Titration Guidelines for CPAP, Bilevel, servo ventilation and AVAPS.

1.5 AARC and AAST CEU credits
Learning objectives

- List the titration goals for OSA management
- Understand the suggested protocols for titrations
- Review the titration process for CPAP, bi-level, servo ventilation and AVAPS

Note: all protocols listed in the presentation are consistent with AASM clinical guidelines.
General Titration Protocol Goals

• The goals should be individualized to meet the needs of each patient.
  – 1. Keep the airway open (airway management)
  – 2. Stabilize breathing patterns by monitoring the patient’s response to therapy
  – 3. Adjust user set parameters as needed for optimal therapy efficacy and adherence
  – 4. Ensure proper mask fit to enhance comfort and acceptance, and to minimize leaks
  – 5. Have patient lie down and breathe on the designated therapy device at the basic settings
  – described with each protocol
  – 6. Recheck mask fit, assure patient comfort and acceptance
  – 7. Adjust flex features to patient comfort
Sleep lab titration options

- OmniLab has the following options available:
  - CPAP, AutoCPAP
  - Bi-level therapy modes such as S, S/T, PC, or T
  - BiPAP Auto
  - BiPAP autoSV Advanced
- Advanced features include:
  - AVAPS
  - A-Flex, Bi-Flex, and C-Flex+

- AutoCPAP and BiPAP Auto are now included
Titration Protocol References

This protocol is consistent with device validation studies and the following AASM clinical guidelines:


Complex Sleep Apnea Components

- OSA
  - Obstructive apneas
  - Obstructive hypopneas
  - CPAP
  - APAP
  - BiLevel

- Central SDB
  - Noninvasive Ventilation
    - Periodic Breathing
    - CSR

- Hypoventilation
  - Central Apnea
  - Central Hypopnea
  - Volume Assured Pressure Support with Rate

Auto Servo Ventilation
CPAP
Titration Protocol
CPAP patient types
Suggested Titration Protocol for CPAP

1. Set CPAP at 4 cm H₂O
2. Set C-Flex or C-Flex+ to patient comfort

3. Observe for Obstructive Events
   - NO: Optimal Pressure Reached
   - YES: Increase CPAP by 1 cm H₂O, Wait 5 minutes, Repeat as needed

4. If the patient cannot tolerate pressure increase, or the pressure threshold of 15 cm H₂O is reached,
   - Switch patient to BiPAP S protocol
CPAP prescription

System One CPAP

___ cm H₂O with Encore Anywhere/SleepMapper
□ Heated Humidifier □ Heated Tube
DISPENSE AS WRITTEN/DO NOT SUBSTITUTE

System One CPAP

___ cm H₂O with Flex
□ EncoreAnwhere/SleepMapper
□ Heated Humidifier □ Heated Tube
Convert to System One BiPAP Auto after 60 days if non-compliant
DISPENSE AS WRITTEN/DO NOT SUBSTITUTE
AutoCPAP
Titration protocol
Suggested Titration Protocol for Auto CPAP

Patient on CPAP changed to Auto CPAP

- CPAP at $\leq 10$ cm H$_2$O
- Set AutoMin at 4 cm H$_2$O or patient comfort
- Set AutoMax to 20 cm H$_2$O
- Set A-Flex to patient comfort

- CPAP at $> 10^*$ cm H$_2$O
- Set AutoMin at 6 to 8 cm H$_2$O or patient comfort
- Set AutoMax to 20 cm H$_2$O
- Set A-Flex to patient comfort
# AutoCPAP Prescription Zone

## System One CPAP

**REMstar Auto**

C-Flex C-Flex+ A-Flex: 1 2 3

Auto Pressure: Min: _____ cmH₂O Max: _____ cmH₂O

- [ ] Encore Anywhere/Sleep Mapper
- [ ] Heated Humidifier  [ ] Heated Tube

**System One**

**REMstar Pro / REMstar Auto**

C-Flex C-Flex+ A-Flex: 1 2 3

CPAP Check Pressure: _______ cm H₂O (±3 cm)

Auto Pressure: Min: _____ cmH₂O Max: _____ cmH₂O

Auto Trial Duration _____ days then 90% pressure (±3 cm)

**Dispense as Written/Do Not Substitute**
BiPAP S
Titration protocol
BiPAP S patient types
Bi-level S mode

- Bi-level support with spontaneous mode activated
- This mode is commonly used with patients who are able to maintain a constant respiratory rate, but require a pressure difference for comfort or to augment a tidal volume while they sleep.
- Can be used with the following patients:
  - Non compliant CPAP
  - Non tolerance to CPAP
  - Obesity hypoventilation
  - COPD or restrictive thoracic
Suggested Titration Protocol for BiPAP S

- Changing from CPAP Therapy to BiPAP S
  - **NO**
    - Set IPAP at 8 cm H₂O
    - Set EPAP at 4 cm H₂O
    - Set Bi-Flex to patient comfort
  - **YES**
    - Set IPAP at CPAP level
    - Set EPAP at 4 cm H₂O below the IPAP level
    - Set Bi-Flex to patient comfort

- Observe for Events

- Obstructive Apneas
  - Increase EPAP by 1 cm H₂O
  - Maintain IPAP and EPAP differential
  - Wait 5 minutes

- Other Events
  - Increase IPAP by 1 cm H₂O
  - Wait 5 minutes

- **NO**

- Optimal Pressure Reached
Suggested Titration Protocol for BiPAP Auto

Patient on CPAP changed to BiPAP Auto

- CPAP at ≤ 10 cm H$_2$O
- Set MinEPAP at 4 cm H$_2$O
- Set PSmin at 4 cm H$_2$O or patient comfort
- Set MaxIPAP to 25 cm H$_2$O
- Set PSmax to 8 cm H$_2$O
- Set Bi-Flex to patient comfort

- CPAP at > 10* cm H$_2$O
- Set MinEPAP at 6 to 8 cm H$_2$O
- Set PSmin at 4 cm H$_2$O or patient comfort
- Set MaxIPAP to 25 cm H$_2$O
- Set PSmax to 8 cm H$_2$O
- Set Bi-Flex to patient comfort
BiPAP autoSV Advanced Titration protocol
Servo ventilation patient types
Treatment options for complex sleep apnea

• CPAP + time on therapy to reset chemoreceptors for patient\(^1\)
  – Must qualify with RDI > 5 with symptoms of OSA or RDI > 15 without symptoms\(^2\)
  – 30-day trial on CPAP then follow up with patient on excessive daytime sleepiness, if improved keep on CPAP
• No improvement in daytime sleepiness after 30 days, try alternatives
  – Medications + CPAP
  – Auto Servo Ventilation
  – Bi-Level therapy with backup rate
    • RAD policy for complex sleep apnea

---

1 Dernaika T et.al; Chest 2006 s;130(4)129
2 Adult Sleep Apnea Task Force, AASM, ; Journal of Clinical Sleep Medicine 2009; 5(3)
BiPAP autoSV Advanced: **Automatic Servo Ventilation**

- Treatment for complicated breathing patterns such as:
  - Central apnea
  - Complex apnea
  - Periodic breathing such as CSR

- Provides non-invasive ventilatory support to treat adult patients with OSA and respiratory insufficiency caused by central and/or mixed apneas and periodic breathing.

- Built with existing RI proven technologies
  - Digital Auto-Trak™ Algorithm that targets peak flow
  - Encore Pro/Anywhere for patient reporting
BiPAP autoSV Advanced: Automatic Servo Ventilation

- Automatic Pressure Support
  - Targets peak flow over a 4 minute moving window
  - Adjusts inspiratory pressure breath to breath when necessary (to achieve targeted peak flow)

- Automatically adjusting EPAP
  - Titrates to eliminate obstructive component
  - Distinguishes between obstructed and clear (open) airway

- Enhanced automatically calculated back-up breath rate
  - Based on patient’s spontaneous breath rate \textit{OR}
  - Standard rates of 4 – 30 bpm

- Bi-Flex Comfort Wave Form
Terms you need to understand

- **EPAPmin**
  - The EPAP will not drop below this pressure

- **EPAPmax**
  - The EPAP will not go above this pressure even if events are detected

- **Max pressure**
  - The maximum pressure the device will deliver even if the algorithm indicates a pressure increase is needed

- **Peak Inspiratory Pressure (PIP)**
  - The maximum pressure reached on inspiration to deliver the pressure support determined by the algorithm

- **PSmin**
  - The minimum amount of pressure support delivered each breath (i.e. minimum difference between the EPAP and the PSmin setting)

- **PSmax**
  - The maximum amount of pressure support that can be delivered (i.e. maximum difference between the EPAP and the PIP)

*Note: This value may limit the amount of Inspiratory pressure delivered*
BiPAP autoSV Advanced Titration Protocol

Titration Goals:

Airway management, stabilize breathing patterns

by

monitoring patient’s response

and

adjusting user set parameters if needed

for

optimal therapy efficacy and adherence
Suggested Titration Protocol for BiPAP AutoSV
**BiPAP autoSV prescription zone**

**BiPAP Auto SV Advanced**

- EPAPmin: _____ cm H₂O (4 cm – 25 cm)
- EPAPmax: _____ cm H₂O (4 cm – 25 cm)
- PSmax: _____ cm H₂O (0 cm – 21 cm)
- PSmin: _____ cm H₂O (0 cm – 21 cm)
- Max Pressure: _____ cm H₂O (25 cm)
- Rate: _____ BPM (auto, 4 - 30, off)
- Bi-flex setting: _____ (1, 2, 3)

- □ Encore Anywhere/Sleep Mapper
- □ Heated Humidifier □ Heated Tube

**DISPENSE AS WRITTEN/DO NOT SUBSTITUTE**
Complex sleep apnea patients may challenge even the most experienced, skilled sleep technologist!

- Complex sleep apnea patients have multiple pathologies each requiring the attention of the technologist

- Helpful hints for complex sleep apnea titrations
  - Obstructive apneas, obstructive hypopneas, central apneas, hypopneas, RERAs and periodic breathing may all be present *intermittently* throughout the sleep period
  - Making the patients 100% normal may not be a realistic goal
  - Optimizing therapy within a range the patients tolerates, will be compliant with and makes them much better than they were is an achievable goal
  - *Patience* is key to successful titrations
  - If a change is needed and made, Watch, Wait, Observe and Think before making any other adjustments
Bi-level ST and BiPAP AVAPS titration protocol
BiPAP S/T Patient Types

- BiPAP AVAPS
- BiPAP S/T
- Restrictive disorders (e.g., kyphosis or fibrosis)
- Obesity hypoventilation
- OSA
- CPAP
- Auto CPAP
- BiPAP Auto
- BiPAP S
- BiPAP ASV Advanced
- Complex sleep apnea
- BiPAP ASV Advanced
- Opioid-induced sleep apnea
- Cheyne-Stokes Respiration
- COPD
- Neuro-muscular disorders and SDB
Bi-level S/T mode

- Bi-level support with Spontaneous and Timed mode activated
- This mode is used with patients that require
  - Time rate from the device to support their inconsistent respiratory pattern
  - Pressure support to augment their tidal volume when the device provides a breath to the patient
  - Ability to receive spontaneously initiated breaths or timed back up breaths from the device
Suggested Titration Protocol for BiPAP S/T

- Set IPAP at 8 cm H₂O
- Set EPAP at 4 cm H₂O
- Set Rate at 8-10 BPM or 2 BPM below the patient's spontaneous rate
- Set I-Time at 1.5 seconds or patient comfort
- Set Rise time at 2 or 3 patient comfort

Observe for Events*

- Obstructive Apneas*
  - Increase EPAP by 1 cm H₂O
  - Maintain IPAP and EPAP differential
  - Wait 5 minutes

- Other Events**
  - Increase IPAP by 1 cm H₂O
  - Wait 5 minutes

Optimal Pressure Reached
BiPAP AVAPS Patient Types
Bi-level with Average Volume Assured Pressure Support (AVAPS)

- Acts primarily as a bi-level pressure support device but is able to provide a constant tidal volume with the AVAPS feature enabled.
  - Can be used with S, S/T, PC or T modes.
- Automatically adjusts the pressure support level to maintain a consistent tidal volume
  - IPAP will automatically increase or decrease to maintain set tidal volume
**AVAPS**

- Automatically adjusts the pressure support level to maintain a consistent tidal volume
  - IPAP will automatically increase or decrease
AVAPS is **NOT recommended** for patients with periodic breathing

- Treatment of periodic breathing requires a variable breath by breath response system so the patient's PaCO2 stabilizes quickly
  - Prevents overshooting or undershooting the PaCO2 breath by breath
  - Does not augment the patient's tidal volume consistently

- AVAPS does not have a quick variable response to changes in tidal volume.
  - It is designed to adjust and maintain a constant tidal volume with each breath over time.
  - This benefit often seen with patients who have slow declines in their ventilatory conditions.
Advanced NIV Titration Goals

Titration Goals:

Airway management, stabilize breathing patterns

by

monitoring patient’s response

and

adjusting user set parameters if needed

for

optimal therapy efficacy and adherence
Suggested starting point for AVAPS

3 ways to choose a starting tidal volume with AVAPS:

1. MD suggestion
2. Patient comfort
3. Ideal body weight: 8 ml/kg*

*AVAPS suggested tidal volume settings based on height and ideal weight.

<table>
<thead>
<tr>
<th>height</th>
<th>59&quot;</th>
<th>61&quot;</th>
<th>63&quot;</th>
<th>65&quot;</th>
<th>67&quot;</th>
<th>69&quot;</th>
<th>71&quot;</th>
<th>73&quot;</th>
<th>75&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>ideal weight</td>
<td>52.0 kg</td>
<td>55.5 kg</td>
<td>59.0 kg</td>
<td>62.5 kg</td>
<td>66.5 kg</td>
<td>70.5 kg</td>
<td>74.5 kg</td>
<td>78.5 kg</td>
<td>83.0 kg</td>
</tr>
<tr>
<td>$8 \text{ ml/kg}$</td>
<td>$V_T$</td>
<td>420 ml</td>
<td>440 ml</td>
<td>470 ml</td>
<td>500 ml</td>
<td>530 ml</td>
<td>560 ml</td>
<td>600 ml</td>
<td>630 ml</td>
</tr>
</tbody>
</table>
Suggested titration Protocol for BiPAP AVAPS

Set Tidal Volume target*
- Set IPAPmin at 8 cm H₂O
- Set IPAPmax at 25 cm H₂O
- Set EPAP at 4 cm H₂O
- Set Rate at 8-10 BPM or 2 BPM below the patient’s spontaneous rate
- Set I-Time at 1.5 seconds or patient comfort
- Set Rise time at 2 or 3 or patient comfort

Observe for Events

Obstructive Events**
- Increase EPAP by 1 cm H₂O

Respiratory Events***
- Inadequate Tidal Volume — Increase the Tidal Volume target
- Inadequate Respiratory Rate — Increase RR by 2 BPM
- Inadequate Oxygenation — Increase EPAP
- Wait 5 minutes

Optimal Pressure Reached
BiPAP S/T AVAPS prescription

BiPAP S/T AVAPS

EPAP: _____ cm H₂O (4 cm – 25 cm)
IPAP max: _____ cm H₂O
IPAP min: _____ cm H₂O
Max Pressure: _____ cm H₂O (30 cm)
Rate: _____ BPM (4 -30)
Tidal Volume _____ ml (200-1500 ml)
☐ Heated Humidifier ☐ Heated Tube

DISPENSE AS WRITTEN/DO NOT SUBSTITUTE
Patient follow-up with Encore

- Continuing clinical assessment is essential for:
  - Compliance
  - Efficacy
- Complex sleep apnea patient may be the most challenging to follow up because they have multiple, changing pathologies requiring therapy
  - Achieving optimal therapy and meeting patient comfort needs can be a challenge that requires ongoing assessment of therapy device downloads and interviews with the patient

Patient follow-up is addressed in a separate presentation to provide adequate information and focus
CEU certificate

• To obtain your CEU certificate log on to
  – Log in or create a log in if you are a new user
  – Complete the evaluation and print out your certificate.

• If you are claiming AARC credits, you **must** compete the evaluation within 30 days or you will **not** receive credit for the program.