In 1992 the AARC Mechanical Ventilation Guidelines Committee defined a “vent check” as: “A patient-ventilator system check is a documented evaluation of a mechanical ventilator and of the patient’s response to mechanical ventilatory support. This procedure is often referred to simply as a ventilator check.” With the exception of the few statements regarding infection control, this AARC Clinical Practice Guideline seems relevant even today. However, the committee did not make a specific frequency recommendation, settling instead on stating “A patient-ventilator system check must be performed on a scheduled basis (which is institution-specific) for any patient requiring mechanical ventilation for life support.” One suspects the committee recognized the futility of trying to pin down an actual frequency and wisely deferred to each institution to determine the schedule that best meets their needs. Nevertheless, questions arise today about whether there is any evidence to support one vent check frequency over another. In 1992, the committee did not have to worry about satisfying requirements for evidence-based medicine, and the word “evidence” does not even turn up in the guideline document. In 2009 and beyond, requirements for evidence to support practice changes will be more common; hence the question: What is the current evidence for ventilator checks?

Unofficial history of the ventilator check

The origin of the vent check seems to coincide with our pioneering efforts in continuous mechanical ventilation as provided by the pressure-limited ventilators of the mid-1960s: the Puritan Bennett PR-1 and PR-2 plus the Bird Mark 7, 8, 10, and 14 “respirators.” It was readily apparent back then that if a patient’s airway resistance and/or lung compliance changed, the pressure-limited ventilator would deliver a different tidal volume, either higher or lower depending on the change in lung mechanics. In contrast to some of our contemporary ventilatory strategies, back then we were fixated on delivering a prescribed tidal volume or minute volume and quickly learned that we had to check the ventilator every one or two hours to determine if any adverse patient changes occurred and that the correct tidal volume was still being delivered. We typically used handheld respirometers to measure the actual exhaled minute ventilation, while counting breaths, in order to calculate average tidal volume. Thus, the vent check was born.

The late 1960s to mid 1970s saw the introduction of bellows and piston-driven ventilators such as the Air-Shields “Respirator,” the Puritan-Bennett MA-1, the Ohio 560, the Engstrom, the Emerson Post-Op, and others. Some of these devices included spirometers for the measurement of exhaled volume. However, despite the transition to volume-controlled ventilation, our rudimentary vent checks taught us that:

1. there were numerous conditions under which ventilators failed to deliver a set tidal volume, and
2. there were many other adverse situations that could arise.

Both of these lessons supported the need for frequent ventilator checks. Over time the vent check evolved into the detailed procedure we have today, which not only includes recording the ventilator data and the alarm settings but also includes a comprehensive examination of the patient, the airway, the ventilator tubing, the humidifier, the “interface” between the patient...
and the ventilator, and most other components of the patient-ventilator system.

**What does a ventilator check tell us?**

As for what a vent check tells us, it tells us only that which we can observe or measure. It will not tell us what we don’t ask it. It cannot see the future, but it may help predict it. It cannot see into the past, but it may contain some historical documentation that may be useful. Nevertheless, the content of a ventilator check has undergone a continuous change that has paralleled the advances in both ventilator technology and the practice of critical care medicine. Vent check policies, regardless of the differences that exist between different facilities, prompt us to regularly observe and monitor our patients and to collect and record specific data and information that has been deemed important by our particular facility. The vent check prompts us to purposefully visit our ventilator patients at preset and ad hoc intervals with particular goals and objectives in mind.

As a profession, we have formalized and embraced the vent check procedure by creating the paradigm of “flowsheets” and similar forms for documenting when the ventilator check was performed and to provide a place to put the observations and measurements so they can be seen, compared, and stored. The ventilator flowsheet is generally available to all the members of the care team, not just the RC department, and has increasingly played an important role in multidisciplinary clinical decision making. Flowsheets guide us in making the correct observations and collecting the appropriate data: not unlike the airline and other industries where it has been determined that a “checklist” approach to complex processes improves the execution of the process and diminishes errors. Recently, checklists have been recommended in medicine and critical care to significantly reduce the risk of costly mistakes and to improve overall outcomes.²

It is not unreasonable to think that our vent check flowsheets serve the same purpose for the ongoing management of patients on mechanical ventilation and should therefore be used accordingly. Reeling off a long list of potential observations, measurements, vent settings, alarm settings, and other “parameters” in this space would probably not be useful. Respiratory care departments, despite their similarities, tend to be fiercely independent about what they include in their vent check flowsheet. Each department typically includes what is important to them and the intensivists with whom they work. This may include, in addition to ventilator data, patient vitals, hemodynamics, metabolics, ventilator-associated pneumonia bundle compliance, and anything else that makes sense to the care team. Many departments have different flowsheets, and therefore different vent check procedures, that are customized for a variety of ventilatory support modalities such as nitric oxide, high-frequency ventilation, or noninvasive ventilation. What is important is not so much what is on the flowsheet, but that there is a flowsheet and it is used as intended.

**The current standard for ventilator checks**

The AARC Clinical Practice Guideline is about as close to a standard as we are going to get; no other professional organization has addressed this issue. The AARC Clinical Practice Guideline contains a concise description and a very comprehensive list of objectives plus indications, contraindications, hazards/complications, limitations/validation, and many other features. Although it does not declare a standard frequency, it does note that: “A patient-ventilator system check should be performed at regularly scheduled intervals and

- following any change in ventilator settings;
- prior to obtaining blood gas samples;
- prior to obtaining hemodynamic or pulmonary function data;
as soon as possible following an acute deterioration of the patient’s condition, particularly when this occurs after violation of a ventilator alarm threshold.”

Every two hours seems to have become the de facto frequency standard for a vent check starting, perhaps, as early as the late 1960s or early 1970s when invasive ventilation had become commonplace in intensive care units. However, informal surveys have shown that there are a growing number of facilities that have changed their vent check frequency standard to every three or four hours, or even longer intervals, or they have different frequencies for different types of ventilator patients or units. An argument heard in support of a longer interval between scheduled checks is that more frequent checks are typically performed anyway as a result of changes in ventilator settings, blood gases, and other events that necessitate ad hoc data collection or examination of the patient-ventilator system. As for the question of evidence, the literature is relatively devoid of anything that could even remotely support the designation of Level I or Level II evidence. At best, the evidence for ventilator checks is Level III (opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees). More likely, much of what we do with respect to ventilator patient monitoring and assessment is driven largely by the particular brand or characteristics of the technology in use as well as the benefits that technology confers upon us.

Impact of new technology

While the content of a ventilator check seems to have evolved in parallel with improved ventilator technology and advances in critical care medicine, the methods of performing vent checks are likewise evolving. It is convenient to think of the vent check as consisting of three somewhat overlapping components (patient assessment, hardware (ventilator/humidifier) assessment, and data collection). It is increasingly apparent that the data collection component of the vent check may be largely amenable to process improvement and/or time-savings efficiencies by way of computerization. Computerized hospital systems, high-speed data networks, and universal data ports (RS-232, Ethernet, etc.) have allowed numerous facilities to inter-face their ventilators to their physiologic data monitoring systems as well as to their electronic medical records (EMR) systems to automate the data transfer and directly populate the EMR with ventilator data. The value of this continuous, unattended data collection approach is both controversial and debatable for many reasons beyond the scope of this article.

A novel and promising approach created by one ventilator company is the inclusion of a dedicated “mini Web server” as part of the firmware designed into the ventilator electronics. This approach allows a clinician to communicate with the ventilator through a laptop computer and the ubiquitous Web browser in order to display ventilator settings, alarms, patient values, waveforms, and other data remotely. This is so new that there is virtually no experience reported on it at the present time, but it is garnering interest in a number of areas.

Two other companies have developed hardware and software interfaces to ventilators. One wirelessly transmits the data out of the ventilator to a central station (continued on page 83)
where it can be displayed and monitored for alarm conditions. When alarm conditions occur, the central station activates one or more pagers carried by respiratory therapists, which direct the RTs to respond to the correct ventilator. The other relies on an intentionally short-range, line-of-sight infrared data transceiver connected to the ventilator’s data port to beam information to a handheld personal digital assistant (PDA) upon demand. The entire data transfer process, from ventilator to PDA, takes a mere second. The respiratory therapist can quickly examine the data for validity while at the bedside and then wirelessly send it to the EMR. This saves the RT a great deal of time that can instead be redirected to other patient care activities.

REFERENCES