

<u>POLICY NAME:</u> Mechanical Ventilator Protocol	<u>POLICY #</u> 10.119H
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1. Purpose:

- A. To provide safe and effective use of mechanical ventilation for patients who require invasive ventilator assistance.
- B. Policy was created for West Virginia licensed Respiratory Therapist, Licensed Students of Respiratory Care, Respiratory Care students that are observed directly by licensed RTs. Policy allows Critical Care RNs to make changes to FiO₂.
- C. This protocol is to establish consistency with adult and pediatric ventilator management greater than 3kg.
- D. This protocol allows a qualified Respiratory Therapist to adjust as indicated by the parameters defined in this policy.

2. Equipment:

- A. Mechanical ventilator.
- B. Manual resuscitation device with mask.
- C. Suction equipment.
- D. Oxygen flowmeter connected to 50 psi gas source.
- E. Cuff manometer.
- F. ETT securing device.

3. Policy:

- A. This policy provides guidelines for the management of patients requiring invasive mechanical ventilation. Once ventilator protocol is initiated no other orders regarding ventilation management are required. All mechanical ventilation changes require documentation to assure that changes fall within the established ventilator protocol.
- B. This policy applies to all patients receiving mechanical ventilation unless otherwise specified by managing physician.
- C. Any deviation from ventilator management described in this policy requires a discussion with, and order from critical care managing physician.
- D. There can only be one invasive ventilator order per patient. All other orders that do not apply actively to patient should be discontinued.

4. Procedure:

- A. Initiation of invasive mechanical ventilation.
 - a. Determination of the successful insertion of endotracheal tube will be confirmed by colorimetric CO₂ detector color change that indicates the presence of CO₂, bilateral breath sounds, bilateral chest rise and fall, condensation in the ETT, and no air sounds heard over the gastric area during inspiration.
 - b. Confirmation of endotracheal tube placement will be completed and documented at all initial intubations or upon arrival from another unit or external facility.
 - c. Documentation for airway management will include:
 - i. RT or Physician who intubated patient.
 - ii. Reason for artificial airway insertion.

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- iii. Endotracheal tube location. Include depth of insertion at the lip or the teeth/gums, and placement (right, center, left).
 - iv. Date and time of endotracheal tube placement. If you receive the patient already intubated note time received and confirmation of patency of ETT.
 - B. A chest radiograph will be obtained to determine correct endotracheal tube depth of 2-5cm above the carina. If patient is received from another area, assure that a chest X-ray was performed. RT to adjust ETT placement per CXR results, document change and reason, and notify primary MD.
 - C. Vital signs (blood pressure, heart rate oxygen saturation (SPO2), and end-tidal CO2 measurement if available) should be monitored and documented.
 - D. Airway will be secured with:
 - a. Endo/Naso-tracheal tube:
 - i. The primary approved method of securement is a commercial device. Princeton Community Hospital will utilize a commercial ETT holder.
 - ii. The secondary approved method of securement is tape, but twill can be utilized for patients who have skin integrity failure.
 - b. Tracheostomy Tube:
 - i. The primary approved method of securement is a Velcro device.
 - ii. The secondary approved method is twill cloth provided in trach-care kit.
 - E. Oral/Skin care:
 - i. The Respiratory Therapist is primarily responsible for rotation of the oral ETT placement every six hours as part of the routine ventilator check.
 - ii. The RN and RT are responsible for skin integrity assessment and documentation.
 - iii. Nasal tracheal tubes are not repositioned; inspect the skin to ensure it is intact. Nasal intubation ETT are not encouraged and will require documentation if in place greater than 72 hours.
- 5. Mechanical Ventilator implementation Order:**
- A. A Princeton Community Hospital approved provider will prescribe orders for Mechanical Ventilation.
 - a. Upon insertion of an artificial airway, either endotracheal tube (ETT) or tracheostomy tube (TT).
 - b. After receiving a patient on invasive mechanical ventilation from surgery or external facility.
 - B. When physician indicates that patient is to be started on mechanical ventilation per protocol physician is not required to be at bedside. When MD orders specific ventilation settings MD must be bedside within one hour to assure proper ventilation is assessed.

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Initial Ventilator Settings Protocol

1. Hamilton Ventilator:

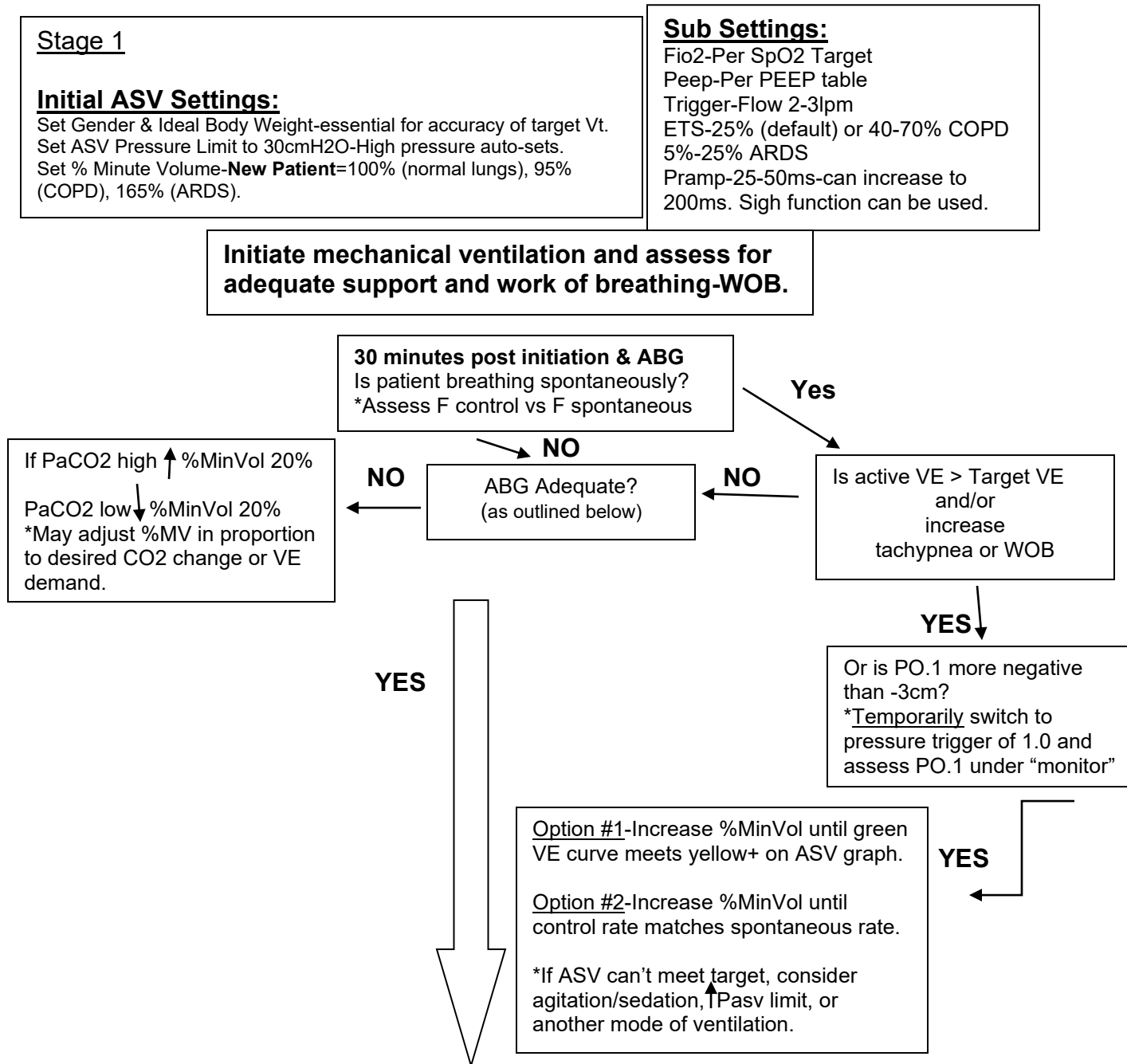
- A. Initial Ventilator Mode is ASV: Enter height and male/female. The IBW is automatically calculated:



- B. Set PASV limit to 35-40cmH₂O. This is found in the control's menu. The High-Pressure alarm will auto-set to 10cmH₂O above this setting.
- C. Set % Minute Volume-**New Patient**= 100% (Normal Lungs), 95% (COPD), 165% (ARDS). When ARDS is confirmed via New Berlin Scoring which is defined as PaO₂/FiO₂ 200 mm Hg or less, consider switching patient to inverse ratio utilizing Bilevel or DuoPap setting with an I:E ratio of 4:1. When receiving a patient from the operating room or external facility acquire documented Minute Volume and adjust % to match.
- D. Set further settings: peep, oxygen, trigger, ETS (Expiratory trigger sensitivity), P-ramp. Set according to clinical requirements and the patient condition.
- E. Set the alarm limits. The maximum peak pressure delivered in ASV is 10cmH₂O below the high-pressure limit or equal to the upper Pasvlimit setting. Changing the Pasvlimit value also changes the high-pressure limit.
- F. Once all settings have been reviewed and fit ventilator protocol settings, connect the patient to the ventilator and start ventilation.
- G. **All ventilator changes must be completed by a Respiratory Therapist. Critical Care RN may make ventilation adjustments to the FiO₂.**

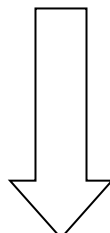
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Adaptive Support Ventilation (ASV) Protocol Decision Paradigm



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YES



Monitor

- | | |
|--|---|
| <ul style="list-style-type: none"> *f Control vs f Spont & P_{insp} *Current %MinVol needed *WOB & P_{0.1} *Consider weaning fSpont increases % monitoring (10ml/kg) | <ul style="list-style-type: none"> *Cstat/Raw/EXP Time Constant *Dynamic Lung *Vent Status Panel *Vt-set Vt alarm (4-10ml/kg) |
|--|---|



Adjust Ventilation to Maintain:

Ph: 7.35-7.45
 PaCO₂: 35-45 mmHg
 PaO₂: 60-120 mmHg
 SpO₂ greater than or equal to

Adjustment Ranges:

FiO₂: 0.3 to 1.0 May wean to .21 per PaO₂.
 PEEP: Based on PEEP/Fio₂ table
 %Min Vol: 70-300%

Lower PEEP/higher FiO₂

FiO₂	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	5	7	8	8	10	10	10	12	14	14	14	16	18	18-24

Any changes in PEEP above 20 cmh₂O require immediate physician notification

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Initial PB840 Setting and Hamilton C1 & C6:

	Basic Settings (Useful for most Patients)	ARDS		Status Asthmaticus/ COPD Exacerbation (May be used in basic patients as well)
Mode	AC: VC+(PB840). ASV (C1&C6)	Bi-level	AC: VC, VC+, or PC	AC: PC, VC or VC+
Respiratory Rate	12-16	*See below for initial Vent Settings	≤ 35	8
Tidal Volume (mL)	6-8 mL/Kg PBW		6-8 mL/Kg PBW Start at 8 and decrease to 6 as needed	6-10 mL/Kg PBW Start at 6 and increase to 10 as needed
Plateau Pressure	≤ 30 cm H2O		≤ 30 cm H2O	≤ 30 cm H2O
Saturation Range	92-95		88-92	88-92
PEEP	5-10 (start at 10 for surgery & trauma)		5 see appendix for PEEP/FiO2 tables	5-8 cm H2O (if there is asynchrony discuss with physician to increase PEEP to match auto-PEEP)
Pressure Support	N/A		N/A	6-12 is used as a standard
Auto PEEP	0		0	≤ 5

1. Ventilator Initiation

- A. The RT will gather the necessary equipment and ensure its proper function based on

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1. Product specific user's manual
2. Corresponding policy and procedure manuals.
- B. Upon receipt of the ventilator protocol order, the RT will place the patient on the mechanical ventilator as indicated by this policy.
- C. Patient tolerance will be assessed with:
 1. Ventilator synchrony
 - a. I:E ratio of 1:1 or greater, unless otherwise specified by the managing physician order.
 - b. Patient cardiopulmonary stability
 - i. Patient is deemed stable when the following vital signs and other objective measures are observed:
 1. Heart rate (HR) \leq 120
 2. Respiratory rate (RR) $8 \geq 30$
 3. Mean Arterial Pressure (MAP) \geq 65 mmHg.
 4. SPO2 within accepted range
 5. Exhaled Minute Ventilation (VE) $<$ 15 liters per minute with pH $7.32 \leq 7.50$
 6. PaCO2 \leq 50 mmHg (or 10 mmHg + hypercapnic baseline with normal pH)
 7. Temperature $96 \geq 101$ °F (increased temps affect ASV)
 8. Absence of dysrhythmias
- D. Bilevel (Initial Settings) or DuoPap: Initiate once Fio2 is 60% or greater:
 1. Initial Settings are deduced from "conventional" mode.
 - a. Set the P-high 1-2 cm higher than the plateau pressure to a max of 35 cm H2O.
 - b. P-low should be set at the level of the PEEP.
 - c. RR should be set at 20.
 - d. T-high should be set at 2.4 seconds for an I:E of 4:1
 - e. Pressure support should be set to achieve a PSV of 3-6 above the P-High
- E. A Blood gas sample will be obtained.
 1. After a minimum of 30 minutes and/or once the patient is stable. Stability can take up to 6 hours. During the stability transition protocol will guide the RT to achieve stability.
 2. As needed with changes in patient condition.

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3. Morning draws should be performed between 5 am and 6 am
 - a. If the results require physician notification obtain results from all other patients and make the call about all morning results.
 - i. Note: Daily AM Arterial Blood Gases are not clinically indicated for stable ventilated patients and routine orders should be discussed with managing physician
 4. Initial arterial blood gas can be delayed allowing RT to insert an arterial line. Due to frequency of blood draws early in ventilator management, arterial line placement would decrease possible side effects from frequent lab draws.
- F. Order for Arterial Line Placement should be ordered after patient is intubated. Arterial Line Placement requires a consent before insertion. Arterial line insertions allow staff to draw blood without a puncture. Arterial line management allows critical care staff to manage blood pressure medications with improved accuracy.
- G. Initial ventilator settings: Use the previous table for initial ventilator settings.
1. Tidal Volume:
 - a. Increase the Tidal Volume 1 ml/kg up to 10 mL/KG If:
 1. the patient is asynchronous with the ventilator, and the Pplat is less than or equal to 30 cmH₂O.
 2. The managing physician should be notified if the Vt is set to 10 mL/KG and the patient asynchrony has not resolved.
 3. When utilizing ASV; tidal volume is calculated by the ventilator, based on the assumption that the optimal breath pattern results in the least work of breathing. Assure that the correct height and gender is inputted.
 - b. Respiratory Rate – Set to the patient’s required minute volume (Ve).
 1. Do not exceed a respiratory rate (RR) of 35 breaths per minute unless specifically ordered by the managing physician.

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- c. Inspiratory: Expiratory Ratio (I:E) – I time less than or equal to E time. Adjust per the patient’s requirements. Longer expiratory times are appropriate for obstructive lung diseases. Do not inverse I:E without a MD notification.
- d. Fraction of Inspired Oxygen: FIO₂/PEEP – Use a combination from the table below to maintain appropriate PaO₂ If the patient’s PEEP/FIO₂ is not compatible with the scale, adjust FIO₂ in increments of 0.10 and/or PEEP in increments of 2 cm H₂O until on scale.
- H. Ventilator settings will be titrated to achieve values within the following ranges:
 - 1. pH 7.35-7.45 (**7.25 < Critical > 7.55**)
 - a. ARDS patients 7.20-7.45
 - 2. PaCO₂ 35-45 (**25 < Critical > 60**)
 - a. ARDS Less than or equal to 80 mm Hg if pH ≥ 7.2
 - 3. PaO₂ greater than or equal to 65 mmHg (**Critical <60**) (PaO₂ takes precedence over SpO₂).
 - a. PaO₂ for COPD and ARDS 55-80
- I. Pulse Oximetry: (PaO₂ takes precedence over SpO₂).
 - 1. **SPO₂ 92% - 95%**
 - 2. **SpO₂ for COPD and ARDS patients 88% - 92%**
- J. The pH will be the value that is first considered for setting intervention.
 - 1. If pH value is normal, then the PCO₂ values should also be accepted as adequate for that specific patient.
 - 2. If the pH and PCO₂ are outside of normal limits, the minute ventilation (respiratory rate and/or tidal volume) should be adjusted to achieve an acceptable value.
 - 3. Increases in minute ventilation decrease acidosis.
 - 4. Decreases in minute ventilation increase acidosis.
- K. Discuss the option of Bicarbonate with physician if set RR has reached 35 BPM, and pH continues to reflect acidosis.
- L. pH less than 7.15 – increase RR to 35.
 - 1. If RR = 35 and a respiratory acidosis is present, increase Vt 1 ml/kg IBW until pH is 7.15 or greater.
 - 2. If Pplat exceeds 30 cmH₂O, contact physician.
- M. If the PaO₂ is abnormal the FIO₂ or PEEP should be titrated to achieve an acceptable value.

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- N. If the FIO₂ is >60 with a PEEP of > 15 on a “conventional” mode, the patient should be transitioned to Bilevel or DuoPap, and the managing physician should be notified.

2. Infection Control

- A. A sputum sample will be collected for culture and sensitivity after each intubation within four hours of intubation.
- B. Head of bed must be elevated to at least 30 degrees.
1. Exceptions:
 - a. Hypotension
 - b. When ordered by the physician.
- C. Ventilator Circuit
1. A new ventilator circuit is used for each patient.
 2. The circuit will be changed only when soiled or if malfunctioning, but no periodic ventilator circuit changes are scheduled unless indicated by manufacturer.
 3. RT will move ETT every 6 hours and perform an oral assessment to assure mouth is clean and no pressure sores present.

3. Ventilator Management and Adjustment

- A. During the continuous Ventilator Management phase, ventilator settings will be adjusted based on the ABG and CXR results, and or to stabilize cardiopulmonary condition of the patient. May use sigh function.
- B. The managing physician will be notified if any of the following take place once the patient is stable, and an arterial blood gas is completed:
1. Based on RT assessment in change of ventilation status.
 2. An increase in FiO₂ of 30% or greater from baseline in the past 24 hours
 3. When peep is increased more than 10 cmh₂O in 24 hours
 4. If there is any other concern of the RT or RN
- C. Notify the MD, APN or PA about other methods to provide effective ventilator settings may be obtained to include Alveolar Lung Recruitment (ALR) maneuver, or PEEP titration based on PaO₂/FiO₂ (P/F) ratio. **Only RT's will perform setting changes on ventilator. Critical Care RN can adjust settings to the FiO₂.**
- D. Ventilator Goals
1. The Pplat target less than or equal to 30 cmH₂O.
 - a. If Pplat greater than 30:
 - i. Decrease Vt 1 ml/kg every 2-3 hours, keeping pH greater than 7.15.

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- ii. Adjust RR to maximum of 35 to keep Ve constant and flowrate for I:E ratio of 1:1--1:3. Minimum Vt is 4 ml/kg IBW.
 - iii. **Exceptions:** If any of the following conditions occur, then the Vt should not be decreased:
 - 1. RR = 35, pH less than 7.15
 - 2. Vt = 4 ml/kg.
 - iv. If Pplat is less than 30: Changes only need to be made if **Vt is less than 6 ml/kg or Pplat is less than 25.**
 - v. Increase Vt 1 ml/kg IBW until Vt = 6 ml/kg or Pplat is greater than 25 cm H2O.
 - vi. Increase Tidal Volume to 7 - 8 ml/kg if air trapping or dis-synchrony is noted. Pplat should remain 30cmH2O or less. May use sigh function.
- E. Oxygenation goals: Use FIO2 / low PEEP scale recommendations (below) to maintain appropriate PaO2 or SpO2 (PaO2 takes precedence).
- F. If the patient's PEEP/FIO2 is not compatible with FIO2/PEEP scale, then adjust FIO2 in increments of 0.10 and/or PEEP in increments of 2 until on scale.
- 1. Any changes in PEEP above 20 cm H2O require direct managing physician involvement.

Lower PEEP/higher FiO2

FiO2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	5	5	8	8	10	10	10	12	14	14	14	16	18	18-24

- G. Exceptions to Oxygenation Scale
- 1. Brief periods (5minutes or less) of SpO2 less than 88% or greater than 95% may be tolerated without making changes in PEEP or FIO2.
 - 2. FIO2 = 1.0 may be used for brief intervals (10 minutes or less) of transient desaturation or to prevent desaturation during treatments.
 - 3. Do not increase PEEP if:
 - a. Pplat greater than 30cmh20 AND oxygenation less than the goal (PaO2 less than 55 or SpO2 less than 88%)

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AND

- b. Vt is equal to 4 ml/kg IBW (or the minimum Vt necessary for pH control).
- 4. Increase FIO2 in increments of 0.1 until
 - a. PaO2 is 55 or greater or
 - b. SpO2 is 88% or greater or
 - c. FIO2 = 1.0
- 5. Increase PEEP in increments of 2 if necessary.
- 6. If FIO2 = 1.0, PEEP = 24, and oxygenation is less than the goal, PEEP increase trial may be performed if ordered by managing physician.
 - a. PEEP Increase Trial (when PEEP is 24 cm H2O or greater)
- 7. Increase PEEP in increments of 2 cmH2O, to a maximum of 28 or until PaO2 is 55 or greater or SpO2 is 88% or greater.
- 8. If PEEP increase is not effective within 4 hours (PaO2 increased by 5) then PEEP will be returned to 24 cm H2O.
 - a. High PEEP Scale – For patients that remain on FIO2 of 0.60 or greater with PEEP = 10 cmH2O for more than 4 hours, notify the managing physician for consideration of High PEEP Scale, or other alternative modalities.
 - b. Patients may be switched to High PEEP according to scale below. However, managing MD must be notified and documented in EPIC RT progress notes.

Higher PEEP/Lower FiO2

FiO2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5-0.8	0.8	0.9	1.0	1.0
PEEP	5	8	10	12	14	14	16	16	18	20	22	22	22	24

- H. Evaluate weaning as needed per Weaning Protocol.
 - I. The Respiratory Therapist will visually check each patient on a ventilator every two (2) hours and will document a formal patient assessment and ventilator system check every six (6) hours. Any changes in mode of ventilation requires a full ventilator assessment.
 - J. Patient assessment will include but not limited to:
 - 1. Breath sounds
 - 2. Heart rate
 - 3. Pulse oximetry (SpO2),
 - 4. Artificial airway
 - a. Size
 - b. Type

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- c. Location (teeth/gums or lips)
 - d. Placement (Right, Center, Left)
- 5. Mode of ventilation
- 6. Set and measured RR
- 7. Set and measured Vt/Inspiratory Pressure Setting
- 8. Set/measured PEEP.
- 9. Set I-Time/Flow
- 10. PIP, Plateau, and Mean Pressures
- 11. Measured Ve or ASV minvol%
- 12. Alarm Settings documented every six hours or when adjusted.
- K. The Respiratory Therapist will complete and document oral care and repositioning of the Endotracheal Tube every four (6) hours.
- b. Weaning**
 - A. FIO2 Wean Protocol: This protocol should be initiated for all patients following the initiation of mechanical ventilation.
 - B. Use pulse oximetry (SpO2) for FIO2 weaning, providing it correlates with Arterial Blood Gas (ABG).
 - 1. Within 30 minutes of intubation, if oxygen saturation is stable, wean FIO2 to achieve SpO2 is SpO2 92% ≤ 95% and/or partial pressure of arterial oxygen (PaO2) is > 65 mmHg.
 - 2. Exceptions: Hemoglobin oxygen saturation level (SpO2) ≥ 94% for the following patient groups:
 - a. Recent ischemia to heart or central nervous system (CNS)
 - b. Anemia (including sickle cell)
 - c. Marked lability in saturation (SpO2) (regularly drops > 4%)
 - C. Daily Awakening and Readiness to Extubate (DARE)
 - 1. Eligibility for ventilator liberation or weaning protocols will be assessed daily between 5am-7am through a collaborative evaluation between the RT and RN and Physician (REGARDLESS OF MODE OR SETTINGS). The passing or failing of DARE will be documented in EPIC under respiratory note and relayed to the oncoming shift. Failure of morning DARE can be initiated later during the day. Failures like anxiety can be reinitiated after anxiety has been managed.
 - 2. Prior to initiating the ventilator liberation procedure, the availability of all necessary personnel and equipment will be confirmed. The physician responsible will be consulted if there is any question about eligibility.

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3. The managing physician will be notified when a patient passes a spontaneous breathing trial (SBT) and is considered a candidate for extubation by respiratory therapy.
 4. Extubation will be performed at the discretion of the managing physician. The goal is to extubate patients by 11am. Allowing to stabilize the patient before night shift.
- D. Assess for readiness of SBT:
1. Hemodynamically stable as defined by:
 - a. Heart rate between 50 and 130 beats per minute
 - b. Absence of active Myocardial Ischemia
 - c. Absence of significant hypo/hypertension
 - i. MAP between 55 and 110
 - ii. SBP between 80 and 180 mmHg
 - d. The absence of vasopressors except for:
 - i. Dopamine/Dobutamine of ≤ 5 mcg/kg/min
 - ii. Norepinephrine ≤ 3 mcg/kg/min and
 2. MVE should be adjusted based on the acid/base results from last ABG.
 3. Acid/base status is appropriate:
 - a. pH >7.25 with base deficit less than 6
 - b. FiO₂ (inspired oxygen) ≤ 0.50
 - c. PEEP < 10 cm H₂O with Pa/FiO₂ ratio > 150 based on ABG.
 4. Patient is without neuromuscular blockade and is not in status epilepticus.
 5. Patient is triggering ventilator or will trigger ventilator when set rate is decreased by 50%
 6. Exhibits positive cough and gag reflex.
 7. Lack of copious secretions
 8. If Traumatic Brain Injury present
 - a. GCS must be greater than 6.
 - b. No suspected increased ICP
 - c. Verify wean with managing physician.
- E. Perform a daily Spontaneous Breathing Trial (SBT) if patient meets above criteria with PS 5-8 cmH₂O using previous PEEP setting. When using ASV decrease percentage of support to initiate weaning. ASV setting of 30% equivalent of PS 5-8 cmH₂O. If patient is not extubated, return patient to original settings before SBT. Prolonged times at low

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support will create atelectasis and increase in WOB and is contraindicated for patient.

1. An initial patient assessment will be performed after five minutes to assure that the patient tolerates spontaneous breathing trial (SBT), and SBT Termination Criteria is not present. Results from assessment should be documented in EPIC under RT Progress notes.
2. If the five-minute SBT screening is successful, the patient will remain on the SBT followed by a patient assessment after 30 minutes and continued as tolerated.
3. If the five-minute SBT screening is not successful, and the patient does not meet the SBT Termination Criteria, return the patient to the previous resting ventilator settings and notify the primary RN, or MD. Document in detail in EPIC under RT Progress Notes.
4. SBT Termination Criteria will be defined as:
 - a. RR greater than 45 breaths per minute for greater than 5 minutes.
 - b. Rapid Shallow Breathing Index (RSBI) greater than 105.
 - c. SpO2 less than 90% for greater than 2 minutes.
 - d. A change in Heart Rate should be expected during weaning. RT to evaluate the continuing of weaning.
 - e. A change in Blood Pressure should be expected during weaning. RT to evaluate the continuing of weaning.
 - f. The development of ectopy.
 - g. The development of respiratory distress marked by accessory muscle use.
 - h. All results from weaning process will be documented in EPIC under RT Progress Notes.³

F. Outcomes:

1. If SBT tolerated, perform extubation screen (ES) below.
2. If patient fails SBT on 4 consecutive days, continue to perform a daily morning SBT and record results.
 - a. Consider tracheostomy.
3. The therapist may also perform a daily SBT on trach patients if they tolerate the trial.

G. **SBT (Spontaneous Breathing Trial) Extubation Screen:**

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1. RT performs screen when patient passes SBT and everyday thereafter.
2. Must answer SBT questions and document in EPIC. Complete all weaning parameter documentation in EPIC. It will include minute volume, respiratory rate, average VT, FVC, NIF, RSBI, and cuff leak assessment.
 - a. Is patient awake and responsive to verbal commands?
 - i. If “**No**” obtain RASS (Richmond Agitation-Sedation Scale) score from RN. Make note in EPIC.
 - b. Can Patient protect airway?
 - i. Cough reflex intact and voluntary cough adequate to clear secretions
 - c. There are no concerns about the patency of the upper airway.
 - i. Perform standard cuff leak test and document results. Make sure the upper airway is suctioned and clear of secretions prior to performing the test.
 1. Note the leak volume.
 - a. A leak of 110 ml or more is considered normal. All leak values must be documented in EPIC under RT Progress notes before extubation.
 - b. A leak of less than 110 ml, or the absence of a leak, may indicate the presence of laryngotracheal edema.
3. If patient passes ES, the RT will notify the managing physician and request an extubation order.
4. If patient fails the ES, continue Spontaneous Mode /increase PS to leave patient in spontaneous ventilation until ready for extubation. Assure patient is receiving enough PS for ventilator synchrony and allow patient to rest between weaning trials. When using ASV as weaning mode increase percentage until patient is comfortable and synchronous on ventilator.

c. Extubation Procedure

- A. Note: It is the extubating physician’s responsibility to be aware of the “DIFFICULT TO INTUBATE PATIENT”.

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1. In addition, if prior airway trauma, injury, or history of difficult intubation consider fiber optic inspection for airway patency prior to extubation.
- B. Gastric feeds should have been held for 1 hour or more.
- C. RT may hyper oxygenate patient and increase PS or ASV% to decrease WOB and optimize ventilation. Can utilize an open lung technique to recruit all airway before extubation to improve patient success of extubation. Consider hyper oxygenating patient prior to extubation also.
- D. Notify RN
- E. Suction patient through the oropharynx and ETT.
- F. Deflate the cuff.
- G. Instruct the patient to inspire maximally and withdraw the tube at peak inspiration.
- H. Place patient on appropriate oxygen/aerosol modality
 1. Keep SpO₂ 92% ≤ 95%; or ≥ 94% for the post-op patient or in the setting of recent ischemia to heart or CNS, or if anemia.
 2. If saturation drops below the above thresholds increase FIO₂ accordingly.
- I. If signs or symptoms of respiratory distress or failure ensue, manage expeditiously and notify the managing physician:
 1. Stridor:
 - a. Racemic Epinephrine at 0.5 ml every 20 minutes for up to three times as needed, humidified O₂.
 - b. Consider dexamethasone.
 2. Respiratory rate (RR) greater than 35 or increasing RR with other signs of distress:
 - a. Place patient on Non-Invasive Ventilation (NIV) or High Flow Nasal Cannula (HFNC) before considering reintubation.
- J. Patient is to Cough and deep breathe every 1-2 hours.
- K. Perform incentive spirometry and document results and predicted volumes.
 1. If the patient cannot consistently meet 50% of predicted volume, then discuss plan of care changed with primary physician and implement nebulizer protocol and include Ezpap therapy.
- L. Nothing by mouth for 4 hours and then assess for aspiration risk.
- M. RT/RN assess patient every 4 hours and as necessary for signs of acute respiratory failure while in ICU.

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Appendix I

A. Alveolar Lung Recruitment (ALR) Maneuver

1. Inclusion Criteria

- a. Notify the APN, MD or PA to perform ALR maneuver and document discussion in EPIC under RT progress notes.
- b. Patient is hemodynamically stable.

B. Procedure

1. Set mode to Bilevel Ventilation with the following settings:
 - a. P_{high}-level of plateau measurement.
 - b. P_{low}-level of PEEP on conventional mode
 - c. RR-20
 - d. Ti-2.4
2. FiO₂- same setting as conventional mode. An initial patient assessment will be performed after two minutes to assure that the patient recruitment maneuver, and Termination Criteria is not present.
3. If the five minute "screening" is successful, the patient will remain on the current settings followed by a patient assessment after 30 minutes and placed back on previous settings.
4. If the five minute "screening" is not successful, and the patient meets the Termination Criteria, return the patient to the previous ventilator settings, and notify the primary RN, or MD.
5. Termination Criteria will be defined as:
 - a. RR greater than 35 breaths per minute for greater than 5 minutes.
 - b. Rapid Shallow Breathing Index (RSBI) greater than 105.
 - c. SpO₂ less than 90% for greater than 2 minutes.
 - d. A change in Heart Rate of 20% above or below baseline.
 - e. A change in Blood Pressure of 20% above or below baseline.
 - f. The development of ectopy.
 - g. The development of respiratory distress marked by accessory muscle use.

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1) Appendix II

A. Alveolar Lung Recruitment (ALR) Maneuver

1. Inclusion Criteria

- Notify the APN, MD or PA to perform ALR maneuver and document the discussion in EPIC utilizing RT progress notes.
- Patient is hemodynamically stable.

B. Procedure

1. Set mode to Pressure Control Ventilation with the following settings:

- PC above PEEP = 15 cm H₂O
- PEEP = 15 cmH₂O
- I:E ratio = 1:1
- Rate = 20 breaths/minute
- FiO₂ = 100%

C. Recruitment maneuver:

- Monitor Dynamic compliance, End-tidal CO₂(if available) and Blood pressure throughout the procedure.
- When blood pressure drops by 10% of baseline at any given period of the maneuver, decrease PEEP by 5 cmH₂O. If this does not correct the blood pressure, ABORT the maneuver, and put patient back to previous settings.
- Increase PEEP by 5 cmH₂O every three (3) breaths. When a drop in dynamic compliance and end tidal CO₂ elimination is observed DO NOT PROCEED TO THE NEXT PEEP increment. The current PEEP level signifies that the opening pressure is reached. Maintain at this setting for 1 minute.
- Titrate down PEEP to 20 cmH₂O (for opening pressure ≤ 25 cmH₂O) or 25 cmH₂O (for opening pressure > 25 cmH₂O) for 1 minute.
- Decrease PEEP by 2 to 3 cmH₂O every three (3) breaths. When a drop in dynamic compliance and end-tidal CO₂ elimination is observed DO NOT PROCEED to the next PEEP increment. The PEEP level signifies that the closing pressure is reached.
- Change PEEP setting to the previously identified opening pressure for 1 minute for de-recruitment maneuver.
- Set Optimal PEEP = 2 to 3 cmH₂O above the previously identified closing pressure.
- Set Pressure control above PEEP to maintain exhaled tidal volumes of 6 ml/kg of PBW.

D. Indication of successful recruitment is shown in an increase in dynamic compliance.

E. Consider repeating procedure after disconnecting the patient from the ventilator or after endotracheal suctioning.

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C. Appendix III

a. PEEP titration to P/F ratio

1. Exclusion: Patient is hemodynamically unstable, and PEEP is contraindicated (i.e. elevated ICP, significant hypotension, but note that often PEEP does not transmit to the mediastinum and decrease cardiac return if it is truly needed to maintain recruitment)
2. Inclusion: First 4 hours of ventilator initiation and P/F ratio is < 300 .
3. If P/F ratio ≥ 300 is not attained at initial settings, increase to PEEP of 10 cm H₂O.
4. If P/F ratio is ≤ 200 , consider utilizing optimal PEEP (see Alveolar Lung Recruitment Maneuver) or advanced modes of ventilation. Assess ABG after 30 minutes.
5. PaO₂/FiO₂ of 101–200 mm Hg defined moderate ARDS and PaO₂/FiO₂ of 100 mm Hg or less was termed severe ARDS.

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