AVAPS-AE
Auto-titration Mode of Noninvasive Ventilation
AVAPS-AE: Why do we need it?
AVAPS-AE is an Auto-titration Mode of Noninvasive ventilation designed to better treat Respiratory Insufficiency patients (OHS, COPD and NMD) in the hospital and homecare environments.

- Proven performance of AVAPS
  - Maintains targeted Tidal volume
- Auto EPAP
  - Maintains patent upper airway at comfortable pressure
- Auto backup rate
  - Applies an Auto backup rate near a patient’s resting rate
AVAPS-AE: Auto EPAP Proactive Analysis

Theory of Operation

Illustration courtesy of Krames Medical Illustration.
AVAPS-AE: Auto EPAP proactive analysis

Popt – Optimal Pressure Search
(High Pressure Search)

Critical Pressure Searches
(Low Pressure Search)
# Auto EPAP today

<table>
<thead>
<tr>
<th>Patient type</th>
<th>Treatment / Device</th>
<th>Pressure support requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSA</td>
<td>CPAP/REMstar Auto</td>
<td>Low to none</td>
</tr>
<tr>
<td>Cardiac</td>
<td>Servo-Ventilation / BiPAP AutoSV</td>
<td>Dynamically applied pressure support</td>
</tr>
<tr>
<td>Respiratory insufficiency</td>
<td>AVAPS-AE / Trilogy, BiPAP A40</td>
<td>High levels of pressure support</td>
</tr>
</tbody>
</table>
Comparison of Auto EPAP methods

Current PRI Auto EPAP/CPAP

AVAPS-AE

Forced oscillation technique (FOT) at 5 Hz, 1 cm amplitude during EPAP
Benefits of FOT

• FOT improves detection of obstructed airways at higher pressure support levels
  – Not affected by high levels of pressure support
  – FOT measurements taken at end exhalation (10 breaths)
FOT – Patent vs. Obstructed Airway

Patent/Normal airway

Resulting flow (low resistance)

Obstructed airway

Resulting flow (higher resistance)
AVAPS-AE
Maintaining Tidal volume and Airway Patency
Auto Backup Rate

Auto backup rate combined with the tidal volume assurance of AVAPS provides a minimum level of ventilation

- Auto backup rate is near resting rate
- Comfortable assistance when needed
- No manual adjustments (auto-default setting)
Auto Backup rate

Targeted auto backup rate is 2 bpm below avg. spontaneous rate

Target auto backup rate

Minimum auto backup rate

Spontaneous breaths

Spontaneous rate

Bpm

Moving breath rate

Time

50 spontaneous breaths

Confidential

Sector, MMMM dd, yyyy, Reference
AVAPS-AE mode is available in Trilogy Aura and BiPAP A40:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVAPS rate</td>
<td>From 0.5 to 5 cmH2O/min in 0.5 cmH2O increments</td>
</tr>
<tr>
<td>Tidal volume</td>
<td>200 – 1500ml</td>
</tr>
<tr>
<td>Maximum pressure</td>
<td>6 – 40 cmH2O</td>
</tr>
<tr>
<td>Pressure support Max</td>
<td>2 – 36 cmH2O</td>
</tr>
<tr>
<td>Pressure support Min</td>
<td>2 – 36 cmH2O</td>
</tr>
<tr>
<td>EPAP Max pressure</td>
<td>4 – 25 cmH2O</td>
</tr>
<tr>
<td>EPAP Min pressure</td>
<td>4 – 25 cmH2O</td>
</tr>
<tr>
<td>Breath rate</td>
<td>Auto/0 – 40 BPM</td>
</tr>
</tbody>
</table>
### AVAPS-AE suggested settings

<table>
<thead>
<tr>
<th></th>
<th>OHS*</th>
<th>COPD – OSA*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vt Target</strong></td>
<td>8 -10 ml/Kg of ideal bodyweight</td>
<td>8 ml/Kg of ideal bodyweight</td>
</tr>
<tr>
<td><strong>Max P</strong></td>
<td>35 cmH2O</td>
<td>30 cmH2O</td>
</tr>
<tr>
<td><strong>EPAP Max</strong></td>
<td>14 cmH2O</td>
<td>14 cm H2O</td>
</tr>
<tr>
<td><strong>EPAP Min</strong></td>
<td>4 cmH2O</td>
<td>4 cm H2O</td>
</tr>
<tr>
<td><strong>Breath Rate</strong></td>
<td>Auto</td>
<td>Auto</td>
</tr>
<tr>
<td><strong>AVAPS Rate</strong></td>
<td>2</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Pmax has to be the sum of EPAP min and PS max

\[
P_{\text{max}} = \text{EPAP min} + \text{PS Max}
\]

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* AVAPS-AE protocol Dr. N. Hart, Dr. P. Murphy, Lane Fox Respiratory unit, St. Thomas’ Hospital London UK
* AVAPS-AE Multi Center Trial protocol Prof Jean François MUIR, France
Noninvasive ventilation via **Mouthpiece**
Mouthpiece Ventilation

- Mouthpiece Ventilation is a type of noninvasive that can be used to provide portable daytime ventilatory support for neuromuscular patients with respiratory failure.

Noninvasive ventilation via Mouthpiece (MPV)

- Traditionally performed on volume ventilators that were adapted and modified to allow for “sip breathing”. Perceived risks/concerns with clinicians about the modifications

- In 1980’s the introduction of masks and pressure ventilators which allowed for compensation of leaks resulted in a shift in methods. (Ease of use etc.)
Benefits of Mouthpiece Ventilation

- Option for 24 hour ventilation without the need for tracheostomy
- Prevention of pulmonary complications related to tracheostomy
- Patient choice involvement and autonomy of care
- Infection reduction – granuloma formation chronic bacterial colonization
- Cough generation from closed airway Reduction in interface related issues. Aesthetic and social interaction improved
Benefits of Mouthpiece Ventilation

- Improves cough and voice function
- MPV facilitates mechanically assisted coughing
- Around the clock assistance
  - Mask ventilation at night
  - Mouthpiece ventilation during the day
- Patient Quality of Life
- Easily applicable
Mouthpiece ventilation Patients

- Patients must have:
  - Sufficient strength and coordination of their bulbar muscles
  - Be able to speak, swallow and protect their airway

- Patients with improved outcomes have had:
  - A program of lung volume recruitment (breath stacking)
  - Risk- takers

Indications & contraindications

- Neuromuscular disease
- Polio Myelitis
- Duchene Muscular Dystrophy (DMD)
- Quadriplegia (SCI)
- Amyotrophic Lateral Sclerosis (ALS)
- Multiple Sclerosis (MS)
- NIV dependent pts – breaks for activities of daily living

✓ Some neck movement and lip function are needed to grab the mouthpiece
✓ Inability to lip seal
Indications for MPV:

- Resting / supporting respiratory muscles
- Increasing VT, decreasing Hypercapnea
- Reducing Atelectasis, improving ventilation and perfusion matching
- Improving secretion clearance
- Maintaining and improving the chest wall range of movement (ROM)

_Bach, JR, Goncalves, M._ 2006 Pulmonary rehabilitation in neuromuscular disorders and spinal cord injury. REVISTA PORTUGUESA DE PNEUMOLOGIA Vol XII N.° 1 (Supl 1) Fevereiro
Clinical evidence; References


3. **Bach,JR.** Alba,AS. & Saporio,LR. 1993. IPPV via the mouth as an alternative to tracheostomy for 257 ventilation users. CHEST 103;174-82.


6. **Bach, JR, Goncalves, M.** 2006 Pulmonary rehabilitation in neuromuscular disorders and spinal cord injury. REVISTA PORTUGUESA DE PNEUMOLOGIA Vol XII N.º 1 (Supl 1) Fevereiro

7. Neuromuscular Disorders 2012 Chapter 13 Hon and Bach Respiratory Muscles aids in management of Neuromuscular Respiratory Impairment to Prevent Respiratory Failure and Need for Tracheostomy.


Mouth Piece Ventilation Equipment

- **Ventilatory Support**
  - Bilevel ventilators
  - Pressure Modes
  - Portable volume ventilators
  - Volume Modes

- **Interfaces**
  - 15 or 22mm angled mouthpieces

Hess; Noninvasive Ventilation in Neuromuscular Disease: Equipment And application, Respiratory Care, August 2006.
Mouthpiece Ventilation Setup

- Recommended Trilogy100 Setup with **dedicated MPV mode**
  - Passive circuit type
  - Spontaneous mode, S/T or PC mode
  - Respiratory rate = 2 – 4
  - IPAP = enough to give Vt that is required
  - EPAP = 4
  - Alarms = off
A dedicated Mouthpiece Ventilation Mode

- Available in AC and PC mode

New Kiss Trigger with Signal Flow Technology

- No inspiratory effort required to trigger device (unique)
- Just engage and disengage the mouthpiece
- Increased comfort, less anxiety
- No nuisance alarms
MPV mode: Assist Control (AC) vs. Pressure Control (PC)

AC volume:— e.g. 1200 mls

- Breathing techniques such as Air Stacking and Glossopharyngeal breathing (Frog) easier to perform. (Increase VC/Muscle strength (5))
- Flow patterns square vs ramp
- Traditional and referenced

PC pressure:— e.g. 18 cmH2O

- Feels like usual nocturnal ventilation
- Easier to assess for prescription and setting
- Rise time

Trilogy and MPV: dual prescription

**Night time ventilation:** Primary prescription

**Daytime ventilation:**
Secondary settings – PC MPV
- Pt only has to swap the circuit and press 2 buttons
- No calibration between circuits
MPV set up/accessories

- Circuits & Goose neck: Straw (easy to purse lips around)
- Mouthpiece (Easy to grip)
Trilogy Accessories
MPV summary

- Trilogy has dedicated **MPV mode**: (same keyboard as BiPAP A40 & BiPAP A30)
- Trilogy with **in-line SpO2** monitoring with alarm
- CoughAssist E70 combination management
- Ventilation **Data management** – Clinical
- Modem technology remote management (Future)
- Interfaces Portfolio
- Respiratory Drug Delivery products
Expanding versatility: upgraded Trilogy

The upgraded Trilogy family of ventilators continues to meet the changing needs of your patients.

Enhanced functionality

- The Trilogy family of ventilators offers enhanced versatility and performance.
- The improved Trilogy offers an enhanced range of features.

Meaningful innovation

- Just one more way our ventilators are working for you as dollars in better sleep and breathing.

Expanded versatility with Magnaview ventilation

- Patients can experience greater freedom from the constraints of ventilation support with the Magnaview system.
- Magnaview ventilation provides both volume and pressure ventilation options.

Unique trigger with signal-flow technology

- Our unique trigger with signal-flow technology allows the clinician to deliver the appropriate ventilation.

AVAPS-AE algorithm

- In AVAPS-AE mode, the patient's pressure support is automatically adjusted to minimize respiratory effort.

Expanded clinical control

- Expanded clinical control allows for more advanced monitoring and control options.

Additional improvements inspired by you

- Sensitive Digital Auto-TRAK
- Improved trigger sensitivity
- Enhanced breath rate
- Improved breath capture
- Enhanced breath rate
- Enhanced breath rate