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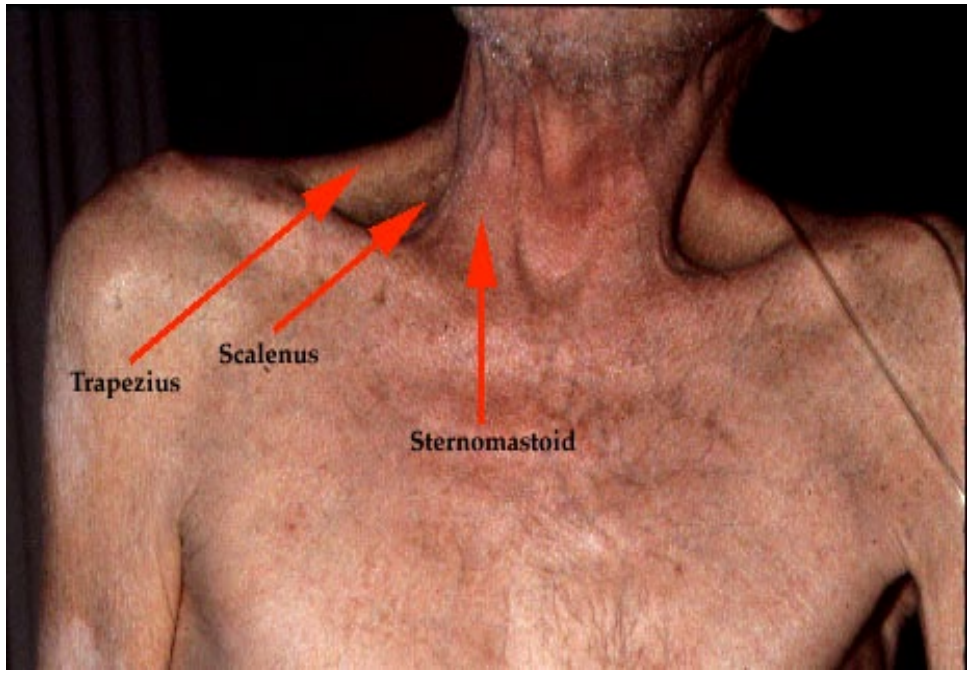
Taking NIV Further

innovation you

NIV - Goals for Use

- Avoid intubation
- Increase PaO_2
- Decrease $PaCO_2$
- Alleviate dyspnea
- Decrease WOB
  - Not to impose extra WOB due to the presence of changing leaks
- Unloading the respiratory muscles allowing them to rest
- Increase alveolar ventilation

Hypercarbic ARF



Hypoxemic ARF

Indications

- *"When feasible and not medically contraindicated, use noninvasive positive-pressure ventilation delivered continuously by face or nose mask, instead of performing endotracheal intubation in patients who are in respiratory failure and are not needing immediate intubation."*
- *"When feasible and not medically contraindicated, use NIV as part of the weaning process…"*

CDC 2004 Guidelines for Preventing Health-Care Associated Pneumonia

CDC MMWR Mar 2004; 53: RR-3

Patient Selection Considerations in Acute Applications

- **Strong evidence**
  - CHF
  - COPD exacerbation
  - Facilitating weaning of COPD
  - Immunocompromised patients
- **Weak evidence**
  - Partial UAW obstruction
  - ARDS
  - Trauma

- **Moderately strong evidence**
  - Asthma
  - Cystic Fibrosis
  - Postoperative RF
  - Avoidance of extubation failure
  - DNI patients

Strong = multiple controlled trials

Moderately strong = single controlled trial or multiple case series

Weak = a few case series or case reports

Acute Applications of Noninvasive Positive Pressure Ventilation; T. Liesching, H. Kwok, N. Hill; *Chest 2003;124:699-713*

Physiologic criteria for NIV consideration

- Moderate to severe respiratory distress
- Tachypnea (RR > 24 BPM)
- Use of accessory muscle or paradoxical abdominal breathing
- Gas exchange
  - pH < 7.35
  - $PaCO_2$ > 45 mm Hg
  - PaO_2:FiO_2 < 200 mm Hg

Respir Care 2004. Vol. 49 (1):72-89

NIV – Contraindications

- Patient is not breathing spontaneously
- Patient’s airway is compromised
- Cardiovascular problems
- Patient is unable to clear secretions
- No improvement on NIV in first two hours of implementation
- Unable to adapt a mask interface
- Uncooperative patient

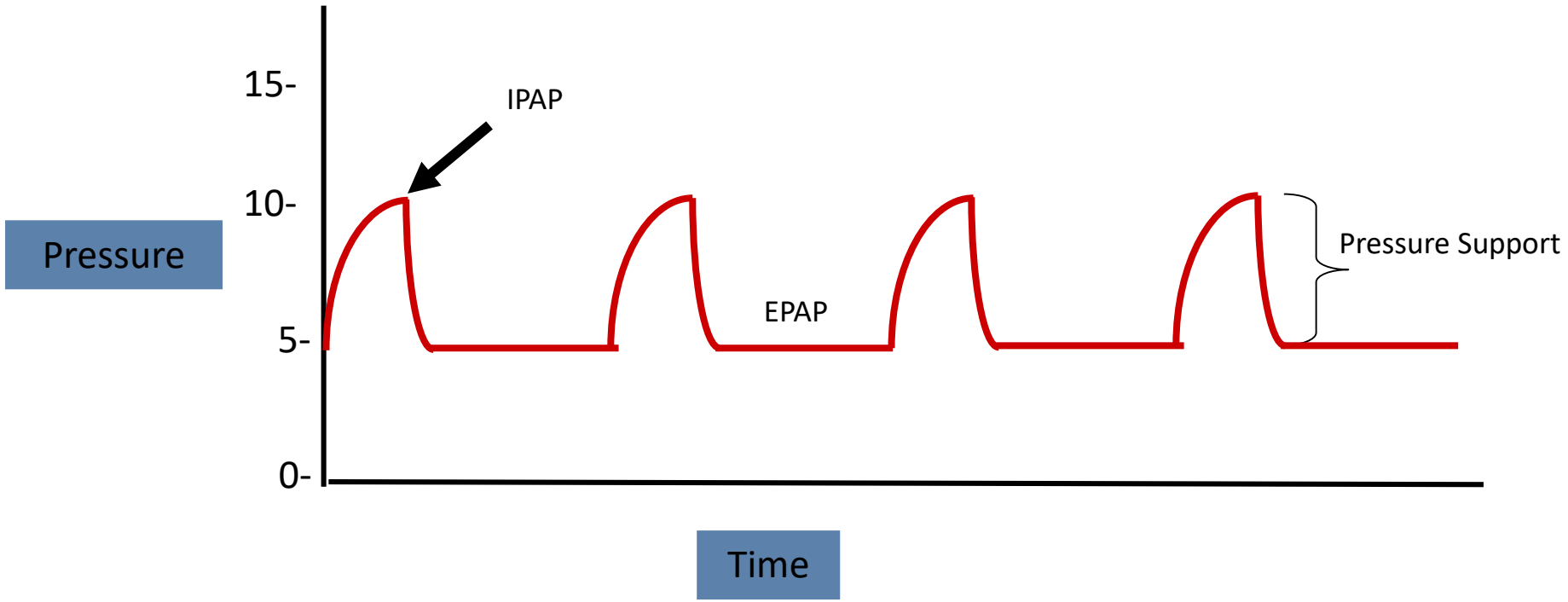
IPAP

- Adjust IPAP to Establish Pressure Support
- PS = IPAP – EPAP
- Augment Ventilation
  - Increase tidal volume
  - Decrease CO2
- Relieve dyspnea
- Rest respiratory muscles
  - Reduce work of breathing

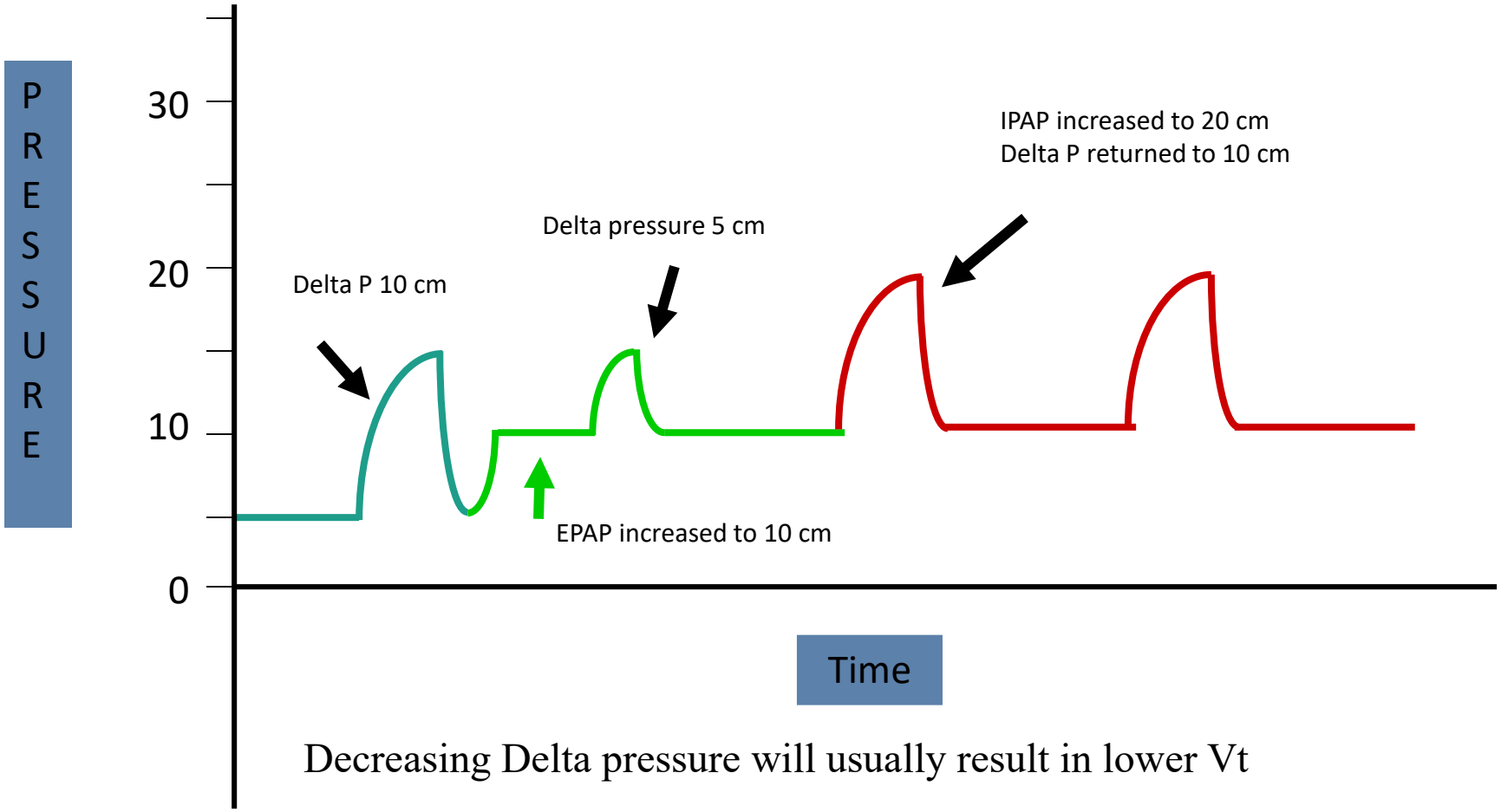
EPAP

- EPAP = PEEP
- Increase FRC
  - Improve oxygenation
  - Reduce work associated with Auto PEEP
  - Stabilize upper airway (OSA)

BiPAP



Changes In EPAP Pressure



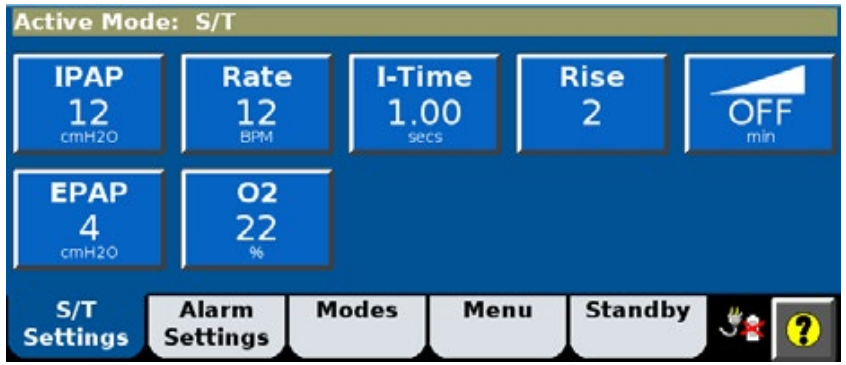
Decreasing Delta pressure will usually result in lower Vt

Taking NIV further

The **Respironics V60** Ventilator gives you the confidence to treat a wider range of patients

V60 NIV Modes

- ST

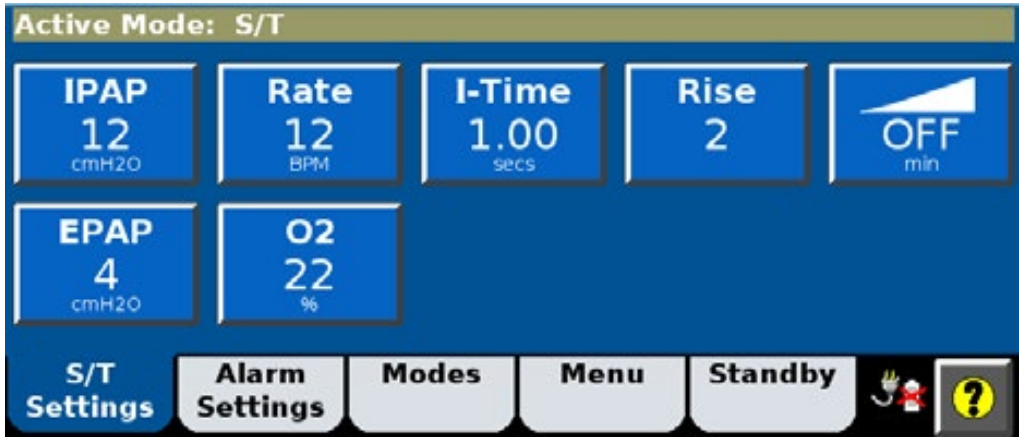


- AVAPS

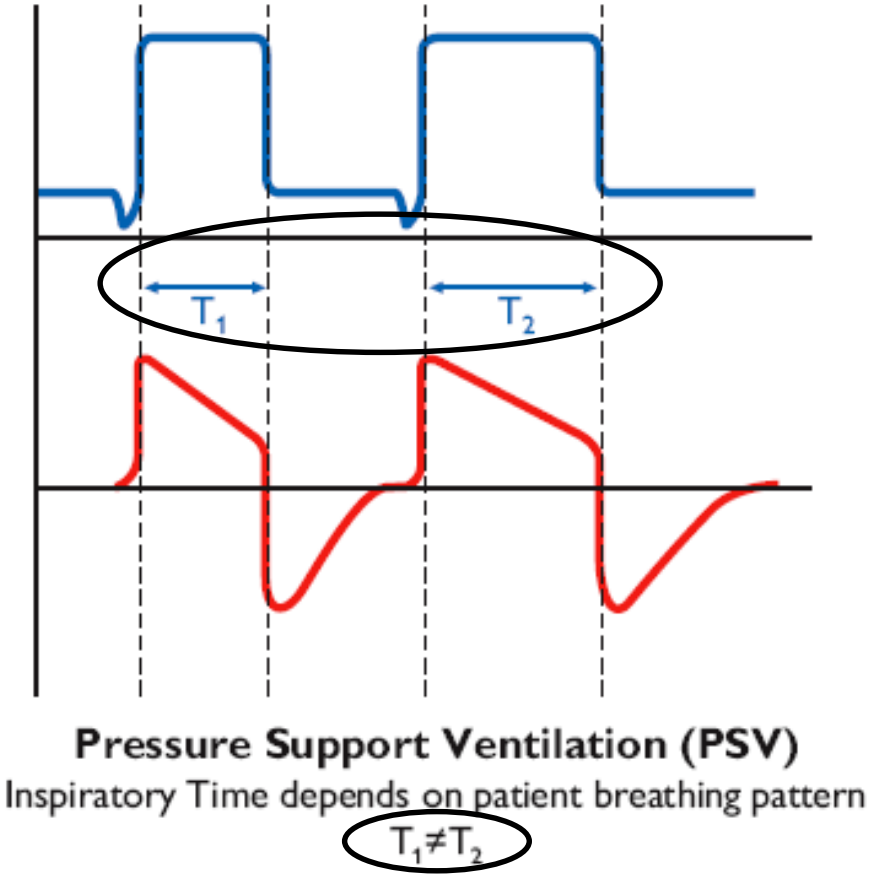
- CPAP with C-Flex

What is S/T (Spontaneous Timed)?

- In S/T ventilation, a set IPAP pressure and a set EPAP pressure is delivered to the patient
  - The patient controls the inspiratory time
  - In the S/T mode, a timed breath is only delivered if the patient rate drops below the set backup rate.
  - A mandatory breath is only delivered at a set I-Time when the patient doesn't meet the rate.

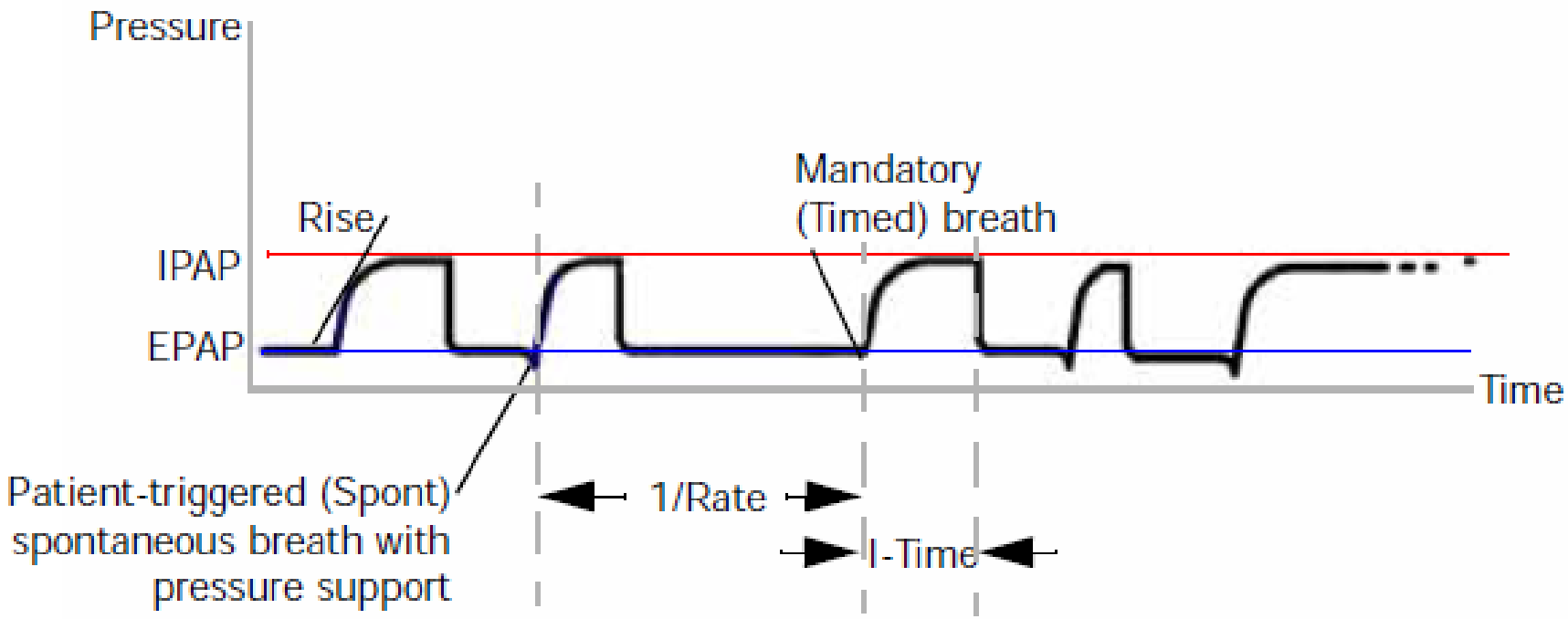


Pressure Support Ventilation – S/T



- Patient or machine triggered
- Flow cycled if spontaneous breath
- Time cycled if machine triggered breath
- TV is variable depending:
  - Pressure support level
  - Inspiratory time

ST Pressure Waveform



Average Volume Assured Pressure Support

AVAPS

AVAPS

- What is AVAPS
  - Average volume-assured pressure support
  - Vent automatically modifies pressure to maintain an average target user-defined VT
    - 1 cmH_2O to possibly 2.5 cmH_20 per minute change in pressure per minute
  - During AVAPS setup, there may be a period of time before the target tidal volume is achieved
  - AVAPS **should not** be used when rapid IPAP adjustments are needed to achieve the desired VT

AVAPS

- This mode is not a PRVC type mode
  - –It will **not** respond quickly
- Not intended for patients with **high resistance and low compliance**
  - –Patients should be through their acute phase
- It is ideal for stabilized chronic patients
- **Do not use a nasal mask when in the AVAPS mode**

AVAPS - Setup

- AVAPS-specific settings: target VT, Min P, and Max P

Set:

- Target Vt
- Min P (which is the minimum IPAP pressure)
- Max P (maximum IPAP pressure).

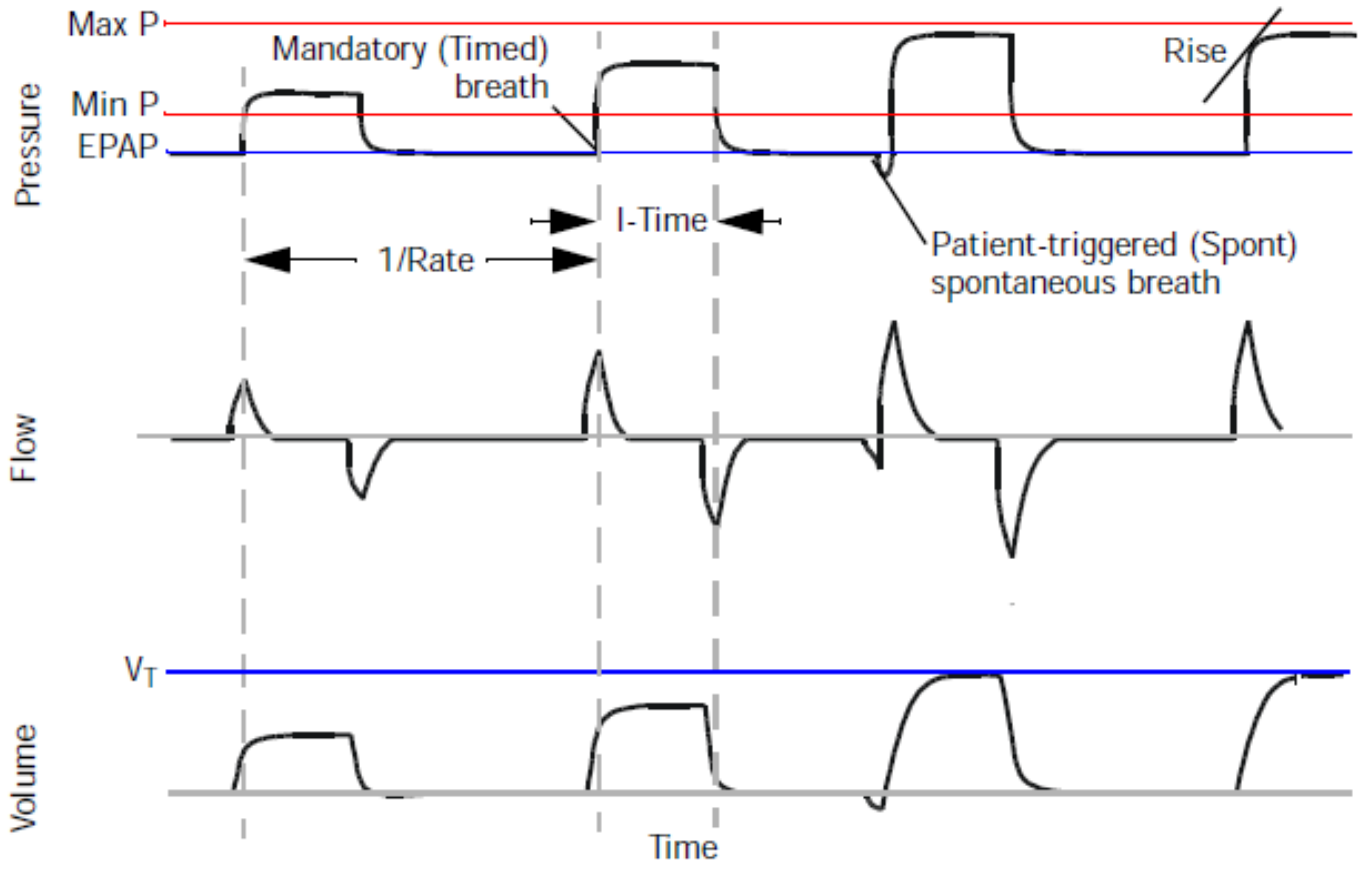
The best way: observe the set EPAP/IPAP and Vt readings on S/T mode.

Set Min P at what IPAP value was on S/T.

Set Max P above Min P so that the patient will be able to achieve an increased flow/pressure when needed.

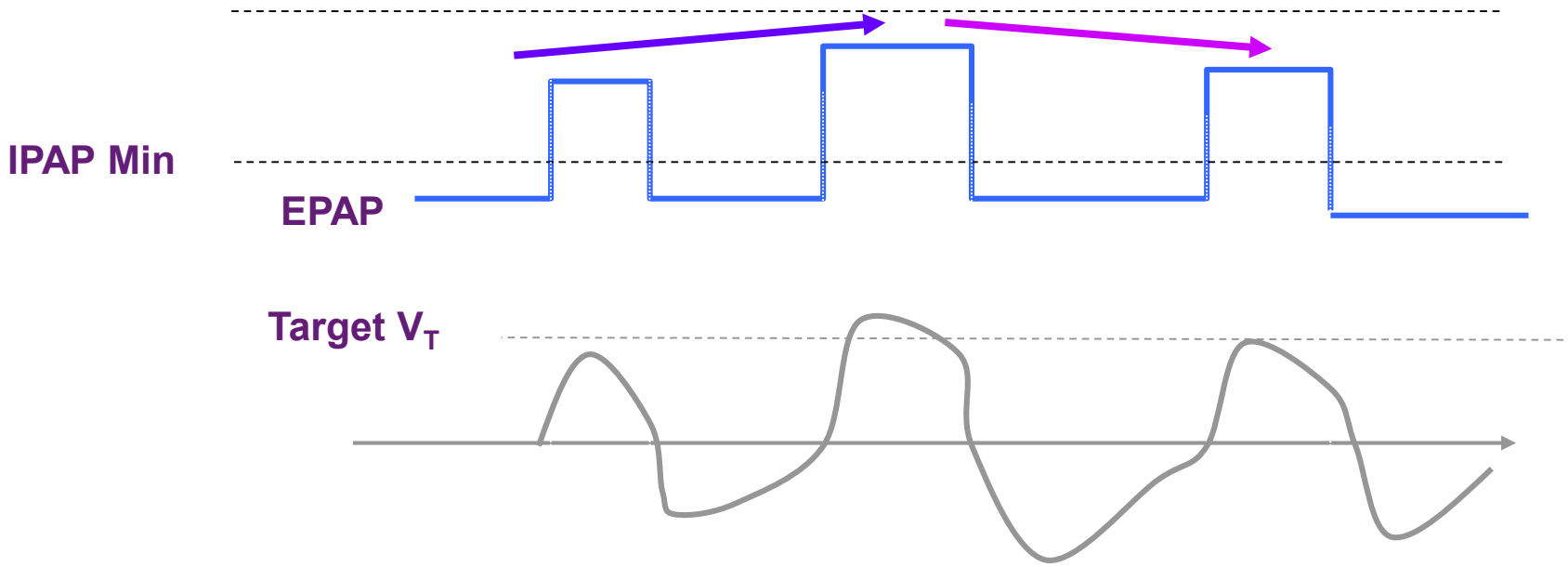
If calculated target pressure is outside Min P or Max P range, the target tidal volume will not be achieved.

Principles of Operation



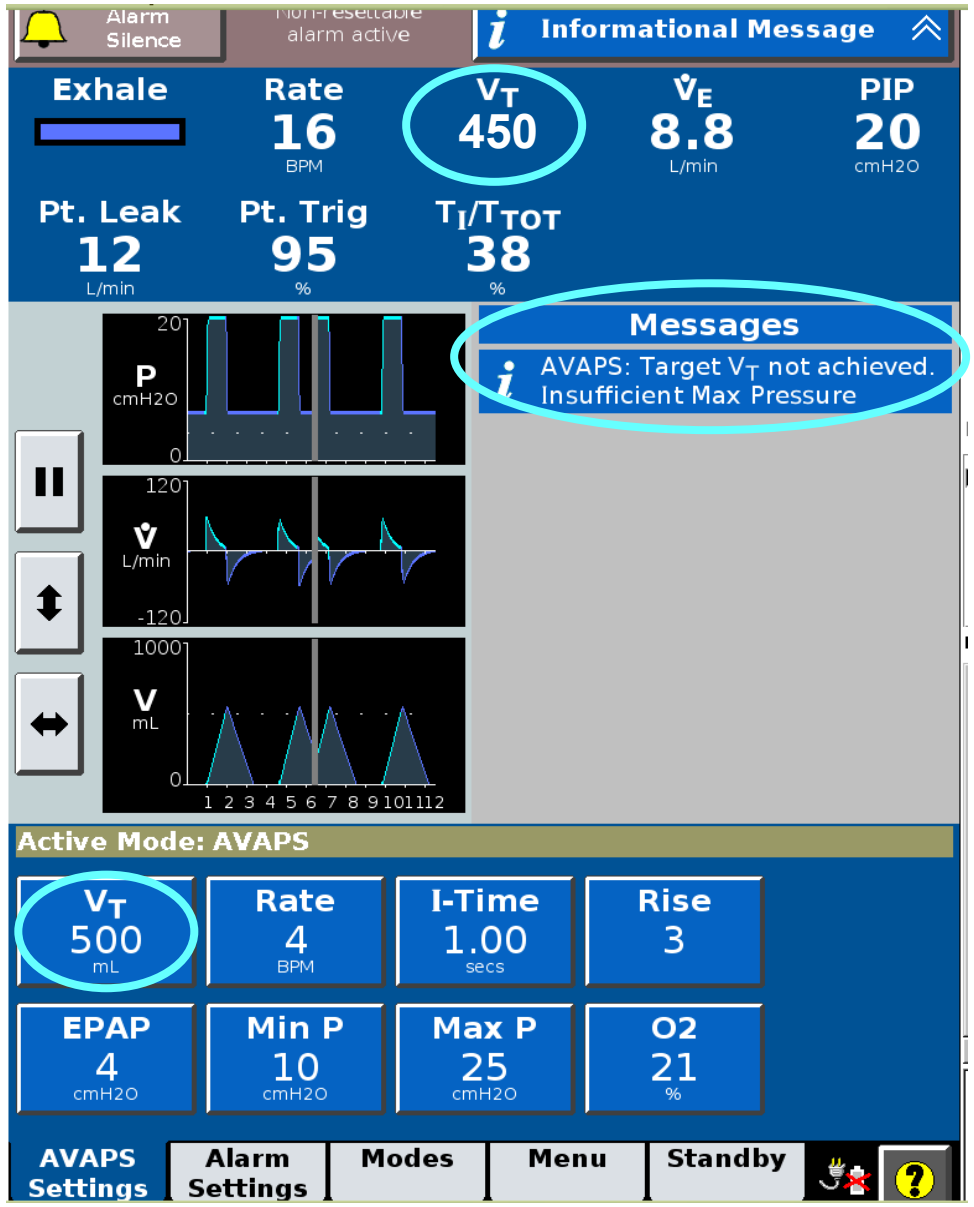
Average volume-assured pressure support

AVAPS automatically adapts pressure support (< 2.5 cmH_2O) per minute to guarantee an average tidal volume



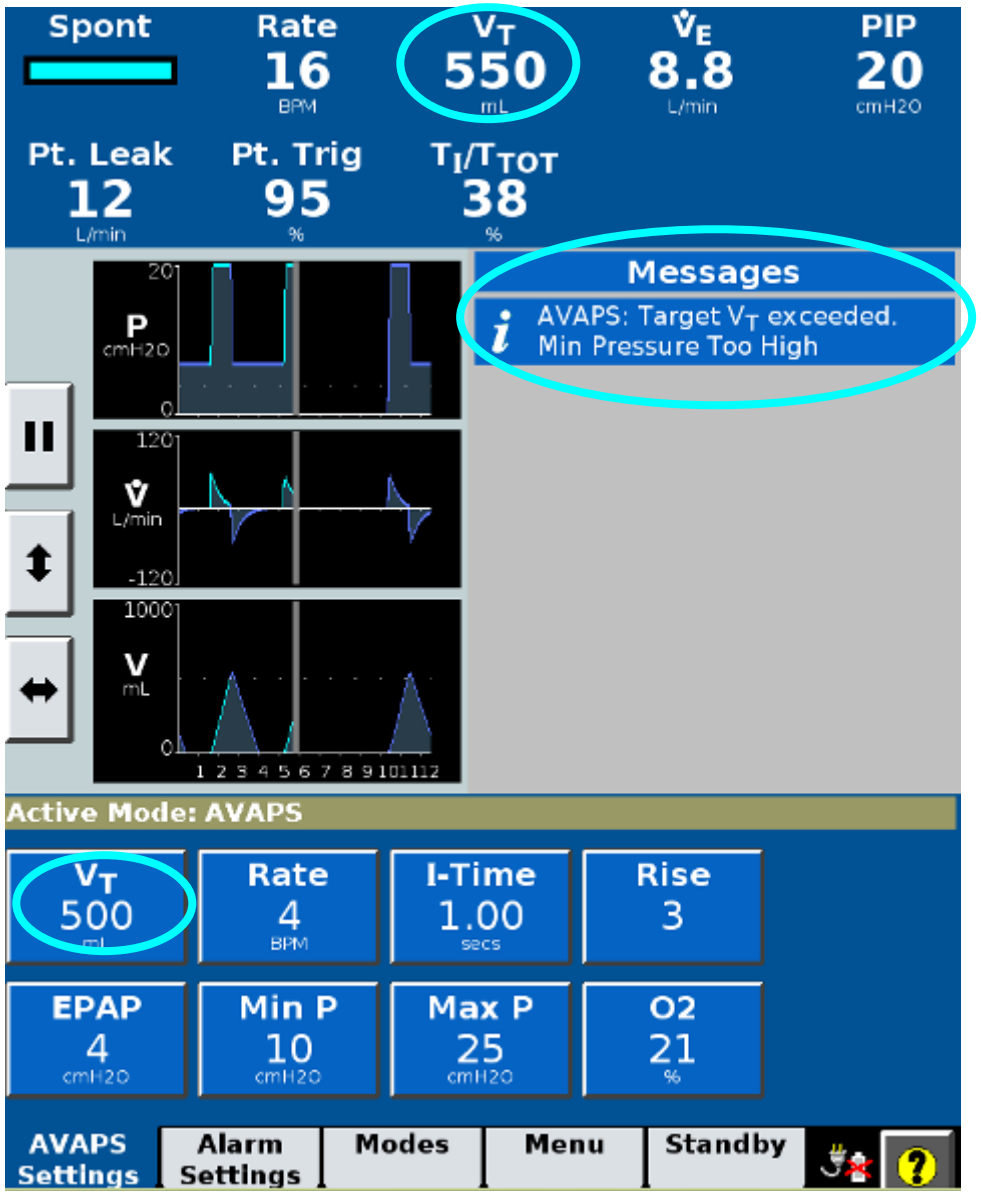
AVAPS alarm

- If target VT is not achieved due to insufficient Max P
  - Information message will appear
  - **You have to set a Low VT alarm in order to have an audible alert**
    - Low VT delayed for 2 minutes after activation of AVAPS



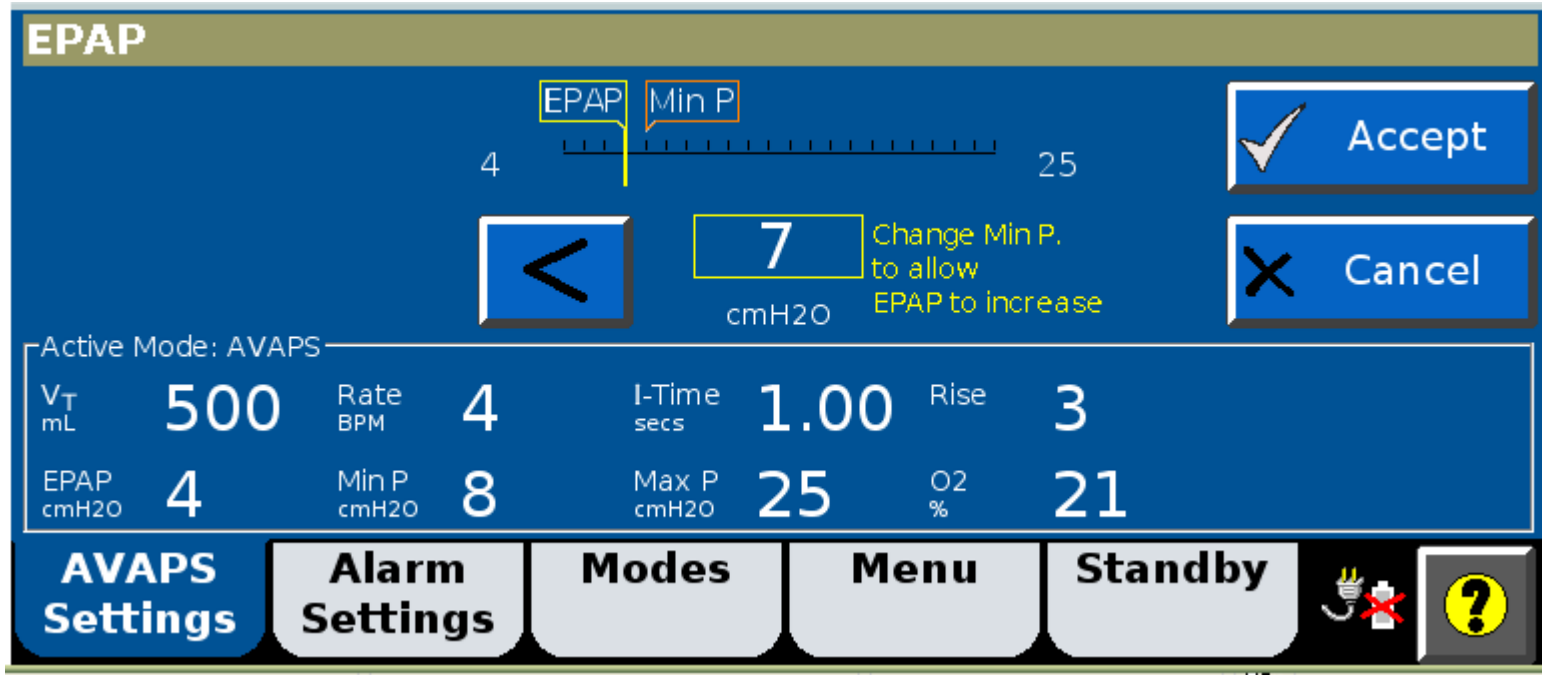
AVAPS alarms

- If target VT is exceeded due to Min P set too high
  - Information message will appear
  - **You have to set a a high VT alarm to have an audible alert**



EPAP relative to Min P

EPAP is limited to values less than Min P – 1 cmH_20



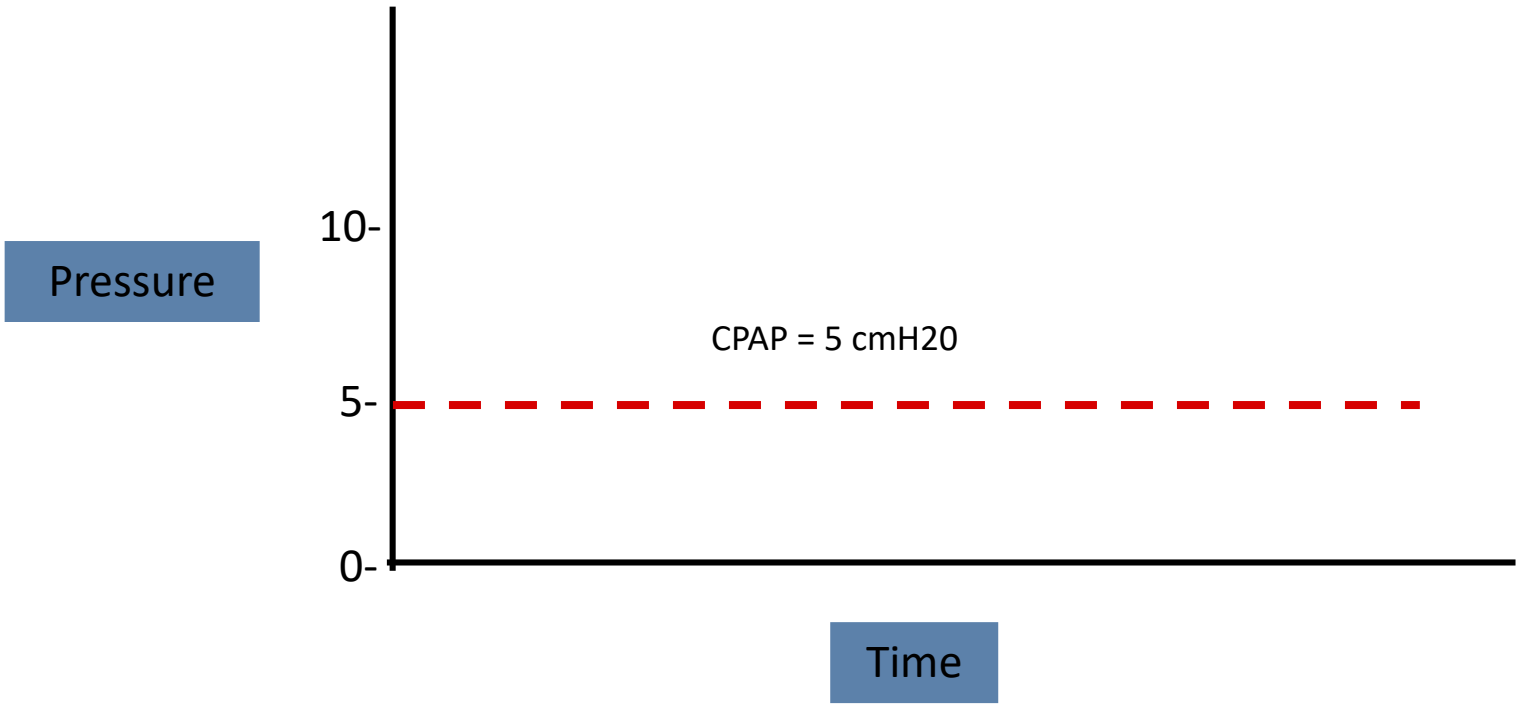
In this example Min P must be ↑ before EPAP can be ↑

AVAPS

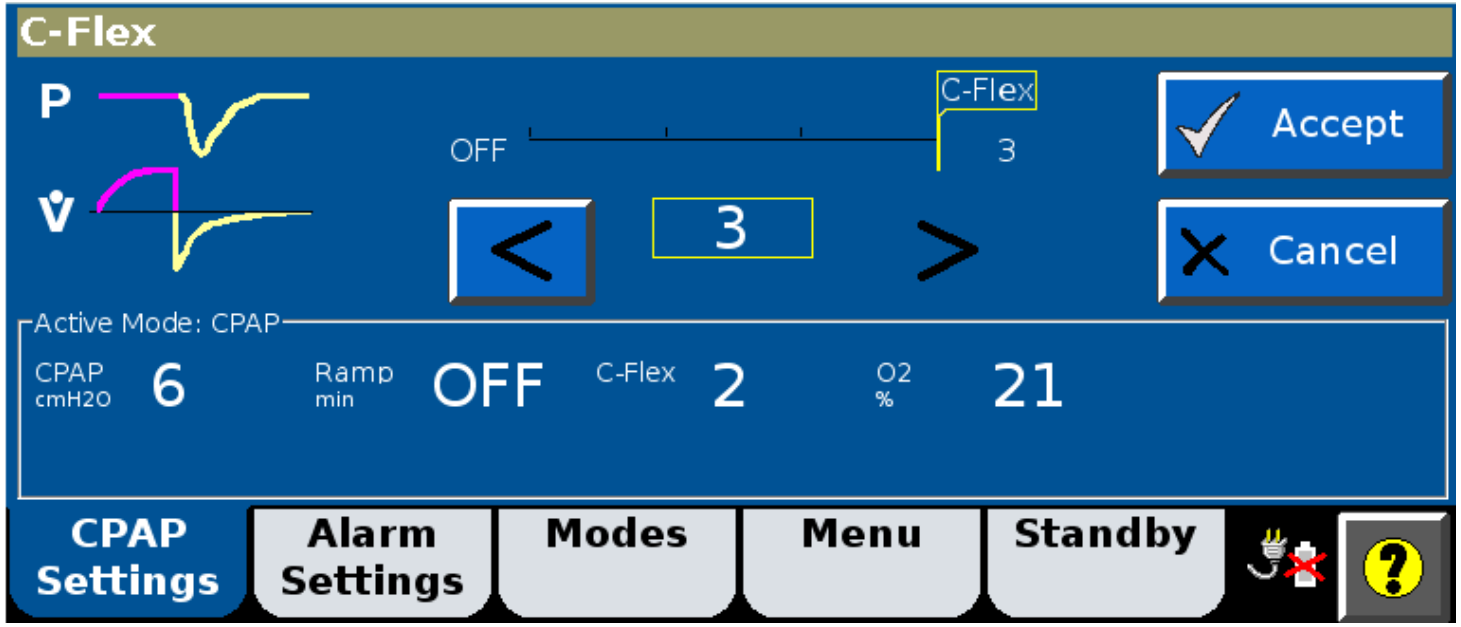
- Neuromuscular disorders
  - With standard bi-level therapy, a patient's tidal volume declines as disease process worsens
- Restrictive thoracic disorder
  - Chest wall deformities (e.g. kyphoscoliosis)
  - Slow progressive disease
- Obesity hypo-ventilation syndrome
  - A change in body position increases airway resistance
  - Without an increase in pressure support, VT declines
- In short, any chronic disease process that is past the acute phase (e.g. COPD, CHF)

CPAP with C-flex

CPAP (Continuous Positive Airway Pressure)



C-Flex


C-Flex
P
V
OFF
C-Flex
3
Accept
Cancel
3
Active Mode: CPAP
CPAP
cmH2O
6
Ramp
min
OFF
C-Flex
2
O2
%
21
CPAP Settings
Alarm Settings
Modes
Menu
Standby

What is C-Flex?

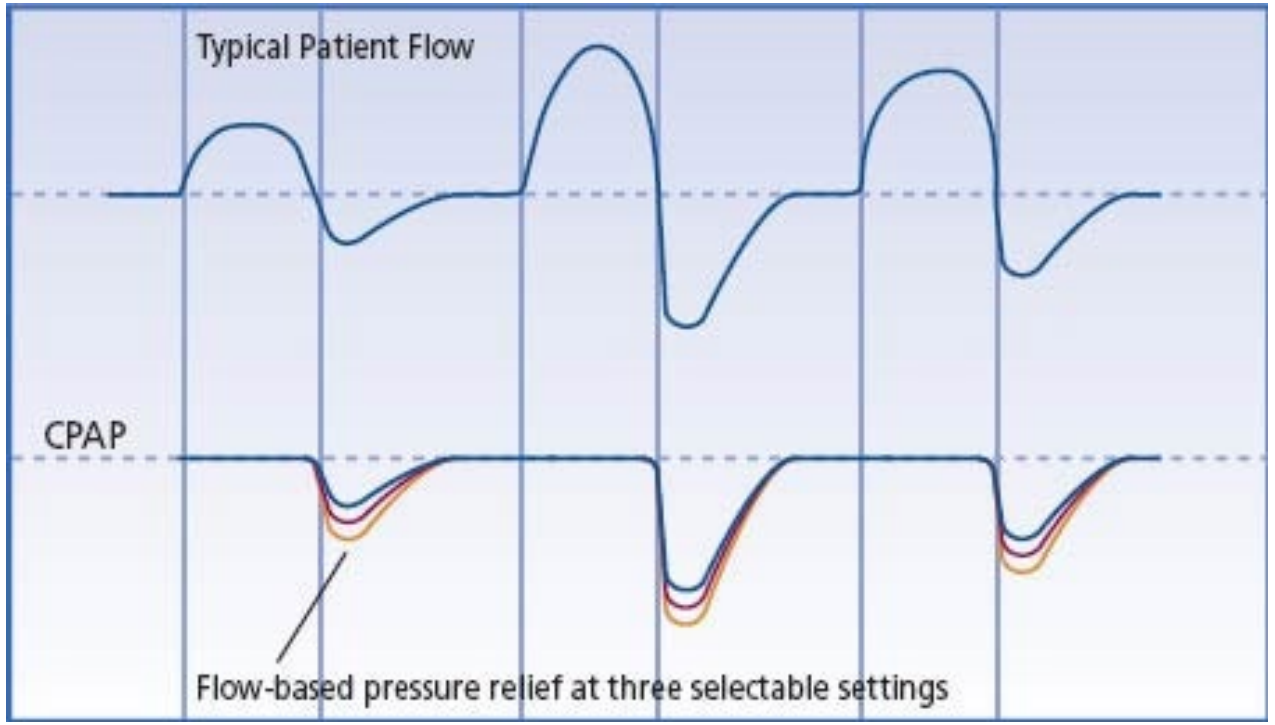
- C-Flex is an option on the V60
  - Only available in CPAP Mode
- C-Flex enhances traditional CPAP by reducing the pressure at the beginning of exhalation
  - This is when patients are often uncomfortable with CPAP
  - C-Flex returns to the set CPAP pressure before the end of exhalation
- Should not be used in patients requiring CPAP for oxygenation purposes

C-Flex

- The amount of pressure relief is determined by the C-Flex setting and the expiratory flow of the patient
  - The higher the setting number (1, 2 or 3)
  - And the greater the expiratory flow
  - The greater the pressure relief
    - During the active part of exhalation only

C-Flex

Reduces pressure at the beginning of exhalation and returns to therapeutic pressure just before inhalation



Pressure relief varies on flow and C-Flex setting

Sleep Breath (2009) 13:73–77
DOI 10.1007/s11325-008-0199-1

ORIGINAL ARTICLE

Longitudinal comparison study of pressure relief (C-Flex™) vs. CPAP in OSA patients

Diana C. Dolan · Renata Okonkwo · Florian Gfullner · J. Randall Hansbrough · Richard J. Strobel · Leon Rosenthal

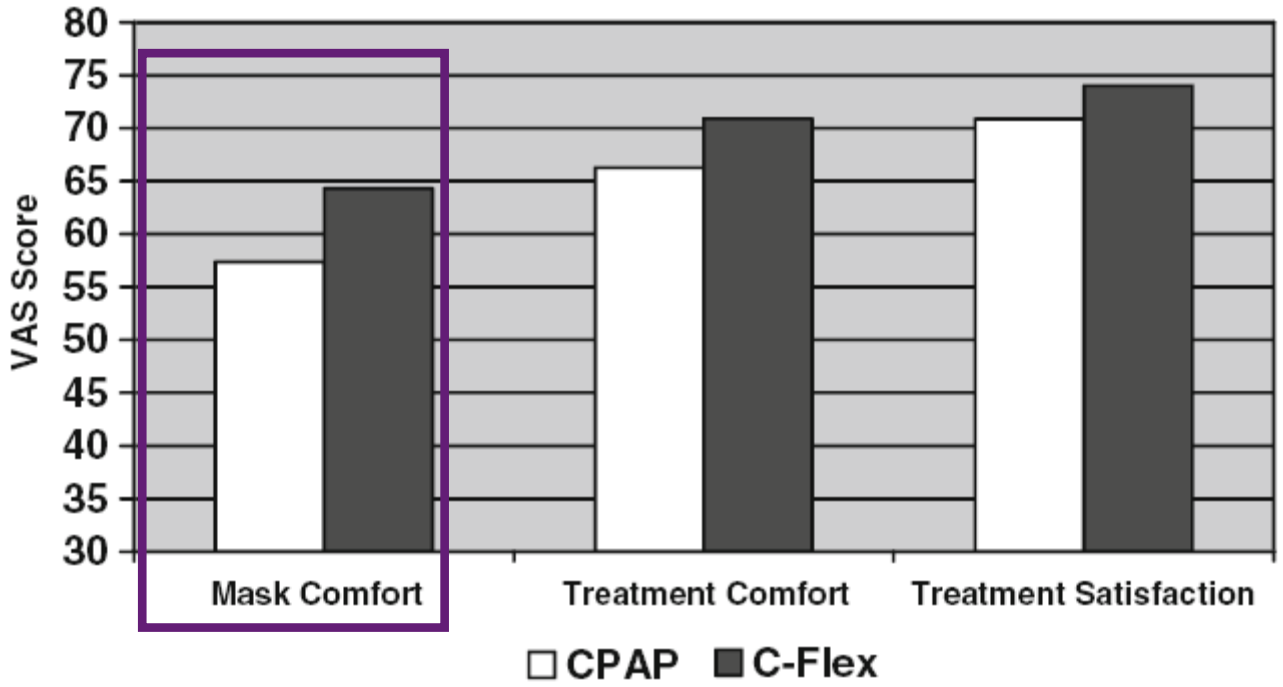


Fig. 2 Comparison of the ratings on the *VAS* scores by treatment. Possible scores range from 0 to 100. There was a main effect of mask comfort (p=.01)

C-Flex support literature

Sleep Breath (2008) 12:393–396
DOI 10.1007/s11325-008-0189-3

SHORT COMMUNICATION

Randomised trial of compliance with flexible (C-Flex) and standard continuous positive airway pressure for severe obstructive sleep apnea

Nathaniel S. Marshall · Alister M. Neill · Angela J. Campbell

This randomised trial provides some evidence that C-Flex might increase initial treatment compliance, compared to CPAP, in patients with severe OSA. However, this trend toward greater compliance was not associated with better short-term treatment outcomes for patients. These findings need to be confirmed in a larger, longer-term trial.

C-Flex support literature

Sleep Breath (2007) 11:31–37
DOI 10.1007/s11325-006-0078-6

ORIGINAL ARTICLE

Efficacy and patient satisfaction with autoadjusting CPAP with variable expiratory pressure vs standard CPAP: a two-night randomized crossover trial

A. T. Mulgrew · R. Cheema · J. Fleetham · C. F. Ryan · N. T. Ayas

C-Flex eliminates sleep disordered breathing as effectively as standard CPAP. Patients indicated a preference for APAP with C-Flex suggesting a possible advantage in terms of patient adherence for this mode of treatment.

C-Flex support literature

Treatment Adherence and Outcomes in Flexible vs Standard Continuous Positive Airway Pressure Therapy*

Mark S. Aloia, PhD; Michael Stanchina, MD; J. Todd Arnedt, PhD; Atul Malhotra, MD, FCCP; and Richard P. Millman, MD, FCCP

Conclusions: Therapy with the C-Flex device may improve overall adherence over 3 months compared to standard therapy with CPAP. Clinical outcomes do not improve consistently, but C-Flex users may be more confident about their ability to adhere to treatment. Randomized clinical trials are needed to replicate these findings. *(CHEST 2005; 127:2085–2093)*

C-Flex: Potential new indications

- Acute settings
  - Acute respiratory failure in OSAS
  - Acute respiratory failure in OHS
- Chronic settings
  - OSAS to improve tolerance and use
- Should not be used in patients requiring CPAP for oxygenation purposes

Just remember – it's CPAP!

Keys to success

The ideal NIV therapy experience

- Trained staff
- Appropriate mask selection
- Patient-to-ventilator synchrony
  - Optimum mask and ventilator performance
  - System compatibility
- Patient compliance
- Patient coaching and earning trust
- Wound Care Nurse, Nurse, RT
- Mask Fitting workshops

Patient Selection

1

FAVORABLE DIAGNOSES

Strong Evidence
- COPD exacerbation
- Acute pulmonary edema / CHF
- Immunocompromised patients
- Facilitate weaning of COPD patients

Intermediate Evidence
- Asthma
- Community-acquired pneumonia in COPD patients
- COPD & CHF patients with DNR/DNI status
- Post-operative respiratory failure (lung resection, bariatric, CABG)

Weaker Evidence (CAUTION)
- ARDS with single-organ involvement
- Community-acquired pneumonia (non-COPD patients)
- Cystic fibrosis
- Neuromuscular disease/scoliosis
- OSA/obesity hypoventilation
- Upper airway obstruction

2

UNFAVORABLE DIAGNOSES
- End-stage pulmonary fibrosis
- Severe ARDS (multi-organ failure)
- Upper-airway or esophageal surgery
- Upper-airway obstruction with high risk for occlusion

CONTRAINDICATED
- Cardiac/respiratory arrest
- Medically unstable (hypotensive shock, uncontrolled cardiac ischemia or arrhythmias)
- Unable to protect airway (impaired cough or swallowing)
- Excessive secretions
- Facial surgery, trauma, burns, or deformity preventing mask fit
- Severe UGI bleeding
- Agitated or uncooperative
- Untreated pneumothorax
- Multi-organ system failure

If unfavorable diagnosis or a contra-indication is present, consider intubation.

3

SIGNS AND SYMPTOMS

If a spontaneously breathing patient with moderate to severe respiratory distress presents with one or more of the following consider NIV:
- Accessory muscle use
- Paradoxical breathing
- RR > 24 (hypercapnic)
- RR > 30 (hypoxemic)

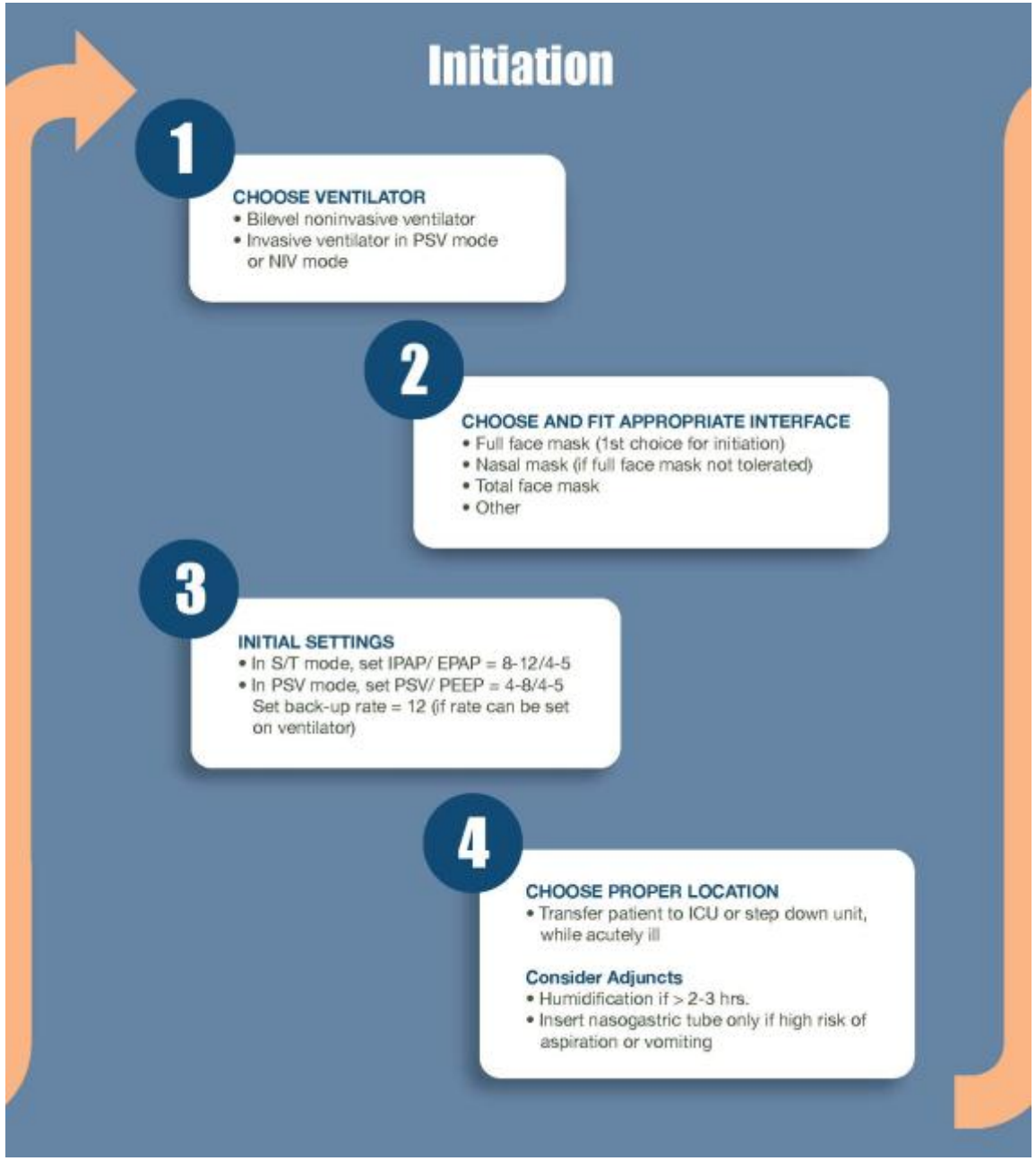
If not, consider other therapy

4

GAS EXCHANGE CRITERIA

If patient falls within the criteria below, initiate NIV (do not await ABG results in severely dyspneic patient):
- $PaCO_2 \geq 45$ mm Hg (hypercapnic)
- pH 7.10 - 7.35
- Hypoxemic respiratory failure with $PaO_2/FiO_2 < 300$

If acuity increases, consider intubation (especially if SAPS II ≥ 34 or P/F < 100)


Initiation
1
CHOOSE VENTILATOR
• Bilevel noninvasive ventilator
• Invasive ventilator in PSV mode or NIV mode
2
CHOOSE AND FIT APPROPRIATE INTERFACE
• Full face mask (1st choice for initiation)
• Nasal mask (if full face mask not tolerated)
• Total face mask
• Other
3
INITIAL SETTINGS
• In S/T mode, set IPAP/ EPAP = 8-12/4-5
• In PSV mode, set PSV/ PEEP = 4-8/4-5
Set back-up rate = 12 (if rate can be set on ventilator)
4
CHOOSE PROPER LOCATION
• Transfer patient to ICU or step down unit, while acutely ill
Consider Adjuncts
• Humidification if > 2-3 hrs.
• Insert nasogastric tube only if high risk of aspiration or vomiting

Adaptation

1

TITRATE PRESSURES TO MEET VENTILATION NEEDS

2

ADJUST IPAP OR PSV IF: PERSISTENT RR > 24, ELEVATION OF $PaCO_2$, RESPIRATORY DISTRESS OR EXCESSIVE USE OF NECK MUSCLES

- Increase IPAP by 2-3 cm H_2O q 5 -10 minutes as tolerated
- If intolerant, check for air leak and/or poor mask fit (a small leak is OK)
- If patient is still intolerant of increased pressure, consider lowering inspiratory pressure

Optimize Patient-Ventilator Synchrony

- Coach breathing with the ventilator
- Minimize air leaks
- Optimize rise time (if available)
- Increase EPAP (If auto-PEEP)
- If synchrony remains poor, consider conscious sedation
- If delayed cycling, limit inspiratory time

3

ADJUST EPAP or PEEP (and IPAP or PSV)

If:

- Inadequate oxygenation
- Significant auto-PEEP

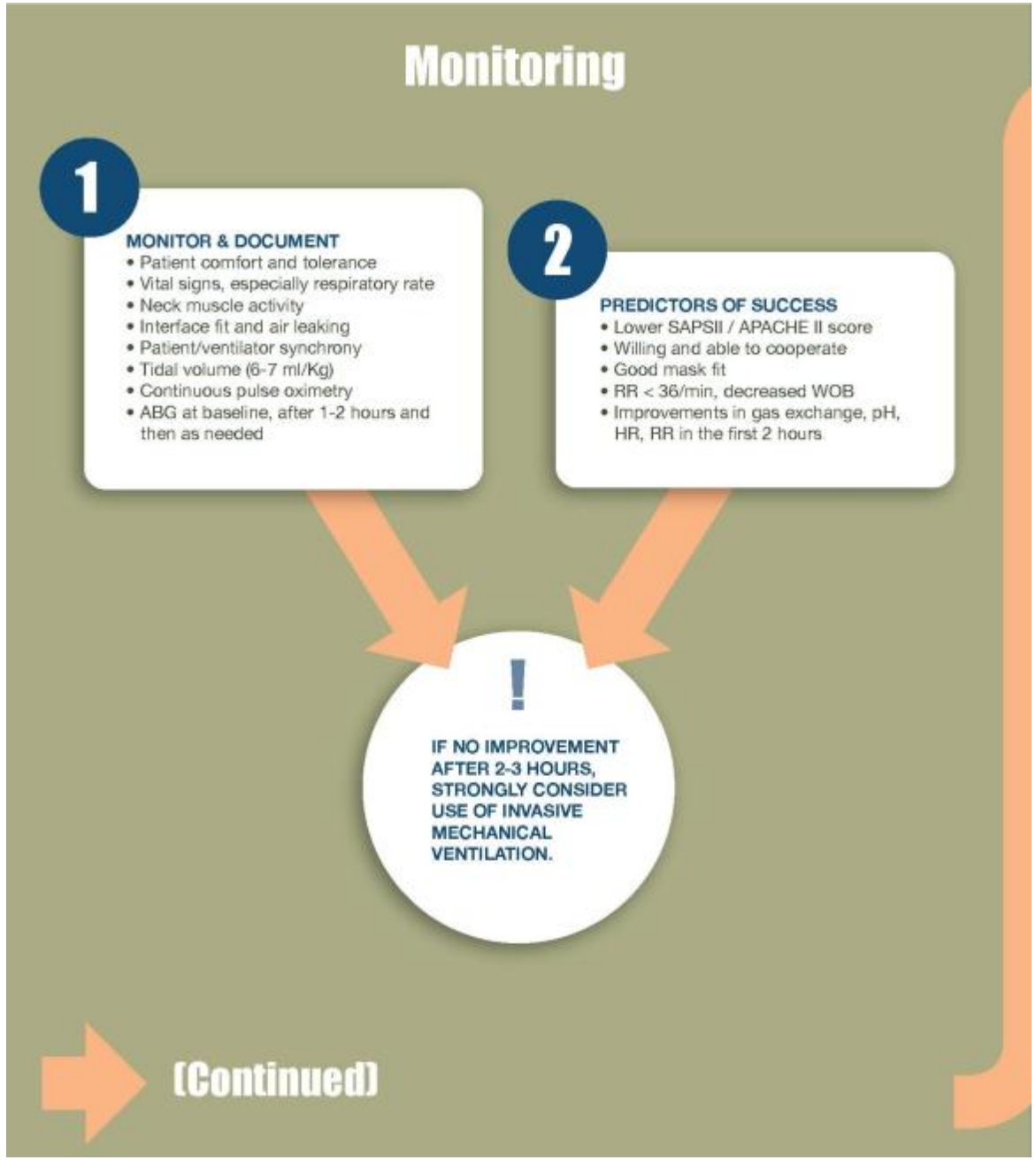
Then:

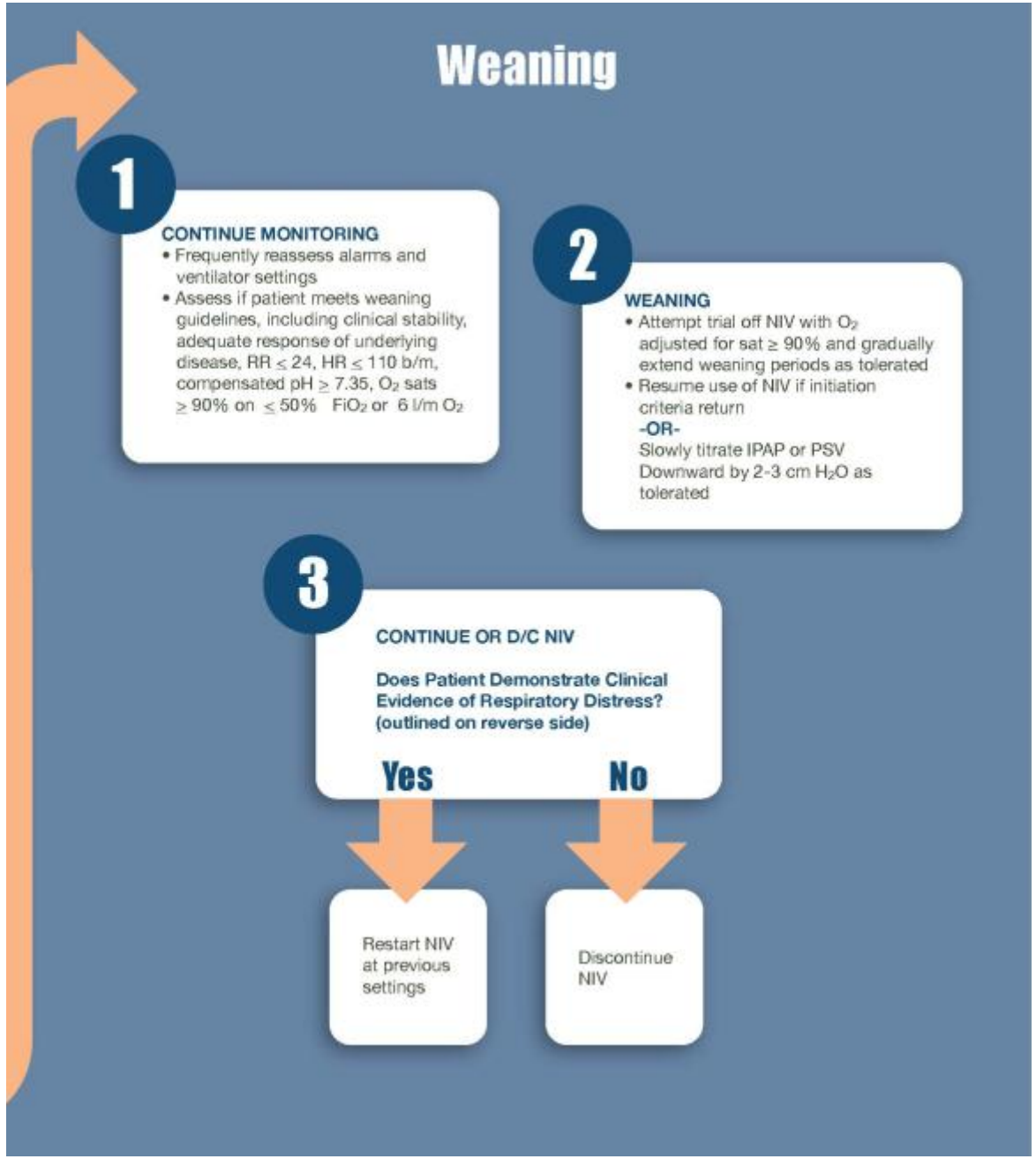
- Increase EPAP by 1-2 cm H_2O q 5 minutes, watching FiO_2/effort
- Titrate FiO_2 or oxygen flow to maintain 0_2 Sats > 90%
- May lower EPAP if intolerant but not < 4 cm H_2O

Note: When increasing EPAP, increase IPAP by same amount to maintain same level of pressure support (for uncompensated PEEP ventilators)

PhysicianCourse.

Over


Monitoring
1
MONITOR & DOCUMENT
• Patient comfort and tolerance
• Vital signs, especially respiratory rate
• Neck muscle activity
• Interface fit and air leaking
• Patient/ventilator synchrony
• Tidal volume (6-7 ml/Kg)
• Continuous pulse oximetry
• ABG at baseline, after 1-2 hours and then as needed
2
PREDICTORS OF SUCCESS
• Lower SAPSII / APACHE II score
• Willing and able to cooperate
• Good mask fit
• RR < 36/min, decreased WOB
• Improvements in gas exchange, pH, HR, RR in the first 2 hours
!
IF NO IMPROVEMENT AFTER 2-3 HOURS, STRONGLY CONSIDER USE OF INVASIVE MECHANICAL VENTILATION.
(Continued)


Weaning
1
CONTINUE MONITORING
• Frequently reassess alarms and ventilator settings
• Assess if patient meets weaning guidelines, including clinical stability, adequate response of underlying disease, RR ≤ 24, HR ≤ 110 b/m, compensated pH ≥ 7.35, O_2 sats ≥ 90% on ≤ 50% FiO_2 or 6 l/m O_2
2
WEANING
• Attempt trial off NIV with O_2 adjusted for sat ≥ 90% and gradually extend weaning periods as tolerated
• Resume use of NIV if initiation criteria return
-OR-
Slowly titrate IPAP or PSV Downward by 2-3 cm H_2O as tolerated
3
CONTINUE OR D/C NIV
Does Patient Demonstrate Clinical Evidence of Respiratory Distress? (outlined on reverse side)
Yes
No
Restart NIV at previous settings
Discontinue NIV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