POLICY: 552.54

TITLE: Air Ambulance Provider Optional Scope of Practice – Transport Ventilator

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SUPERCEDES:

APPROVAL SIGNATURES ON FILE IN EMS OFFICE

Air Ambulance Provider Optional Scope of Practice – Transport Ventilator

I. AUTHORITY

Health and Safety Code, Division 2.5, California Code of Regulations, Title 22, Division 9

II PURPOSE

To serve as a patient treatment standard for Air Ambulance Provider Paramedics.

III. POLICY

DO NOT MISS

- Qualified Paramedics that have not yet obtained their FP-C or CCP-C may assist the Qualified Nurse with Ventilator setup, maintenance and management. Settings are determined by the Qualified Nurse.
- Qualified Paramedics that have completed their FP-C or CCP-C may fully utilize this protocol.
- Check weight or size limitations for transport ventilator prior to transport.
- High Pressure Alarm limit terminates breath when activated.
- PEEP Compensated: PS and PC settings originate from set PEEP
- Circuit must NOT contain external PEEP valve.
- Sprint Pack must not be charged or utilized while in transport vehicle
- RAM cannula is NOT an option with specific ventilators(e.g., LTV).

PURPOSE: To provide guidelines for initiating and managing mechanical ventilator support

1. Ventilator strategies vary according to the clinical scenario and are initiated to:
    a. Maintain alveolar ventilation to ensure adequate elimination of carbon dioxide
    b. Maintain alveolar/arterial oxygenation to ensure adequate delivery of oxygen to the tissues
    c. Minimize the risk of adverse pressure and volume effects on the lungs and cardiovascular system
    d. Decrease the work of breathing, and optimize patient comfort

There is no single optimal mode of mechanical ventilation. Patient disease processes and condition vary over time; therefore, clinicians must regularly assess and adjust ventilator mode and/or settings to optimize oxygenation and ventilation.

PROTOCOL: General Ventilator Management

1. All intubated patients should be placed on ventilator for transport times > 10 minutes
2. If patient received on vent support and appears to be tolerating current settings with acceptable values (PIP, $Sp0_2$, $ETC0_2$, Vte, VS, etc.) those settings should be continued during out-of-hospital care.
3. Medical Crew has the ability to adjust any and all settings as necessary based on full patient assessment utilizing the guidelines in this outline and or with MD consult.
4. $ETC0_2$ monitoring (numerical and capnography) should be performed for all patients with advanced airway on ventilator support
5. Crew must have both high and low pressure 0_2 source equipment available
6. Providers must document supportive rationale for all changes and or values outside recommended parameters in PCR.
7. Check weight or size restrictions for the transport ventilator (e.g., the LTV 1200 ventilator is only for use on patients 3 kg and up)

POLICY APPLICATION:

Applies to all patients transported by a Qualified Transport Program requiring mechanical ventilation

SETTING:

1. Pre hospital mechanical ventilation should be utilized whenever possible post intubation
2. Interfacility
   a. Assess all labs and radiology exams (ABG, Chemistry, CBC, chest x-ray, CT)
   b. Utilize respiratory therapist when available

GENERAL GUIDELINES FOR VALUES AND PARAMETERS:

The following should be used as target values unless otherwise directed by a physician or when clinical assessment dictates alterations:

1. pH: 7.35 – 7.45
2. $PaC0_2$ and/or $ETC0_2$: 35 - 45 unless:
   a. The patient's $PaCO_2$ is chronically elevated as the result of a persistent disease state (i.e. Chronic Obstructive Pulmonary Disease -do not attempt to correct to normal physiologic range as hypercapnia is expected)
   b. Follow physician order for target $PaCO_2$/$ETCO_2$ when available
3. PaO_2: 60 to 100 and/or SpO2 > 92%
4. Normal Initial Settings should be guided by $ETCO_2$, SpO_2 and/or ABG.
5. Consider all acute or chronic conditions which may skew normal ventilation management strategies.
6. Adult settings
   a. Consider all acute or chronic conditions which may skew normal ventilation management strategies
   b. Spontaneous Intermittent Mandatory Ventilation (SIMV) in Volume or Pressure Mode
   c. Starting rate: 12-16/min
   d. Tidal Volume: 6-8ml/kg ideal body weight
   e. FiO2: 50% to 100%. Start at 100% in emergency intubation and reduce as indicated
   f. PEEP: 5cm H_20 (if possible, avoid increasing PEEP in patients with increased ICP, hypotension, or uncontrolled pneumothorax)
   g. I:E Ratio: 1:2 (consider longer "E" time in carbon dioxide trapping conditions)
   h. Inspiratory time: 0.8 – 1.2 sec; however, in situations when this is not possible, I:E ratio should guide inspiratory time
   i. PIP: 20 H_20
   j. Flow: 60ml/min
   k. Pressure Support: Initiate at 10cm H_2O for spontaneous breathing patients

l. Utilize thermavent for humidification if applicable

7. Pediatric settings
   a. Pediatric ventilator settings should be guided by physician consultation whenever possible.
   b. Spontaneous Intermittent Mandatory Ventilation (SIMV) in Pressure Control Mode
   c. Starting Rate: Neonates: 30-40, Pediatric: 20-24
   d. Exhaled Tidal Volume: Start at 8ml/kg. Range is from 6-10ml/kg. Look at chest rise, listen for breath sounds and check PIP
   e. FiO_2: 50% to 100%. Use lowest possible FiO_2 to maintain normal SpO_2 and/or PaO_2

8. Correcting Abnormalities:
   a. PaCO2 > 45, and/or $ETCO_2$ > 45
      1) Increase tidal volume by increments of 1ml/kg until acceptable values are obtained (not to exceed 10ml/kg) and/or
      2) Increase rate by increments of 2 until acceptable values are obtained (not to exceed 30, and reduce if evidence of breath stacking)
      3) "I time" should not be below 0.5 seconds
   b. $PaCO_2$ < 35, and/or $ETCO_2$ of < 35
      1) Rule out a cardiovascular cause
      2) Decrease tidal volume by increments of 50ml until acceptable values are obtained (not to go below 6ml/kg) and/or
      3) Decrease rate by increments of 2 until acceptable values are obtained (not to go below 10)
   c. $Pa0_2$ < 60 and/or $Sp0_2$ <92%
      1) Increase FiO_2 in increments of 20% until acceptable values are obtained
      2) If FiO2 100%, increase PEEP in increments of 1-3cmH_2O until acceptable values are obtained (not to exceed 10cm H_20 unless directed by a physician)
      3) The increasing of PEEP is typically justified when a PaO_2 of 60 mmHg or SaO_2 > 92% cannot be achieved by increasing FIO_2
9. Mechanical Ventilation with Acute Respiratory Distress Syndrome (ARDS)
   a. In mechanically ventilated patients with ARDS consider low tidal volume ventilation (LTTV), with or without increased PEEP (open lung ventilation):
      1) Tidal volume: Set to 8ml/kg of IBW and check plateau pressure. May decreaseto 6ml/kg in 1ml/kg increments if plateau pressures exceed 30 cm H_2O.
      2) May require extra sedation for asynchrony during LTTV.
      3) Frequency: Set to meet minute ventilation requirements, and monitor for auto PEEP.
      4) PEEP: Consider increasing in increments of 1 to 3 cm H_2O while maintaining plateau pressure < 30 cm H_2O.
         a) May not exceed 10 cm H_2O without physician order.
         b) Avoid if possible, in patients with known or suspected hypotension, elevated ICP, or uncontrolled pneumothorax

10. Clamping Endotracheal Tube to Maintain Peep when transferring between two ventilator circuits
    a. Rationale: To avoid preventable de-recruitment, loss of Functional Residual Capacity (FRC) in specific pulmonary compromised patients during disconnect from positive pressure / PEEP with the goal of maintaining existing baseline PEEP/recruitment
    b. Indications:
       1) PEEP greater than or equal to 8 cmH_20
       2) $Fi0_2$ 1.0 (and not able to wean)
       3) Specific cases: high mean airway pressures (Paw >15 cmH_20), $Fi0_2$ > 0.60
    c. Contraindications:
       1) Patients presenting with known or suspected auto PEEP (air trapping)
       2) COPD, asthma

3) Patients with any air leak disease process (i.e.: Pulmonary Interstitial Emphysema, Pneumothorax)
4) Uncuffed ETT's with significant leak

d. Procedure
1) Prepare receiving ventilation device
2) At end exhalation clamp ETT hemostats or Kelly clamps
a) DO NOT clamp at any time during inspiratory phase
b) This will require diligent timing for unclamping to prevent inadvertent breath stacking
3) Secure clamped ETT and disconnect from current support- ventilator or BVT.
4) Place patient on prepared ventilator circuit or BVT device.
5) Unclamp ETT
6) Assess VS, $ETCO_2$, SpO_2, Vte's, PIP, chest rise/fall
7) Adjust ventilator settings as needed

POTENTIAL COMPLICATIONS DURING MECHANICAL VENTILATION:
1. Increased Intrathoracic Pressure (with diminished cardiac output and/or hypotension)
2. Hypoxia
3. Hypercapnia or Hypocapnia
4. Pulmonary barotrauma (i.e. pneumothorax)
5. Ventilator-associated lung injury
6. Auto-PEEP (i.e. intrinsic PEEP or breath stacking)
7. Elevated intracranial pressure
8. Psychological Effects (Anxiety, Inability to communicate, etc.)

VITAL SIGNS AND REASSESSMENT:
1. $ETCO_2$, SpO_2, and heart rate must be continuously monitored
2. Blood Pressure must be frequently monitored
3. Reassess patient after any observed changes in vital signs, changes in condition, changes in ventilator settings, and after patient repositioning

SPECIAL CONSIDERATIONS:
1. If at any point an uncertainty regarding ventilator settings arises, seek physician guidance.
2. Use the pediatric circuit for patients weighing less than 20 kilograms.
3. Elevate head of bed to 30 degrees unless contraindicated; this decreases the risk of ventilator-associated pneumonia.
4. In patients with PEEP greater than 10cm H_2O and when changing ventilator circuits, apply clamp to ETT prior to disconnect and use haste when reconnecting.
5. Provide suctioning when the patient requires it, based on assessment. Suctioning should not be performed as a routine intervention.
6. Consider oral or nasal gastric tube placement – particularly in the pediatric population.
7. Use caution with sedation and analgesia in the hypotensive patient.
8. Consider neuromuscular blockade to optimize ventilation.
9. Adjust ventilator settings one at a time, allowing for adequate time to determine the effects of the change before making additional changes.
10. For ventilator failure or uncertainty – revert to bag mask ventilation.

MISCELLANEOUS:
1. Monitored Values in LED display window:
a. Monitored values will auto scroll open when turning on vent
b. Monitored volumes and pressure have a normal variance of +/-10% from set
c. All volumes and pressures are measured at the airway therefore considered accurate except in cases with significant ETT leaks
d. Monitored values are NOT visible during any active alarm

e. To clear Alarm message hit SILENCE/RESET- if alarm has been rectified message will be cleared

TROUBLESHOOTING:

1. External Power Lost Alarm:
   a. External power has been removed or no longer adequate
   b. Vent is running off battery
   c. Check / troubleshoot external power connection(s) and source

2. Vent Inop:
   a. When vent turned off Vent Inop LED will illuminate until SILENCE/RESET is pressed, may remain illuminated for up to 30 minutes
   b. If Vent Inop LED occurs in conjunction with unintentional vent power down
      1) Remove from patient immediately
      2) Unit must be removed from service and sent for inspection/repair

3. High 0_2 pressure Alarm:
   a. Occurs when gas inlet pressure exceeds the following:
      1) >89 psi active High-pressure source
      2) >11 psi active Low-pressure source
   b. Increased pressure will NOT be delivered to patient
   c. Ensure you are not in Low 0_2 Pressure Source and connected to high pressure
   d. Change to alternative 02 port or source
   e. If unable to rectify switch to alternative 0_2 delivery option per protocol

4. Low 0_2 pressure Alarm:
   a. Alarm INACTIVE in Low Pressure Source (LPS)
   b. Occurs when gas inlet pressure < 39 psi AND $Fi0_2$ set > 0.21
   c. This will NOT impede ventilator pressures delivered to patient
      1) Ventilator will continue to ventilate
      2) $Fi0_2$ is unknown
   d. Check 0_2 source psi
   e. Check 0_2 source is ON
   f. Check **ALL** high-pressure connections
   g. Ensure 0_2 high pressure hose is NOT kinked
   h. Switch to alternative high-pressure 02 port
   i. If unable to rectify switch to LPS 0_2 delivery per protocol

5. High pressure limit:
   a. Check for DOPE (Dislodgement, Obstruction, Pneumothorax, or Equipment problem)
   b. Verify alarm setting is adequate based on current PIP
   c. Assess for the following additional causes
      1) Patient out of synch, agitated
      2) Vt too large
      3) Abdominal distention
      4) Kinked ETT
      5) Bronchospasm
      6) Secretions

6. Low pressure limit:
   a. Check for DOPE (Dislodgement, Obstruction, Pneumothorax, or Equipment problem)
   b. Verify alarm setting is adequate based on current PIP
   c. Assess typical causes
      1) Circuit leak

2) Disconnect
3) Increase in ETT leak
4) ETT Cuff failure

7. Low VE:
   a. Check for DOPE (Dislodgement, Obstruction, Pneumothorax, or Equipment problem)
   b. Verify alarm setting is adequate based on current VE
   c. Primary alarm for PC
      1) Has Vte changed?
      2) In PC Vte will decrease in presence of decreased compliance, obstruction, bronchospasm, kinked ETT, secretions, etc.
   d. Has RR changed?

8. High PEEP
   a. Rule out air trapping / Auto PEEP
   b. Consider the following causes
      1) Inadequate I:E ratio
      2) Spontaneous breathing patient inadvertently generating excessive pressure on exhalation
      3) Excessive RR and or agitation
   c. Common in immersion injury and CNS patient scenarios

9. Low PEEP
   a. Rule out leak in circuit or ETT
   b. Consider spontaneous breathing patient with excessive negative inspiratory demand
   c. Classic in agonal breathing patterns (sever neuro, immersion injury cases, etc.)

10. Vt and / or I-time unobtainable
   a. Depending on patient size selected not all I-times and set Vt are compatible
   b. If a specific set I-time and Vt are necessary and not compatible in Volume
      1) Ensure the values you selected are appropriate
      2) Switch to PC using appropriate pressure to deliver desired Vte
         Adjust 'background' inactive Volume to a value that supports desired set I-time

MAKING VENT CHANGES

1. Assuming DOPE (Dislodgement, Obstruction, Pneumothorax, or Equipment problem) algorithm assessed and ETT position verified
   a. To increase PaO_2 / $Sp0_2$:
      1) Increase FiO_2
      2) Ensure Vte within desired range based on ideal body weight
      3) PC
      4) Increase Mean Airway Pressure (Paw):
         a) Increase PEEP
         b) Increase I-time
         c) Increase breath rate
         d) Consult with MD for inverse I:E ratios
   b. To decrease $PaCO_2$ / $ETC0_2$:
      1) Remember to consider and allow permissive hypercapnia when appropriate
      2) CAUTION and rationale must be utilized if attempting to normalize $C0_2$ in obstructive disease patients
      3) Increase Minute Ventilation (VE= RR x Vt)
         a) Ensure Vte within desired range
         b) Increase breath rate

c. To Increase $PaCO_2$ / $ETC0_2$:
   1) Ensure an increased $PaCO_2$ is what is truly desired
   2) Take into consideration reliability of $ETC0_2$ value based on V/Q, disease process, compensatory mechanism, patient driven, ETT leaks, etc.
   3) Decrease Minute Ventilation (VE= RR x Vt)
      a) Ensure Vte within desired range and not excessive
      b) Decrease ventilation rate
      c) Certain cases may be result of patient driven minute ventilation
         - Sedation
         - Paralytics

Considerations for changes:

1. Take into consideration reliability of $ETC0_2$ value based on poor cardiac output
2. Assess capnogram ($ETC0_2$ waveform for signs of obstruction (shark fin pattern) or air stacking and adjust settings accordingly
3. Decreasing ventilation rate in presence of obstructive lung disease:
   a. Allows longer time for exhalation and therefore better CO_2 removal
   b. May result in initial elevated $ETCO_2$ - this is GOOD- CO_2 is now being eliminated
4. In severe cases where excessive pressures are required, may need to consider:
   a. Low Vt strategy 4-6 ml/kg
   b. Higher ventilation rates
   c. Increased I-times
   d. Accepting hypercapnia
   e. Accepting lower $sp0_2$