

# HAMILTON·C2

## Intelligent Ventilation



2 ml

**NEO**

Safe ventilation  
for the smallest.

Safe ventilation – at rest and on the move

**HAMILTON**  
**MEDICAL**

# HAMILTON-C2



The HAMILTON-C2 is designed to provide Intelligent Ventilation, delivering:



Ease of use



Improved patient outcome

## Help protect 5 million lives!

Errors in health care in the USA alone cause up to 98,000 deaths every year.<sup>1</sup> In response, the Institute of Health Care Improvement (IHI) started the 100,000 Lives Campaign, an initiative to improve patient care and prevent avoidable deaths. This developed into the 5 Million Lives Campaign with the aim of protecting patients on a global scale.<sup>2</sup>

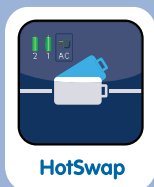
### Start with changes in your ICU

The 5 Million Lives Campaign and other initiatives focus on changes that can be implemented in any hospital – and particularly in ICUs. According to the IHI, “Intensive care is not only complex, it is also expensive ... Errors occur in ICUs at unacceptable rates”.<sup>3</sup> A number of initiatives, such as the Ventilator Bundle (5 Million Lives Campaign, IHI), focus on critical care.

### HAMILTON MEDICAL technology supports you

As a manufacturer of ICU ventilators, we support many safety initiatives. We have joined other high-risk industries such as aviation and nuclear power in embracing automation and user interface design.<sup>4</sup> The result: The HAMILTON-C2, our compact ICU ventilator, providing:

- a unique Ventilation Cockpit that is designed to improve safety through intuitive operation and monitoring
- proven closed-loop ventilation that automatically applies lung-protective strategies, reducing the risk of operator error and promoting early weaning
- a single, versatile source of invasive and noninvasive ventilation for adults, pediatrics and neonatal ICUs, emergency and recovery rooms, subacute care, and intrafacility transport
- integrated turbine and hot-swappable batteries for maximum mobility



Efficiency through innovation

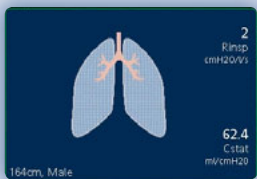
<sup>1</sup> Kohn LT et al. Washington DC; National Academy Press, 1999

<sup>2</sup> <http://www.ihl.org/IHI/Programs/Campaign> [Status: June 2010]

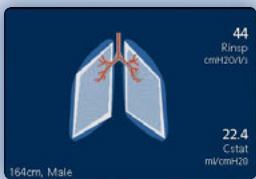
<sup>3</sup> <http://www.ihl.org/IHI/Programs/Campaign/CampaignMaterials> [Status: October 2006]

<sup>4</sup> Baker SP et al. Aviat Space Environ Med 2008;79:2-6

# HAMILTON·C2



Normal compliance and resistance



Low compliance (stiff lung) and high resistance

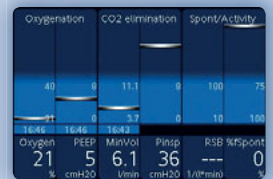
## Understand lung mechanics

The Dynamic Lung expands and contracts in synchrony with actual breaths. It visualizes in real-time:

- tidal volume
- lung compliance
- resistance
- patient activity



**Low dependency**  
Consider taking the patient off the ventilator.



**Highly dependent patient**



## Ease of use

Aren't a dozen ventilation modes more confusing than helpful? Aren't there already more monitoring parameters available than most users ever need? Ventilators clearly need to be simpler to use<sup>1</sup>. Once again, HAMILTON MEDICAL has led the way with the HAMILTON-C2: a pioneering mechanical ventilator designed from the ground up for ease of use.

### See and understand all important information at a glance<sup>1,2</sup>

In mechanical ventilation monitoring means curves, numbers and more numbers. But what do they tell us about the patient's condition? The HAMILTON-C2 provides the innovative Ventilation Cockpit to visualize the patient's respiratory mechanics and ventilatory support in an intuitive way.

### Provide patient-centered care with fewer resources

Unlike conventional modes which require you to set many parameters, closed-loop ventilation with Adaptive Support Ventilation (ASV) requires attention to just one: minute ventilation.

#### Studies show that ASV:

- ventilates virtually all intubated patients – whether active or passive and regardless of their lung disease<sup>3</sup>
- requires less user interaction, adapts to patient's breathing activity more frequently, and causes fewer alarms<sup>4</sup>
- adapts to changes in the patient's lung mechanics over time<sup>5</sup>

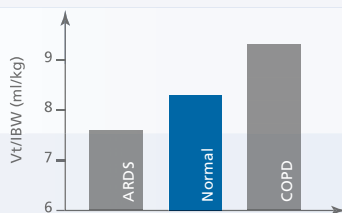


### How to know when to take the patient off the ventilator?

The Vent Status panel gives you a visual representation of 6 parameters related to patient-ventilator dependency, grouped into:

- oxygenation
- CO<sub>2</sub> elimination
- patient activity

Since the panel is user-configurable, it helps you enforce your ICU's weaning protocol.



ASV adapts itself automatically to the lung mechanics of the patient. So a patient with ARDS and lung protective ventilation strategy will be also treated.<sup>5</sup>

<sup>1</sup> Beydon L. et al. Anesthesiology 2010;112:364-72

<sup>2</sup> Vignaux L et al. Intensive Care Med 2009;35:1687-91

<sup>3</sup> Arnal JM et al. Int Care Med 2008;34:75-81

<sup>4</sup> Petter AH et al. Anesth Analg 2003;97:1743-50

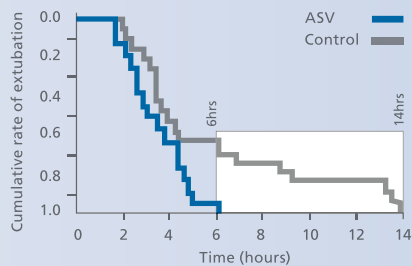
<sup>5</sup> Arnal JM et al. Int Care Med 2006;32:120

# HAMILTON-C2



## Understand changes in the patient and how ASV reacts

The ASV Breathing Map shows how the adaptive lung controller moves toward its targets. It shows both the target and actual parameters for tidal volume, frequency, pressure, and minute ventilation.



## Reduce time on the ventilator by over 50%

ASV facilitates shorter times on the ventilator: 6 hours with ASV as compared to 14 hours with conventional ventilation.<sup>4</sup>

A 2 day reduction in weaning time was achieved with ASV with a similar success rate. The study suggests that ASV may be used in the weaning of COPD patients with the advantage of shorter weaning times<sup>6,7</sup>.

## Improved patient outcome

**Critical care is expensive – and so is ventilation.** Each extra ventilator day in the USA costs \$1,522.<sup>1</sup> And the risk of ventilator-associated pneumonia (VAP) compounds these costs: a study showed that preventing just one case of VAP can save \$57,000.<sup>2</sup>

The HAMILTON-C2 lets you optimize clinical resources and skills while reducing cost of ownership and management overhead. Most importantly, it can help reduce the patient's time on the ventilator.

### Know when to consider taking the patient off the ventilator

With the Ventilation Cockpit's Vent Status panel, you get an intuitive visualization of the most important parameters and settings related to patient-ventilator dependency. Studies show that notifying caregivers about the patient's recovery from respiratory failure can significantly reduce the duration and total cost of ventilation.<sup>3</sup>

### Start weaning at intubation

HAMILTON MEDICAL's unique closed-loop ventilation system ASV (Adaptive Support Ventilation) automatically promotes free breathing for patients in all ventilation modes and phases. It encourages spontaneous activity right from the start of ventilation and promotes weaning from first deployment. Studies show the results: shorter ventilation times (see graph).<sup>4</sup> ASV adapts to lung mechanics by automatically applying lower tidal volumes in ARDS patients.<sup>5</sup>

### At the bedside or on the move: benefit from a double-duty solution

The HAMILTON-C2's compactness and independence from external power and air supplies allow for maximum mobility throughout the hospital.

### Reduce training costs

The HAMILTON-C2's intuitive interface simplifies ventilator set-up. That translates into easy training and less chance of operator error.

<sup>1</sup> Dasta JF et al. Crit Care Med 2005;33:1266-71

<sup>2</sup> Cocanour CS et al. Surg Infect. 2005;6:65-72

<sup>3</sup> Ely W et al. N Engl J Med. 1996;335:1864-9

<sup>4</sup> Sulzer CF et al. Anesthesiology 2001;95:1339-45

<sup>5</sup> Iotti GA et al. Int. Care Med 2010;36:1371-9

<sup>6</sup> Kirakli C et al. Eur Respir J. 2011;38:774-80

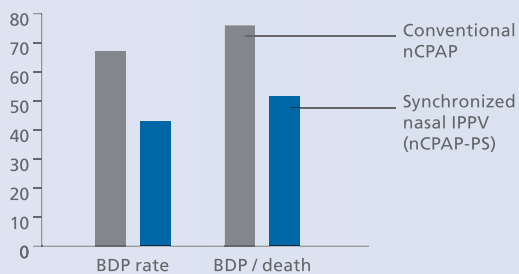
<sup>7</sup> Chen CW et al. Respiratory Care 2011;56:976-83



**Care for the smallest**  
Give the smallest patients the respiratory support they need – even during transport.



# HAMILTON-C2



**Reducing the risk of BPD**  
The use of synchronized nasal intermittent positive pressure ventilation (IPPV) as implemented in the HAMILTON-C2 with nCPAP-PS mode reduces the risk of BPD and BPD/death significantly in babies with very low birth weight.<sup>6</sup>

**nCPAP-PS**  
The nasal CPAP mode nCPAP-PS allows for assisting babies with synchronized inspiratory pressure support. The system delivers mandatory breaths to keep up a guaranteed rate in case of apnea. Thanks to the biphasic concept of the pneumatic system, the baby can inhale and exhale at any time.<sup>8</sup>



## Efficiency through innovation

### Lung Protective Ventilation

Inflammation caused by lung overdistension (volutrauma) is thought to be important in the pathogenesis of broncho-pulmonary dysplasia (BPD). Preterm infants with variable lung compliance are particularly at risk. Use of protective tidal volumes, 4 – 6 ml/kg in preterm infants, has been shown to reduce ventilator length of stay, incidence of BPD and pneumothorax.

The HAMILTON-C2 with volume targeted ventilation delivers consistent, appropriate tidal volumes as low as 2 ml with the aim of reducing lung damage. This lung protective type of ventilation can provide an effective, safer means of ventilating the neonatal patient.<sup>1</sup>

### Monitoring for stability

Stability of tidal volume is especially important in avoiding hypocapnia and volutrauma associated with rapid changes in compliance due to clearing of lung fluid and surfactant administration.<sup>2,3</sup>

All monitored waveforms are based on proximal airway measurements. Work of breathing (WOB) and synchrony are enhanced with flow trigger sensitivity reduced to 0.1 lpm. End tidal and volumetric CO<sub>2</sub> measurements not only reduce blood gas frequency, but provide measurement of dead space and CO<sub>2</sub> elimination.

### Binasal ventilation in synchrony

The breathing patterns of a very premature infant are frequently erratic and inadequate. Nasal CPAP effectively supports the breathing of preterm infants.<sup>4</sup>

Synchronized nasal intermittent positive pressure ventilation results in a decreased work of breathing, stabilizes the chest-wall and reduces asynchronous motion between the chest and the abdomen and improves tidal volumes and minute ventilation.<sup>5,6,7</sup>

The binasal ventilation mode nCPAP-PS of the HAMILTON-C2 provides nasal CPAP with additional positive pressure support.



<sup>1</sup> Lista G et al. *Pediatr Pulmonol.* 2004;37:510-4

<sup>2</sup> Am J et al. *Respir Crit Care Med* 2011;184:100-5

<sup>3</sup> Keszler M et al. *Pediatr Pulmonol.* 2004;38:240-5

<sup>4</sup> Mahmoud RA et al. *Paediatr Respir Rev.* 2011;12:196-205

<sup>5</sup> Aghai ZH et al. *Pediatr Pulmonol.* 2006;41:875-81

<sup>6</sup> Kiciman NM et al. *Pediatr Pulmonol.* 1998;25:175-81

<sup>7</sup> Moretti C et al. *Early Hum Dev.* 1999;56:166-77

<sup>8</sup> Bhandari V et al. *Pediatrics* 2009;124:517-26

# HAMILTON-C2

## Touchscreen and single knob operation

You can operate the HAMILTON-C2 with the touchscreen or with a single knob. Hard keys give direct access to the most important functions.

## Alarm lamp

When you are at a distance or even when several devices are operating in the same room, you can immediately identify an alarming ventilator by the alarm lamp at the top.

## Serial interface for PDMS or patient monitor

The serial RS-232 interface provides a port for connection to hospital monitors and Patient Data Management Systems (PDMS).

## Extended battery backup option

With the extended battery option, the HAMILTON-C2 ventilator can run for an indefinite time on hot-swappable batteries. With 2 fully charged batteries an independency of 6.5 hours can be achieved.

## High-performance, ultra-quiet turbine

The turbine can deliver up to 240 l/min flow. Flow is precisely allotted by the inspiratory valve. The patented noise reduction allows the use of the HAMILTON-C2 even in an ultra-quiet environment.



## The configuration you need



### Configurable Ventilation Cockpit

The Ventilation Cockpit lets you configure your patient's monitored data the way you want. You can select from various layouts to display a combination of Intelligent Panels, including the Dynamic Lung, Vent Status, and ASV target graphics, plus traditional waveforms.

### Flexible device configuration

To adapt the HAMILTON-C2 to your environment, you can configure the device mounting in several ways:

- to a standard trolley, with optional humidifier and O<sub>2</sub> cylinder mounts
- to a compact transport solution attached to the bed or to the wall together with a small O<sub>2</sub> cylinder
- to ceiling panels or other mounting systems with a quick-lock mechanism

### Flexibility Options

- Volumetric (Mainstream) CO<sub>2</sub>
- Sidestream CO<sub>2</sub>
- Neonatal ventilation
- NeoNIV (nasal CPAP)



#### IntelliTrig

Changing breathing patterns or circuit leaks are a challenge in non-invasive ventilation. With the innovative IntelliTrig technology, the HAMILTON-C2 automatically responds to varying leaks and adapts sensitivity thresholds for optimal response to the patient's breathing pattern.



#### ASV

Adaptive Support Ventilation (ASV) is a closed loop mode based on a breath-by-breath "assess, optimize and achieve" concept:

1. Assess the patient's lung mechanics.
2. Optimize the tidal volume/respiratory frequency combination based on lung mechanics.
3. Achieve optimum tidal volume/respiratory frequency by automatically adjusting mandatory rate and inspiratory pressure applying lung-protective strategy rules.



#### Neo

The neonatal option on the HAMILTON-C2 effectively supports your most fragile patient, the premature infant, with volumes as small as 2 ml and frequencies up to 150 breaths per minute. With the addition of the neonatal option, the HAMILTON-C2 is the first neonatal bedside ventilator that can accompany the infant during hospital transports. To further enhance neonatal ventilation, the mode nCPAP-PS is available as an option to provide a gentle nasal CPAP treatment with additional pressure support.



#### IntelliSync

IntelliSync is a smart feature that is now standard on the HAMILTON-C2. HAMILTON MEDICAL's Adaptive Support Ventilation (ASV) has been on the market since 1996 and numerous studies and customer testimonials prove its superiority in comparison to conventional modes. With IntelliSync, you are now able to take advantage of these benefits in other modes like NIV-ST, nCPAP-PS and in PSIMV+. IntelliSync lets your patient breathe fully spontaneously if the set guaranteed rate can be maintained and thus allows a better synchronization and facilitates the weaning process.

For further information about the HAMILTON-C2,  
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