Home Ventilation Workshop

2 AARC CEU credits
Objectives

• Describe the circuit options, breath types, modes, alarms, features and troubleshooting.

• Review the unique mouthpiece ventilation mode.
Portable volume and pressure controlled ventilator that is designed with simplicity in mind.
Added sensitivity for a wide range of adults and pediatric patients.
**Intended Use**

- Provides continuous or intermittent ventilatory support for the care of individuals who require mechanical ventilation
- May be used for both invasive and noninvasive ventilation
- Adult and pediatric patients weighing at least 5 kgs (11 lbs)
- Patients suffering from acute or chronic respiratory failure, acute or chronic respiratory insufficiency or obstructive sleep apnea
- To be used in the home, institution/hospital or portable settings.

- **Not** intended to be used as a transport ventilator.
Features

- Display screen
- Audio pause
- Up/Down
- Start/Stop
- AC power light
- Left/Right
SD Card Slot
On the back

- Detachable battery
- Cord retainer
- Serial connector
- Remote alarm
- External battery connector
- Ethernet connector
- Oxygen valve connector
- Filter
- Removable air path
Trilogy100 has 2 circuit options

- Passive porting block
- Active porting block
Trilogy100 Circuit Options - Active

- Utilizes an active exhalation valve
  - Diaphragm opens with expiration
  - Diaphragm closes with inspiration

- Active w/PAP (proximal airway pressure) porting block

- Choose Active w/PAP in Set up Menu
Trilogy100 Circuit Options – Passive

- Utilizes an Exhalation Port
  - Integrated into a mask
  - Whisper Swivel II

- Passive Porting Block

- Choose Passive in Set up Menu
Trilogy200 has 3 circuit options

All Trilogy200 circuit options require the use of a single universal porting block
Trilogy200 Circuit Options – Passive

- Utilizes an Exhalation Port
  - Integrated into a mask
  - Whisper Swivel II

- Universal Porting Block

- Choose Passive in Set up Menu
Trilogy200 Circuit Options - Active

- Utilizes an active exhalation valve
  - Diaphragm opens with expiration
  - Diaphragm closes with inspiration

- Universal porting block

- Choose Active PAP in Set up Menu
Trilogy200 Circuit Options - Flow

- Utilizes an active exhalation valve with a flow sensor
  - Inline flow sensor is proximal to the airway for enhanced triggering

- Universal porting block

- Choose Active Flow in Set up Menu
Volume Modes with the Passive Circuit

- Volume Modes with the Passive Circuits provide equivalent therapy
  - EPAP with Passive and PEEP with Active remove CO2
  - Passive circuit with leak compensation delivers the prescribed tidal volume
  - Noninvasive or invasive ventilation

- Benefits
  - Simpler circuit
  - Ease of set up
  - Leak compensation
Traditional volume mode ventilation

At the machine

800 cc

Preset Vt

500 cc

Vt = Preset Vt - Leak

At the patient

Vt

Volume mode with a circuit with a leak

At the machine

500 cc

Preset Vt

Leak

At the patient

Vt

Vt = Preset Vt
Volume mode in passive circuit

Leaks are compensated for:
- Leaks are estimated at the end of each breath
- Leaks are compensated at the next breath

At the machine

Breath 1
- 500 cc
- Preset Vt

Breath 2
- 500 cc
- Preset Vt

At the patient

Vt = Preset Vt – new leak

Advanced leak compensation

Vt = Preset Vt
Ventilation Types and Modes
# Breath types

<table>
<thead>
<tr>
<th>Breath Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandatory</td>
<td>Breaths are initiated by the ventilator. Air delivery is controlled by the current VCV or PCV settings.</td>
</tr>
<tr>
<td>Assisted</td>
<td>Breaths are triggered by the patient. Air delivery is controlled by the ventilator by the current VCV or PCV settings.</td>
</tr>
<tr>
<td>Spontaneous*</td>
<td>Breaths are triggered and controlled by the patient.</td>
</tr>
<tr>
<td>Sigh</td>
<td>A breath of 150% volume is delivered once in every 100 breaths in VCV.</td>
</tr>
</tbody>
</table>

*During inhalation, Pressure Support Ventilation may be set to give the assistance of a constant proximal pressure.*
Ventilation types and modes

• Volume Control Ventilation
  - Assist Control (AC)
  - Synchronized Intermittent Mandatory Ventilation (SIMV)
  - Control Ventilation (CV)

• Pressure Control Ventilation
  - CPAP
  - Spontaneous (S)
  - Spontaneous/Timed (S/T)
  - Timed (T)
  - Pressure Control (PC)
  - PC-SIMV

True Respironics BiPAP Modes
## Pressure modes

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CPAP</strong></td>
<td>Continuous Positive Airway Pressure</td>
</tr>
<tr>
<td><strong>Spontaneous (S)</strong></td>
<td>Therapy mode in which breaths are taken by the patient. The ventilator supports breathing with user-defined Pressure Support (PS) and Rise Time values.</td>
</tr>
<tr>
<td><strong>Spontaneous Timed (S/T)</strong></td>
<td>Therapy mode that is similar to S mode, except that it can also deliver a mandatory breath if the patient does not spontaneously breathe within a set timeframe.</td>
</tr>
<tr>
<td><strong>Timed (T)</strong></td>
<td>Therapy mode where all breaths delivered are mandatory.</td>
</tr>
<tr>
<td><strong>Pressure Control (PC)</strong></td>
<td>Therapy mode that delivers assisted and mandatory breaths with a user-defined pressure.</td>
</tr>
<tr>
<td><strong>Pressure Control SIMV (PC-SIMV)</strong></td>
<td>Therapy mode that delivers spontaneous, assisted, and mandatory breaths with a user-defined pressure.</td>
</tr>
</tbody>
</table>
## Volume modes

<table>
<thead>
<tr>
<th>Therapy Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assist Control (AC)</td>
<td>Therapy mode that delivers assisted and mandatory breaths with a user-defined inspired tidal volume.</td>
</tr>
<tr>
<td>Control Ventilation (CV)</td>
<td>Therapy mode that delivers mandatory breaths with a user-defined inspired tidal volume.</td>
</tr>
<tr>
<td>Synchronized Intermittent Mandatory Ventilation (SIMV)</td>
<td>Therapy mode that delivers spontaneous, assisted and mandatory breaths with a user-defined inspired tidal volume.</td>
</tr>
</tbody>
</table>
Waveform patterns

Ramp

Square
Flow trigger

- Available in both circuit configurations
- For both Volume and Pressure modes
- For both non-invasive and invasive
- Trigger sensitivity: 1 – 9 l/min
- Cycle sensitivity: 10 – 40% of peak flow

Auto-TRAK trigger

- Available in passive exhalation port circuit configuration
- For both Volume and Pressure modes
- For both non-invasive and invasive
- No trigger adjustments required
Sensitive Auto-Trak

- Provides an enhanced triggering response for patients with minimal respiratory effort
- Digital Auto-Trak requires 6 cc of volume change to initiate a breath
- Sensitive Auto-Trak requires 3 cc
AVAPS-AE

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.

Achieving a targeted volume is now completely automatic.

- Proven performance of AVAPS
- Auto EPAP
- Auto backup rate
AVAPS-AE

Auto EPAP maintains patent upper airway at a comfortable pressure

- Auto adjusting EPAP to meet changing patient needs
- Maintains a patent airway
**AVAPS-AE**

**Auto backup rate** provides comfortable assistance when needed

- Auto backup rate is near resting rate
- No manual adjustments (auto-default setting)
Adjustable AVAPS

- Adjustable AVAPS allows you to adjust the maximum rate at which the pressure support automatically changes to achieve the target tidal volume.

- It can be set from 1 cm H$_2$O per minute to 5 cm H$_2$O per minute.

- Allows clinician to customize the setting to the patient’s needs.
Mouthpiece Ventilation (MPV)
Expanding ventilatory support

Mouthpiece ventilation (MPV)

MPV is a form of volume ventilation whereby the patient’s normal state is disconnected from the ventilator and the patient initiates a breath, as needed, through an oral interface.
What type of patient could benefit from MPV?

Conditions with respiratory muscle dysfunction

• Muscular dystrophies
• ALS
• Other myopathies: acid maltase deficiency, polymyositis, mitochondrial disorders
• Neurological disorders: spinal muscular atrophies (SMA I, II, III)
• Neuropathies: Guillain-Barre syndrome, multiple sclerosis
• Skeletal pathologies such as kyphoscoliosis, rigid spine syndrome
Is there a risk to using MPV?

- The MPV feature represents no more risk than any other form of NIV
- MPV may be used an entire lifetime by some neuromuscular patients and may extend the quality of life for patients who will eventually need invasive ventilation
“NIV via 15-mm angled mouthpiece is the most important method of daytime ventilatory support”

Kiss trigger and MPV support system

- A new ‘kiss’ trigger with signal flow technology detects when the patient engages and disengages from the mouthpiece to deliver on-demand ventilation
- This feature combines with a mouthpiece ventilation (MPV) support system to enhance ease of use
MPV History

• MPV technique originated in 1950’s as a therapeutic adjunct for dyspnea in polio patients

• John E. Affeldt of Rancho Los Amigos Hospital
  – IPPV with a mouthpiece could relieve dyspnea in ventilator-dependent polio patients
  – Used when negative pressure was interrupted by transfers, nursing care, physical therapy
Evolution of MPV

• Traditionally performed on volume ventilators that were adapted and modified to allow for “sip breathing”.
  – Resistance added to the circuit
  – Prevented nuisance low pressure alarms

• 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.)
Disease State Targets

- 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
Daytime Ventilation via Mouthpiece: Clinical evidence

- **Objectives**
  - Assess the impact of daytime MPV as an extension of NIPPV

- **Methods**
  - 45 pts that were normocapnic at night on NIPPV
  - Monitored TcCO2 both night and day
  - Assessed every 6 months

Toussaint et al, Diurnal ventilations via mouthpiece: survival in end-stage Duchenne patients, ERJ, 2006.
Daytime Ventilation via Mouthpiece: Clinical evidence

- **Results**
  - Daytime MPV provided 50% survival
  - Stabilized lung function for 5 years

- **Conclusion**
  - MPV during the day as an extension to nocturnal ventilation is safe
  - Provides reliable survival
  - Recommend use of cough assisting devices

Toussaint et al, Diurnal ventilations via mouthpiece: survival in end-stage Duchenne patients, ERJ, 2006.
Optional time-based patient reminder
- MPV Circuit Disconnect Alarm

Dual Prescription Function
- Facilitates independent day & nighttime settings
  - MPV during the day & mask ventilation a night
  - AC mode for MPV, PC mode with AVAPS for nocturnal mask ventilation

KISS Trigger
- Unique algorithm for a normally “disconnected” state
- Eliminates issues with a traditional flow trigger:
  - No sensitivity to adjust – mitigates auto triggering
  - *Does not* require patient effort to generate a breath
  - Important for progressively weaker respiratory muscles
Trilogy 100: MPV

- **MPV Circuit Support Arm**
  - Adjustable to fit most powered wheelchairs
  - Adjustable to optimize position of mouthpiece to patient
  - No need to “engineer” circuit and connection/support

- **Disposable MPV Circuit**
  - Includes small angled and dental straw-style mouthpieces
Research Evidence
Mouthpiece Ventilation

Evaluation of ventilators for mouthpiece ventilation in neuromuscular disease.

**Aim:**

The aims of the study were to analyze the practice of mouthpiece ventilation and to evaluate the performance of ventilators for mouthpiece ventilation.

**Methods:**

- **Questionnaire** - Subject-reported benefits:
- **Bench test** - performance of 6 home ventilators with mouthpiece ventilation.

Evaluation of ventilators for mouthpiece ventilation in neuromuscular disease.

Results
Questionnaires - n = 30, mean age 33 ± 11 y, using NIV for 12 ± 7 y. Fifteen subjects used NIV for > 20 h/day, and 11 were totally ventilator-dependent

Subject-reported benefits:
• Reduction in dyspnea (73%) and
• Fatigue (93%) and an
• Improvement in speech (43%) and eating (27%).

Bench test:
Alarms were common with home ventilators, although less common in those with mouthpiece ventilation software.

Conclusion

• Subjects are satisfied with mouthpiece ventilation.
User Interface

Viewing and Changing Settings
Detailed Screen

Low pressure alarm

High pressure alarm
Control keys
Accessing prescription setting screens

Two levels of Menu access
• Full
• Limited

To change prescription setting from limited access
• Hold Audio Pause and Down Arrow Keys
Accessing prescription setting screens

- Set-up Screen
- When airflow is off
- Hold Audio Pause and Down Arrow Keys
- Setting circuit type
Menu screen
Menu screen

Safely Remove SD Card
Menu screen

Settings and Alarms

- Dual prescriptions
- Modes
- Settings for mode chosen
- Alarms
Menu screen

Options

- Menu Access
- Detailed View
- Language
- Pressure Units
- Alarm Volume
- Keypad Backlighting
- LCD Brightness
- Screen Saver
- Date Format
- IP Address Mode
- Operational Hours
Menu screen

Alarm Log

- Lists last 20 alarms
  - High priority appear in red
  - Medium priority appear in yellow
  - In Full and Limited Access
  - Alarm log can only be cleared in full access
Menu screen

Event Log

- Event Log – 12,000 events
  - Can only be viewed and cleared in full access
Menu screen

Information

– Summary of current
  • Prescription settings
  • Device settings
  • System settings
  • Can be viewed in full and limited access
Changing settings

- Use the Up/Down key to highlight the menu item
- Press the Right key to select the menu item
- Use the Up/Down key to select the parameter
- Press the Right key to modify
- Use the Up/Down key to change setting
- Press Right key to OK
Keypad lock option

Hold RIGHT key for 5 seconds to unlock.
Screen saver option

• Reduce power consumption
• Dim in a darkened room
• Pressing any key, the occurrence of an alarm or informational message will exit screen

Breath

Black

Off and Dim Screen Savers are also available
On-screen waveforms allow clinicians to visually identify...

- Triggering
- Cycling
- Synchrony
Additional features

In-line nebulizer treatment feature

- Alarm sensitivity is adjusted for a 20-minute period in order to reduce nuisance alarms

Battery count/discharge on screen

- Allows clinicians to easily determine life of battery

Circuit type on screen
Alarms
Types of alarms

System Alarms
- High/Low Pressure Alarms (BiPAP only)
- Circuit Occlusion
- Low Leak
- Power Alarms
- Ventilator Inoperative
- Check circuit

Patient Alarms
- High/Low Pressure Alarm (Volume only)
- High/Low RR
- High/Low Minute Ventilation
- Patient Disconnect
- Apnea
Alarms

• Alarm LED indicator on the audio pause button lights
• Audible alarm sounds
• Message appears on the screen describing the alarm

High Priority – Red
Medium Priority – Yellow
Informational – No Indication
Alarms and messages
Directional messages

Hold RIGHT key for 5 seconds to unlock.
Confirmation messages

Confirmation Message

Icon

SOFT KEY PANEL

MENU PANEL

Confirmation messages

Check Settings and Alarms

Activate S/T Mode?

No

Yes

OK
Power Options
Power options

1. Internal AC/DC Power Supply
2. External 12V/24V battery
   - Not recharged through vent
   - Automotive adapter
3. Detachable Lithium Ion Battery
   - 3 hours
   - Easily hot swapped
   - Recharges as long as it is plugged in
4. Internal Lithium Ion Battery
   - 3 hours
   - Recharges as long as it is plugged in
## Battery charge indicator

<table>
<thead>
<tr>
<th>Battery</th>
<th>Symbol</th>
<th>LED Status</th>
<th>Battery Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Battery</td>
<td>![Battery Icon]</td>
<td>5 LEDs are lit</td>
<td>80-100% capacity</td>
</tr>
<tr>
<td>Detachable Battery</td>
<td>![Battery Icon]</td>
<td>4 LEDs are lit</td>
<td>60-79% capacity</td>
</tr>
<tr>
<td>External Battery</td>
<td>![Battery Icon]</td>
<td>3 LEDs are lit</td>
<td>40-59% capacity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 LEDs are lit</td>
<td>20-39% capacity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 LED is lit</td>
<td>11-19% capacity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 LED flashes</td>
<td>≤ 10% capacity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 LEDs lit</td>
<td>0% capacity</td>
</tr>
</tbody>
</table>

- Battery Count/Discharge is now on the screen
Battery cycle times

Trilogy 100 counts cycles

• Detachable battery ≥ 500 cycles

  "Replace Detachable Battery" Low priority Alarm - Alarm repeats in 1 hour if Reset key is pressed

• Internal battery ≥ 475 cycles

  "Ventilator Service Required" Urgent Service Alarm - Alarm repeats in 1 hour if Reset key is pressed
Prescription update screens

Via SD Card and DirectView™

With Blower Off

With Blower On
Prescription update screens

- After prescription update, the following screens are displayed so the user can ensure the prescription is correct.
Mouthpiece Ventilation Mode
Set Up
Trilogy 100: MPV

A complete MPV solution:
1. MPV mode and system optimization
2. Proprietary MPV trigger
3. Pre-configured MPV circuit support arm & disposable circuit

Dedicated MPV mode:
- AC mode: optimized for volume guarantee & breath stacking
  - $V_T$ 50mL – 2000mL
- PC mode – may improve patient comfort
- Mitigates nuisance alarms:
  - $\downarrow$ PEEP to 0 cmH$_2$O
  - $\downarrow$ rate to 0
  - $\uparrow$ range of high/low inspiratory pressure alarms
    - 1 – 80 cmH$_2$O
Mouth Piece Ventilation is an attribute of AC or PC ventilation and has to be enabled in the setup mode.

### Setup

**Dual Prescription**: OFF  
**Circuit Type**: Passive  
**Mode**: AC  
**MPV**: ON  
**Tidal Volume**: 500 ml

---

**Menu ▶ Settings And Alarms**  
**Finish**  
**Navigate**  
**Modify**
Trilogy 100: MPV

Passive AC MPV

10/01/2012 07:57 PM

RR 19 BPM
Vti 0 ml
Peak Flow 0.0 l/min

PIP 23.7 cm H2O

Menu ➤ Settings And Alarms ➤ Audio Pause

Dual Prescription OFF
Mode AC
Tidal Volume 500 ml
Breath Rate 0 BPM
Inspiratory Time 1.0 seconds

When MPV is enabled the Breath Rate will default to “0”.

Finish ➤ Navigate ➤ Modify
When MPV is enabled PEEP will default to “0”.

A new Circuit Disconnect Alarm has been designed for MPV.

The Low Inspiratory Pressure Alarm can be set as low as 1 cm. above PEEP.
Maintenance and Support
Maintenance

- Clean grey foam filter at least every 2 weeks
- Replace every 6 months
- Preventative maintenance 10,000 hrs or 2 years whichever come first
- Blowers hours are located in the information menu
Accessories and support

- Cart and In-Use Bag available
- DC battery cable
- MPV circuit
- Clinical Instructional CD
- Caregiver Instructional DVD
- Quick Start Guide
- 24 hour technical and clinical support
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.