White Paper

SAFE INITIATION AND MANAGEMENT OF MECHANICAL VENTILATION

A White Paper from the American Association for Respiratory Care (AARC) and University HealthSystem Consortium's (UHC) Respiratory Care Network

This paper provides guidance for best practices for safe initiation and management of mechanical ventilation. It helps define the competency, training, and interdisciplinary approach necessary for patient safety and improved outcomes.

Background and Purpose

Approximately nine percent of all safety intelligence data demonstrate that changes to mechanical ventilator settings were performed by health care providers that had no competency training regarding the specific functions of the ventilator in use.[1] Mechanical ventilators are very complex and require training and competency to ensure positive patient outcomes and to avoid patient harm. Inappropriate setting changes, failure to change alarms when ventilator settings are changed, changing settings without appropriate orders, and failure to communicate changes to the interdisciplinary team are under reported.

This issues paper is intended to provide additional guidance to acute and long term health care facilities, home care/durable medical equipment organizations (DME), and other providers to ensure that all personnel trained to setup, install, and make setting adjustments have formal training in the basics of mechanical ventilation as well as competency specific to ventilator(s) in use. An interdisciplinary approach with good communication between all members of the healthcare team will result in safe delivery of mechanical ventilation and improve outcomes.

Training and Competencies Purpose

Initiating and maintaining both invasive and non-invasive mechanical ventilation is a complex process. The licensed clinician must differentiate among various manufacturers, ventilator models, available modes, and breath types to determine which is appropriate for each individual patient. In addition, the terminology surrounding mechanical ventilation modes and features is not universal. This lack of standardized vocabulary leads to ambiguity and confusion regarding mechanical ventilation application.[2] Once mechanical ventilation is initiated, the clinician must also be able to adjust the ventilatory support for the patient based on physiologic response as measured by invasive and non-invasive monitoring. Therefore, it is imperative that each clinician who initiates and manages mechanical ventilation demonstrate competency before participating in this type of patient care.

Competency

Competency is the ability of a practitioner to integrate the professional attributes required to perform in a given role, situation, or practice setting. These professional attributes include knowledge, skill, judgment, attitudes, values, and beliefs. Many acute care and long term care facilities as well as home care/DME providers require annual competency testing for staff to document knowledge and skills regarding a multitude of procedures, including invasive and non-invasive mechanical ventilation. The American Association for Respiratory Care (AARC) position statement for "Pre-Hospital Ventilator Management Competency" advocates regular competency evaluations of pre-hospital providers of mechanical ventilation.[3] The North Carolina Board for Respiratory Care position statement "Making Adjustments to Functioning Ventilators" also advocates completion and documentation of competency or skills review for anyone making ventilator adjustments.[4] Any clinician initiating and caring for home ventilators in a post-hospital setting should also maintain regular competency evaluations.

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Though there is wide support for regularly timed competency demonstrations by clinicians who initiate and manage mechanical ventilation, a standardized

competency assessment tool has not been developed. Many organizations develop their own assessment tool to be specific to the ventilator models used in that organization. It is important to note that an appropriate competency tool is one that not only addresses the clinician's ability to manipulate the machine correctly but also their ability to integrate mechanical ventilation principles with the patient's unique condition, physiologic need, and ongoing physiologic status as well as meet identified interdisciplinary team goals. Competencies required of the respiratory therapist with regards to mechanical ventilation include all technical aspects of the mechanical ventilator, indications for mechanical ventilation, pathophysiology, independent application of mechanical ventilation, pharmacology of critical care, mechanical ventilation adjuncts, evidence-based application of mechanical ventilation, protocols and guidelines, management of the airway, bedside monitoring, and effective communication.[5] Using expert consensus, Goligher et al. developed a list of 56 learning objectives required to develop core ventilator management competencies. These objectives address respiratory physiology, initiating ventilation, modes of mechanical ventilation, non-invasive ventilation, monitoring, patient-ventilator interactions, complications of mechanical ventilation, and weaning and extubation.[6]

Professional Training

Many of the clinicians who participate in initiation and management of mechanical ventilation receive training in the professional phase of formal education. Respiratory therapists participate in an average of 900 clinical hours in addition to didactic and laboratory instruction on the function and application of mechanical ventilation.[7,8] A 2010 survey of respiratory therapy educational programs identified that 99.71% of all respiratory therapy programs included competencies on the application of invasive and non-invasive mechanical ventilation, 97.98% included competencies on the application of all ventilation modes, and 97.96% included competencies on the interpretation of ventilator data.[9]

Research indicates that it is unclear how well medical school prepares residents to initiate and manage mechanical ventilation.[10] Cox et al. identified that a significant percentage (46%) of surveyed residents reported being satisfied with mechanical ventilation training and noted that there was a significant difference in perception of the resident's readiness to care for patients receiving mechanical ventilation between the academic program director and the resident.[10] Registered nurses have limited knowledge of mechanical ventilation[11] and data to support education and training for mechanical ventilation during formal nursing education is lacking.

Continuing Education

The National Academy of Medicine (formerly the Institute of Medicine) identifies the purpose of continuing education as to "enable health care professionals to keep their knowledge and skills up to date with the ultimate goal of improving performance and patient outcomes."[12] Some research has focused on the use of continuing education as a mechanism to improve the knowledge and skills required for initiating and maintaining mechanical ventilation.[11] It has been identified that didactic learning alone is not sufficient; rather, hands-on training, demonstration, and clinical simulations engage the learner and improve ability to retain the information.[13,14] Therefore, continuing education for clinicians engaged in the application of mechanical ventilation should be developed to address knowledge gaps identified in the population and incorporate opportunities to practice skills in an interactive environment.

Ventilator Initiation

Ventilator Pre-Use Checks

While all modern ventilators conduct an internal Self-Test at power up, additional pre-testing is necessary to ensure safe ventilator operation prior to placing on a patient. Manufacturer operators' manuals consistently state that a preoperational check must be performed prior to the ventilator being placed on a patient.[15,16] This check is to confirm the function and integrity of the ventilator circuit including the internal ventilator components, tubing, and the humidifier system. This procedure is generally performed at the time of circuit or humidifier setup. This test must also be completed anytime the circuit is changed or modified.

Patient-Specific Setting Selection

When powered up, some ventilators default to generic predetermined settings while others default to the last operational settings. Depending on the patient's needs, the default settings may present a hazard to the patient. Many institutions use disease driven ventilator protocols that help to reduce the risk of barotrauma or pneumothorax by using lung protective strategies.

Anytime a clinician is initiating mechanical ventilation on a patient, it is important to fully understand the patient's history, reason for ventilatory assistance, anatomy and goal for ventilation. Any of these factors can potentially dictate settings.

Another aspect for consideration is the alarm settings. Alarm settings are both informative and protective. Setting limits on volume, pressure and rate is every bit as important as the ventilatory settings themselves. Many institutions have policies requiring alarm settings to be set at a specific percentage of the ventilation setting. Alarm settings act as a ventilation/pressure limit for patient safety.

Ventilator Management

This issue paper supports the position statement adopted by the North Carolina Respiratory Care Board, which states:

> The Respiratory Care Practitioner is the health professional best suited to provide, monitor, adjust and document ventilator care. In order to ensure the safety of all patients receiving mechanical ventilator support, it is essential to limit the number of individuals who make adjustments to mechanical ventilator settings. Given the scope of practice and training of the Respiratory Care Practitioner (RCP), combined with the daily experience and annual assessment of competency related to mechanical ventilation, the RCP is the individual whose training is most focused on the features and functions of ventilators, who will be most familiar and up to date on ventilator technology, and also will be most directly familiar with the organization's policies, procedures and clinical paths that are pertinent to ventilator operation. Therefore, the RCP should be recognized as having the primary role in making all ventilator adjustments. Every adjustment made to the ventilator requires a careful review of alarm settings and adjustments as needed for the safety of the patient.[4]

All clinicians who make changes to mechanical ventilators should be able to demonstrate the same level of competency and training as that of the respiratory therapist. Each change made to the patient's ventilator settings warrants an assessment of the patient to determine the effect of the change. Thorough knowledge of patient physiology and response to specific setting changes needs to be part of the competency of any clinician who is making adjustments to the ventilator. Interdisciplinary communication between the physician, nurse, and respiratory therapist is essential to assure that the adjustments are safe. An example would be that, during daily rounds, a physician changes a patient's mechanical ventilator mode to continuous positive airway pressure (CPAP) but does not discuss the change with the nurse or respiratory therapist. The physician does not adjust the alarms on the ventilator or document the changes. The nurse notices that the patient appears in distress with low oxygen saturations. The nurse assumes that the patient is anxious and sedates the patient. A few minutes later, the respiratory therapist is called to the room as the patient is displaying signs of respiratory distress and desaturation. The nurse and respiratory therapist notice that the patient's mechanical ventilator has been changed to CPAP and the patient is hypoventilating due to the sedation. The physician must be informed of the situation. Although physicians are well trained in pathophysiology, they may not be adequately trained on the alarm setting for each type of ventilator or each mode of ventilation. The best practice is interdisciplinary communication, physician entered/written orders, nurse and respiratory therapist verification of the orders, and then changes to be made by the clinician who is appropriately trained and has documented competency in ventilator management, physiologic response to each mode/setting and ventilator type used, and proper alarm settings.

Alarm Management

Establishing appropriate and safe strategies for ventilator alarm management is critical to patient care. Respiratory therapists should place an emphasis on developing policies and procedures that support facility wide emphasis on setting and monitoring ventilator alarms specific to each setting. Evidence suggests that considerable morbidity and mortality can be attributed to inappropriate monitoring and setting of ventilator alarms. This has resulted in an emphasis by The Joint Commission to establish objectives and goals for hospital accreditation consideration. Consistent with this effort, respiratory therapists should advocate for interdisciplinary teams to generate institutional specific alarm policies, with an emphasis placed on their most crucial alarm activity. This may be accomplished by incorporating evidence-based practice, soliciting the recommendations of all clinicians in the environment of care, and directing policies relative to patient risk.[17] These policies and procedures should also include clinical targets, directives regarding permission to modify alarms settings, and most importantly, providing education validated by competency assessment. Respiratory therapists should establish other key parameters that include, but are not limited to: 1) time required to respond to alarms, 2) establishing a list of parameters that require monitoring, 3) competency assessment intervals, and 4) designation of alarm priority level, i.e. level 1, 2, or 3.[18] Careful consideration should be given to justify the use of default or "cookie cutter" alarms to avoid inappropriate generalization. Recommendations should support individualized settings in an attempt to create patient specific safety parameters.

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Ventilator alarm management policies should incorporate manufacturer specific alarm setting requirements, alarm functionality tests and an associated competency assessment. Standardization among manufacturers is non-existent, necessitating equipment specific training to familiarize staff with what alarm features are available, how to modify alarms, the sounds associated with various alarms including priority differences, how to extract alarm data, and reporting procedures for improving practice.

Every effort should be made to establish good practice patterns in an attempt to mitigate nuisance alarms and alarm

fatigue, while creating an environment that is the safest and most responsive to patient care needs. When available, professional organization recommendations should be incorporated into policy and procedure guidelines in support of best practice.

Ventilator Failure

Each facility and home care/DME provider should ensure that a plan for backup ventilation is provided. An example of this would be establishing a set number of back up ventilators on hand at a facility to accommodate equipment failure and federal and local emergency preparedness plans in the event of a natural disaster.

A backup ventilator should be placed in the home setting of any home ventilator patient who lives greater than a 2 hour drive from the home care/DME provider, and a plan should be communicated to the patient, caregiver, and physician of how to handle equipment failure situations and natural disaster situations in the home setting.

Documentation, Orders, and Protocols

Orders

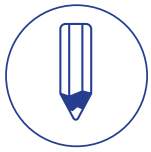
In this era of electronic health records (EHRs) it has become easier to implement standardized orders for the many aspects of respiratory care. These computer-based orders can be used across treatment locations and facilities once developed. Development should be a broad base collaboration between respiratory therapy providers, midlevel providers and physicians. They should be built upon evidence-based recommendations of professional societies and have acceptance from all members of the health care team.

These standardized protocols should be entered as order sets that can be easily found in organized drop down menus. They should be easy to be signed by the supervising mid-level provider or physician based on the privileging standards of a facility. These order sets and protocols should be reviewed and edited based on ongoing recommendations and evolving medical literature.

Home care/DME orders should be detailed and certify continued medical necessity for long term mechanical ventilation in the home. The details of this order should include a list of all required supplies and appropriate interface and mode of home ventilation. The certification of medical necessity must document the patient prognosis and plan of care, along with documentation of the consequences to the patient if ventilator support is withdrawn.

Documentation

The EHR has had its greatest advantage in its ability to share information across the continuum of care both at the bedside and through remote access. Therefore, it is imperative that physiologic parameters and the settings of the support technology be entered into the EHR. In the majority of facilities such data can be automatically collected and downloaded by the monitors connected to the patients and the electronically integrated ventilators, support devices and medication delivery systems. The record should also be able to communicate with laboratory and pharmacy databases to document pertinent information necessary to titrate therapy. These electronically based systems not only allow rapid and standardized care but can also give us rapidly accessible data bases that can be used for quality improvement and research.



It is equally important for home care/DME providers to document patient home assessments and ventilator changes/settings at every patient visit so this documentation can be shared with treating physicians and other clinicians as appropriate to ensure continuity of care.

Guidelines and Protocols

At the core of this electronic based care system should be respiratory therapist-driven protocols and guidelines. Though the perception persists that respiratory therapist-driven protocols increase workload, such standardization has been shown to improve not only real-time patient care and patient outcomes, but also resource utilization and, therefore, cost.[19,20]

Interdisciplinary communication

Interdisciplinary communication is an essential tool that not only provides the care team with valuable medical information needed to properly manage a patient, but also can help to alleviate unexpected situations that might in fact, harm a patient. Accreditation agencies, such as the Joint Commission, mandate standards regarding care coordination. Joint Commission Standard PC.02.02.01 requires hospitals to coordinate the patient's care, treatment and services based on the patient's need. The hospital must have a process to receive or share patient information when the patient is referred to other internal or external providers of care, treatment and services. Hand-off communication, or anytime a new provider will be caring for a patient, allows for the giver and receiver to fully discuss patient needs and the care plan.

It is often difficult to manage assigned workloads and unexpected emergencies. However, activities that are integrated into the institutions may help guide the caregiver into promoting safety first and above all other concerns. Having all caregivers of an organization use a standard tool should improve communication efforts.
Utilizing a standard communication tool may enhance effectiveness. A common tool is SBAR (situation, background, assessment and recommendation), where the caregivers use concise communication techniques.

Some institutions may use multidisciplinary rounds to help enhance patient care. Scheduled rounds help engage the caregivers in what is expected for the shift. However, respiratory therapists should make themselves available to the team when rounds are scheduled, and it should be considered part of the daily assignment to attend rounds. Still, medical emergencies may pre-empt rounds. Respiratory therapists should be responsible for contacting other members of the healthcare team, if rounds are rescheduled, and make arrangements to attend, especially if rounds include patients on mechanical ventilation.

Some EHRs may have advanced tools, such as notes, that can be used to communicate concerns or ideas. While face-to-face communication is always best, individuals working on other shifts may not be able to participate in direct communication. This may be more apparent in smaller facilities, long-term ventilator units, home care/

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DME providers, or where a respiratory therapist may not be present for all respiratory care activities. If institutions use a note-type function in an EHR or paper record, training on the appropriate content of the note should be included.

While some personnel may find it difficult to offer suggestions or contradict what others are offering, the role of being a patient advocate should be on the forefront of every caregiver's thought process. Fear of criticism can be daunting. But clinicians have a responsibility to ensure quality safe respiratory and patient care. Respectfully stating a position and providing appropriate medical knowledge for the situation is important in order to gain trust of other members of the care team.

Conclusions (Recommendations)

1. Continuing education to improve knowledge and skill in the initiation and management of mechanical ventilation should be developed to address identified knowledge gaps for all healthcare providers who initiates and maintains mechanical ventilation. These educational opportunities should incorporate interactive environments.
2. Completion and documentation of competency or skills review should be performed annually and when new equipment is introduced.
3. All parameter and alarm changes on ventilatory support devices should be clearly recorded, documented, and communicated to the entire health care team.
4. Policies and procedures for ventilator alarms should be evidence-based, include clinical targets, directives regarding permission to modify alarms settings, identify the time required to respond to alarms, establish a list of parameters that require monitoring, identify competency assessment intervals, and identify the alarm priority level designation.

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