A newborn baby is lying in a hospital bed, wearing a white diaper. The baby's feet are visible, and a grey medical sensor is attached to the right foot. The sensor is connected to a thin green tube that runs across the baby's foot. The background is slightly blurred, showing the white bedding and a medical monitor in the distance.

小兒侵襲性呼吸器介紹 與臨床應用

呼吸治療師 張志豪

OUTLINE

Choice of ventilator

Patient monitor

Ventilator settings

Ventilator mode

Clinical use of ventilator

HFOV

SLE5000 ventilator



侵襲性呼吸器的選擇

新生兒呼吸器(<10Kg)

控制：壓力、吸氣時間、持續氣流供給

通常沒氣囊

小兒呼吸器(>10Kg)

控制：壓力/容積、吸氣時間

通常有氣囊

侵襲性呼吸器



Vital sign
HR,RR...etc

兒科呼吸治療監測評估



Vital sign
HR,RR...etc



CXR

兒科呼吸治療監測評估



Vital sign
HR,RR...etc



CXR



ABG data

兒科呼吸治療監測評估



Vital sign
HR,RR...etc



Patient

Resp pattern
Abd distention
Skin color...etc



CXR



ABG data

兒科呼吸治療監測評估



Vital sign
HR, RR...etc



Patient
Resp pattern
Abd distention
Skin color...etc



CXR



SpO₂



ABG data

兒科呼吸治療監測評估



Vital sign
HR, RR...etc



Patient
Resp pattern
Abd distention
Skin color...etc



CXR



SpO₂



ABG data



Device
Tube
Ventilator...etc

兒科呼吸治療監測評估

侵襲性呼吸器的常見參數

呼吸模式 - IMV SIMV PCPPV NAVA...etc

使用氧氣濃度 - 21%~100%

呼吸次數

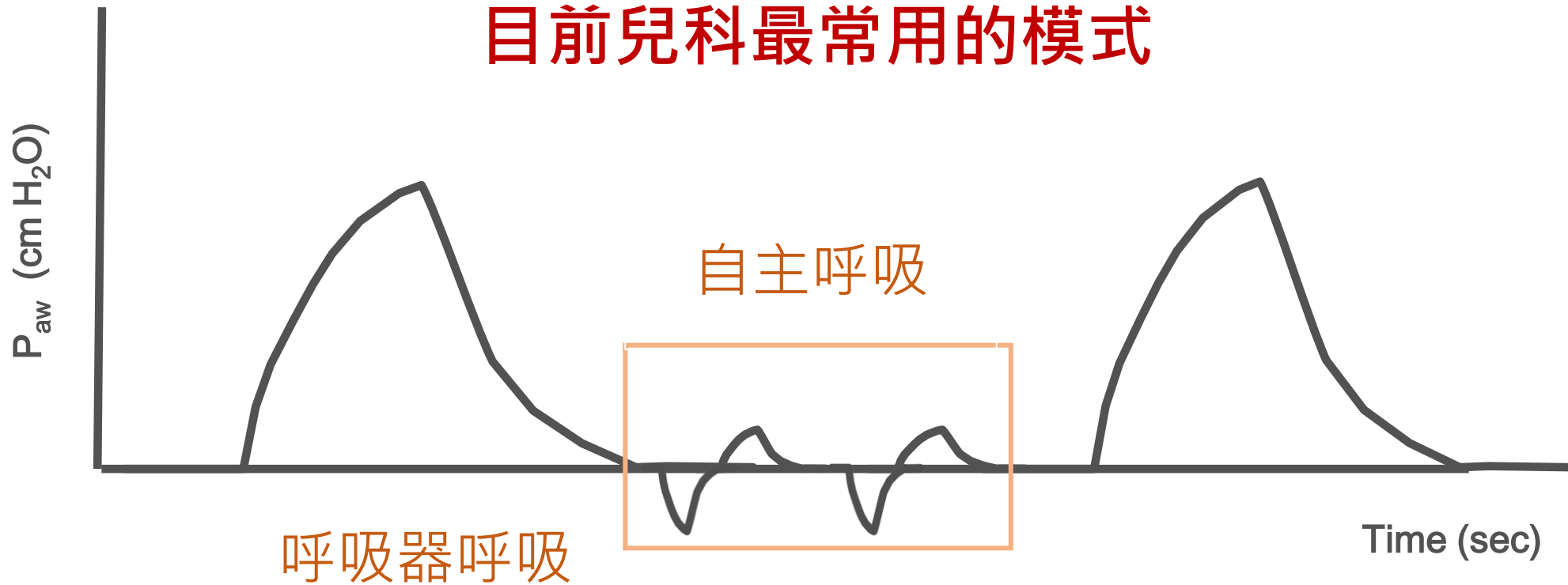
壓力 PC / 容積 Volume

吐氣末正壓PEEP

侵襲性呼吸器

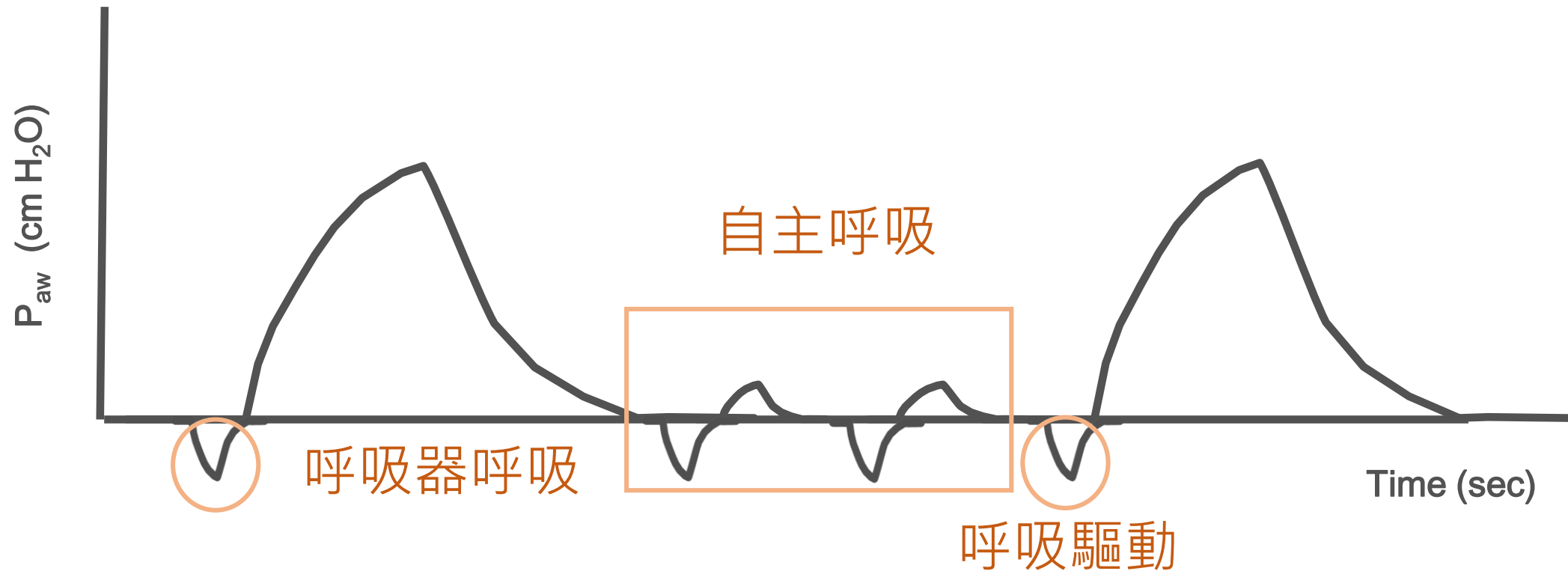
侵襲性呼吸器- CMV mode

目前兒科最常用的模式



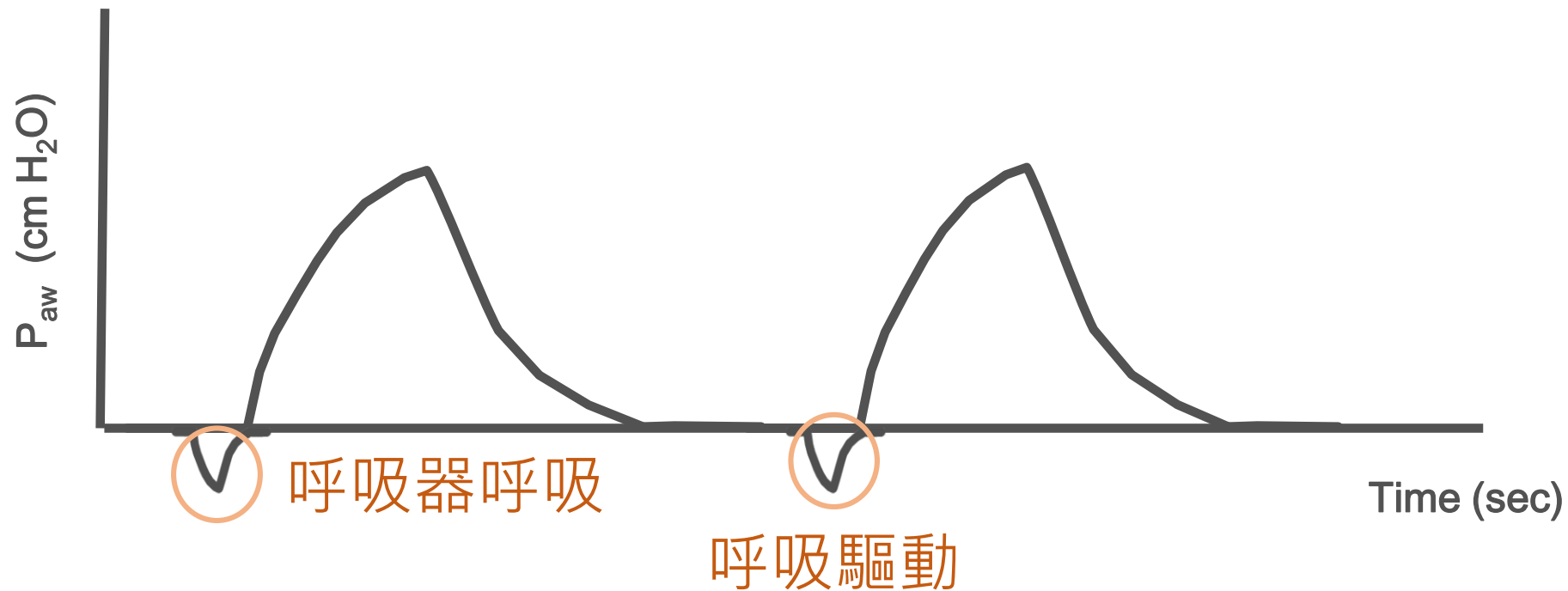
侵襲性呼吸器- 常見模式介紹

侵襲性呼吸器- SIMV mode



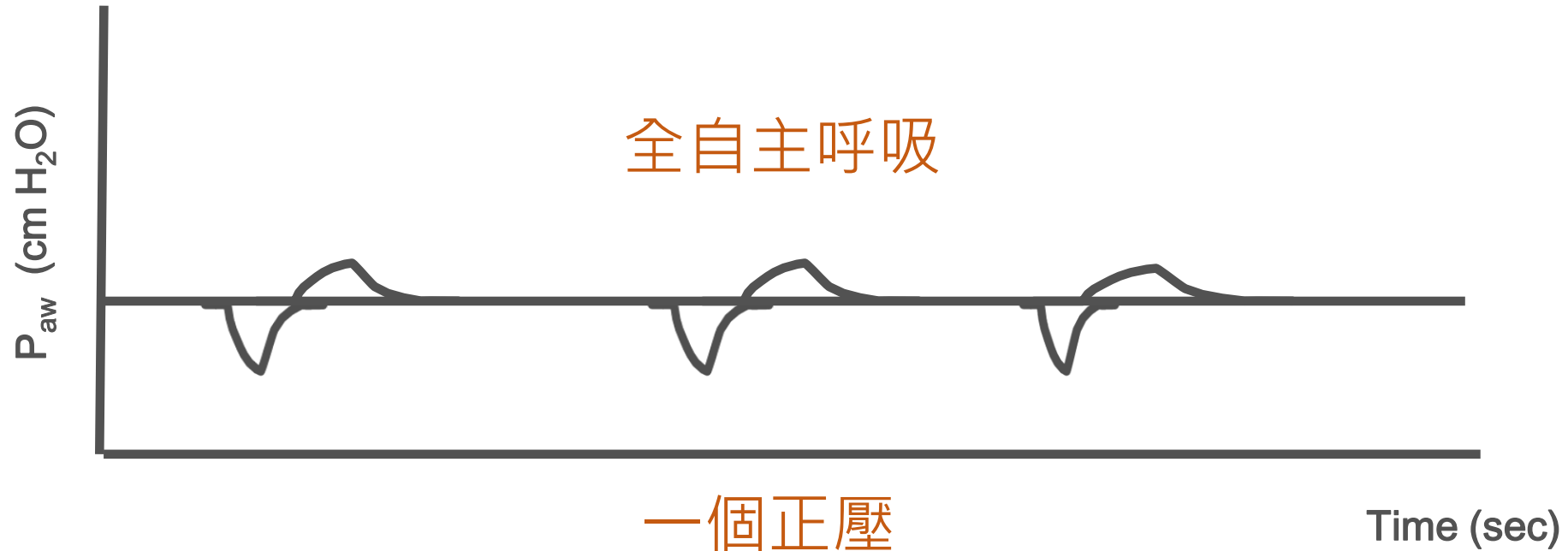
侵襲性呼吸器- 常見模式介紹

侵襲性呼吸器- PCPPV mode



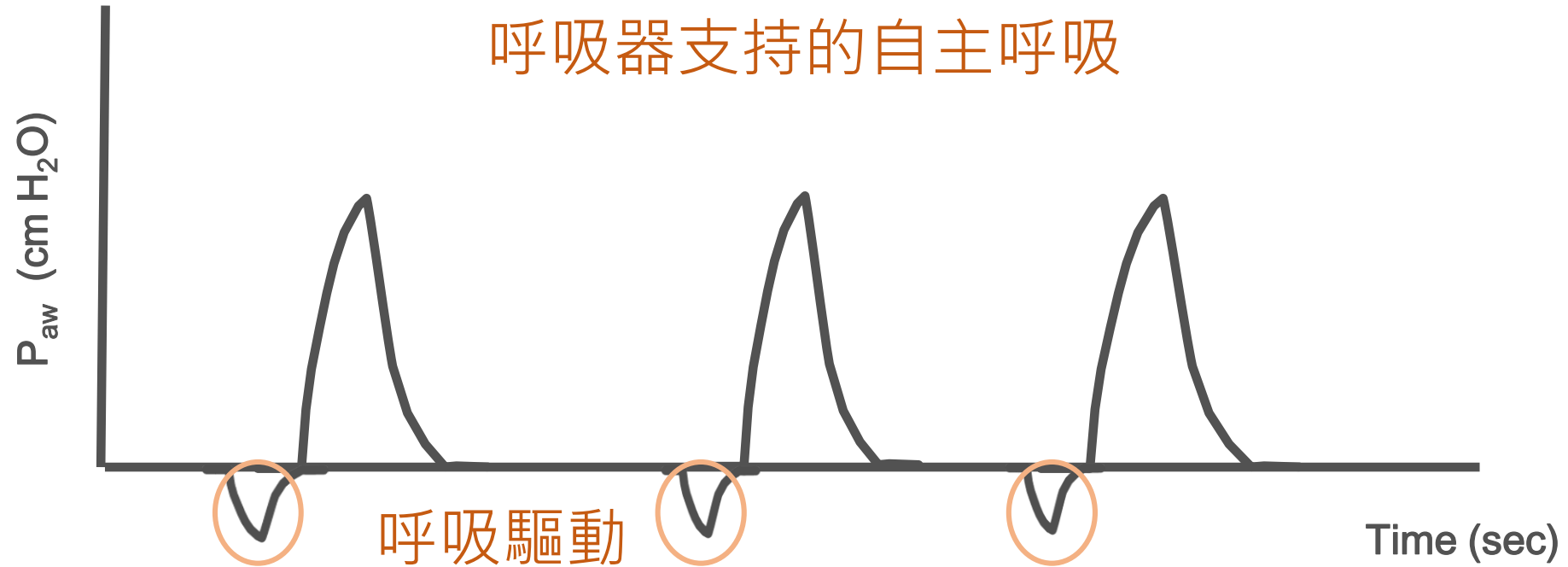
侵襲性呼吸器- 常見模式介紹

侵襲性呼吸器- CPAP mode



侵襲性呼吸器- 常見模式介紹

侵襲性呼吸器- PSV mode



侵襲性呼吸器- 常見模式介紹

GA / Stage	Premature	Terms	Infant / BPD	Child
pH	>7.25	>7.35	>7.3	7.3-7.45
PaCO₂ (mmHg)	45-59	35-50	45-70	35-45
PaO₂ (mmHg)	50-70	60-80	60-80	80-100

Arterial Blood Gas

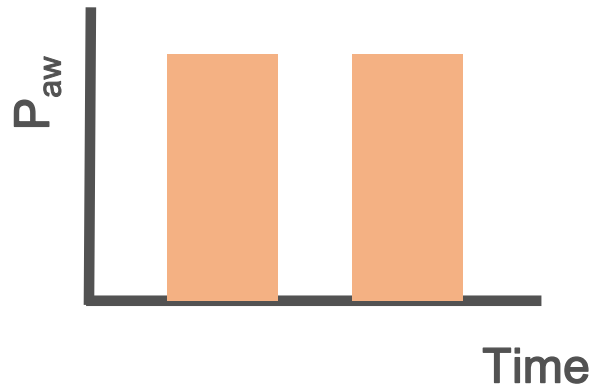
設定 / 階段	Premature	Infant Toddler	Child	Adolescent Adult
呼吸速率	25-35	20-25	15-20	12
吸氣時間	0.4	0.6	0.7	0.9
吸氣壓力	20	25	30	30
潮氣容積	4-8	6-8	6-10	6-10
PEEP	4-7	4-7	4-7	4-7
氧氣濃度	titrate	titrate	tolerated	tolerated

Ventilator parameter

O2 management

Mean airway pressure / FiO2

Area under pressure/time scale

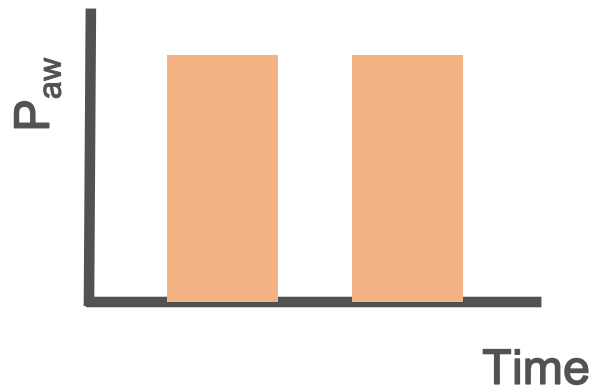


RATE

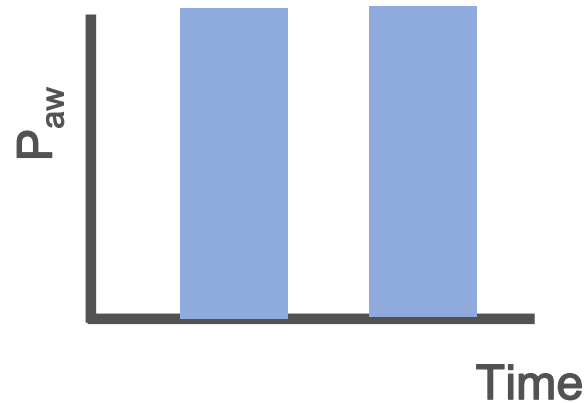
O2 management

Mean airway pressure / FiO2

Area under pressure/time scale



RATE

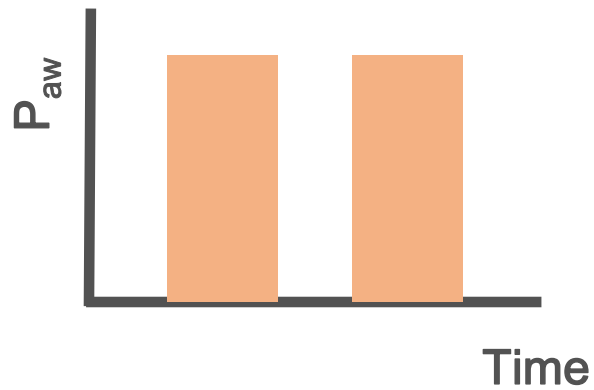


PIP

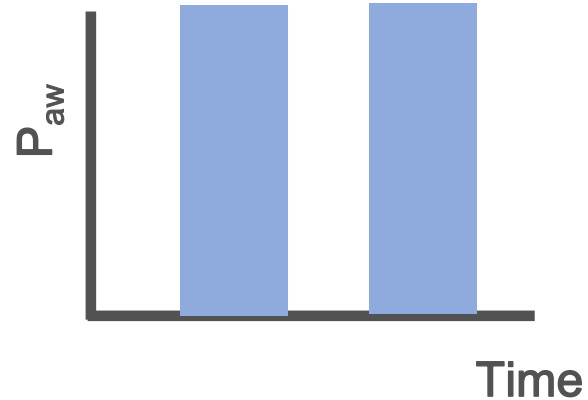
O2 management

Mean airway pressure / FiO2

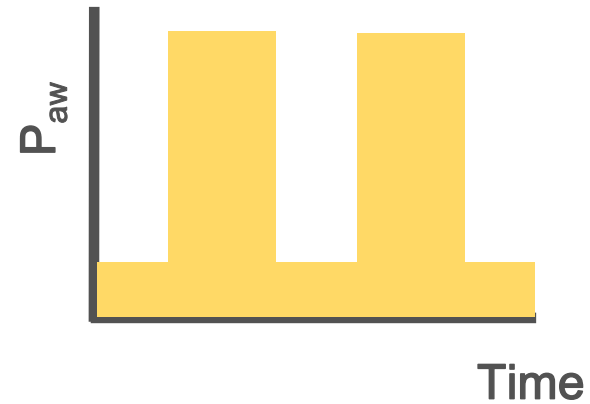
Area under pressure/time scale



RATE



PIP

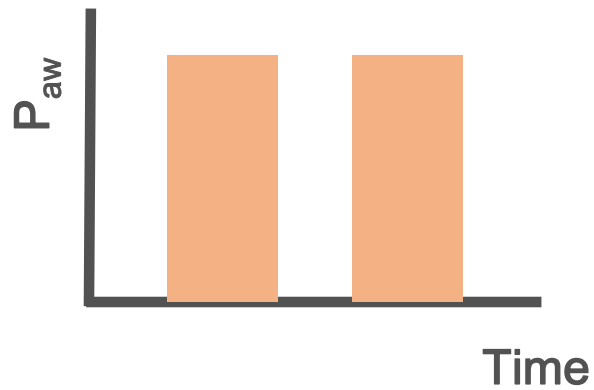


PEEP

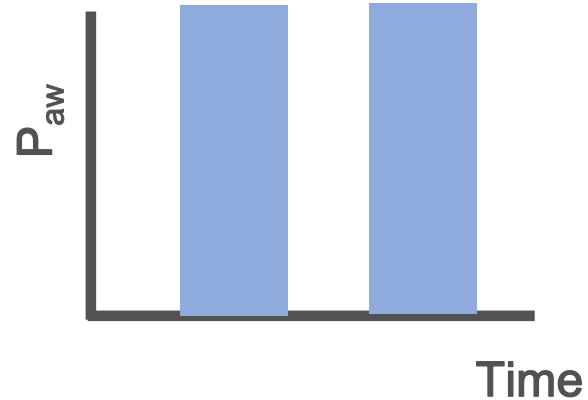
O2 management

Mean airway pressure / FiO2

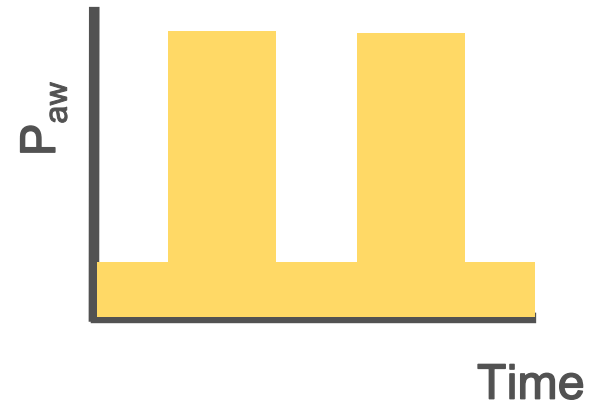
Area under pressure/time scale



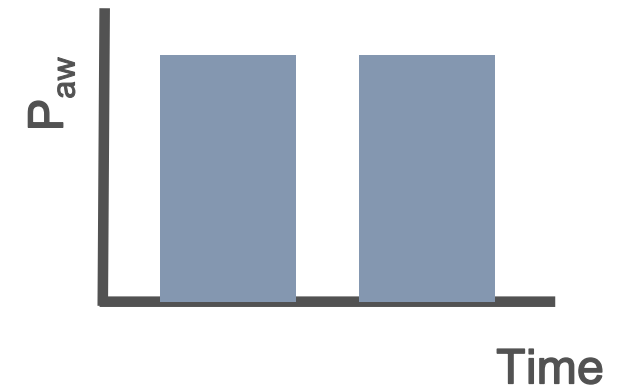
RATE



PIP



PEEP



Ti

CO2 management

Minute Ventilation

Tidal volume

Volume/PC level

Respiratory Rate

CO2 management

Minute Ventilation

Tidal volume

Volume/PC level

Respiratory Rate

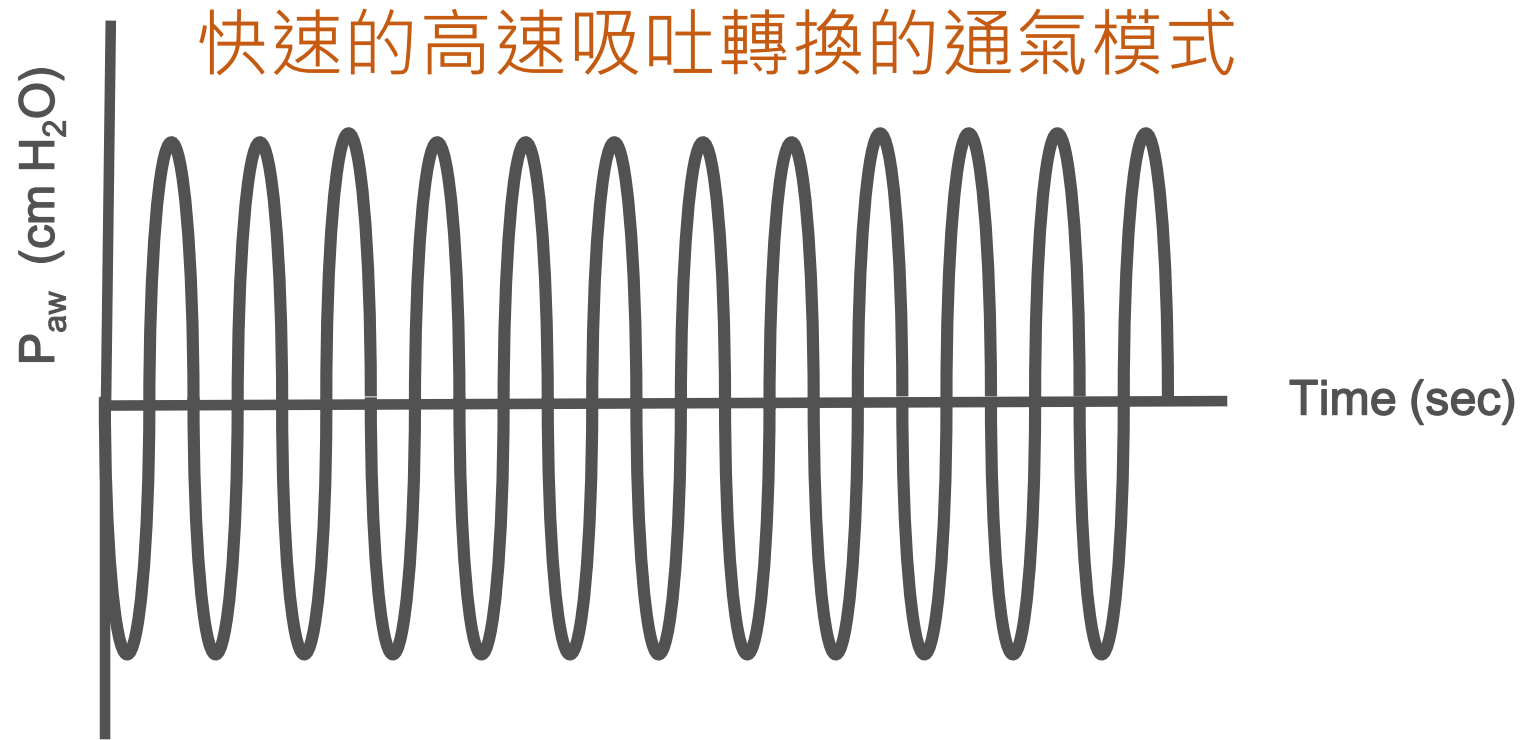
CO2 High → **Increase Minute Ventilation**

CO2 Low → **Decrease Minute Ventilation**

設定 / 階段	Premature	Infant Toddler	Child	Adolescent Adult
呼吸速率	25-35	20-25	15-20	12
吸氣時間	0.4	0.6	0.7	0.9
吸氣壓力	20	25	30	30
潮氣容積	4-8	6-8	6-10	6-10
PEEP	4-7	4-7	4-7	4-7
氧氣濃度	titrate	titrate	tolerated	tolerated

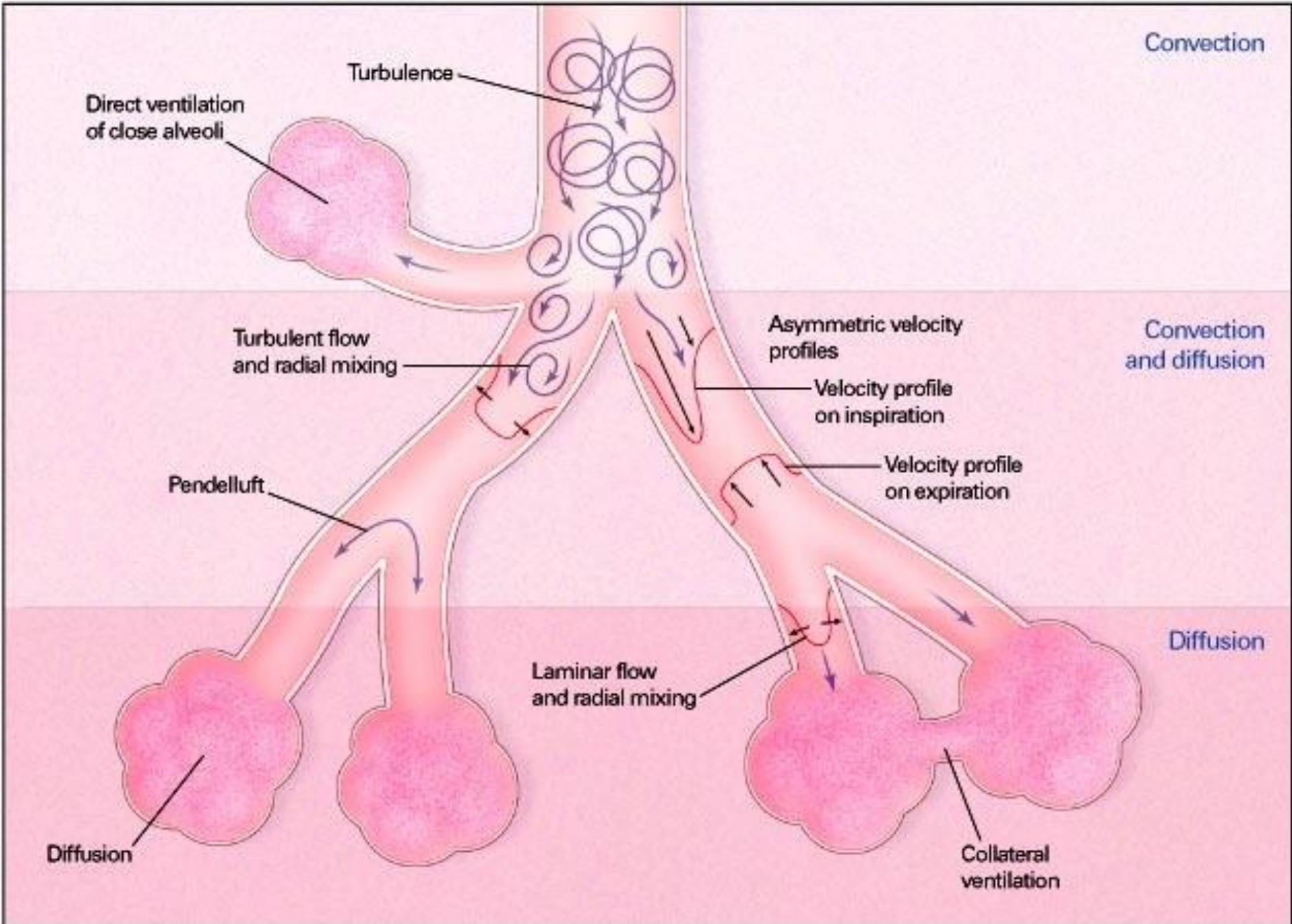
Ventilator parameter

高頻呼吸器- HFO mode



頻率 振幅 平均氣道壓力 氧氣濃度

進階呼吸支持-高頻呼吸器(HFO)



高頻震盪通氣的適應症

傳統模式失效

氣漏症候群-低容積策略

廣泛性肺疾病-高容積策略

低容積策略:設定平均氣道壓力比傳統模式低1-3cmH₂O

高容積策略:設定平均氣道壓力比傳統模式高1-3cmH₂O

進階呼吸支持-高頻呼吸器(HFO)

頻率及振幅的設定建議

Body weight	HFOV Hz(頻率)
< 1000 gms	15 Hz
1000 – 2000 gms	12 Hz
2 - 12 kg	10 Hz
13 - 20 kg	8 Hz
21 - 30 kg	7 Hz
> 30 kg	6 Hz

振幅：觀察胸壁有振盪之情形，但須避免震盪過大

進階呼吸支持-高頻呼吸器(HFO)

➤ Oxygen(O₂)

- Mean airway pressure (MAP)
- FiO₂

➤ Ventilation(CO₂)

- ΔP (Amplitude)
- Frequency (Hz)
- Alveolar ventilation during HFV= ($f \times VT^2$)

Gas exchange during HFV

CO2 management

Conventional mode:

CO2 high: Rate / PC(volume): 

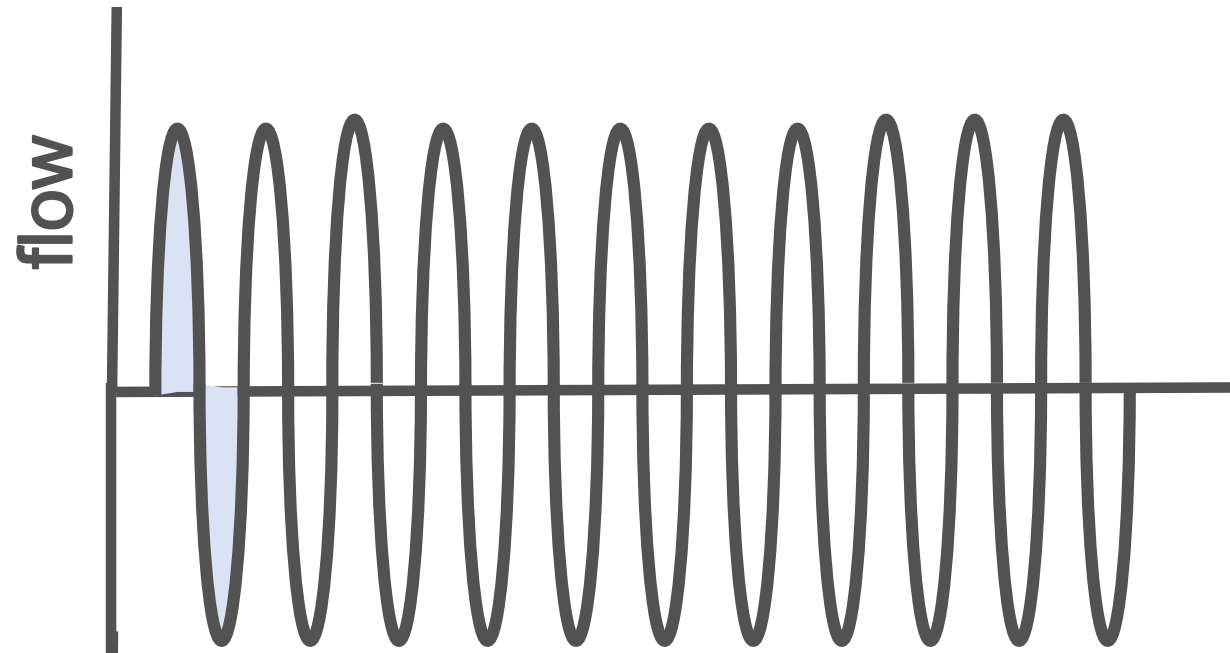
CO2 low: Rate / PC(volume): 

HFO mode:

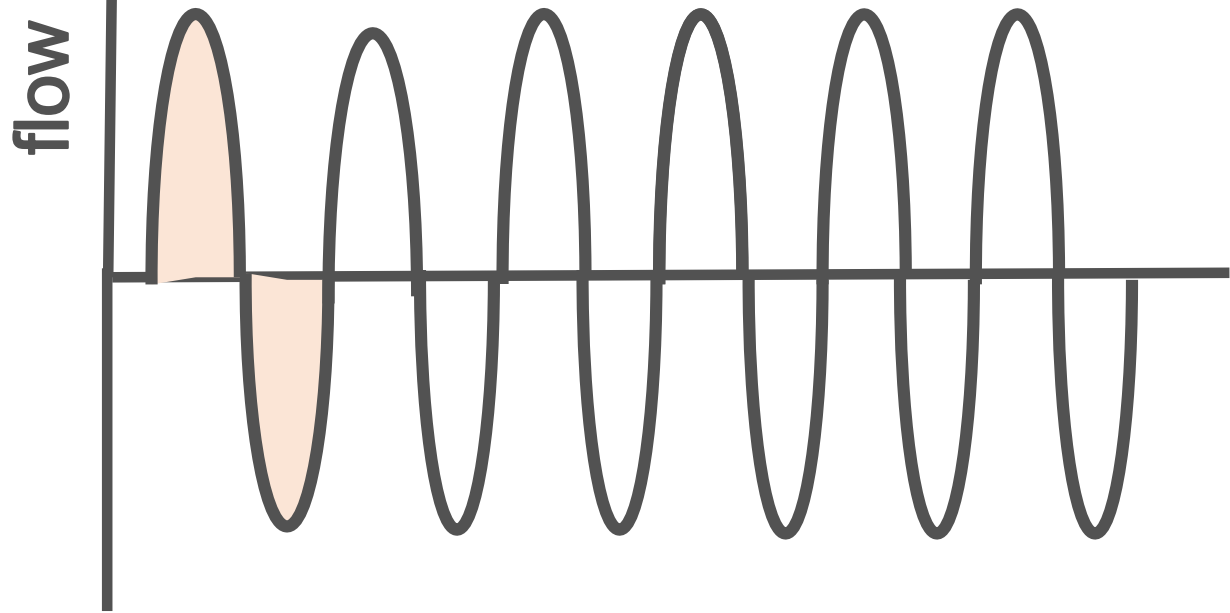
CO2 high: ΔP (Amplitude)  Hz: 

CO2 low: ΔP (Amplitude)  Hz: 

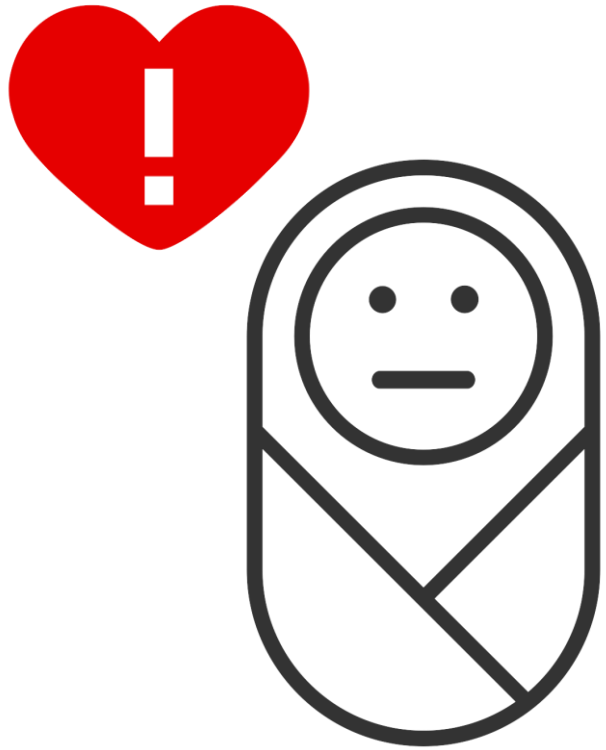
Attention!!



Time (sec) **15HZ**



Time (sec) **10HZ**



Apnea

Bradycardia

Cyanosis

一位37周，體重 3250gm 的新生兒

因呼吸窘迫插管使用呼吸器條件如下：

Mode	RATE	Ti	PIP	PEEP	FiO2
IMV	25	0.6	25	6	50%

ABG Data:

pH: 7.24

PaO₂: 124.5

PaCO₂: 68

HCO₃: 24.6

BE: 1.2

SaO₂: 100%

該如何調整呼吸器呢？



一位**37周**，體重 **3250gm**的新生兒

因呼吸窘迫插管使用呼吸器條件如下：

Mode	RATE	Ti	PIP	PEEP	FiO2
IMV	25	0.6	25	6	50%

ABG DATA:

pH:	7.24
PaO ₂ :	124.5
PaCO ₂ :	68
HCO ₃ :	24.6
BE:	1.2
SaO ₂ :	100%

條件、限制、問題!!



一位**37周**，體重 **3250gm**的新生兒

因呼吸窘迫插管使用呼吸器條件如下：

Mode	RATE	Ti	PIP	PEEP	FiO2	Mode	RATE	PIP	FiO2
IMV	25	0.6	25	6	50%	IMV	30	25	40%

ABG DATA:

pH: 7.34

PaO₂: 96

PaCO₂: 50

HCO₃: 24.2

BE: 1.0

SaO₂: 97%

做出相應的調整!!
並繼續觀察



一位33周，體重 2200gm的新生兒

因呼吸窘迫插管使用呼吸器條件如下：

Mode	RATE	Ti	PIP	PEEP	FiO2
IMV	20	0.5	15	5	35%

ABG Data:

pH: 7.2

PaO₂: 44

PaCO₂: 70

HCO₃: 26.9

BE: 6.2

SaO₂: 77%

該如何調整呼吸器呢？



一位**33周**，體重 **2200gm**的新生兒

因呼吸窘迫插管使用呼吸器條件如下：

Mode	RATE	Ti	PIP	PEEP	FiO2
IMV	20	0.5	15	5	35%

ABG DATA:

pH:	7.2
PaO ₂ :	44
PaCO ₂ :	70
HCO ₃ :	26.9
BE:	6.2
SaO ₂ :	77%

條件、限制、問題!!



一位**33周**，體重 **2200gm**的新生兒

因呼吸窘迫插管使用呼吸器條件如下：

Mode	RATE	Ti	PIP	PEEP	FiO2
IMV	20	0.5	15	5	35%

Mode	RATE	PIP	FiO2
IMV	30	20	50%

ABG DATA:

pH: 7.37

PaO₂: 64

PaCO₂: 42

HCO₃: 26.4

BE: 6.0

SaO₂: 92%

做出相應的調整!!
並繼續觀察



SLE 5000 Infant Ventilator

300g ~ 20Kg

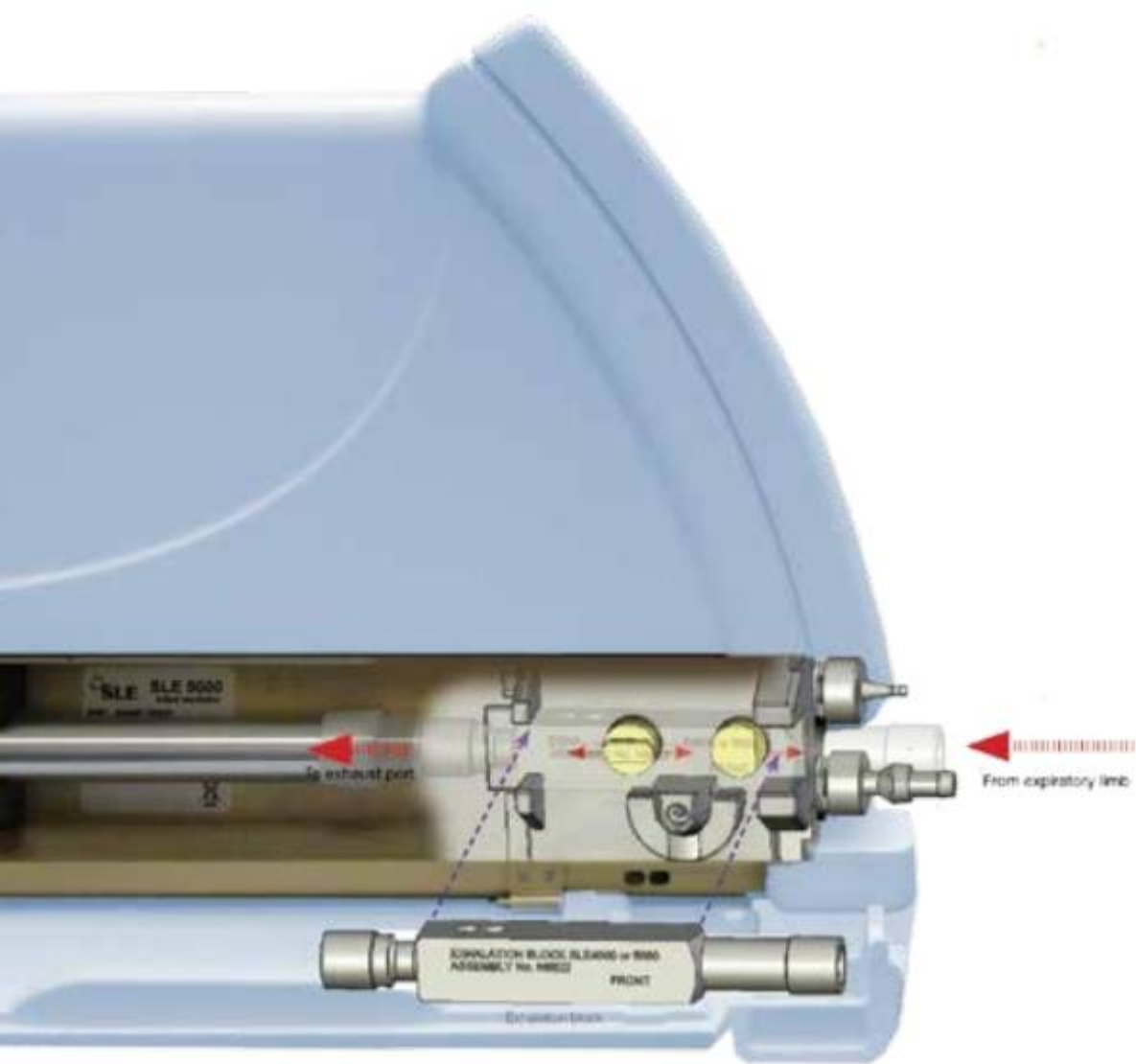
300g ~ 10Kg actually

Pressure controlled, volume targeted

Pressure limited, time cycled

High frequency oscillation ventilator(HFOV)





特殊的吐氣閥設計

觸控式面板

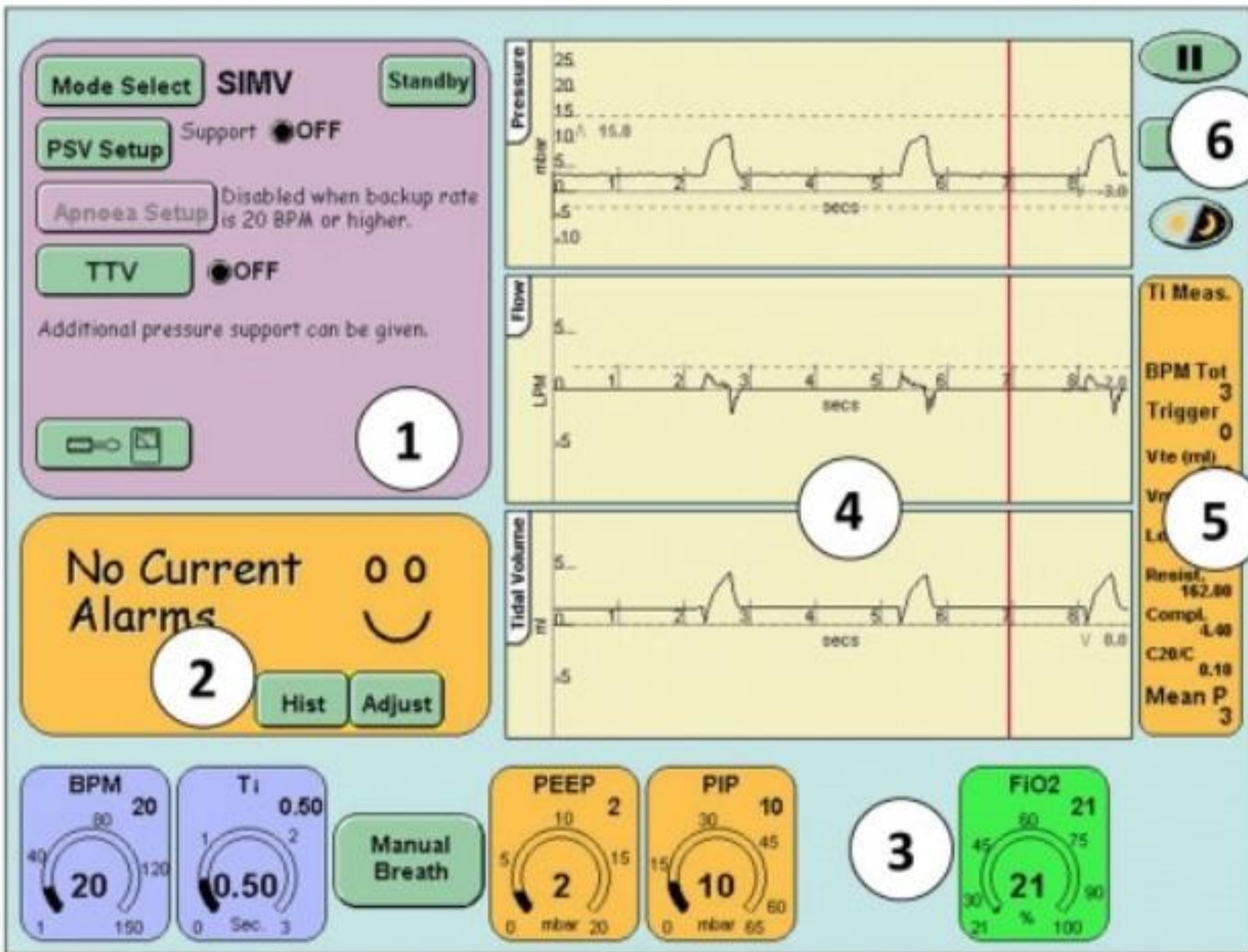
進氣端

吐氣端

壓力感側線

流量傳感器





1. Mode

2. Alarm

3. Parameter

4. Waveform

5. Data display

6. Option



Mode Select **SIMV** Standby

PSV Setup Support OFF

Apnoea Setup Disabled when backup rate is 20 BPM or higher.

TTV OFF

Additional pressure support can be given.

Ventilation Off

Mode Select

Ventilation Off	CPAP
CMV	PTV
PSV	SIMV
HFO Only	HFO+CMV

← Confirm

呼吸模式
選擇

BPM 20

Ti 0.50

Manual Breath

PEEP 2

PIP 10

FIO2 21

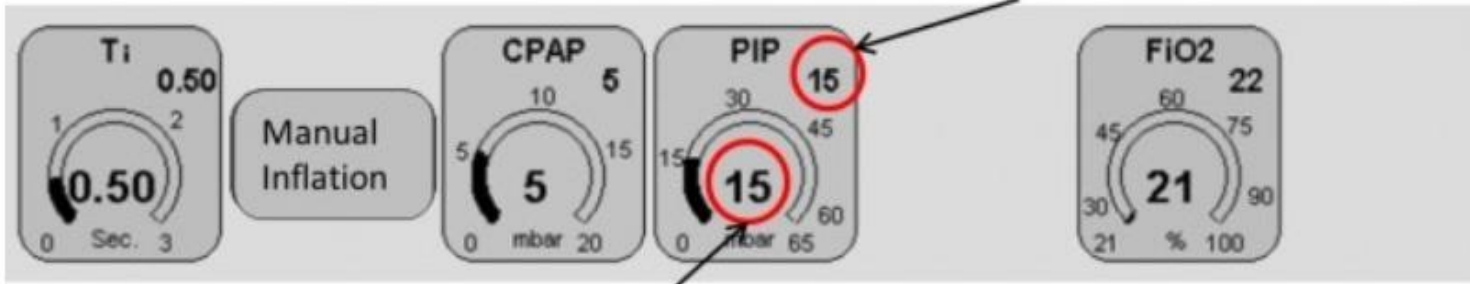






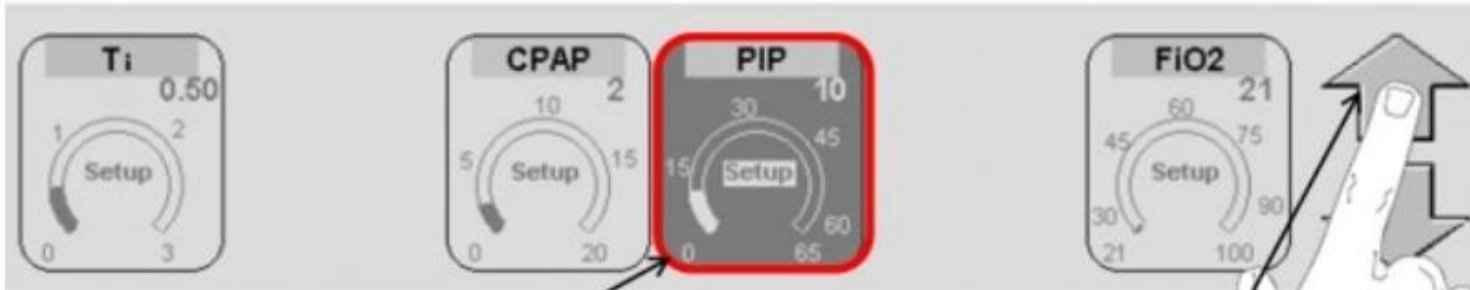
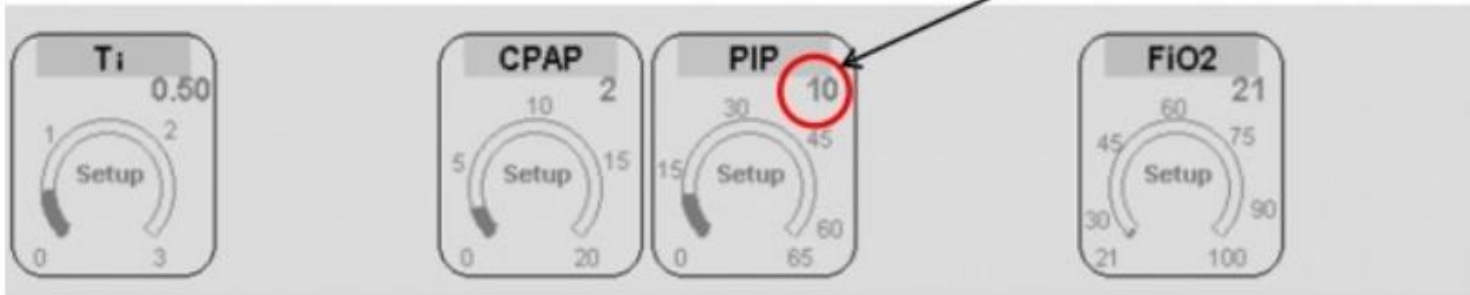

智能
設定欄位

Setting



Measured value

Pre-set value

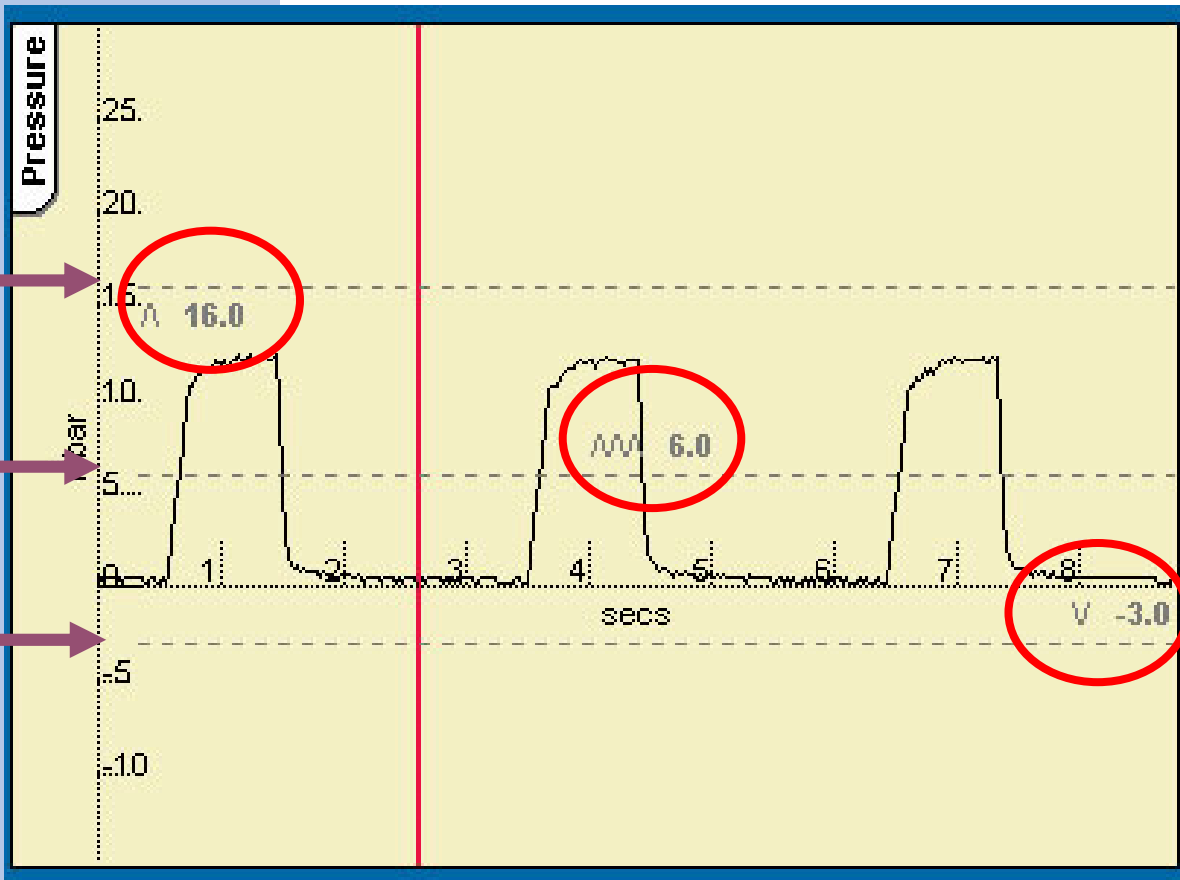


A parameter to be set is indicated in white

The selected parameter can be adjusted using the cursor buttons

參數設定

High
Cycle Fail
Low



No Current Alarms 00

Hist Adjust

SLE5000 Infant Ventilator

Mode Select HFO Standby

Alarm Panel No Current Alarms

Reset Hist Adjust

HFO I:E 1:2 HFO Rate 10 Mean 14 Delta P 36 O2% 21

Pressure 59.0

Flow 30

Total Volume 30.0

警報系統

Alarm History

1	High O2 Level		02/09:57:21
2	Calibrate Flow Sensor	NOT ACK	02/09:54:31
3	Calibrate Flow Sensor	NOT ACK	02/09:53:40
4	User Interface Failure	NOT ACK	02/09:53:35
5	Leaking Fresh Gas	NOT ACK	02/09:53:35

Reset Adjust





Thanks for your
attention!

Any Question?

呼吸治療師 張志豪