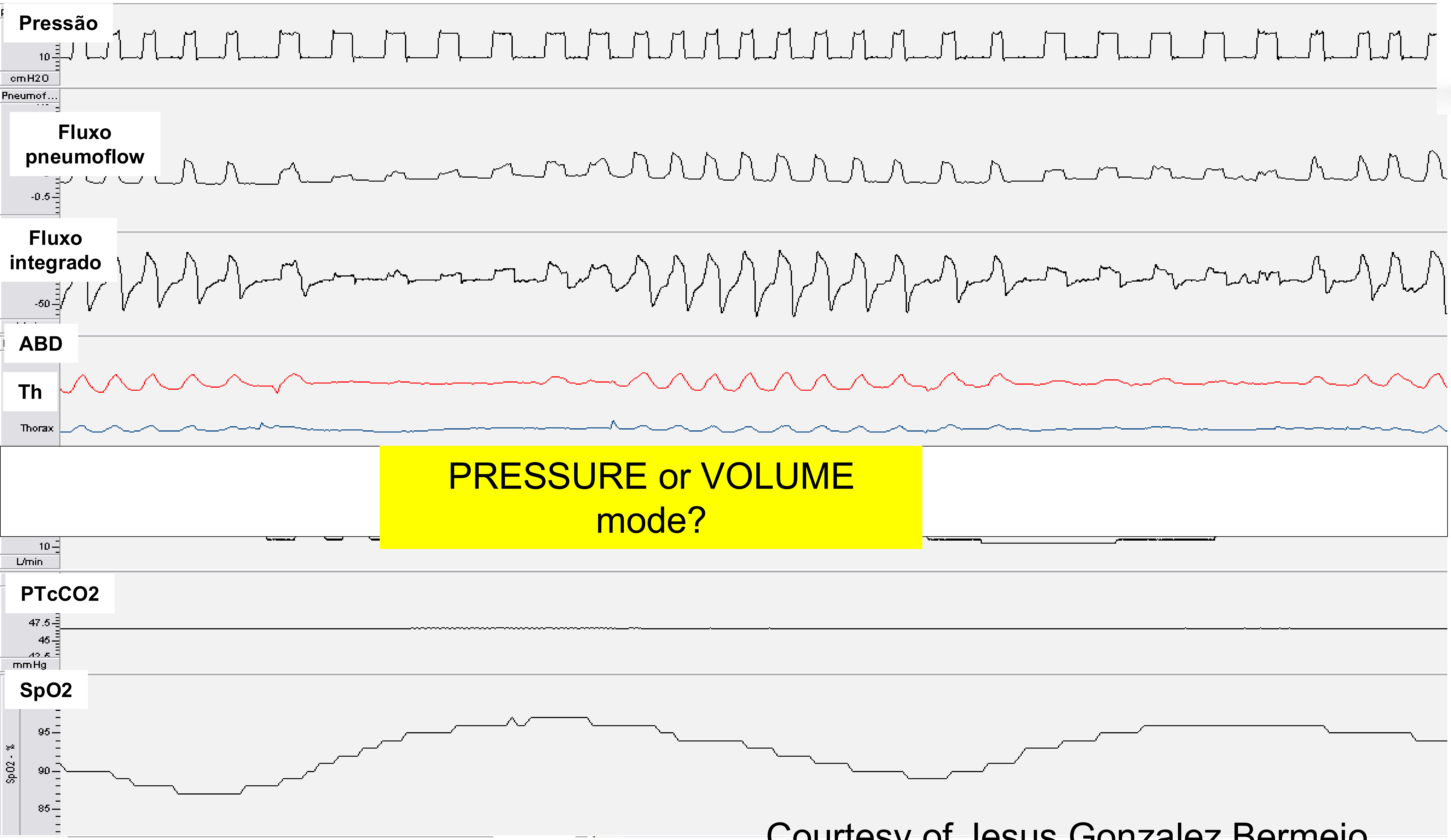


CHEST 2018; 153(1):251-265

THE MAIN MODES OF MECHANICAL VENTILATION

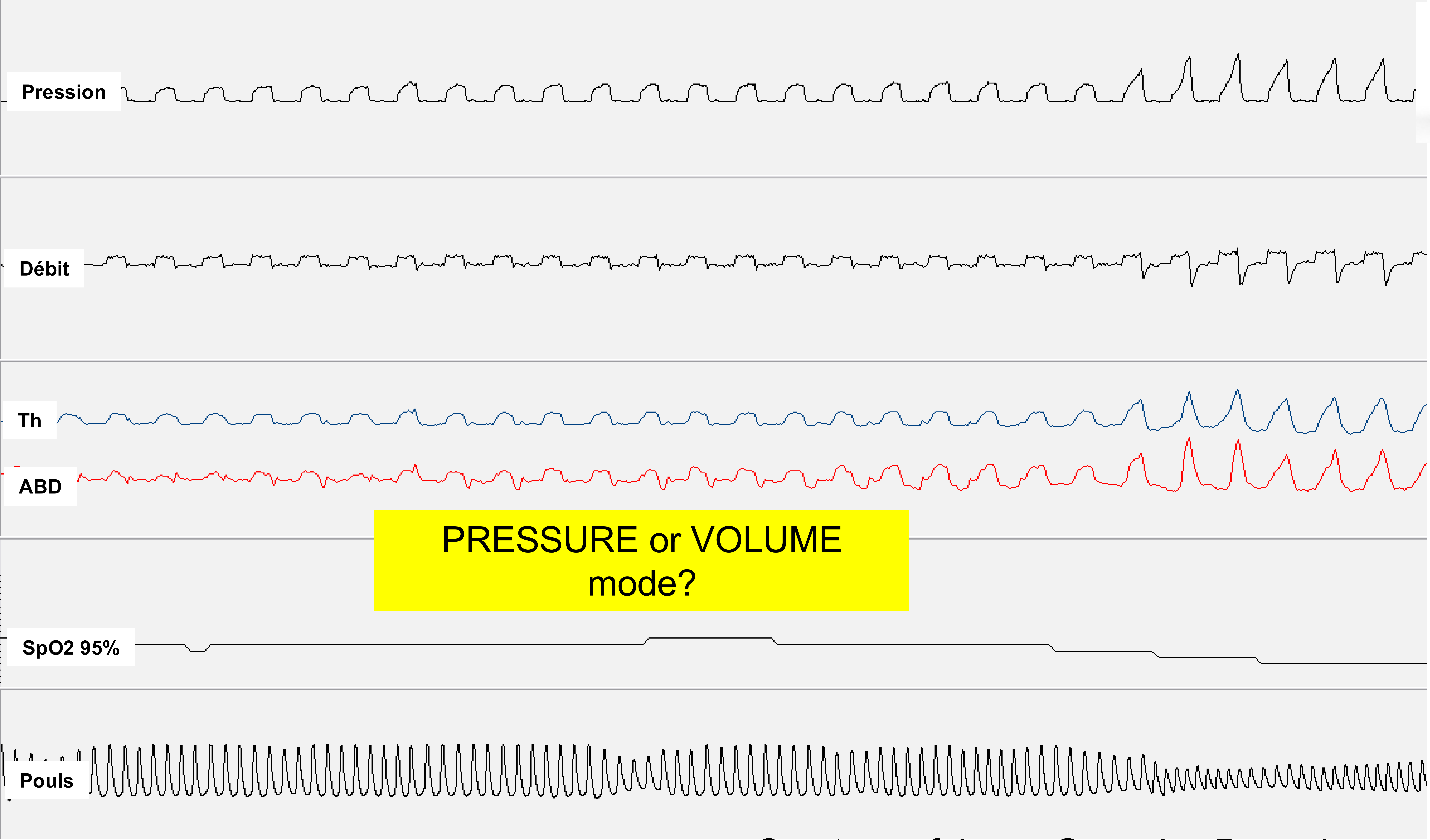






PRESSURE or VOLUME mode?

Courtesy of Jesus Gonzalez Bermejo

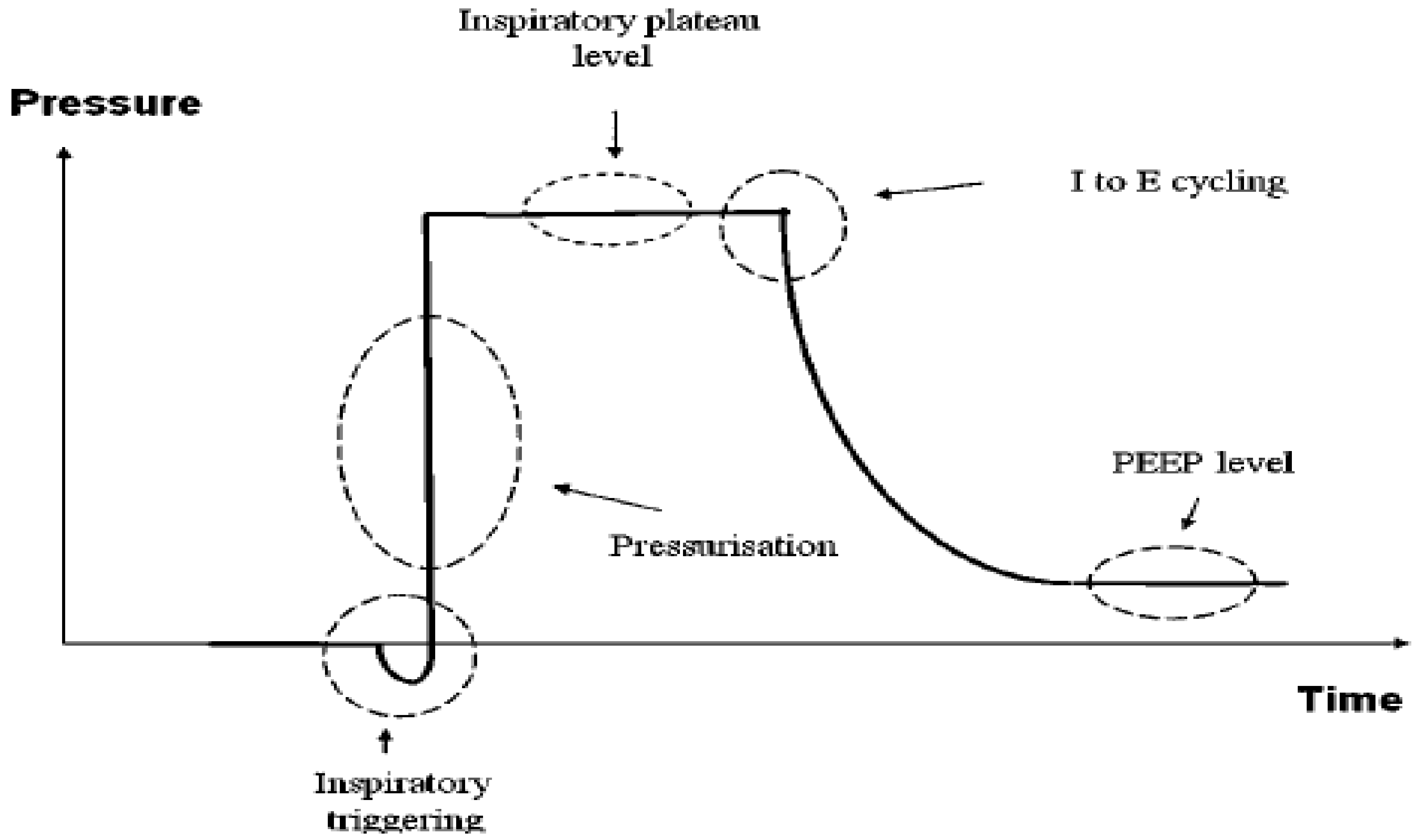


PRESSURE or VOLUME mode?

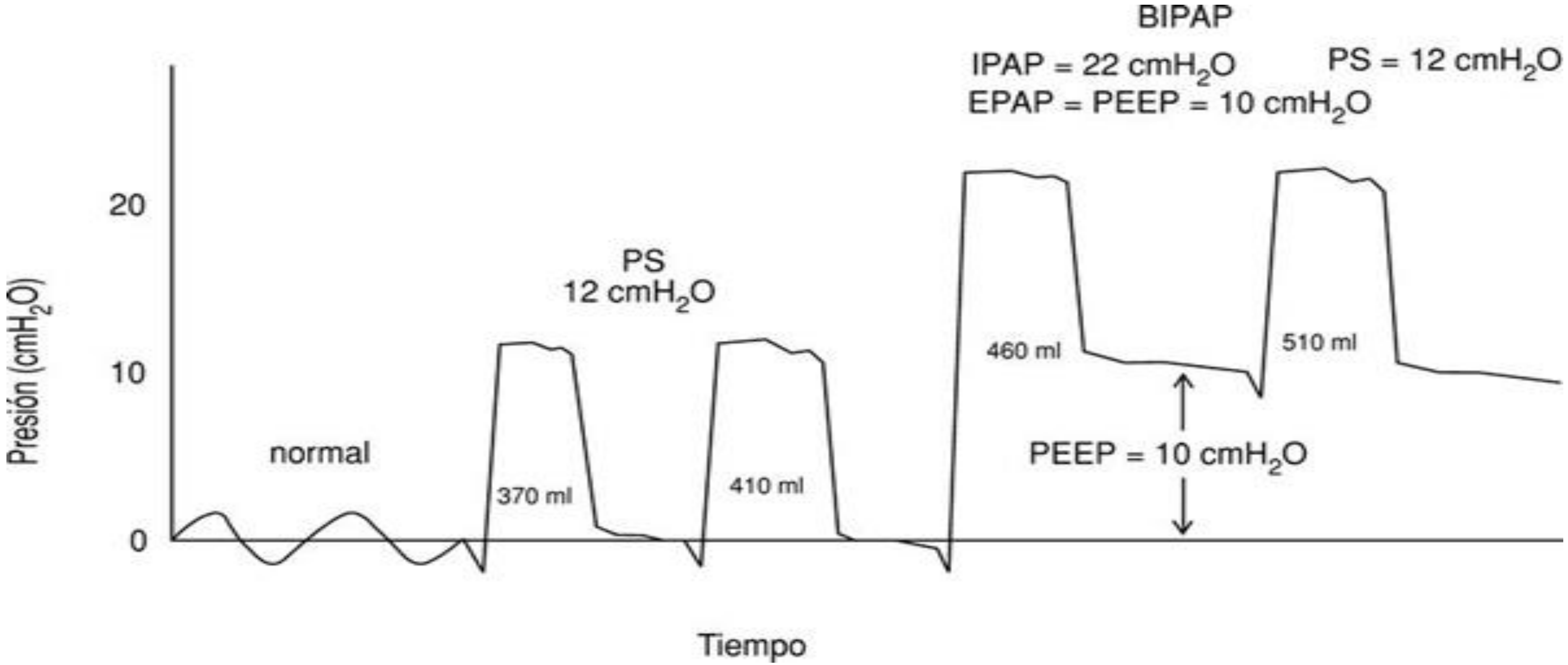
Courtesy of Jesus Gonzalez Bermejo

Pressure targeted mode

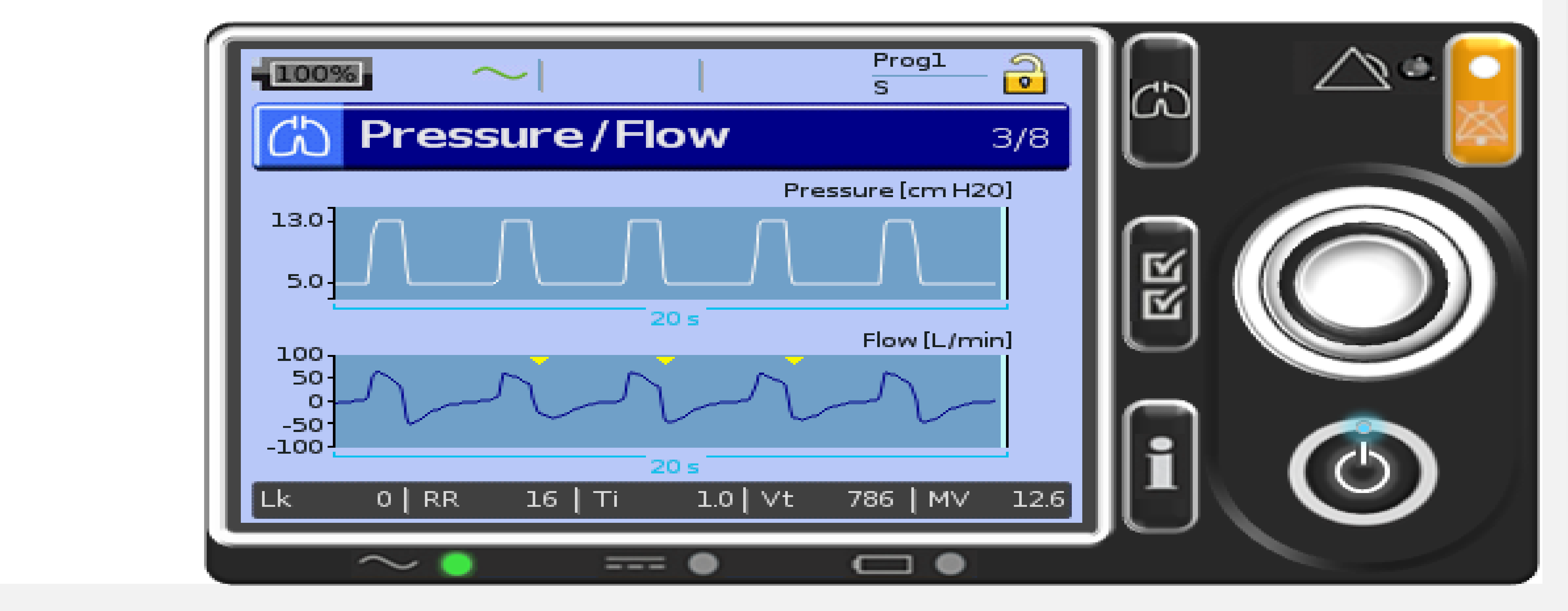
The ventilatory cycle

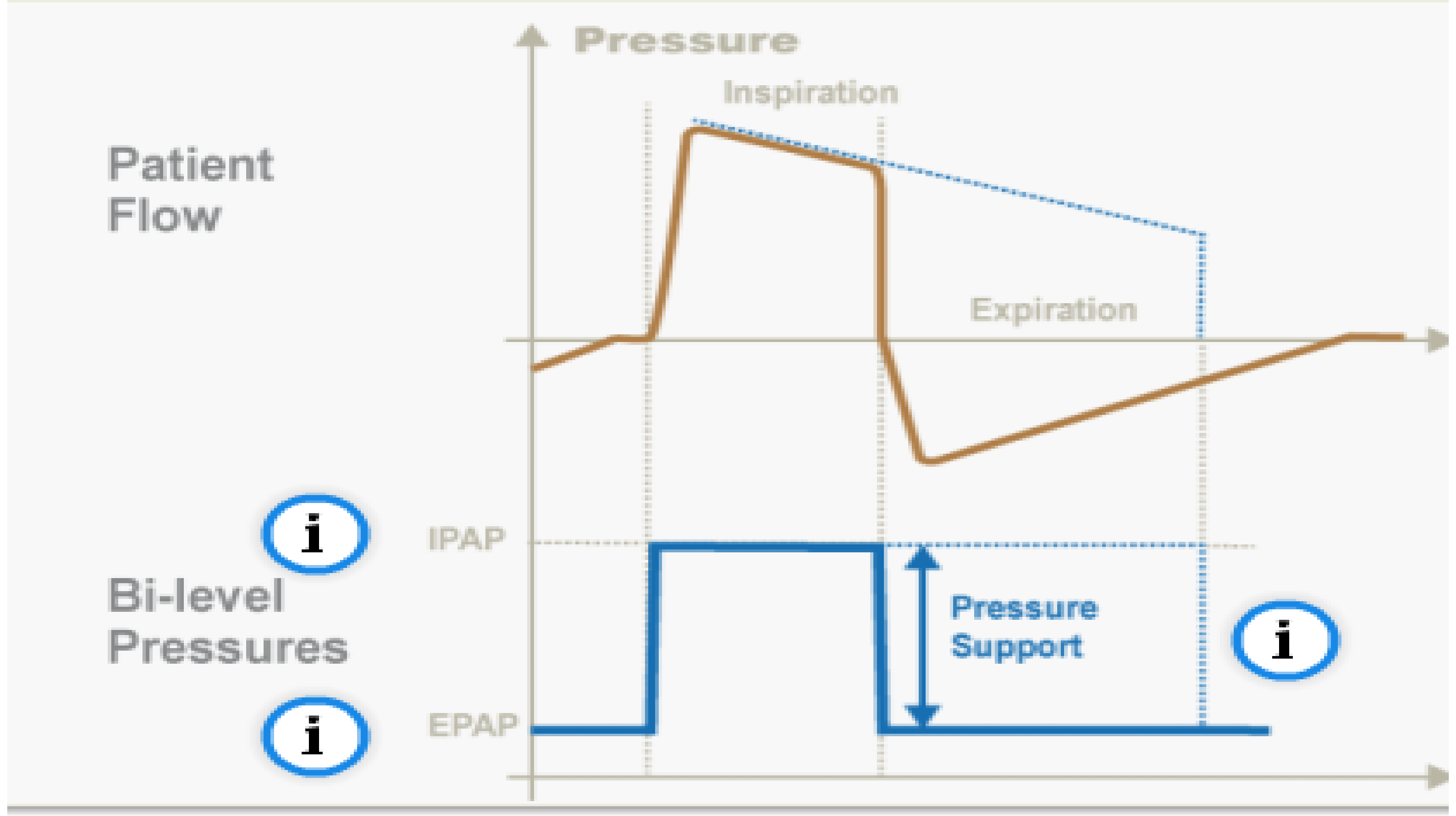


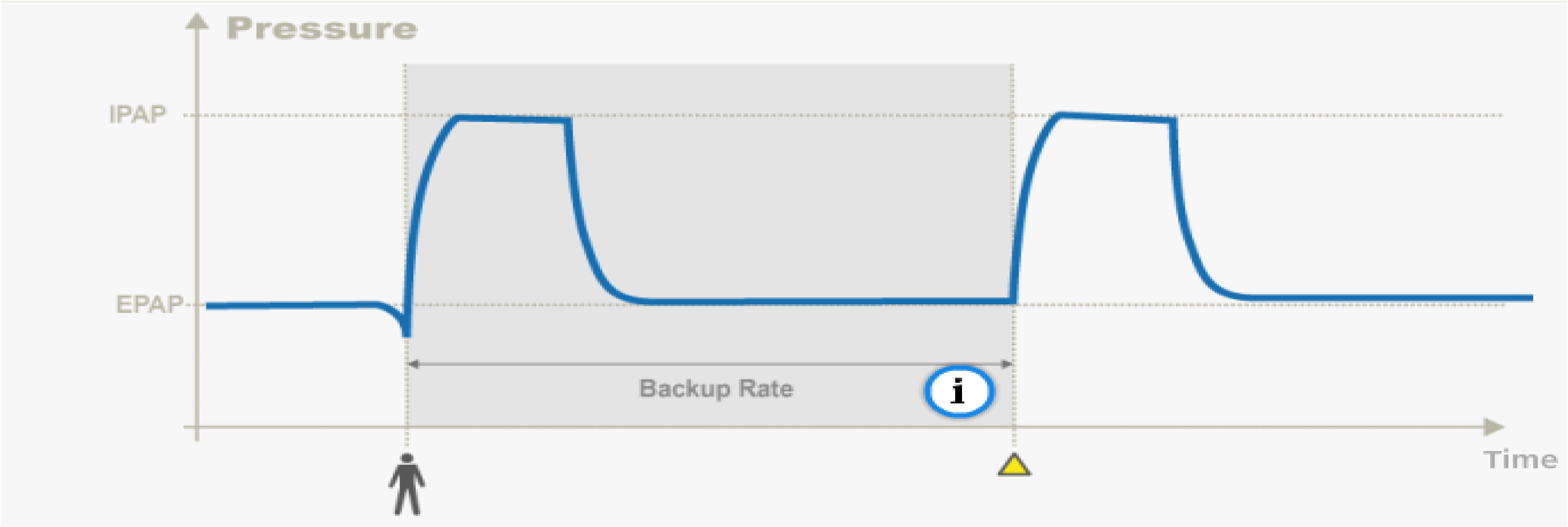
Bilevel positive airway pressure vs PSV

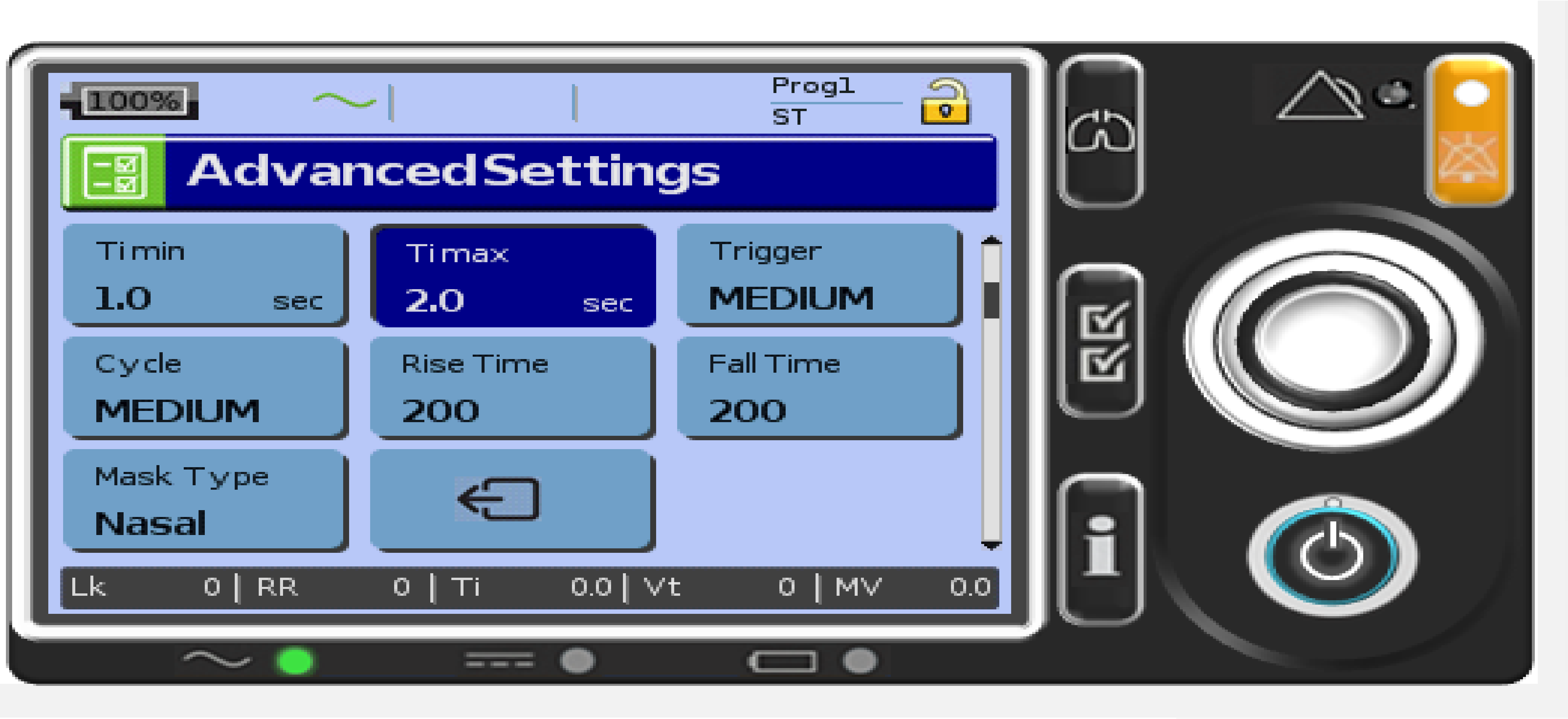


What to set during bilevel PAP

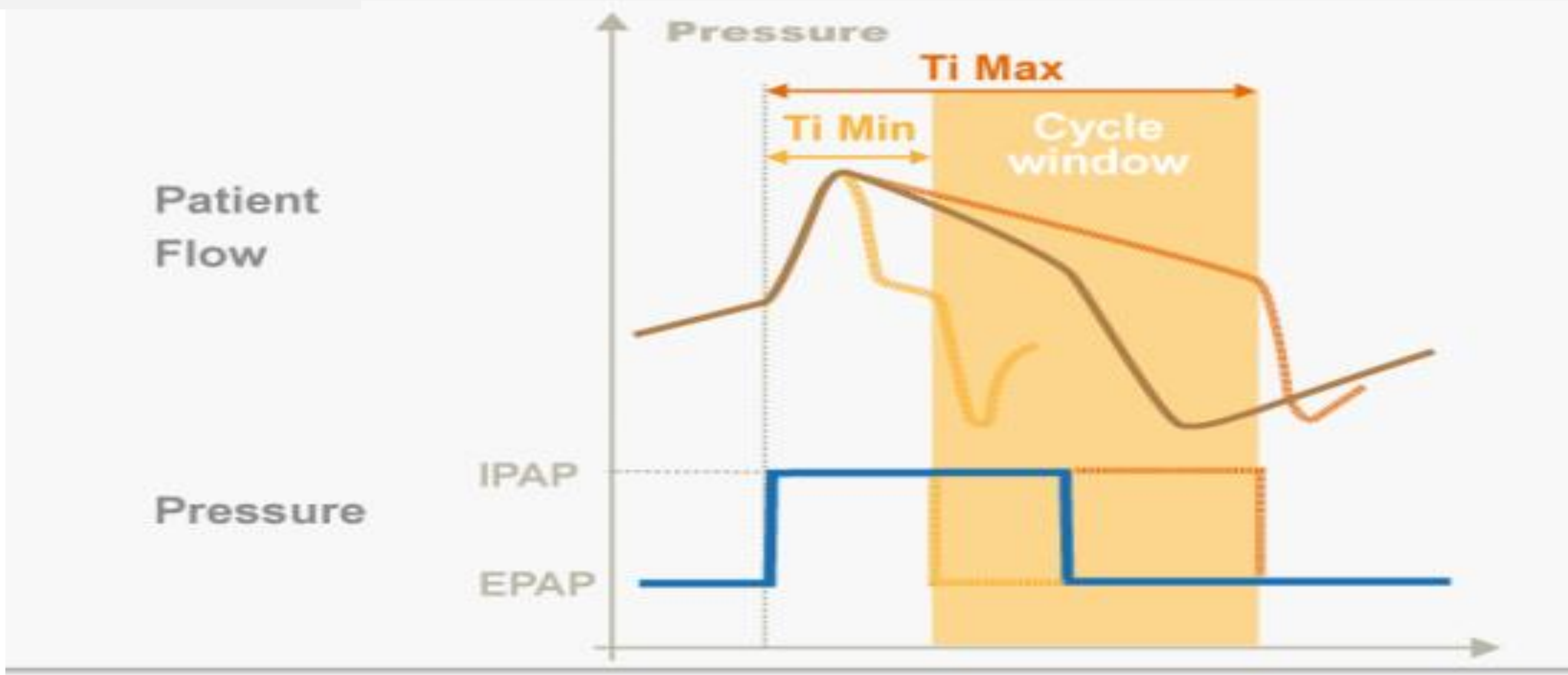






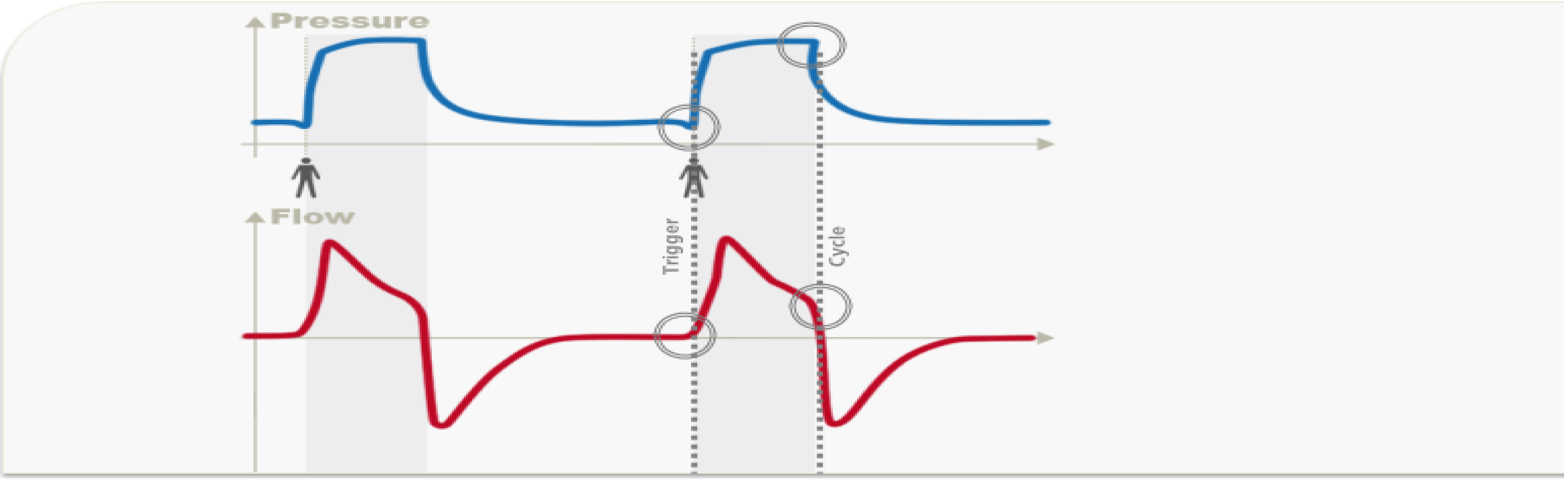


Ti Min - minimum inspiratory time
Ti Max - maximum inspiratory time



Trigger - when the ventilator initiates IPAP
Cycle - when the ventilator initiates EPAP

In pressure support ventilation, during spontaneous breathing, the ventilator **triggers** (initiates IPAP) as an **increase in patient flow**.
The ventilator **cycles** (terminates IPAP and changes to EPAP) as it senses a **decrease in patient flow.**



Trigger sensitivity

Higher trigger sensitivity result in less flow required to trigger to IPAP and may be required for patients who are not able to generate sufficient flow to trigger the ventilator.

Lower trigger sensitivity result in more flow required to trigger to IPAP and may be useful for patients who are prone to auto-triggering, for example in situations of high unintentional leak.

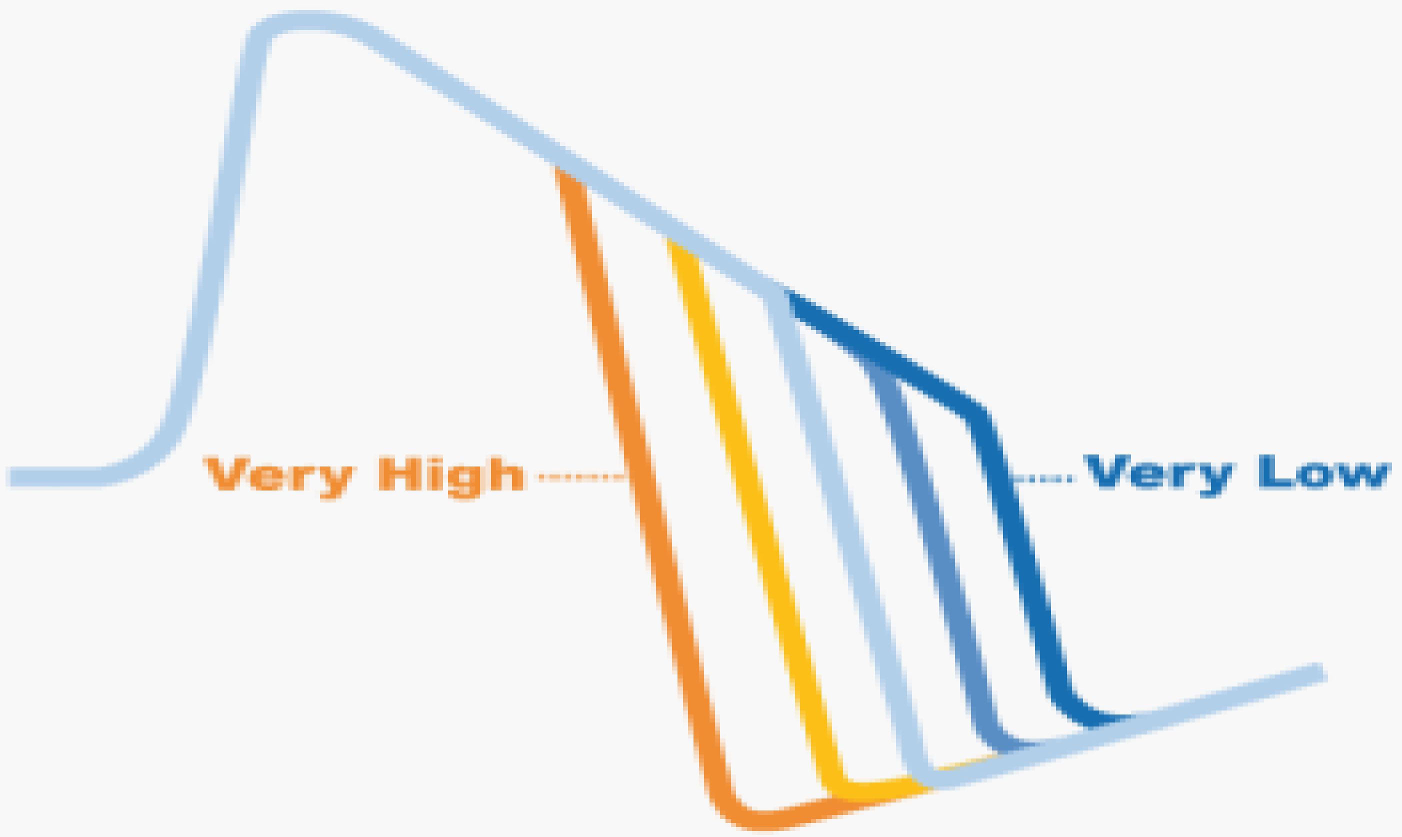
Very High sensitivity	*Easy to trigger (requires less flow)*
High sensitivity	*Sensitive*
Med sensitivity	*Default*
Low sensitivity	*Less sensitive*
Very Low sensitivity	*Hard to trigger (requires more flow)*

Trigger sensitivity: determines **how much inspiratory flow** is required before the ventilator moves from EPAP to IPAP.

Cycle sensitivity

Higher cycle sensitivity will result in a shorter inspiratory time which may be helpful in patients with obstructive lung disease.

Lower cycle sensitivity will result in a longer inspiratory time which may be helpful in patients with restrictive lung disease who might otherwise be prone to premature cycling.



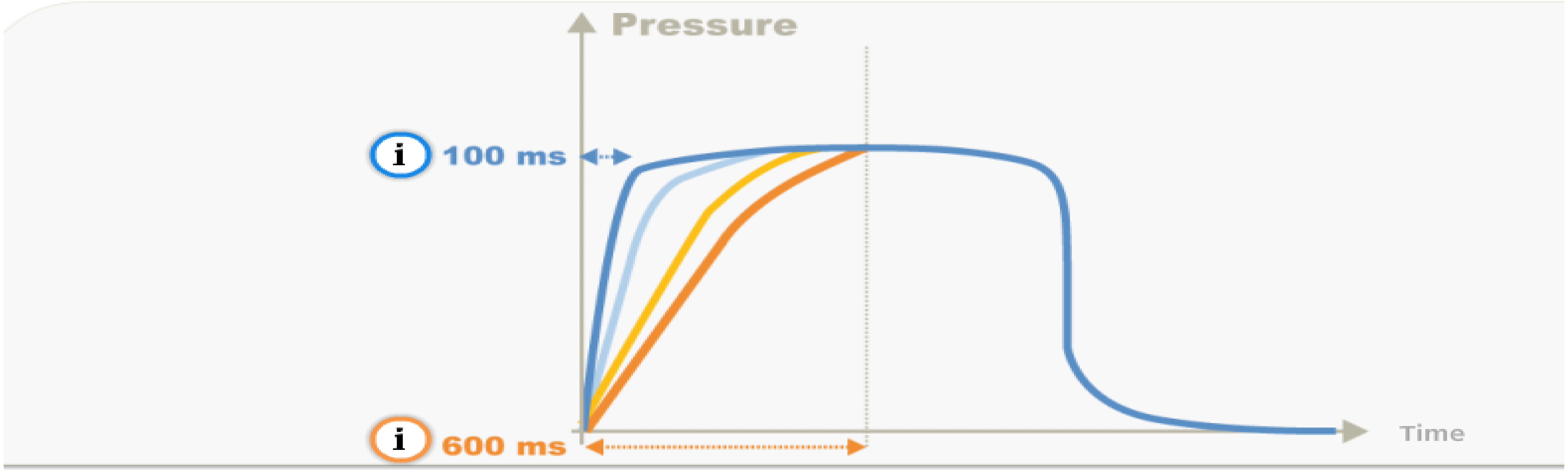
Very High sensitivity	*Easy to cycle*	**50% of peak flow**
High sensitivity	*Sensitive*	**35% of peak flow**
Med sensitivity	*Default*	**25% of peak flow**
Low sensitivity	*Less sensitive*	**15% of peak flow**
Very Low sensitivity	*Hard to cycle*	**8% of peak flow**

Cycle sensitivity: determines the **percentage of peak inspiratory flow** required before the ventilator moves from IPAP to EPAP.

Rise time

The rise time setting alters the inspiratory flow rate. Click on each button to understand how.

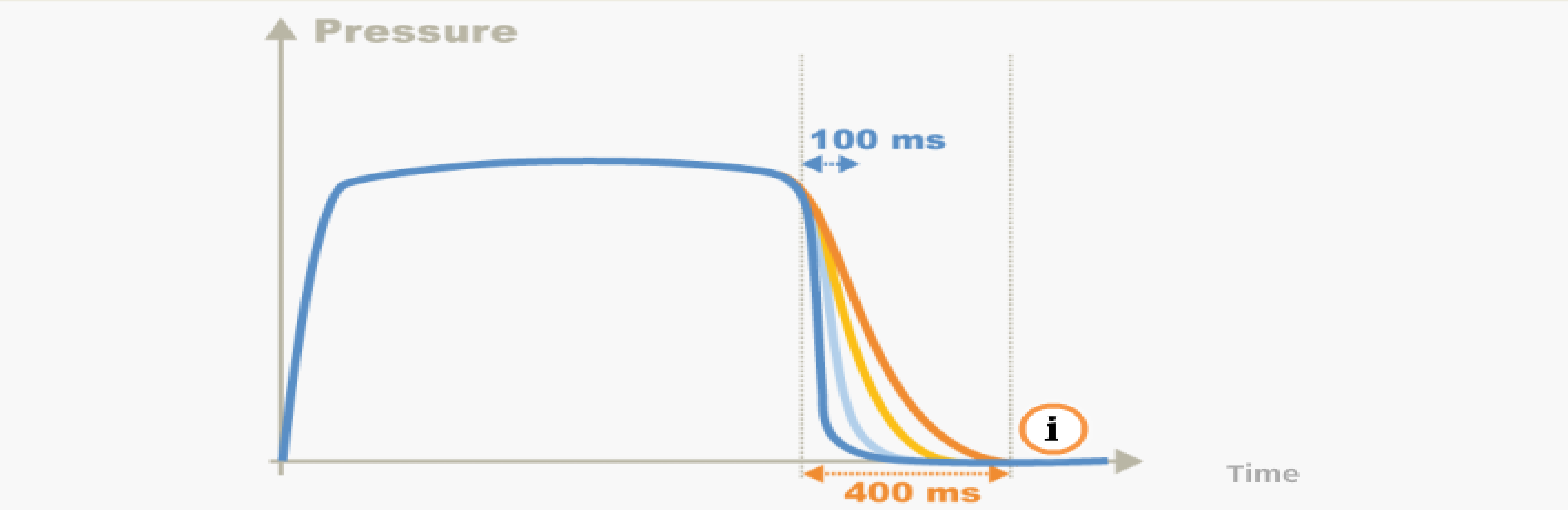
The **shorter the rise time,** the higher the flow rate and the **quicker the ventilator reaches the IPAP setting.**
The **longer the rise time,** the slower the flow rate and the **longer the ventilator will take to reach IPAP**.

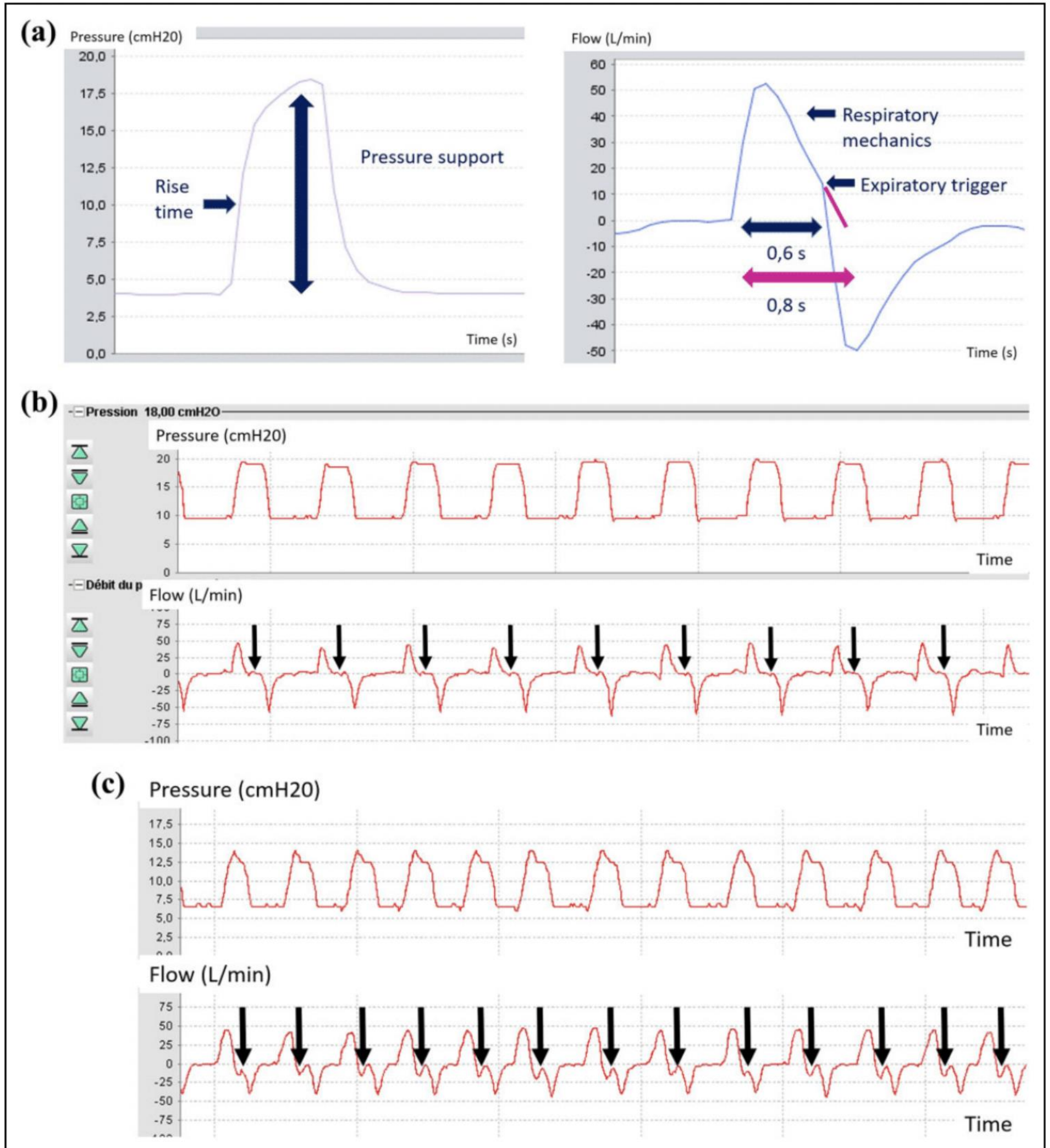


Fall time

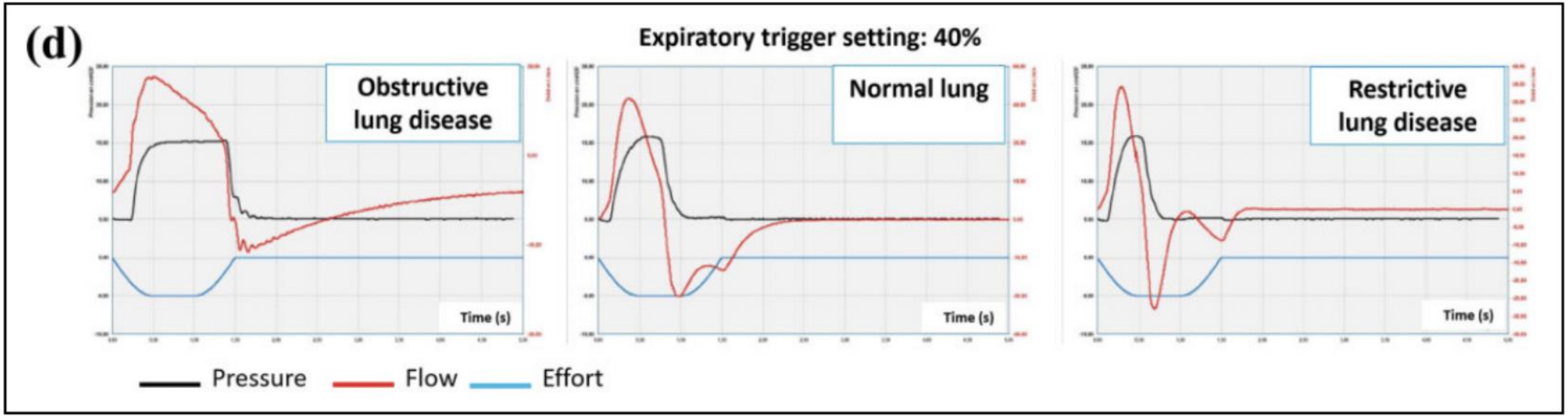
The fall time setting alters the time taken for the ventilator to transition from IPAP to EPAP.

The **shorter the fall time,** the **quicker the ventilator pressure decreases.**
The **longer the fall time,** the **longer the ventilator will take to reach EPAP.**





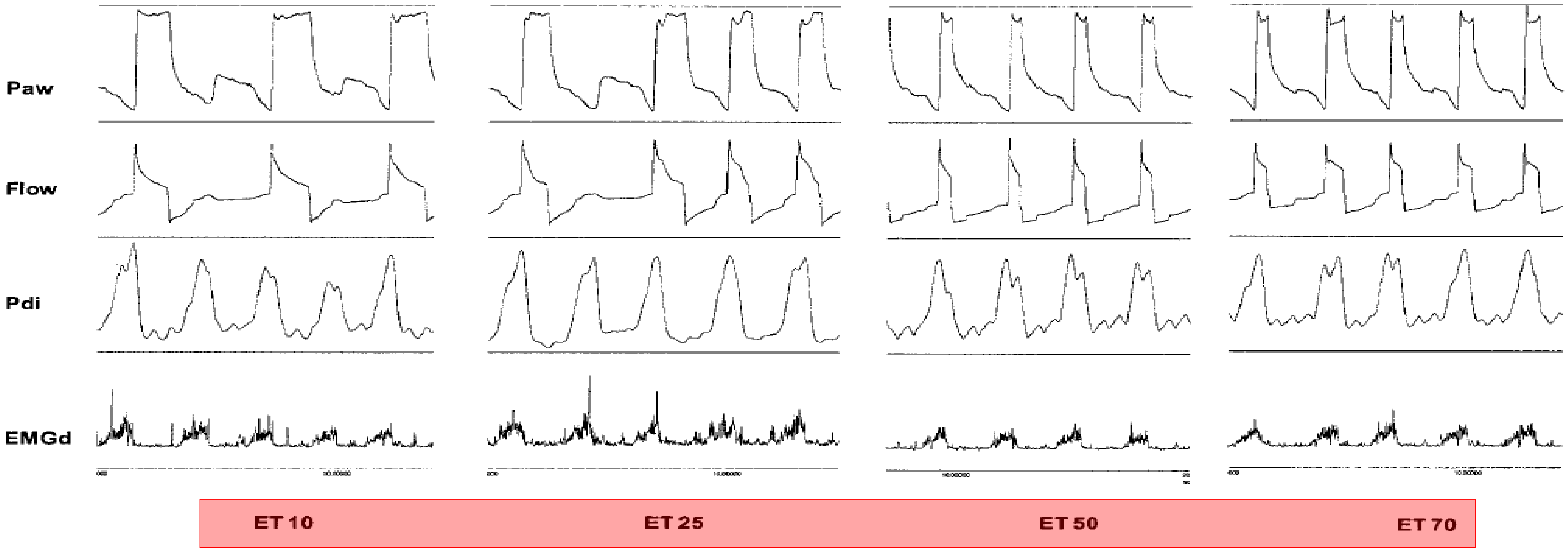
(a)
Pressure (cmH20)
Rise time
Pressure support
Time (s)
Flow (L/min)
Respiratory mechanics
Expiratory trigger
0,6 s
0,8 s
Time (s)
(b)
Pression 18,00 cmH2O
Pressure (cmH20)
Time
Débit du p
Flow (L/min)
Time
(c)
Pressure (cmH20)
Time
Flow (L/min)
Time



(d)
Expiratory trigger setting: 40%
Obstructive lung disease
Normal lung
Restrictive lung disease
Time (s)
Time (s)
Time (s)
Pressure
Flow
Effort

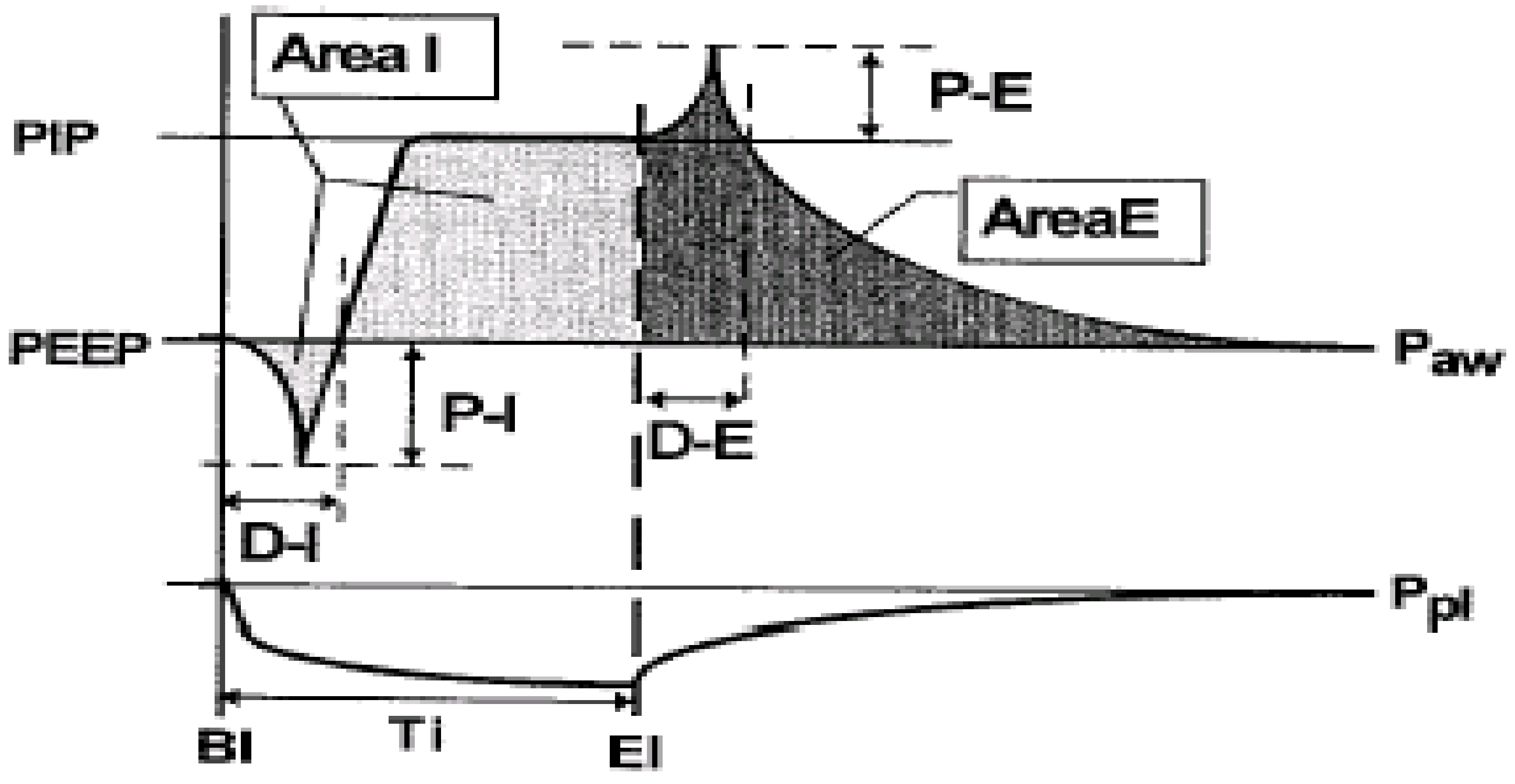
Impact of Expiratory Trigger Setting on Delayed Cycling and Inspiratory Muscle Workload

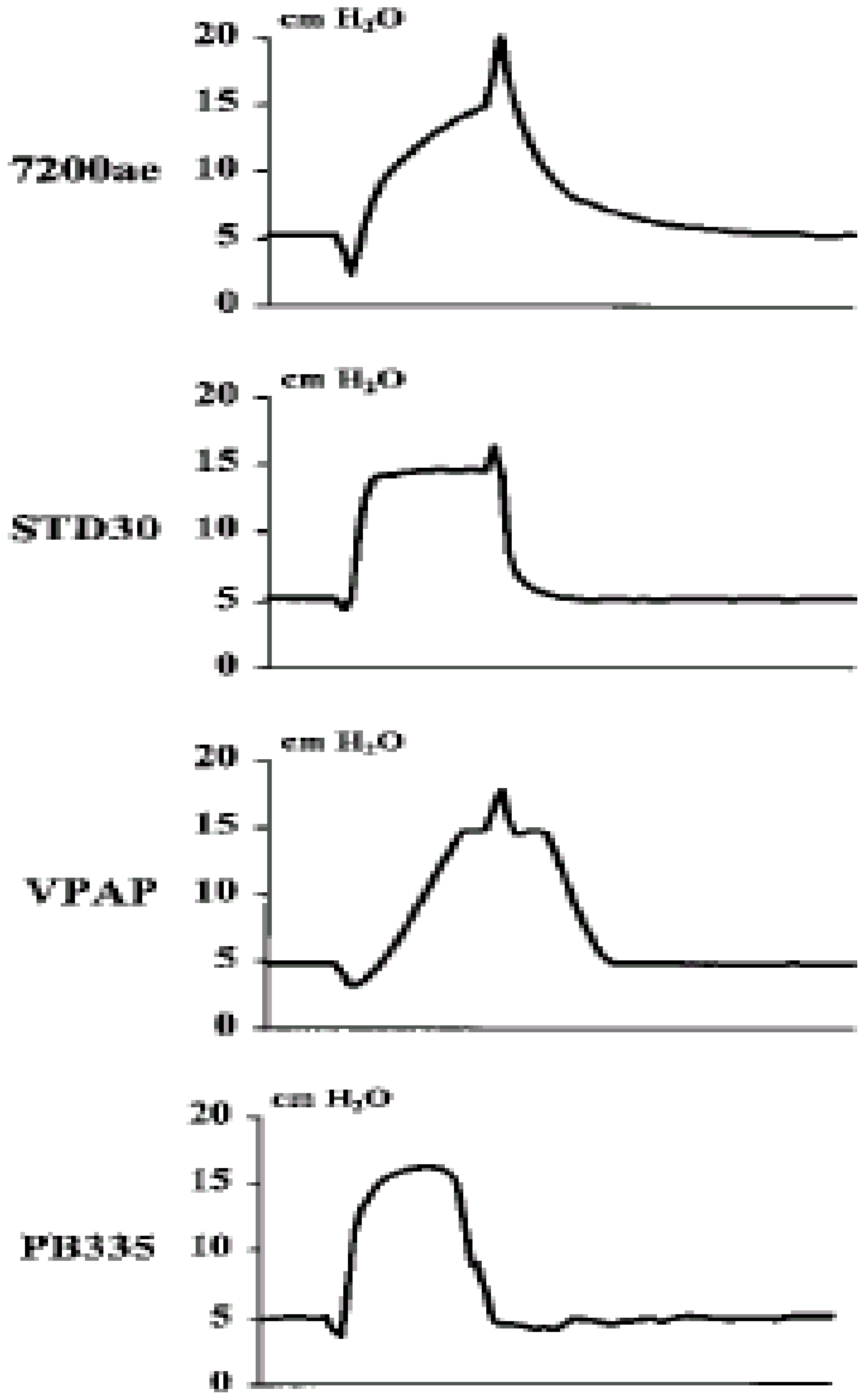
Didier Tassaux



Am J Respir Crit Care Med Vol 172. pp 1283–1289, 2005

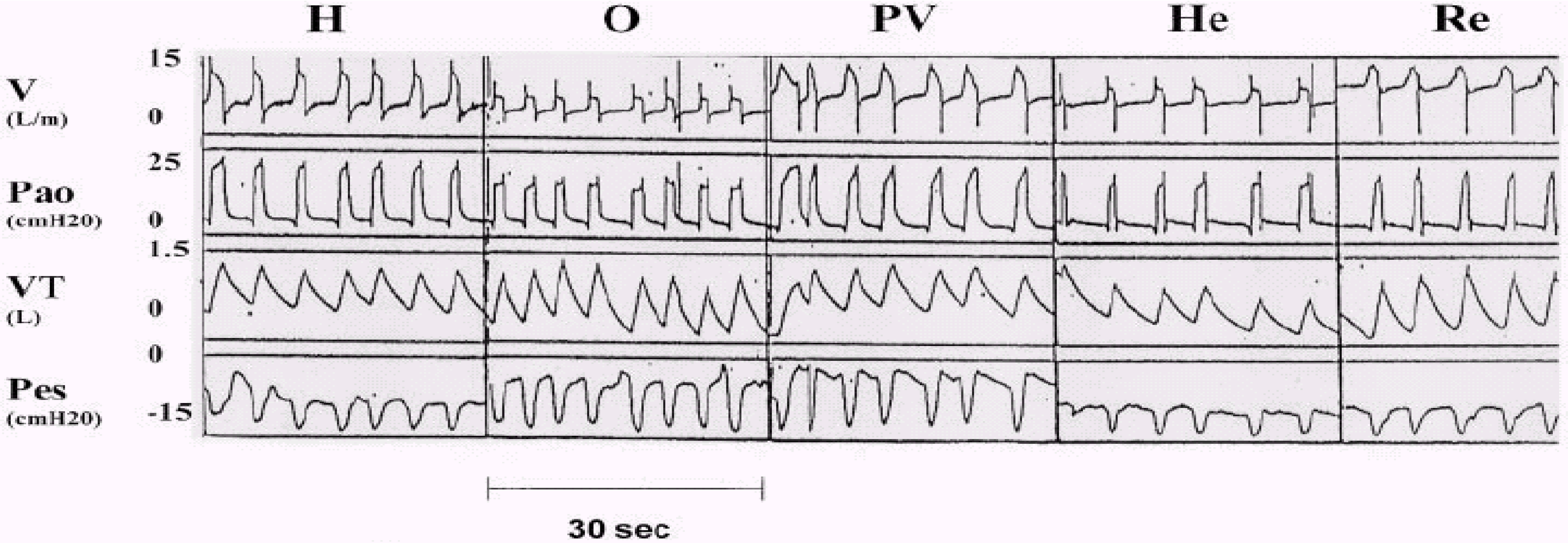
Performance Characteristics of Bilevel Pressure Ventilators (Bench study)





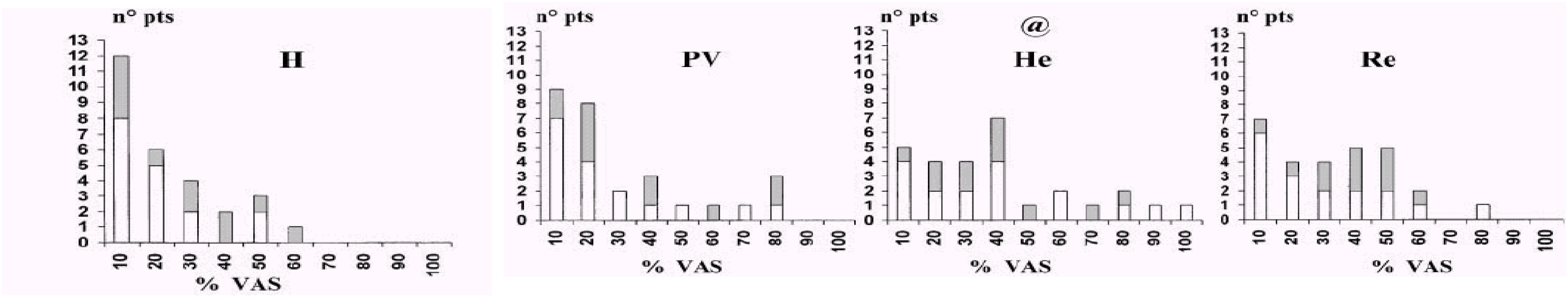
Bunburaphong T, Chest 1997

Comparison of 5 Bilevel Pressure Ventilators in patients with CRF



Vitacca M, Chest 2002

Comfort level (VAS) with Bilevel Pressure Ventilators



VAS	18±16	26±24	37±25	29±20

Vitacca M, Chest 2002

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Performance Characteristics of Seven Bilevel Mechanical Ventilators in Pressure-Support Mode with Different Cycling Criteria: A Comparative Bench Study

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F

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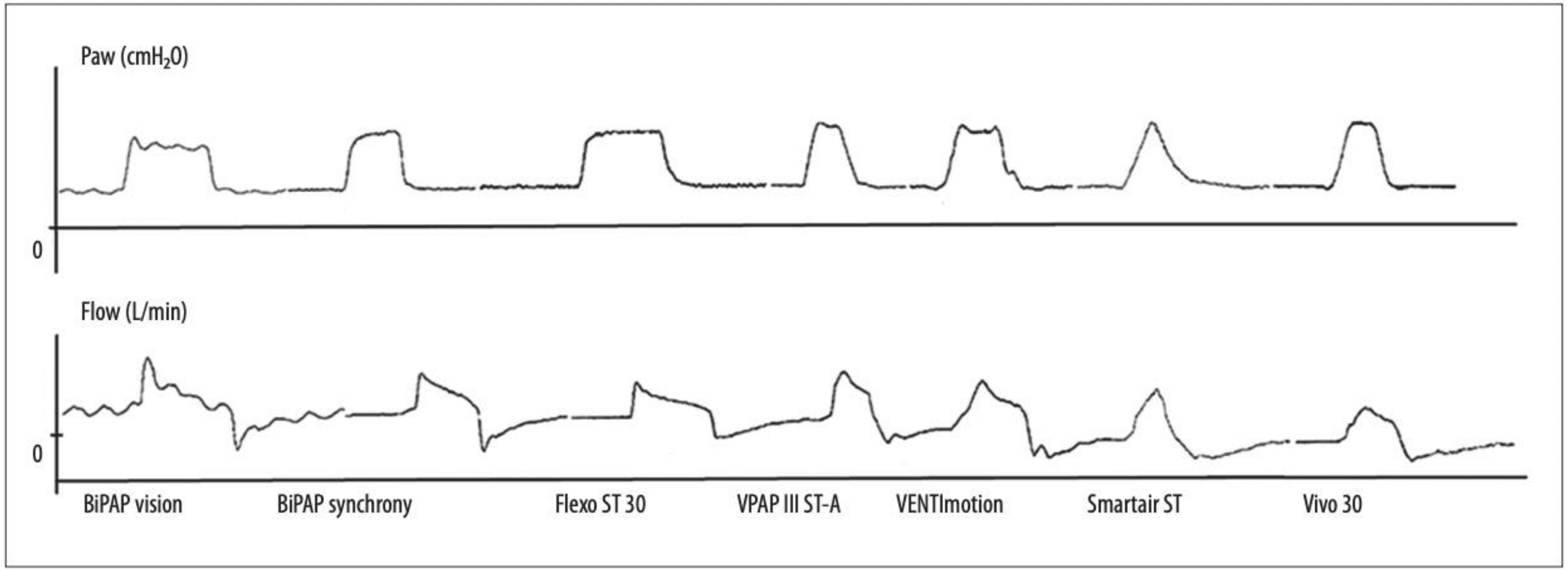


Figure 5. Pressure-time and flow-time curves for the 7 bilevel ventilators, tested at a pressure support level of 15 cmH_2O and a PEEP level of 5 cmH_2O.

VISION and VENTImotion ventilators showed better trigger

Reliability of Tidal Volume in Average Volume Assured Pressure Support Mode

André Stagnara, Loredana Baboi PhD, Pascale Nesme MD, Fabien Subtil MD PhD,
Bruno Louis PhD, and Claude Guérin MD PhD

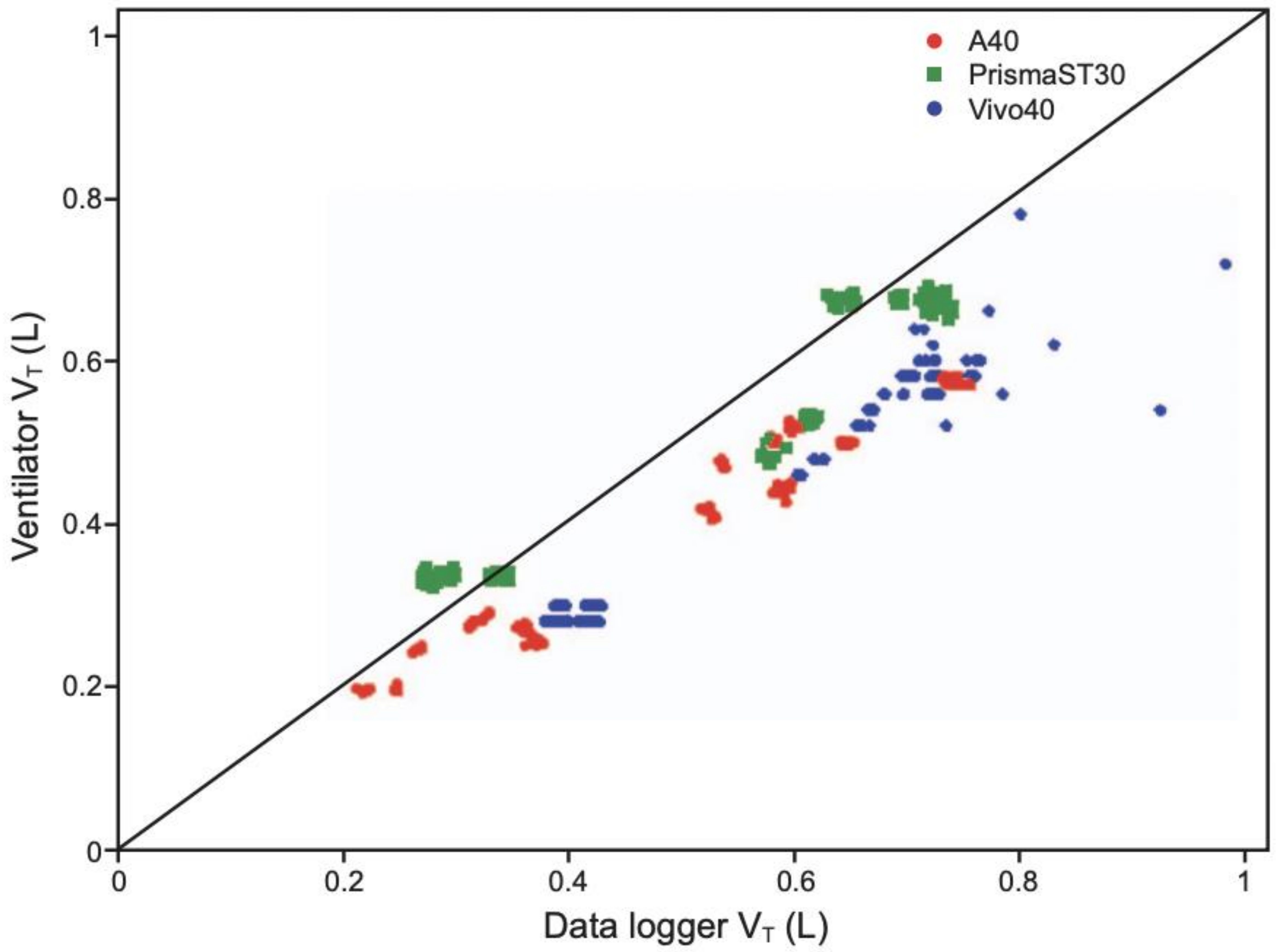


Table 2. Coefficients of Error (95% CI) in Every Condition Tested in Each Ventilator

Combination	A40*	PrismaST30*	Vivo40*
NIL + model 1 PEEP 5 cm H_2O	−33.0 (−34.6 to −31.4)	−3.3 (−8.4 to 1.7)	−35.3 (−37.7 to −33.2)
NIL + model 2 PEEP 5 cm H_2O	−29.5 (−31.1 to −27.9)		
NIL + model 1 PEEP 10 cm H_2O	−30.9 (−32.5 to −29.3)	5.2 (2.7–7.8)	
NIL + model 2 PEEP 10 cm H_2O	−26.6 (−28.2 to −24.9)		
NIL − model 1 PEEP 5 cm H_2O	−9.22 (−10.8 to −7.6)	−3.3 (−8.4 to 1.7)	−27.7 (−29.8 to −25.7)
NIL − model 2 PEEP 5 cm H_2O	−13.2 (−14.8 to −11.6)		
NIL − model 1 PEEP 10 cm H_2O	−17.5 (−19.1 to −15.9)	5.2 (2.7–7.8)	
NIL − model 2 PEEP 10 cm H_2O	−9.9 (−11.6 to −8.3)		

Values are percentages.
* $P <$ .001 vs 0.
NIL = nonintentional leak

Eur Respir J 2010; 35: 627–636
DOI: 10.1183/09031936.00188708

Effect of manufacturer-inserted mask leaks on ventilator performance

B. Louis*,#, K. Leroux¶, D. Isabey*,#, B. Fauroux+,§ and F. Lofaso*,ƒ

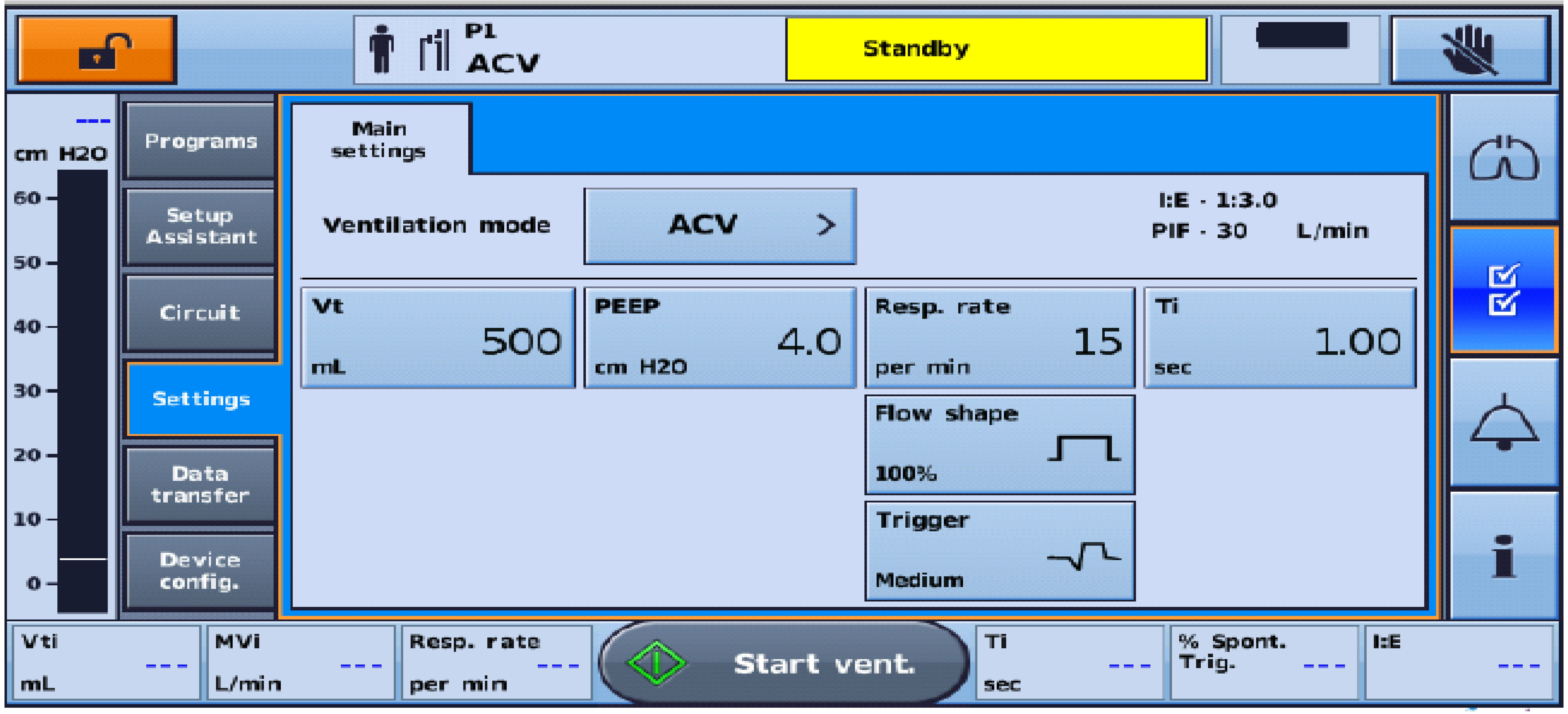
TABLE 4 Performance of the ventilators with the mask having the largest leak (ResMed Ultra Mirage Full Face Medium; ResMed, Saint Priest, France) while the ventilator settings remained those adapted with the recommended masks

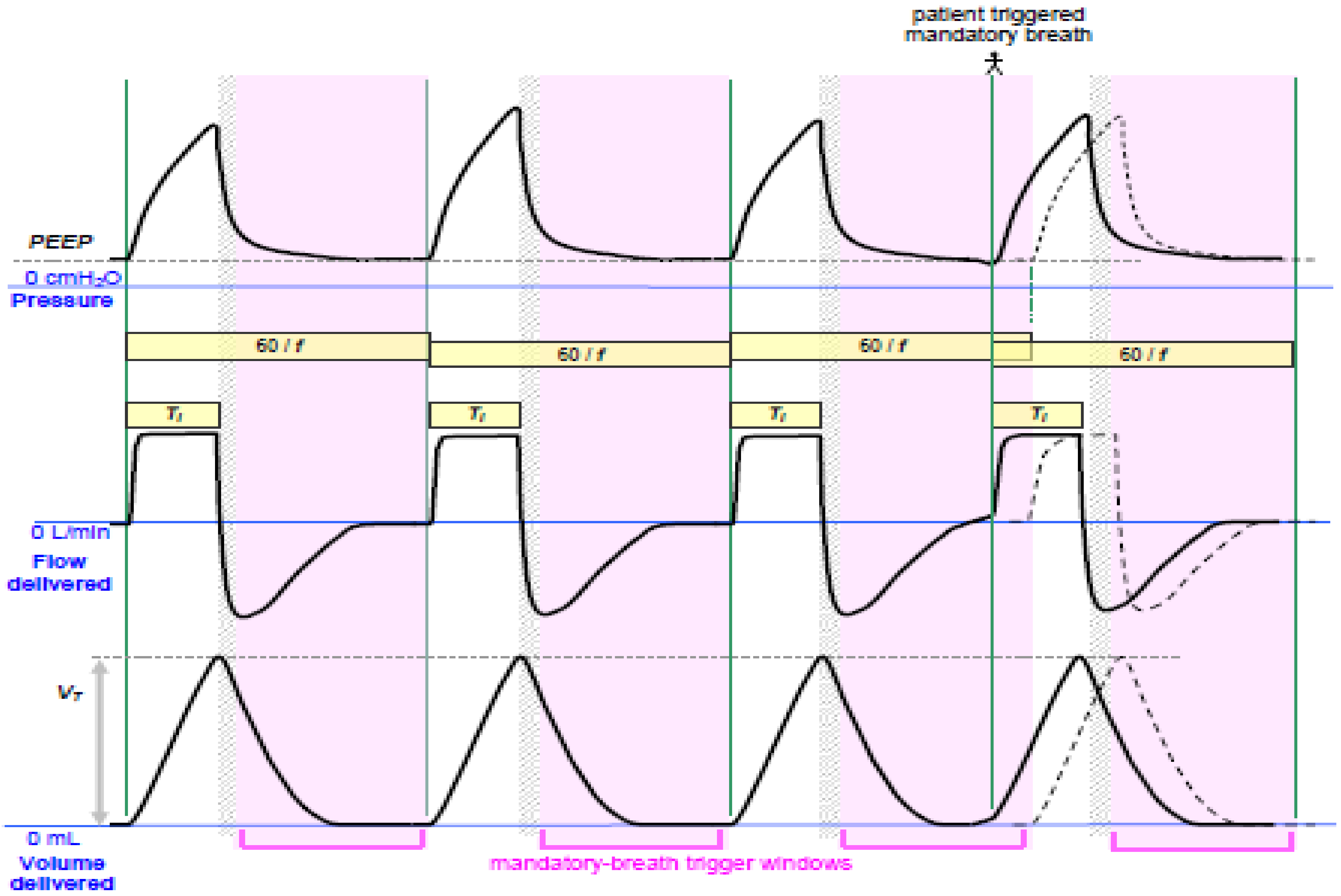
Do not Forget the Mask

Conditions			Measured parameters					
Ventilator	Patient profile	PS cmH$_2$O	IPAP %	Δf %	tI %	VT %	Rebreathing % of VT	PP %
	Restrictive disease	10	AT	AT	AT	AT	AT	AT
		15	AT	AT	AT	AT	AT	AT
		20	AT	AT	AT	AT	AT	AT
VPAP III STA UM Cfg	Obstructive disease	10	99±0.2	49±9	91±4	92±3	0±0#	22±8
		15	99±0.2	45±7	83±3	85±3	0±0#	23±3
		20	AT	AT	AT	AT	AT	AT
	Restrictive disease	10	97±0.2	100±6#	81±5	83±4	0±0#	2±2
		15	99±0.2	97±4	91±1	92±1	0±0#	0±1
		20	99±0.4	95±4	89±1	90±1	0±0#	1±1
Synchrony 2	Obstructive disease	10	99±0.2	88±2	97±4	97±3	0±0#	6±0
		15	100±0.4	96±12#	101±13#	100±12#	0±0#	2±5
		20	99±0.5	108±23#	102±0	102±3	0±0#	-4±11
	Restrictive disease	10	100±0.3	103±2	100±0#	100±0	0±0#	-2±1
		15	100±0.3#	103±11#	100±1	100±0	0±0#	-2±1
		20	100±0.3	103±18#	100±1	100±0	0±0#	-2±1
Vivo 40	Obstructive disease	10	108±0.6	113±29	112±3	112±3	0±0#	-1±1
		15	106±0.7	144±42	105±6	112±3	0±0#	-4±1
		20	106±0.8	79±17	96±2	103±2	0±0#	3±3
	Restrictive disease	10	98±0.6	81±13	100±1	100±0	0±0#	2±3
		15	AT	AT	AT	AT	AT	AT
		20	AT	AT	AT	AT	AT	AT

Assist control (volume ventilation)

(A)CV

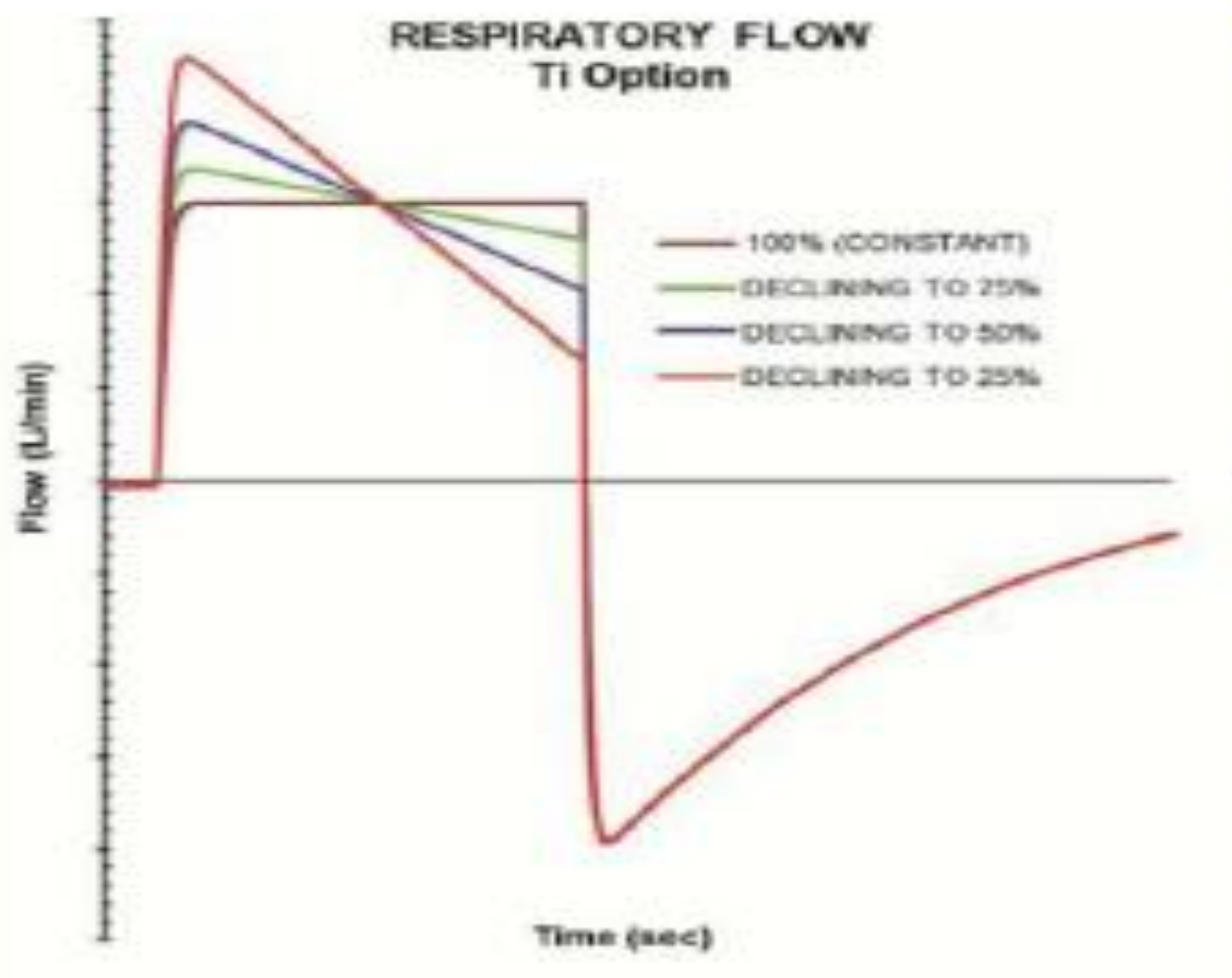


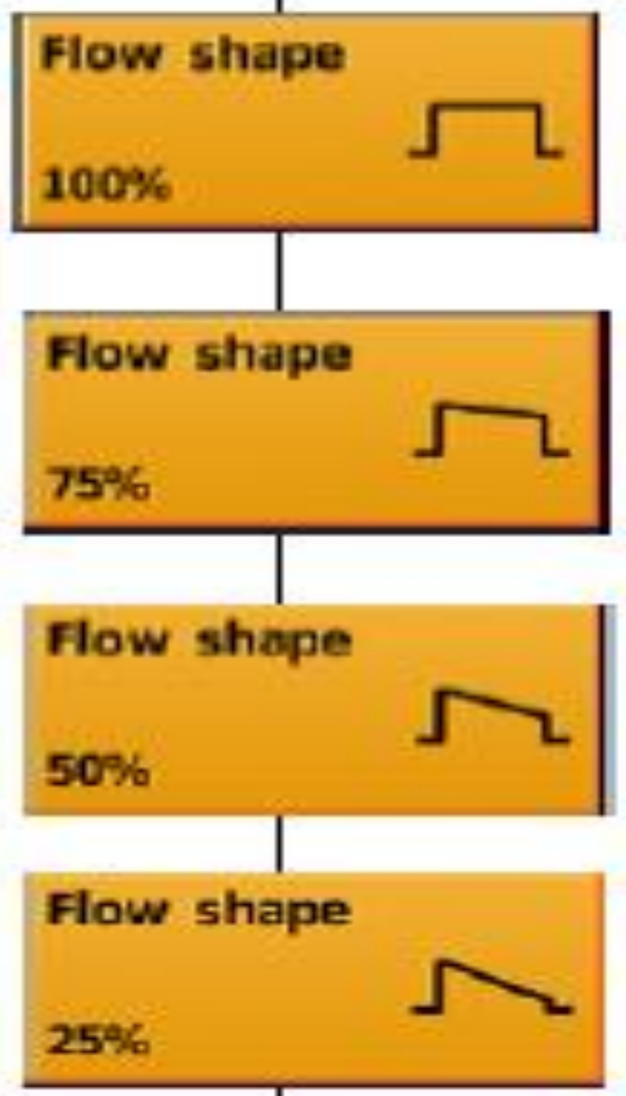


patient triggered mandatory breath
PEEP
0 cmH₂O
Pressure
60 / f
60 / f
60 / f
60 / f
Tᵢ
Tᵢ
Tᵢ
Tᵢ
0 L/min
Flow delivered
Vᴛ
0 mL
Volume delivered
mandatory-breath trigger windows

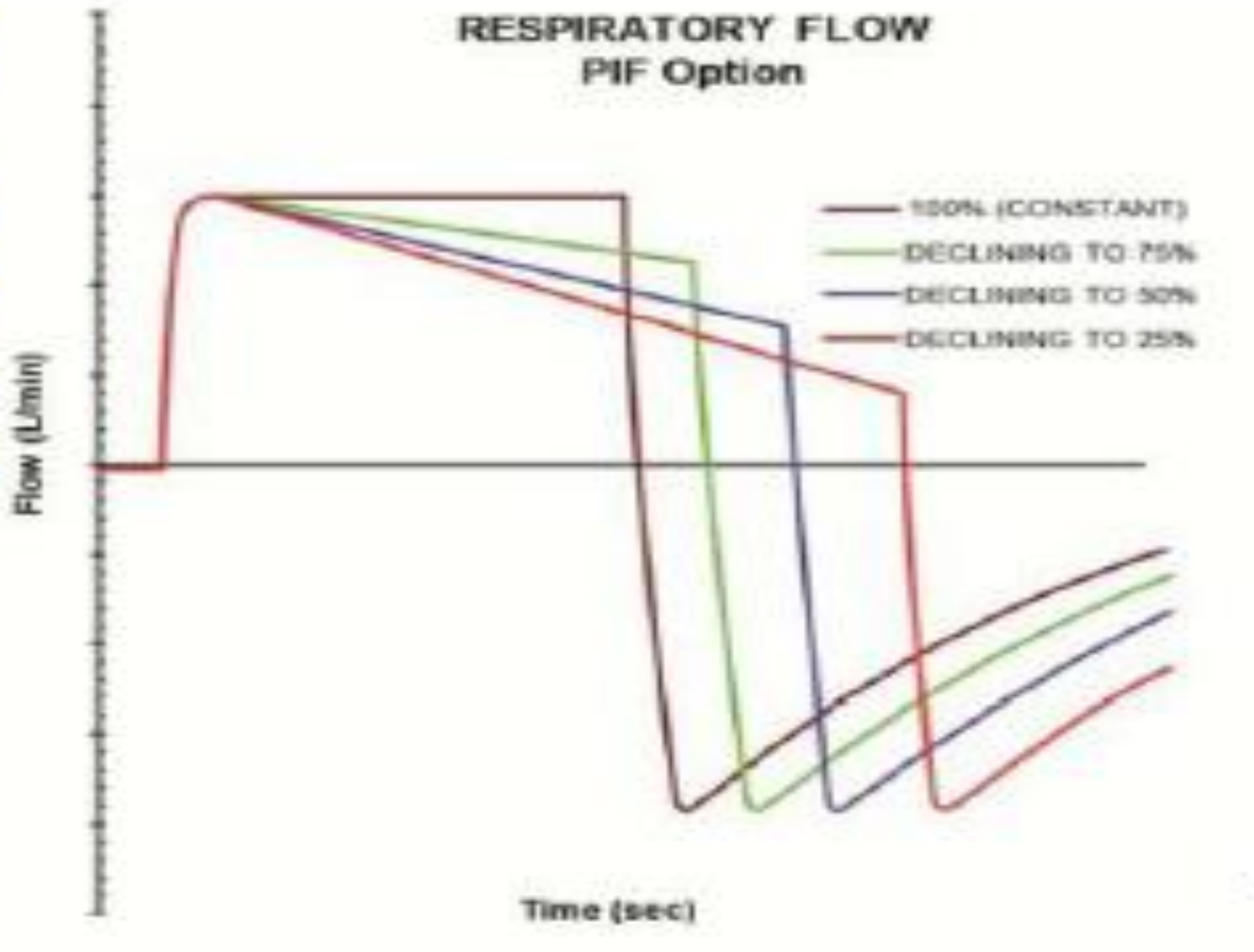
Flow shape - Ti and PIF

"Volume Breath Option" set to Ti





"Volume Breath Option" set to PIF



ResMed

Dual control modes

Devices including dual control modes

	Brands
Target volume with variable pressure support	AVAPS™ (A40™, Trilogy 100™ and 200™ *Philips*) Target volume pressure support (Vivo™ 50 and 60, *Breas*; Ventilogic™, *Weinmann*, Monnal T50™, *ALMS*; Elysee™ 150, 250, 350, *Resmed*)
Target volume with both variable pressure support and back-up respiratory rate	IVAPS™ (VPAP S9™, Stellar™ 100 and 150, Lumis™ Astral™, *Resmed*)
Target volume with variable pressure support, back-up respiratory rate and autoadjusted EPAP	Avaps AE™ (A40™, Trilogy™ 100 and 200 *Philips*)

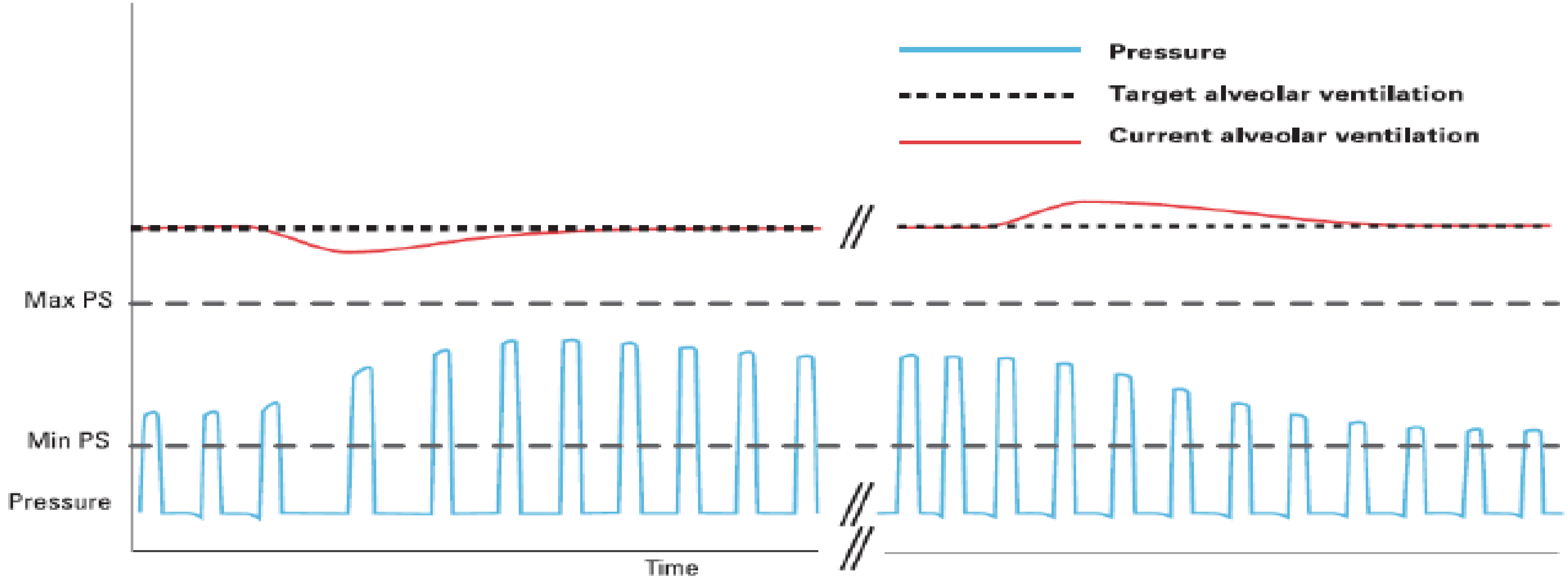
AVAPS-AE

Maintaining tidal volume and airway patency

NIPPON GASES

iVAPS (intelligent Volume Assured Pressure Support) mode

- Intelligent. Automatic. Alveolar.
- iVAPS is designed to maintain a preset target alveolar minute ventilation by monitoring delivered ventilation, adjusting the pressure support and providing an intelligent backup breath automatically.



ResMed

Putative Advantages of dual control modes

- Ability to respond to changes in respiratory mechanics, ensuring relatively constant ventilation throughout the night
- Beneficial in patients unable to tolerate high IPAP levels
- ‘‘Simplification’’ of ventilator adjustments
- Decrease the frequency of NIV adjustments over time in rapidly progressive diseases

Conclusions

Bench tests and physiologic studies may help to choose ideal ventilator

Pressure-limited ventilators usually preferred

- for patients requiring only nocturnal or partial daytime ventilation
  - Performance varies with different devices

Volume-limited ventilators may be preferred

- for patients with little or no spontaneous breathing capability
- for patients with severe neuromuscular weakness
  - Performance varies with different devices

Dual control modes

- May be easier to set, are equivalent in efficacy and better compliance?
  - Performance varies with different circuits