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AARC Clinical Practice Guideline

Patient-Ventilator System Checks

MV-SC 1.0 PROCEDURE:

Patient-Ventilator System Check

MV-SC 2.0 DESCRIPTION:

2.1 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.

2.2 Objectives:

2.2.1 To evaluate and document the patient's response to mechanical ventilation at the time that the check is performed

2.2.2 To assure and document the proper operation of the mechanical ventilator

2.2.3 To verify and document that the ventilator is functioning and is properly connected to the patient

2.2.4 To verify and document that appropriate alarms are activated(1)

2.2.5 To verify and document that inspired gas is properly heated and humidified(1)

2.2.6 To verify and document that inspired oxygen concentration is measured with every change in FIO2 or, at least, every 24 hours.(1) (Although retinopathy of prematurity, or ROP, is thought to be of multifac-torial etiology,(2-4) the association between ROP and duration of exposure to high arterial oxygen levels suggests that continuous measurement of FIO2 for infants at risk is warranted.(5))

2.2.7 To verify and document that ventilator settings comply with physician orders(1,6,7)

2.3 All data relevant to the patient-ventilator system check must be recorded on the appropriate hospital form(s) at the time of performance, must be included as an official part of the patient's medical record,(1,6,7) and include observations indicative of the ventilator's operation at the time of the check *(except where "should" is used)*. Observations should include but are not limited to

2.3.1 observation that the ventilator is turned on and that the patient circuit is securely attached;(8)

2.3.2 documentation that an operational verification procedure (OVP,

as described in the appropriate department's policy and procedure manual) was performed prior to or at the time that the ventilator was first applied to the patient;(1)
2.3.2.1 An OVP may be accomplished manually by occluding the patient connection and observing airway pressure rise on a pressure monitor or may be a self-test performed by the ventilator to assure proper internal function.
2.3.2.2 OVP should be performed at the bedside just prior to connection to the patient after the patient circuit has been changed or disassembled for any reason.
2.3.3 documentation that an alarm for airway disconnection is functional and is properly set;
Patient-Ventilator System Check documentation of measured FDO2 (fractional concentration of oxygen delivered) with an appropriately calibrated analyzer;
2.3.5 documentation of measured inspired gas temperature, if applicable;
2.4 Patient-ventilator system checks must include patient information and observations indicative of the ventilator's settings at the time of the check.
Observations should include but are not limited to
2.4.1 Patient name
2.4.2 Patient hospital number
2.4.3 Diagnosis
2.4.4 Endotracheal or tracheostomy tube size and position
2.4.5 Documentation of time of last patient circuit change
2.4.6 Date of patient-ventilator system check
2.4.7 Time of patient-ventilator system check
2.4.8 Current ventilator settings
2.4.8.1 FDO2 set and humidifier temperature setting (when applicable)
2.4.8.2 Mode of ventilation
2.4.8.3 Set ventilator frequency
2.4.8.4 Peak, mean, and baseline airway pressures and presence of auto-PEEP (if applicable)
2.4.8.5 Set peak inspiratory pressure limit and pressure support level, if applicable
2.4.8.6 Set tidal volume (if applicable)\
2.4.8.7 Delivered tidal volume (measured or calculated)
2.4.8.8 Set sigh variables (if appli-cable)
2.4.8.9 Set minute ventilation (if applicable)
2.4.8.10 Set minimum mandatory minute ventilation (if applicable)
2.4.8.11 Set inspiratory flowrate and waveform (if applicable)
2.4.8.12 Set continuous flowrate (for IMV mode, if applicable)

2.4.8.13 Set I-E ratio, percent inspiration, or inspiratory and expiratory times
2.4.8.14 Set sensitivity threshold (if applicable)
2.4.9 Documentation of alarm settings and activation of appropriate alarms
2.4.10 A description of any instance of equipment failure
2.4.11 Signature of person performing patient-ventilator system check (including credentials) or initials (depending on state law and/or hospital policy)
2.5 Documentation of order from physician (or other authorized person) for mechanical ventilator settings--orders *should include at least one and preferably both of the following:*
2.5.1 Desired range for PaCO2, PtcCO2, and/or desired range for PaO2, SpO2, PtcO2, or SaO2;
2.5.2 Ventilator variables to initiate or manipulate in order to achieve desired blood gas results (eg, mode, tidal volume, airway pressures, ventilatory frequency, or FDO2).
2.6 Patient-ventilator system checks must include, in brief narrative form, clinical observations indicative of the patient's response to mechanical ventilation at the time of the check.*Clinical observations should include but are not limited to an evaluation of*
2.6.1 breath sounds;
2.6.2 spontaneous respiratory rate, volume, and pattern;
2.6.3 chest motion;
2.6.4 pallor, skin color;
2.6.5 patient's level of consciousness or remarks;
2.6.6 endotracheal-tube cuff pressure and apparent stability and position of the tube
2.6.7 secretions;
2.6.8 condition of ancillary equipment (eg, chest tube apparatus and manual resusci-tator);
2.6.9 results of bedside pulmonary function evaluations;
2.6.10 untoward effects of disconnection from ventilator during bedside procedures;
2.6.11 documentation of oxygenation and ventilation status (eg, arterial blood gas results, exhaled PCO2 measurements, and transcutaneous saturation or transcutan-eous blood gas measurements).
2.6.12 documentation of patient-ventilator synchrony during assisted or supported breaths

MV-SC 3.0 SETTINGS:

This guideline pertains to the in-hospital critical care setting.

MV-SC 4.0 INDICATIONS:

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. In addition, a check should be performed

4.1 prior to obtaining blood samples for analysis of blood gases and pH;

4.2 prior to obtaining hemodynamic or bedside pulmonary function data;

4.3 following any change in ventilator settings;

4.4 as soon as possible following an acute deterioration of the patient's condition (this may or may not be heralded by a violation of ventilator-alarm thresholds);

4.5 any time that ventilator performance is questionable.(9)

MV-SC 5.0 CONTRAINDICATIONS:

There are no absolute contraindications to perfor-mance of a patient-ventilator system check. If disruption of PEEP or FDO2 results in hypoxemia, bradycardia, or hypotension, portions of the check requiring disconnection of the patient from the ventilator may be contraindicated.(10,11)

MV-SC 6.0 HAZARDS/COMPLICATIONS:

6.1 Disconnecting the patient from the ventila-tor during a patient-ventilator system check may result in hypoventilation, hypoxemia, brady-cardia, and/or hypotension.(10,11)

6.2 Prior to disconnection, preoxygenation and hyperventilation may minimize these complications.(12-19)

6.3 When disconnected from the patient, some ventilators generate a high flow through the patient circuit that may aerosolize contaminated condensate, putting both the patient and clini-cian at risk for nosocomial infection.(20)

MV-SC 7.0 LIMITATIONS OF PROCEDURE/ VALIDATION OF RESULTS:

Measurements of volumes and inspired oxygen concentration are affected by the accuracy and reproducibility of the monitoring instruments.

7.1 Volume monitoring devices should be cali-brated at regular intervals. Volume monitoring accuracy should be ±10% of the measured volume.(21)

7.2 Oxygen analyzers should be calibrated at regular intervals. Oxygen analyzer accuracy should be ±3% of actual concentration.

MV-SC 8.0 ASSESSMENT OF NEED:

Because of the complexity of mechanical ventilators and the large number of factors that can adversely affect patient-ventilator interaction, routine checks of patient-ventilator system perfor-mance are mandatory.

MV-SC 9.0 ASSESSMENT OF OUTCOME:

Routine patient-ventilator system checks should prevent untoward incidents, warn of impending events, and assure that proper ventilator settings, according to physician's order, are maintained.

MV-SC 10.0 RESOURCES:

10.1 Equipment: Appropriate equipment should be available to perform the patient-ventilator system check. *Such equipment should include but is not limited to*

10.1.1 stethoscope;
10.1.2 oxygen analyzer;
10.1.3 volume monitor (if applicable);
10.1.4 pressure monitor (if applicable);
10.1.5 supplies necessary for observing Universal Precautions.(21)

10.2 Personnel: Mechanical ventilation is a complex task that requires the caregiver to understand the technical components of the ventilator, the pathophysiology of the respiratory system, and patient-ventilator interaction. Persons performing checks should hold a recog-nized and relevant credential (eg, CRTT, RRT, RN), should be trained in and have demon-strated ability in

10.2.1 the technical setup and operation of the mechanical ventilator;
10.2.2 cardiopulmonary physiology and pathophysiology;
10.2.3 interpretation of the results of arterial blood gas analysis;
10.2.4 assessment of patient need for and adverse reaction to the procedure;
10.2.5 appropriate response to adverse reactions;
10.2.6 application of Universal Precautions.

MV-SC 11.0 MONITORING:

In order to assure that patient-ventilator system checks are being performed according to these guidelines, an indicator should be created to monitor this activity as part of the appropriate department's quality improvement program. *Specific criteria for the indicator should include at least items 2.4 and 12.0 of this guideline.*

MV-SC 12.0 FREQUENCY:

A patient-ventilator system check should be performed at regularly scheduled intervals and

12.1 following any change in ventilator settings;

12.2 prior to obtaining blood gas samples;
12.3 prior to obtaining hemodynamic or pulmonary function data;
12.4 as soon as possible following an acute deterioration of the patient's condition, partic-ularly when this occurs after violation of a ventilator alarm threshold.

MV-SC 13.0 INFECTION CONTROL ISSUES:

13.1 Condensation from the patient circuit should be considered infectious waste and disposed of according to hospital policy.
13.2 The patient circuit should be changed at regular scheduled intervals according to hospital policy.
13.3 Universal Precautions should be observed during the patient-ventilator system check.(22)

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