



Mechanical Ventilation; Adult



History

- Multiple etiologies leading to need for advanced airway control
- Requires ventilation support
- Height and underlying lung conditions

Signs and Symptoms

- Loss of consciousness or AMS with inability to protect airway
- Difficult oxygenation and/or ventilation
-

Differential

- ROSC
- Trauma
- Stroke
- Seizure
- Shock (see Shock Protocol)
- Toxicological

Age Appropriate
Airway Protocol(s) AR 1, 2, 3, 5, 6
if indicated

Post-intubation/ BIAD Management
Protocol AR 8
if indicated

History of
COPD or Asthma?

Alarming Ventilator and unsure how to troubleshoot

- Immediately disconnect patient and use BVM.
- Once oxygenation and ventilation stabilized, restart ventilator set-up procedure.

Home Ventilator Inter-facility Transfer with Ventilator

- Set initial parameters to home or facility settings
- Titrate to oxygenation, work of breathing, SpO₂, and EtCO₂.
- Use home ventilator if functioning properly.

P	MODE: Volume – Assist Control
	FiO₂: 100%
	PEEP: 5 cmH ₂ O
	TIDAL VOLUME (V_t): 8 mL/kg <i>Follow PBW and V_t on page 3</i>
	BPM: RESPIRATORY RATE: 16 BPM
	FLOW RATE: 60 mL/min <i>(preset)</i>
	Check Plateau Pressure <i>Press Manual Breath</i> <i>P Pressure button</i> Goal Pressure < 30 cm/H ₂ O
	Decrease Tidal Volume 1 mL/kg increments Until ≤ 29 cm/H ₂ O (DO NOT DECREASE < 4 mL/kg)
	After 10 minutes Decrease FiO₂ down to 50% Then adjust PEEP and FiO₂ Goal SpO ₂ 92 – 98%
	Step 1: PEEP = 8 FiO₂ = 40% Step 2: PEEP = 8 FiO₂ = 50% Step 3: PEEP = 10 FiO₂ = 50% Step 4: PEEP = 10 FiO₂ = 60% Step 5: PEEP = 10 FiO₂ = 70%

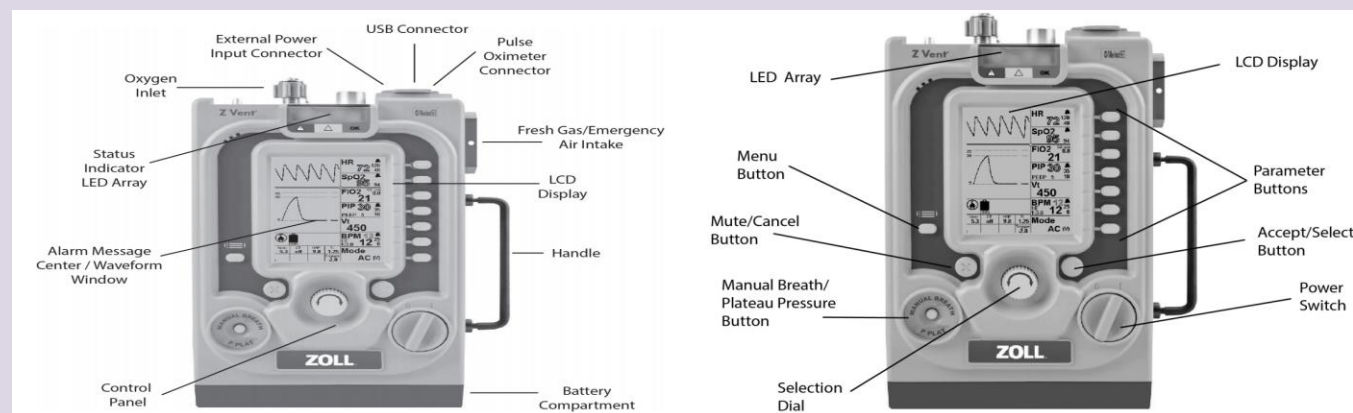
P	MODE: Volume – Assist Control
	FiO₂: 100%
	PEEP: 5 cmH ₂ O
	TIDAL VOLUME: 8 mL/kg <i>Follow PBW and V_t on page 3</i>
	BPM: RESPIRATORY RATE: 10 BPM
	FLOW RATE: 60 mL/min <i>(preset)</i>
	I:E Ratio Increase to 1:4 or 1:5
	Check Plateau Pressure <i>Press Manual Breath</i> <i>P Pressure button</i> Goal Pressure < 30 cm/H ₂ O
	Decrease Tidal Volume 1 mL/kg increments Until ≤ 29 cm/H ₂ O (DO NOT DECREASE < 4 mL/kg)
	Check Peak Inspiratory Pressure (PIP) Goal V _t is 8 mL/kg

	ADJUST PIP Alarm Settings <ul style="list-style-type: none">• Up until full exhalation achieved on 8 mL/kg Tidal Volume
	After 10 minutes Decrease FiO₂ down to 50% Goal SpO ₂ 92 – 98%
	<ul style="list-style-type: none">• Decrease FiO₂ in increments of 10% to goal of 50%.

Notify Destination or
Contact Medical Control

Choosing COPD/ Asthma Arm

- First decision point is deciding if underlying problem leading to the need for mechanical ventilation is directly related to COPD or Asthma.
- Typically these patients will have bronchospasm, which may be worsened by mechanical ventilation.
- In general we should maximize medical therapy, continuous DuoNeb, methylprednisolone, and oxygen therapy to prevent the need for mechanical ventilation.



Pearls

- Recommended Exam: Mental Status, Skin, HEENT, Heart, Lungs, Abdomen, Back, Extremities, Neuro**
- Mechanical ventilation may be used in any patient ≥ 1 year old.**
- MODE:**
 - In all adult patients use Volume – Assist Control.
 - This mode requires adequate sedation as it can be uncomfortable in a patient who is awakening.
- TIDAL VOLUME:**
 - Tidal volume is very important in preventing lung injury and calculated by height and predicted body weight, or ideal body weight, and NOT actual body weight.
 - Follow Tidal Volume by Height Table on page 3.
 - Follow Tidal Volume by Height Table on page 3 when adjusting Peak Inspiratory Pressure alarms to allow full exhalation.
 - High Tidal Volumes are well known to cause alveolar damage and lung injury.
- FLOW RATE:**
 - A normal breath (non-mechanical ventilation) has highest flow and volume at the beginning and both decrease as inspiration comes to an end.
 - Setting Flow Rate at 60 L/minute allows patient to take full breath without air hunger toward end of inspiration. This is more comfortable for the patient.
 - If patient looks like they are trying to take in more volume initially, the Flow Rate can be increased by increments of 5 as needed to improve patient comfort.
- FiO₂ and PEEP Adjustments:**
 - Seems intuitive that when SpO₂ is less than desired the FiO₂ should be increased.
 - When FiO₂ is $\geq 50\%$ and SpO₂ remains low, this indicates a shunt, and PEEP must be used in conjunction with FiO₂ to correct the shunt and increase oxygenation.
 - Follow PEEP adjustment recommendations on page 1.
- EtCO₂:**
 - EtCO₂ and arterial CO₂ do not always correlate well in patients with lung disease or during serious illness or injury.
 - Use caution in adjusting respiratory rate to reach a goal of 35 – 45 mmHg. Most intubated patients do not need tight control in this range.
 - Patients with suspected head injury do need EtCO₂ with a target of 35 – 45 mmHg.
 - Allowing patients with COPD and asthma exacerbations to have higher EtCO₂ outside the 35 – 45 mmHg range is acceptable. Lower ventilation rates allow more time for exhalation and prevents auto-PEEP and/ or air trapping.
- DOPE:** Displaced tracheostomy tube / ETT, Obstructed tracheostomy tube / ETT, Pneumothorax and Equipment failure.



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TIDAL VOLUME INITIAL SETTINGS By HEIGHT

FEMALE							MALE						
Height / Predicted body weight / Vt							Height / Predicted body weight / Vt						
HEIGHT	PBW	4 ml	5 ml	6 ml	7 ml	8 ml	HEIGHT	PBW	4 ml	5 ml	6 ml	7 ml	8 ml
4' 0" (48)	17.9	72	90	107	125	143	4' 0" (48)	22.4	90	112	134	157	179
4' 1" (49)	20.2	81	101	121	141	162	4' 1" (49)	24.7	99	124	148	173	198
4' 2" (50)	22.5	90	113	135	158	180	4' 2" (50)	27	108	135	162	189	216
4' 3" (51)	24.8	99	124	149	174	198	4' 3" (51)	29.3	117	147	176	205	234
4' 4" (52)	27.1	108	136	163	190	217	4' 4" (52)	31.6	126	158	190	221	253
4' 5" (53)	29.4	118	147	176	206	235	4' 5" (53)	33.9	136	170	203	237	271
4' 6" (54)	31.7	127	159	190	222	254	4' 6" (54)	36.2	145	181	217	253	290
4' 7" (55)	34	136	170	204	238	272	4' 7" (55)	38.5	154	193	231	270	308
4' 8" (56)	36.3	145	182	218	254	290	4' 8" (56)	40.8	163	204	245	286	326
4' 9" (57)	38.6	154	193	232	270	309	4' 9" (57)	43.1	172	216	259	302	345
4' 10" (58)	40.9	164	205	245	286	327	4' 10" (58)	45.4	182	227	272	318	363
4' 11" (59)	43.2	173	216	259	302	346	4' 11" (59)	47.7	191	239	286	334	382
5' 0" (60)	45.5	182	228	273	319	364	5' 0" (60)	50	200	250	300	350	400
5' 1" (61)	47.8	191	239	287	335	382	5' 1" (61)	52.3	209	262	314	366	418
5' 2" (62)	50.1	200	251	301	351	401	5' 2" (62)	54.6	218	273	328	382	437
5' 3" (63)	52.4	210	262	314	367	419	5' 3" (63)	56.9	228	285	341	398	455
5' 4" (64)	54.7	219	274	328	383	438	5' 4" (64)	59.2	237	296	355	414	474
5' 5" (65)	57	228	285	342	399	456	5' 5" (65)	61.5	246	308	369	431	492
5' 6" (66)	59.3	237	297	356	415	474	5' 6" (66)	63.8	255	319	383	447	510
5' 7" (67)	61.6	246	308	370	431	493	5' 7" (67)	66.1	264	331	397	463	529
5' 8" (68)	63.9	256	320	383	447	511	5' 8" (68)	68.4	274	342	410	479	547
5' 9" (69)	66.2	265	331	397	463	530	5' 9" (69)	70.7	283	354	424	495	566
5' 10" (70)	68.5	274	343	411	480	548	5' 10" (70)	73	292	365	438	511	584
5' 11" (71)	70.8	283	354	425	496	566	5' 11" (71)	75.3	301	377	452	527	602
6' 0" (72)	73.1	292	366	439	512	585	6' 0" (72)	77.6	310	388	466	543	621
6' 1" (73)	75.4	302	377	452	528	603	6' 1" (73)	79.9	320	400	479	559	639
6' 2" (74)	77.7	311	389	466	544	622	6' 2" (74)	82.2	329	411	493	575	658
6' 3" (75)	80	320	400	480	560	640	6' 3" (75)	84.5	338	423	507	592	676
6' 4" (76)	82.3	329	412	494	576	658	6' 4" (76)	86.8	347	434	521	608	694
6' 5" (77)	84.6	338	423	508	592	677	6' 5" (77)	89.1	356	446	535	624	713
6' 6" (78)	86.9	348	435	521	608	695	6' 6" (78)	91.4	366	457	548	640	731
6' 7" (79)	89.2	357	446	535	624	714	6' 7" (79)	93.7	375	469	562	656	750
6' 8" (80)	91.5	366	458	549	641	732	6' 8" (80)	96	384	480	576	672	768
6' 9" (81)	93.8	375	469	563	657	750	6' 9" (81)	98.3	393	492	590	688	786
6' 10" (82)	96.1	384	481	577	673	769	6' 10" (82)	100.6	402	503	604	704	805
6' 11" (83)	98.4	394	492	590	689	787	6' 11" (83)	102.9	412	515	617	720	823
7' 0" (84)	100.7	403	504	604	705	806	7' 0" (84)	105.2	421	526	631	736	842

TROUBLESHOOTING Hypoxia or Deterioration DOPEs

D	Dislodged ETT or cuff leak
O	Obstruction of ETT or circuit
P	Pneumothorax, Pneumonia, Pulmonary embolism or edema, Plug (mucous)
E	Equipment problem
S	Stacked breaths, air trapping, or auto-PEEP

RESPONSE to Hypoxia or Deterioration DOTT

D	Disconnect ventilator, squeeze chest if auto-PEEP, Decompress if pneumothorax
O	Oxygen 100% FiO2, BVM and check compliance
T	Tube position and function, check EtCO2
T	Tweak ventilator settings or equipment

Pressure Alarm Troubleshooting

Problem Location

Consider

High PIP	+	High Plateau > 30	Alveoli	Compliance problem: Pneumothorax, Pneumonia Pulmonary Edema or Embolism, CHF
High PIP	+	Normal Plateau < 30	Airway problem	Airway, ventilator, or circuit problem: DOPE, Right Main stem intubation, Air trapping or auto-PEEP, Mucous plug, Patient out of synchrony with ventilator