

Knowledge based weaning

Protocolized Care in the Weaning Process.



Improving Intensive Care Unit (ICU) outcomes by reducing ventilator associated complications and ventilator days may warrant re-engineering the weaning process.¹ Alternative methods which assist clinicians in organizing and implementing accurate weaning processes may shorten the duration of ventilator dependence and positively impact ICU outcomes.² Knowledge based weaning (KBW) provides an alternative to the traditional weaning process.

A major challenge in the ICU is determining whether a patient is capable of weaning from the ventilator. Weaning patients from mechanical ventilation is initiated by the bedside clinician, not the ventilator.³ Reductions in the level of ventilator support are typically performed once or twice a day during routine ventilator checks or at designated times, generally during daytime hours. The weaning process characteristically begins when the clinician believes the patient is able to tolerate less support, and is present to make appropriate changes in ventilator settings. Decisions to proceed with the weaning process by the respiratory therapist or physician are commonly intermittent and unstructured. Optimal ventilator settings during weaning are those which provide the lowest level of support and prevent excessive work of breathing and fatigue. Once committed to the weaning process, optimal ventilator settings should be maintained throughout. Progressive reduction of ventilator support requires frequent reassessment to determine whether to maintain, reduce or escalate ventilator support. Respiratory decom-

pensation may not be recognized until significant fatigue has developed. Current methods of weaning rely on a reactive approach to detect inappropriate ventilator weaning. Excessive weaning may surpass the patient's ability to transition to less support, paradoxically prolonging ventilator dependence. Conversely, data suggests many patients are ventilated longer than necessary. Prospective, controlled studies have shown that greater than 70% of patients who tolerate a spontaneous breathing trial could be extubated successfully.^{4,5,6} These studies advocate a spontaneous breathing trial to identify patients capable of being liberated from mechanical ventilation. In addition, studies reviewing self-extubation have documented a significant percentage of self extubated patients do not require reintubation. These studies suggest that care providers may not always recognize patient's readiness to be weaned and extubated.^{7,8}

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Complications from mechanical ventilation are associated with significant mortality, morbidity, increased ICU length of stay and ICU cost.⁹ Ventilator associated lung injury and pneumonia are significant morbidities directly related to duration of ventilator dependence.¹⁰ The need for continuous quality improvement has caused many ICU clinicians to focus on reducing ventilator days and complications from mechanical ventilation. In 1994, Esteban suggested that weaning from the ventilator accounts for up to 42% of the time a patient is mechanically ventilated.¹¹

Multidisciplinary protocols can improve the weaning process through the implementation of a consistent, team approach.¹² Protocol based weaning defines and organizes a process for ventilator adjustments, expected outcomes, patient monitoring and patient care during weaning. Several studies have shown that implementation of protocols to aid the weaning process results in a significant reduction in ventilator days and cost.² Furthermore, reductions in ventilator days directly impacts ventilator associated complications. Successful protocol based weaning results from a coordinated approach using a multidisciplinary team rather than the mode of ventilator weaning. The multidisciplinary team approach to designing and implementing weaning protocols provides the opportunity to incorporate knowledge from several disciplines on how the weaning process affects patients. In addition, the multidisciplinary approach facilitates the coordination of care plans during the weaning process.¹³ The multidisciplinary team should include nutritionists, pharmacists, physical and occupational therapists in addition to physicians, respiratory therapists and nurses. A diversity of clinical staff provides a well-rounded assessment of the patient, plan of care and expected outcomes. Effective protocols must balance adequate information to deal with the complexity of weaning and limit data overload for the clinician. If a protocol becomes too difficult to

navigate, the protocol may not be utilized appropriately. Protocols with excessive detail may decrease their effectiveness, increase error rates and even limit successful implementation. Alternatively, if a protocol does not have enough detail, application may be limited to a narrow spectrum of patients, proving ineffective for clinical variability inherent in critical care patients.¹⁴

KBW computer software incorporates clinical logic and rules coupled to a knowledge base in order to automate the weaning process.¹⁵ Automated weaning may provide several advantages over traditional methods of weaning. KBW facilitates data acquisition and monitoring, continually supplying information to the knowledge base. The knowledge base maintains current medical data and practice patterns from a multidisciplinary team to define and organize weaning.^{16,17,18} The knowledge base engages the reasoning engine to provide rules for the weaning process. KBW provides the basis for organized, consistent and continuous weaning to reduce clinical variability. Furthermore, KBW allows the complexity of the weaning process to be transparent to the end user, improving the user interface. Improving the user interface has the potential to improve compliance, prevent process confusion and errors while limiting data overload. Improved monitoring and trending coupled with a reasoning engine can guide therapy and allow weaning to progress over the entire 24 hour period. In addition, continuous monitoring provides trends of "smart alerts" which may signal impending weaning failure, providing a proactive weaning system. Reengineering the weaning process provides the potential to improve outcome while decreasing cost. KBW will provide a foundation for weaning in the 21st century.

This article expresses exclusively the author's opinion.

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