LTV-VC METARULES

- All Patients will be placed in PRVC in the Draeger with a Target VT =6.0ml/kg
- Protocol will be run with in 30 minutes of new ABG's.
- Use PaO2 if available; only use SpO2 if PaO2 more than 30 minutes old.
- Treat correctable problems before failing patient or reassessing:
    1. Anxiety, pain, delirium
    2. Acute bronchospasm
    3. Mucus plug
    4. Excessive sedation
    5. Patient position
    6. Ventilator circuit problem
- Don Not increase ventilation rate above 35 bpm
- Do Not decease VT below 4ml/KG
- Do Not Decrease VT and ventilation rate at the same time.
- ATC will be off
- Check Pplat at every schedule vent check and if Pplat > 30 contact MD and obtain ABG to determine if tidal volume reduction is indicated.
- Follow oxygenation and ventilation tables adjusted for high altitude
- Chart at bedside sheet in addition to electronic charting.

Conventional Arm (VC – LTV)
Oxygenation Table (Protocol)

NIH ARDS Network Written Oxygenation Protocol from FACTT Trial Protocol

C.1.4 Oxygenation.

In both treatment groups, target ranges for oxygenation will be:

$$55 \text{ mmHg} \leq PaO_2 \leq 80 \text{ mmHg}$$

or

$$88\% \leq SpO_2\text{-sat} \leq 95\%$$

When both PaO_2 and SpO_2 are available simultaneously, the PaO_2 criterion will take precedence.
Oxygenation will be maintained in the target ranges using the following $PEEP/FiO_2$ combinations:

FiO_2	.30	.40	.40	.50	.50	.60	.70	.70	.70	.80	.90	.90	.90	1.0	1.0
PEEP	5	5	8	8	10	10	10	12	14	14	14	16	18	18	18-24

(Levels of PEEP in this FiO_2/PEEP scale represent levels set on the ventilator, not levels of total PEEP, auto-PEEP, or intrinsic PEEP.)

Arterial oxygenation will be assessed by either SpO_2 or PaO_2 at a minimum frequency of q4 hours. When SpO_2 is used to assess arterial oxygenation, the following measures will be taken if possible to improve accuracy: the SpO_2 sensor will be checked to ensure optimal position, cleanliness, and consistent readings with satisfactory waveforms; no position changes or endobronchial suctioning for $\geq$ 10 minutes; no invasive procedures or ventilator changes for $\geq$ 30 minutes. SpO_2 will be observed for a minimum of 1 minute, and a representative value will be recorded on the appropriate source-document flowsheet.

If arterial oxygenation is not within the target range, then either FiO_2 or PEEP will be adjusted within 30 minutes. Following these adjustments, oxygenation will be reassessed within 15 minutes and subsequent adjustments made if necessary.

If a patient's PEEP/FiO_2 is not compatible with the PEEP/FiO_2 scale (e.g. immediately after randomization or after urgent changes in FiO_2 or PEEP in response to desaturations, hypotension, etc.), either PEEP or FiO_2 (or both) will be adjusted at intervals of 5-15 minutes until the PEEP/FiO_2 is compatible with the scale. The procedures for adjusting PEEP and FiO_2 to make them compatible with the scale are as follows:

- Arterial oxygenation higher than the target range:

FiO_2 or PEEP will be decreased (by .10 or 2.0 respectively), whichever is farther (number of step changes) from the target scale shown in the accompanying table. If both PEEP and FiO_2 are equally distanced from the scale, then PEEP will be decreased.

- Arterial oxygenation lower than the target range:

FiO_2 or PEEP will be increased (by .10 or 2.0, respectively), whichever is farther from the target scale shown in the table. If both PEEP and FiO_2 are equidistant from the scale, then PEEP will be increased first.

- Arterial oxygenation within the target range:

If single adjustment in either FiO_2 or PEEP would correct the FiO_2/PEEP to the target scale, then FiO_2 will be adjusted. If the FiO_2/PEEP cannot be corrected to the target scale with a single adjustment, then FiO_2 will be adjusted by .10 and PEEP will simultaneously adjusted in the opposite direction by 2.0. E.g., increase FiO_2 by .10 and decrease PEEP by 2.0, or decrease FiO_2 by .10 and increase PEEP by 2.0.

If $PaO_2 < 55$ mmHg or $SpO_2 < 88\%$ and tidal volume = 4 ml/kg PBW (or the minimum tidal volume necessary for pH control, section C.1.4) and plateau pressure ≥ 30, then FiO_2 will be raised until $PaO_2 \geq 55$ or $SpO_2 \geq 88\%$ or $FiO_2 = 1.0$. If $PaO_2 < 55$ mm Hg or $SpO_2 < 88\%$ and $FiO_2 = 1.0$, PEEP will be raised by 2 cm H_2O increments to 24 cm H_2O. (In these circumstances, plateau pressure may exceed 30 cm H_2O).

Brief periods ($\leq$5 minutes) of $SpO_2 < 88\%$ or $> 95\%$ may be tolerated without making changes in PEEP or FiO_2.

$FiO_2 = 1.0$ may be used for brief intervals (10 minutes) of transient desaturation or to prevent desaturation during treatments such as tracheo-bronchial suctioning or position changes.

- If $FiO_2 = 1.0$ and PEEP = 25 cmH_2O and I:E =1.0 and $PaO_2 < 55$ or $SpO_2 < 88\%$, then a PEEP increase trial may be performed as follows:
  1. Increase PEEP by 2-5 cmH_2O increments to a maximum of 34 cmH_2O or until $PaO_2 \geq 55$ or $SpO_2 \geq 88\%$.
  2. If the PEEP increase trial is not effective within 4 hours (PaO_2 increased by at least 5 mmHg), then PEEP will be returned to 24 cmH_2O.

C.1.5 Simultaneous changes

Changes in more than one ventilator setting driven by measurements of PO_2, pH, and plateau pressure may be performed simultaneously, if necessary. Arterial blood gases will be obtained after all ventilator changes as clinically indicated.

Conventional Arm (VC – LTV)
Oxygenation Table (Protocol)

Utah Tool Box (high altitude target range)
Oxygenation Table
PaO2 < 50 or SpO2 < 85%

PEEP	FiO_2 = .3	FiO_2 = .4	FiO_2 = .5	FiO_2 = .6	FiO_2 = .7	FiO_2 = .8	FiO_2 = .9	FiO_2 = 1.0
5	↑ FiO_2 0.2 ↑PEEP 3	↑ FiO_2 0.2 ↑PEEP 3	↑ FiO_2 0.2 ↑PEEP 3	↑ FiO_2 0.2 ↑PEEP 3	↑ FiO_2 0.2 ↑PEEP 3	↑ FiO_2 0.2 ↑PEEP 3	↑ FiO_2 0.1 ↑PEEP 5	↑PEEP 5
8	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.1 ↑PEEP 4	↑PEEP 4
10	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.1 ↑PEEP 4	↑PEEP 4
12	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.1 ↑PEEP 4	↑PEEP 4
14	↑ FiO_2 0.3	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.1 ↑PEEP 4	↑PEEP 4
16	↑ FiO_2 0.3	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.1 ↑PEEP 4	↑PEEP 4
18	↑ FiO_2 0.3	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.1 ↑PEEP 4	↑PEEP 4
20	↑ FiO_2 0.3	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.1 ↑PEEP 4	↑PEEP 4
22	↑ FiO_2 0.3	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.2 ↑PEEP 2	↑ FiO_2 0.1 ↑PEEP 2	↑PEEP 2
24	↑ FiO_2 0.3	↑ FiO_2 0.2	↑ FiO_2 0.2	↑ FiO_2 0.2	↑ FiO_2 0.2	↑ FiO_2 0.2	↑ FiO_2 0.1	PEEP ↑Trial

(Use PaO2 if available, only use SpO2 if PaO2 not available)
When PaO2 or SpO2 are in this low range, repeated sequential adjustments may be made as guided by the cells in the table until adequate oxygenation with a SpO2 ≥ 88% is achieved

Conventional Arm (VC – LTV)
Oxygenation Table (Protocol)

Utah Tool Box: (high altitude target range)
Oxygenation Table
PaO2 50 to 54 or SpO2 85 to 88%

PEEP	FiO_2 = .3	FiO_2 = .4	FiO_2 = .5	FiO_2 = .6	FiO_2 = .7	FiO_2 = .8	FiO_2 = .9	FiO_2 = 1.0
5	↑ FiO_2 0.1	↑ PEEP 3	↑ PEEP 3	↑ PEEP 3	↑ PEEP 3	↑ PEEP 3	↑ PEEP 3	↑ PEEP 3
8	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ PEEP 2	↑ PEEP 2	↑ PEEP 2	↑ PEEP 2	↑ PEEP 2	↑ PEEP 2
10	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ PEEP 2	↑ PEEP 2	↑ PEEP 2	↑ PEEP 2
12	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ PEEP 2	↑ PEEP 2	↑ PEEP 2	↑ PEEP 2
14	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ PEEP 2	↑ PEEP 2
16	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ PEEP 2	↑ PEEP 2
18	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ PEEP 2
20	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ PEEP 2
22	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ PEEP 2
24	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	↑ FiO_2 0.1	Consider PEEP Increase Trial

(Use PaO2 if available, only use SpO2 if PaO2 not available)
When PaO2 or SpO2 are in this low range, repeated sequential adjustments may be made as guided by the cells in the table until adequate oxygenation with a SpO2 $\geq$ 88% is achieved

Conventional Arm (VC – LTV)
Oxygenation Table (Protocol)

Utah Tool Box: (high altitude target range)
Oxygenation Table
PaO_2 = 55 – 61 or SpO2 88 – 90%

PEEP	FiO_2 = .3	FiO_2 = .4	FiO_2 = .5	FiO_2 = .6	FiO_2 = .7	FiO_2 = .8	FiO_2 = .9	FiO_2 = 1.0
5	Maintain	Maintain	↑ PEEP 3	↓ FiO_2 0.1 ↑PEEP 3	↓ FiO_2 0.1 ↑PEEP 3	↓ FiO_2 0.1 ↑PEEP 3	↓ FiO_2 0.1 ↑PEEP 3	↓ FiO_2 0.1 ↑PEEP 3
8	↑ FiO_2 0.1	Maintain	Maintain	↑ PEEP 2	↑ PEEP 2	↓ FiO_2 0.1 ↑PEEP 2	↓ FiO_2 0.1 ↑PEEP 2	↓ FiO_2 0.1 ↑PEEP 2
10	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1	Maintain	Maintain	Maintain	↓ FiO_2 0.1 ↑PEEP 2	↓ FiO_2 0.1 ↑PEEP 2	↓ FiO_2 0.1 ↑PEEP 2
12	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1	Maintain	↑ PEEP 2	↑ PEEP 2	↓ FiO_2 0.1 ↑ PEEP 2
14	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1	Maintain	Maintain	Maintain	↓ FiO_2 0.1 ↑PEEP 2
16	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1	Maintain	↑ PEEP 2
18	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1	Maintain	Maintain
20	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1	Maintain
22	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1	Maintain
24	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1	Maintain

(Use PaO_2 if available, only use SpO_2 if PaO_2 not available)
Highlighted cells are different than high target range table (PaO_2 = 62 – 68)

Conventional Arm (VC – LTV)
Oxygenation Table (Protocol)

Utah Tool Box (high altitude target range)
Oxygenation Table
PaO_2 = 62 – 68 or SpO_2 91 –93%

PEEP	FiO_2 = .3	FiO_2 = .4	FiO_2 = .5	FiO_2 = .6	FiO_2 = .7	FiO_2 = .8	FiO_2 = .9	FiO_2 = 1.0
5	Maintain	Maintain	↓ FiO_2 0.1	↓ FiO_2 0.1 ↑PEEP 3	↓ FiO_2 0.1 ↑PEEP 3	↓ FiO_2 0.1 ↑PEEP 3	↓ FiO_2 0.1 ↑PEEP 3	↓ FiO_2 0.1 ↑PEEP 3
8	↑ FiO_2 0.1	Maintain	Maintain	↓ FiO_2 0.1	↓ FiO_2 0.1 ↑ PEEP 2	↓ FiO_2 0.1 ↑PEEP 2	↓ FiO_2 0.1 ↑PEEP 2	↓ FiO_2 0.1 ↑PEEP 2
10	↑ FiO_2 0.1 ↓PEEP 2	↓ PEEP 2	Maintain	Maintain	Maintain	↓ FiO_2 0.1	↓ FiO_2 0.1	↓ FiO_2 0.1
12	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↓ PEEP 2	↓ PEEP 2	Maintain	↓ FiO_2 0.1	↓ FiO_2 0.1	↓ FiO_2 0.1
14	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	Maintain	Maintain	Maintain	↓ FiO_2 0.1
16	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↓ PEEP 2	↓ PEEP 2	Maintain	↓ FiO_2 0.1
18	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	Maintain	Maintain
20	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↓ PEEP 2	↓ PEEP 2
22	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓ PEEP 2	↓ PEEP 2
24	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓PEEP 2	↑ FiO_2 0.1 ↓ PEEP 2	↓ PEEP 2

(Use PaO2 if available, only use SpO2 if PaO2 not available)
Highlighted cells are different than low target range table (PaO2 = 55 – 61)

Conventional Arm (VC – LTV)
Oxygenation Table (Protocol)

Utah Tool Box (high altitude target range)
Oxygenation Table
$PaO_2 > 68$ or $SpO_2 > 93\%$

PEEP	FiO_2 = .3	FiO_2 = .4	FiO_2 = .5	FiO_2 = .6	FiO_2 = .7	FiO_2 = .8	FiO_2 = .9	FiO_2 = 1.0
5	Maintain	↓ FiO_2 .1	↓ FiO_2 .1	↓ FiO_2 .1	↓ FiO_2 .1	↓ FiO_2 .1	↓ FiO_2 .1	↓ FiO_2 .1
8	↓ PEEP 3	↓ PEEP 3	↓ FiO_2 .1	↓ FiO_2 .1	↓ FiO_2 .1	↓ FiO_2 .1	↓ FiO_2 .1	↓ FiO_2 .1
10	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ FiO_2 .1	↓ FiO_2 .1	↓ FiO_2 .1	↓ FiO_2 .1	↓ FiO_2 .1
12	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ FiO_2 .1	↓ FiO_2 .1	↓ FiO_2 .1
14	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ FiO_2 .1	↓ FiO_2 .1	↓ FiO_2 .1
16	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ FiO_2 .1
18	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ FiO_2 .1
20	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2
22	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2
24	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2	↓ PEEP 2

(Use PaO2 if available, only use SpO2 if PaO2 not available)

Conventional Arm (VC-LTV) Ventilation Table (protocol)

VR = Actual Vent Setting	VT > 6 ml/kg			VT = 6 ml/kg			VT ≥ 4 ml/kg and < 6 ml/kg		
pH	Pplat < 25 cm H2O	Pplat 25 – 30 cm H2O	Pplat > 30 cm H2O	Pplat < 25 cm H2O	Pplat 25 – 30 cm H2O	Pplat > 30 cm H2O	Pplat < 25 cm H2O	Pplat 25 – 30 cm H2O	Pplat < 30 cm H2O
> 7.45	1. ↓ VT by 1 ml/kg	2. ↓ VT by 1 ml/kg	3. ↓ VT by 1 ml/kg	4. ↓ VR by 20%	5. ↓ VR by 20%	6. ↓ VT by 1 ml/kg	7. ↑ VT by 1 ml/kg ↓ VR by 20%	8. ↓ VR by 20%	9. ↓ VT by 1 ml/kg but do not ↓ < 4 ml/kg
7.30 – 7.45	10. ↓ VT by 1 ml/kg	11. ↓ VT by 1 ml/kg	12. ↓ VT by 1 ml/kg	13. No Change in Therapy	14. No Change in Therapy	15. ↓ VT by 1 ml/kg	16. ↑ VT by 1 ml/kg	17. No Change in Therapy	18. ↓ VT by 1 ml/kg but do not ↓ < 4 ml/kg
7.15 – 7.29 and VR < 35 bpm	19. ↑ VR by 20% increments[a] ↓ VT by 1 ml/kg	20. ↑ VR by 20% increments[a] ↓ VT by 1 ml/kg	21. ↑ VR by 20% increments[a] ↓ VT by 1 ml/kg	22. ↑ VR by 20% increments[a]	23. ↑ VR by 20% increments[a]	24. ↓ VT by 1 ml/kg ↑ VR by 20% increments[a]	25. ↑ VR by 20% increments[a] ↑ VT by 1 ml/kg	26. ↑ VR by 20% increments[a]	27. ↑ VR by 20% increments[a]
7.15 – 7.29 and VR = 35 bpm	28. ↓ VT by 1 ml/kg Check with MD to consider Bicarb	29. ↓ VT by 1 ml/kg Check with MD to consider Bicarb	30. ↓ VT by 1 ml/kg Check with MD to consider Bicarb	31. Check with MD to consider Bicarb	32. Check with MD to consider Bicarb	33. ↓ VT by 1 ml/kg Check with MD to consider Bicarb	34. ↑ VT by 1 ml/kg Check with MD to consider Bicarb	35. Check with MD to consider Bicarb	36. ↓ VT by 1 ml/kg but do not ↓ < 4 ml/kg Check with MD To consider Bicarb
< 7.15 and VR < 35 bpm	37. ↑ VR by 20% increments Check with MD to consider Bicarb	38. ↑ VR by 20% increments Check with MD to Consider Bicarb	39. ↑ VR by 20% increments Check with MD to Consider Bicarb	40. ↑ VR by 20% increments Check with MD to Consider Bicarb	41. ↑ VR by 20% increments Check with MD to Consider Bicarb	42. ↓ VT by 1 ml/kg Check with MD to consider Bicarb	43. ↑ VR by 20% increments[a] ↑ VT by 1 ml/kg Check with MD to consider Bicarb	44. ↑ VR by 20% increments Check with MD to Consider Bicarb	45. ↑ VR by 20% increments Check with MD to Consider Bicarb
< 7.15 and VR = 35 bpm	46. Check with MD to consider Bicarb prior to ↑ VT by 1 ml/kg	47. Check with MD to consider Bicarb prior to ↑ VT by 1 ml/kg	48. Check with MD to consider Bicarb prior to ↑ VT by 1 ml/kg	49. Check with MD to consider Bicarb prior to ↑ VT by 1 ml/kg	50. Check with MD to consider Bicarb prior to ↑ VT by 1 ml/kg	51. Check with MD to consider Bicarb prior to ↑ VT by 1 ml/kg	52. ↑ VT by 1 ml/kg Check with MD to consider Bicarb	53. Check with MD to consider Bicarb prior to ↑ VT by 1 ml/kg	54. Check with MD to consider Bicarb prior to ↑ VT by 1 ml/kg

Conventional Arm CPAP/Pressure Support Weaning Protocol

I. Criteria for Entering A Pressure Support (PS) Weaning Trial

1. Patients will be assessed between 06:00 am to 10:00 am. If a patient procedure, test, or other extenuating circumstance prevents assessment for these criteria between 0600 and 1000, then the assessment and initiation of subsequent weaning procedures may be delayed for up to six hours.
2. 12 hours since initial protocol ventilator changes
3. FIO2 $\leq$ 0.40 and PEEP $\leq$ 8 cm H2O with SpO2 $\geq$ 88% or PaO2 $\geq$ 55
4. Not receiving neuromuscular blocking agents
5. Systolic arterial pressure $\geq$ 90 mm Hg without vasopressor support ($\leq$ 5 ug/kg/min dopamine or dobutamine or equivalent low dose of another vasopressor will not be considered a vasopressor)
6. Inspiratory efforts are present (if no efforts are evident at the baseline ventilator rate, then decrease ventilator rate to 50% of baseline level for up to 5 minutes to detect inspiratory efforts)
7. If numbers 1 through 6 are present, then the patient is evaluated with a CPAP 5 cm H2O trial with FIO2 0.50 for $\leq$ 5 minutes
    a. If RR on CPAP trial was $\leq$ 25, then go to unassisted breathing trial IV.
    b. If RR 26 to 35 per minute during the CPAP trial then the patient enters the PS weaning trial.
    c. If RR > 35 per minute during the CPAP trial and anxiety is not present then the patient returns to Assist/Control at the most recent settings and will be re-assessed for weaning the following day between 06:00 am and 10:00 am
    d. If RR > 35 per minute and anxiety is present, then appropriate treatment for anxiety may be given and a second 5 minute CPAP trial initiated within 4 hours
    e. If RR < 10 then return to the patient to Assist/Control

II. Establishing Tolerated Pressure Support (PS) Level (only use PS levels of 5, 10, 15, and 20 cm H2O)

1. Initial PS setting:
    a. Set initial PS at 20 cm H20 and PEEP 5 cm H2O, and FIO2 0.50.
    b. Record RR, minute volume, SpO2 %, and pH from ABG if available.
    c. Assess tolerance to PS. If any of the following failure criteria occur with PS level of 5, 10, or 15 cm H2O then return to previous higher PS level with acceptable parameters. If any of the following criteria occur with PS level of 20 cm H2O, then the patient is returned to Assist/Control at the previous settings:
        i. RR < 10 or > 35 per minute
        ii. SpO2 < 88%
        iii. Spontaneous tidal volume < 4 ml/kg predicted body weight
        iv. Respiratory distress
        v. pH < 7.30 if measured
    d. After 5 minutes record the RR.
        i. If RR $\leq$ 25, decrease pressure support by 5 cm H2O and go back to b.
        ii. If RR 26 to 35 then go to III on current PS level.
    e. On any PS level or on CPAP if RR < 10 on any evaluation then return to AC
    f. If the oxygenation protocol recommends increasing FIO2 to 0.6, then return to AC at previous settings.

III. Pressure Support (PS) Weaning (only use PS levels of 5, 10, 15, and 20 cm H2O)

1. Evaluate PS level every 1 to 3 hours and record average minute volume and RR for calculation of average tidal volume. If all of the following criteria are met then reduce the PS level by 5 cm H2O to a minimum PS of 5 cm H2O and re-evaluate within 20 minutes. If all of these criteria are met after 20 minutes then re-evaluate again in 1.5 hours, if all of these criteria are not met after 20 minute evaluation then return to previous PS level or AC according to the rules in #2 and #3 below:
    g. RR $\geq$ 10 or $\leq$ 35 per minute
    h. SpO2 $\geq$ 88%
    i. Spontaneous tidal volume $\geq$ 4 ml/kg predicted body weight
    j. No respiratory distress*
    k. pH $\geq$ 7.30 if measured
2. If any of the above criteria are not met on any evaluation, and the PS is at 5 or 10 cm H2O, then increase the PS by 5 cm H2O and re-evaluate within 20 minutes. If these criteria are then met after 20 minutes on

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PS 10 or 15, then remain on PS 10 or 15 and re-evaluate again in 1.5 hours. If these criteria are not met after 20 minutes on PS 10 then return to AC.

3. If any of the above criteria are not met on any evaluation and the pressure support level is at 15, or 20 cm H2O, then return the patient to Assist/Control at the previous settings and return to last PS level tolerated at 06:00 am to 10:00 am the following day.
4. If minute volume on PS has decreased by 25 to 40 % from initial PS or Assist/Control minute volume on any evaluation, then consider obtaining an ABG.
5. If minute ventilation on PS has decreased by > 40% from initial PS minute volume or Assist/Control on any evaluation, then obtain an ABG.
6. If PS of 5 cm H2O, PEEP 5, and FIO2 $\leq$0.4 is tolerated according to the above tolerance criteria for $\geq$ 2 hours, then initiate an unassisted breathing trial.
7. An ABG is not required for any assessment of PS, but if it is obtained then the pH and PaO2 are used for decision making for one set of instructions from the protocol.
8. The oxygenation protocol appropriate for altitude is used to titrate FIO2 between 0.3 and 0.5.
9. If the oxygenation protocol recommends increasing FIO2 to 0.6, then return to AC at previous settings.
10. Re-evaluate within 20 minutes after any instructions to increase or decrease PS, FIO2, or PEEP.
11. On any PS level or on CPAP if RR < 10 on any evaluation then return to AC.

IV. Unassisted Breathing Trial

1. Place the patient on CPAP $\leq$ 5 cm H20 with FIO2 0.4 to maintain an SpO2 $\geq$ 88 %
2. If the below criteria are met for $\geq$ 30 to 120 minutes, then continue with unassisted breathing and call the physician to evaluate for extubation.
    a. Respiratory rate $\geq$ 10 or $\leq$ 35 per minute
    b. SpO2 $\geq$ 88 % or PaO2 $\geq$ 55 mm Hg
    c. Spontaneous tidal volume $\geq$ 4 ml/kg predicted body weight
    d. No respiratory distress*
    e. pH $\geq$ 7.30 if measured
3. Return to PS 8 cm H2O if any of the above criteria are not met (and go to III.1.).
4. If the patient meets all of the above criteria during $\geq$ 120 minutes of the unassisted breathing trial, but the clinician decides not to extubate the patient, then return to PS 5 cm H20 and go to III.1.
5. Follow oxygenation protocol for adjustment of FIO2 and PEEP.
6. If oxygenation protocol recommends an increase to FIO2 0.6 or greater, then return to AC.
7. Re-evaluate within 20 minutes after any instructions to increase PS, FIO2, or PEEP.
8. On any PS level or on CPAP if RR < 10 on any evaluation then return to AC.

* Respiratory distress is defined as two or more of the following:

1. Heart rate greater than 120% of the 0600 rate ($\leq$ 5 min at > 120% may be tolerated).
2. Marked use of accessory muscles.
3. Abdominal paradox.
4. Diaphoresis.
5. Marked subjective dyspnea.

Adapted from NIH weaning protocol Alveoli/FACTT