

SMARTCARE™ WEANING SOFTWARE *Found on DRAEGER'S EvitaXL VENTILATOR* *Paul Mathews PhD, RRT & Bethene Gregg PhD, RRT*



Decisions to proceed with weaning by the respiratory therapist or physician are commonly intermittent and unstructured. Optimal weaning settings are those which provide the lowest level of support and prevent excessive work of breathing and fatigue. We also know that once committed to the weaning process, optimal settings, adjusted as needed, should be *maintained* throughout. Progressive reduction of ventilator support, however, requires frequent reassessment to determine whether to maintain, reduce or escalate ventilator support. Current methods of weaning, unfortunately, often rely on a **reactive** approach to detect inappropriate ventilator settings, an approach that can, paradoxically, prolong ventilator dependence instead of decrease it.

The trend, in modern respiratory therapy is to increasingly move towards assisted forms of mechanical ventilation, for, as the saying goes, "weaning begins with intubation." It's a training process for respiratory muscles, much like athletes undergo to improve performance, and, in consideration of the current pathophysiologic understanding of acute lung injury, spontaneous breathing modes should be used as much as possible. Constantly adjusting ventilator settings according to the changing demands and needs of the patient, however, is a major problem in the daily routine of almost every ICU or "weaning unit".

Enter SmartCare™PS, Dräger Medical's weaning program integrated into their EvitaXL ventilator. SmartCare was developed

as a knowledge-based weaning system resulting from a protocol developed by Brochard and coworkers in Europe. Their approach included a special innovation of a derived pressure support mode that let's the ventilator react to the patient's demand for an adjusted ventilatory support classified by SmartCare every two to five minutes. SmartCare

is not only a computer system, then, but, a bedside-tested clinical protocol for weaning that aims for comfortable recovery from respiratory failure and liberation from the ventilator.

As we know, traditional weaning technique has in the last decade or so, been based on periodical clinical judgments of the patient's respiratory status, reduction of sedoanalgesics, early use of pressure support ventilation, CPAP and ventilator independence, including spontaneous breathing trials with T-piece. The main problem, however, was the need for considerable staff to monitor all this in a frequently understaffed work environment.

SmartCare's computer software, which encompasses patient weight ranges of 15kg – 200kg, incorporates clinical logic and rules coupled to a knowledge base in order to "automate" the weaning process. Automated weaning may provide several advantages over traditional methods. First, the software facilitates data acquisition and monitoring, continually supplying information to the knowledge base. The knowledge base maintains current medical data and practice patterns to define and organize weaning. The knowledge base then engages the reasoning engine to provide rules for the weaning process and the software provides the basis for *organized*, more *consistent* and *continuous* weaning to reduce clinical variability. Furthermore, the software allows the complexity of the weaning process to be transparent to the end user, improving the user interface which can improve compliance, prevent process confusion and prevent errors.

Improved monitoring and trending, coupled with a reasoning engine, can guide therapy and allow weaning to progress over an entire 24 hour period. In addition, continuous monitoring provides trends of "smart alerts" which may signal impending weaning failure, providing a **proactive** weaning system. This has the potential to improve outcome while decreasing cost, perhaps a new foundation for weaning in the 21st century.

So, how does it really work?

SmartCare Software 1.1 for the Dräger EvitaXL 6.0 (or higher), automatically adjusts pressure support levels to maintain spontaneous breathing frequency, tidal volume and end-tidal CO2 parameters within a predetermined range. This feature, found only on the EvitaXL, has been in successful clinical use for approximately one year now and Dräger has numerous studies showing how their software can significantly reduce weaning time (www.draegermedical.com for more information).

The software presents three sets of values based on actual body weight of the patient. These are, "15 to 35 kg", "36 to 55 kg", and "over 55 kg". Each body weight range has different criteria for acceptable tidal volume and frequency. Based on the patient's initial frequency, tidal volume and etCO2, SmartCare assigns the





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patient's ventilation to one of eight categories: normal ventilation, insufficient ventilation, hypoventilation, central hypoventilation, tachypnea, severe tachypnea, hyperventilation, or a category called "unexplained hyperventilation". For example, normal ventilation for patients weighing over 55 kg is defined as a spontaneous frequency between 15 and 30 breaths/minute, a tidal volume over 300 ml, and an etCO₂ below 55 mm Hg. "Insufficient ventilation" is classified as an acceptable frequency, but with a tidal volume that is too low or where an etCO₂ is too high. Hypoventilation on the other hand, is considered to be an acceptable tidal volume but with a frequency that is too low and an etCO₂ that is too high. The remaining types of ventilation are similarly delineated. The software presents a screen to the user which allows the user to select "Neurological Disorder", "COPD" or both under "Medical History". Choosing "Yes" for neurological disorder for instance, sets the high frequency limit to 34 breaths/minute for body weights of 36 kg and over. Selecting the "COPD" setting, allows the high etCO₂ limit to rise to 65 mm Hg.

Ventilation other than normal will initiate an increase or decrease in pressure support by 2-4 cm's H₂O, within a specified period of time depending on which parameter limit was violated. If a patient has an endotracheal tube and a HME humidifier, the target pressure support for ventilator discontinuance is 12 cm's H₂O. The pressure support goal for a patient with a tracheostomy tube and wet humidifier, for instance, is five cm's H₂O. When the target pressure has been obtained, SmartCare conducts a spontaneous breathing test, and if successful, displays a message ("SC – CONSIDER SEPARATION" to the therapist indicating that the patient may be considered for separation from the ventilator.

SmartCare checks the patient's RR, Vt and etCO₂ every 10 seconds. It will analyze ventilation every two minutes if there was no PS change or every 5 minutes if there was a PS change; certainly more often than any therapist could. The objective of SmartCare of course, is to obtain a target level of pressure support that is tolerated well and which eventually indicates the patient's readiness to be discontinued from the ventilator. We were able to reproduce the various categories of ventilation in our laboratory using a Duel Adult Test Lung made by Michigan Instruments, Inc.. We connected the EvitaXL capnograph to the drive section of the test lung as well, and bled in a low flow rate of a 10 % CO₂ gas mixture to control the etCO₂ values. Bleeding CO₂ into the "patient" test lung produced a "Flow measurement out of range" message and SmartCare would interrupt, as it was designed to do. (External flow compensation cannot be used with SmartCare which, unfortunately, means delivery of externally driven aerosol therapy is not allowed during SmartCare.) The use of the Evita internal nebulizer, however, *is* possible during a SmartCare session allowing delivery of aerosol therapy via this route. As each of the types of ventilation were simulated and a parameter threshold was breached, SmartCare increased (or decreased) the level of pressure support; again, as it was designed to do. We also *purposefully* interrupted SmartCare numerous times so as to test the software's response. When interrupted, the SmartCare symbol (with a diagonal line through it) appeared on the screen and the current level of pressure support was maintained until the offending condition had been corrected – a good thing to see. When alarm limits are activated, SmartCare may be re-activated by touching "Alarm Reset". SmartCare can also be interrupted by design, say, for overnight resting periods, by activating the "Night Rest" mode; another nice feature.

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SmartCare is interrupted with sensor alarms or airway pressure alarms and aborted altogether with Apnea Ventilation. It will not be available at all if: 1) the patient's body weight isn't entered in the SmartCare section, 2) external flow compensation is active, or 3) the CO₂ sensor is not functioning.

SmartCare is designed to be just as flexible as the EvitaXL ventilator itself and there is a separate guideline for patients with body weight between 15 and 35 kg. For all other patients Draeger's ATC™ may be used during the weaning session. In this way SmartCare not only adapts to the patient population, but also allows one to incorporate *their* therapy strategy, whether it is with, or without, ATC.

As a result of our review, SmartCare seems to meet the requirements for a knowledge-based weaning system, even in long-term ventilated patients. SmartCare should shorten weaning time and should help busy therapists to more closely monitor and adjust their patient's ventilatory support. Of course it does not forgo the need for attention by a knowledgeable respiratory therapist, however. Still, with SmartCare, Draeger takes the first step to "smarter" medical equipment. Adding intelligence to their mechanical ventilator by integrating "protocolized" care based on recognized medical expertise is certainly a leap forward. Another advantage of this system is its easing of the need for more and more staff. Even if the staff of an ICU makes every endeavour possible to wean a patient from the ventilator, the therapist can not be at the patient's bedside every minute of the day as SmartCare can.

Maintaining high quality patient care while reducing the clinical workload, increasing patient comfort during ICU treatment, reducing the time spent on a ventilator and shortening the patient's stay in the ICU and the hospital, are most definitely "smart" goals. SmartCare does seem to contribute to those goals thus, we recommend that you take a good look at Draeger's EvitaXL and its SmartCare weaning system, the next time you're in the market for mechanical ventilators.

The company can be reached at 800-437-2437. They also have an extensive website located at www.draegermedical.com.