Use of Strategic National Stockpile [SNS] Ventilators in the Pediatric Patient

Instructional Guidelines with Training Scenarios

2nd Edition (2010)

Illinois Emergency Medical Services for Children

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Illinois Emergency Medical Services for Children is a collaborative program within the Illinois Department of Public Health. The Pediatric Work Group is composed of physicians, nurses, paramedics, pharmacologists, psychologists, state/local health department personnel as well as representatives from key organizations, such as the American Red Cross, Illinois Association of School Nurses, Illinois Chapter of the American Academy of Pediatrics, Illinois College of Emergency Physicians, Illinois Hospital Association, Illinois State Council of the Emergency Nurses Association, Illinois Medical Emergency Response Team, Illinois Nurse Volunteer Emergency Needs Team and Illinois Poison Center, among others.

Training materials previously developed by a team at Children's Memorial Hospital, Chicago, IL through HRSA and ASPR grant funding, contributed substantially to the development of the first edition of this document. The practice scenarios were developed by Lynn Chlebanowski, RRT, Children's Memorial Hospital, Chicago.

This 2nd Edition has incorporated information related to the LTV-1200 ventilator along with other additional information.

Photographs of the LP-10, LTV-1200 and the Uni-Vent Eagle ventilators were obtained from the manufacturer's manual. The VersaMed ventilator photographs were provided by Lynn Chlebanowski, RRT, Children's Memorial Hospital, Chicago.

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Use of SNS* Ventilators in the Pediatric Patient

* LP-10 Volume Ventilator, LTV-1200 Ventilator and the UNI-VENT® Eagle™ Ventilation System

Overview & Mechanical Ventilation Review

The threat of nature in the form of an influenza illness has accelerated preparations for a potential pandemic flu, which may result in thousands of patients requiring mechanical ventilation.

In the wake of a pandemic flu most available ventilators owned by hospitals will be in use, necessitating the delivery of ventilators currently stored in the Strategic National Stockpile [SNS]. In addition to a surge of all patient populations in a pandemic, there may also be many children who require respiratory support in hospitals that do not routinely care for children on ventilators.

This document has been developed for use by clinicians (physicians, nurses and respiratory care providers) who have baseline knowledge of pulmonary physiology and the concepts of ventilation and who may find themselves working with ventilators that are not used on a daily basis. The intent is to provide clinicians with a quick reference for Just-in-Time training and set up of the SNS Ventilators (as of 2010).

Mechanical Ventilation is indicated in pandemic flu for acute respiratory failure, defined as insufficient oxygenation, insufficient alveolar ventilation, or both. The principal benefits of mechanical ventilation are improved gas exchange and decreased work of breathing. Mechanical ventilation can be volume, pressure, flow or time-limited.

Volume-limited Ventilation: Inspiration ends after delivery of a present tidal volume. The airway pressure is variable and related to compliance, airway resistance, and tubing resistance. Volume limited modes of mechanical ventilation include assist control and synchronized intermittent mandatory ventilation.

Pressure-limited Ventilation: Inspiration ends when a present maximum airway pressure is reached. The tidal volume is variable and related to compliance, airway resistance, and tubing resistance. Minute ventilation cannot be guaranteed as a consequence of the variable tidal volume.

Flow-limited Ventilation: A preset airway pressure is delivered once the ventilator is triggered. Inspiration ends when the inspiratory flow decreases to a predetermined percentage of its peak value. Pressure support is the mode of ventilation that is typically flow-limited.

Time-limited Ventilation: Inspiration ends after a present inspiratory duration.

The level of ventilatory support is determined by the modes and other settings. In most cases assist control tends to provide the most support, synchronized intermittent mandatory ventilation offers the widest range of support and pressure support would provide the least amount of support.

Settings to consider when providing mechanical ventilation include trigger mode and sensitivity, respiratory rate, tidal volume, positive end –expiratory pressure (PEEP), flow rate, flow pattern, and fraction of inspired oxygen (FiO_2). During volume-limited ventilation, the clinician sets the tidal volume and it remains constant. In pressure-limited ventilation, the tidal volume is variable and is directly related to the inspiratory pressure level and compliance, but indirectly related to the resistance of the ventilator.

SNS Ventilator Advantages

- ☐ Portable
- ☐ Easy to set up
- ☐ Electrical or battery powered
- ☐ Can ventilate without high pressure source
- ☐ Volume ventilators (but pressure can be limited)

Manufacturers

These guidelines are based on manufacturer specifications and recommendations.

www.PuritanBennet.com (LP-10)

www.carefusion.com (LTV1200)

www.impactinstrumentation.com (UNI-VENT)

www.versamed.com (VersaMed iVent)

Use of the SNS Ventilators in Infants

Each of the SNS ventilators can be utilized in the pediatric patient. The table below outlines key information regarding use of each of these ventilators specifically in the ***infant*** population. Weight limitations and lowest tidal volume delivery is listed below for each ventilator, along with information related to pressure ventilation, circuit considerations and sensitivity. Be sure to also consider accessing manufacturer information when utilizing these ventilators in neonates and infants.

	LP10	LTV 1200	Eagle Univent	VersaMed iVent
Volume Ventilation	10 kg patient weight limitation; Lowest tidal volume - 100 ml	Ventilator designed to work with patients as small as 5 kg	Lowest tidal volume available is 10 ml	5 kg patient weight limitation; Lowest tidal volume is 50 ml
Pressure Ventilation	Possible to limit volume breaths to ventilate infants smaller than 10 kg; however, volumes then unknown.	Has pressure ventilation capabilities. Infants traditionally ventilated with Pressure modes.	Possible to limit volume breaths with plateau pressure. Volumes can be measured.	Has pressure ventilation capabilities. Infants traditionally ventilated with Pressure modes.
Circuit Considerations	Pediatric circuits available.	Pediatric circuits available.	Pediatric circuits available.	Only one size circuit available (ped/adult). Volume lost to the circuit may make ventilation of infants smaller than 10 kg difficult even in pressure.
Sensitivity	Pressure trigger only. Difficult for infants to pressure trigger breath.	Pressure and Flow trigger available. Flow trigger easier for infants to trigger breath.	Pressure trigger only. Difficult for infants to pressure trigger breath.	Pressure and Flow trigger available. Flow trigger easier for infants to trigger breath.

VENTILATOR INFORMATION

LP-10 Volume Ventilator with Pressure Limit

- Volume ventilator (A/C or SIMV)
- Volume is measured with spirometer (no LED readout)
- Minimum Vt – 100 ml
- Can limit breath by using pressure limit control (volume is no longer guaranteed)
- No pressure support
- Peak airway pressures measured by manometer
- PEEP is set on external valve

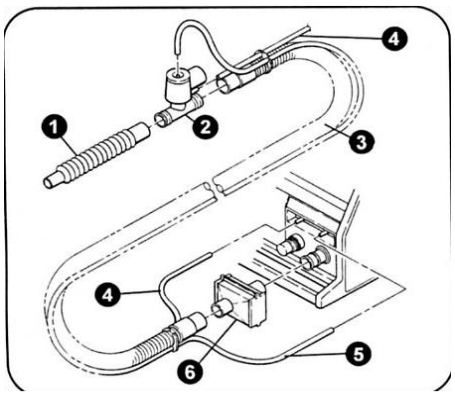
BATTERY LIFE

- Internal battery 30 min – 1 hour
- External – approximately 10 hours

SETTINGS

- Set Mode (A/C or SIMV)
- Set Rate
- Set Tidal Volume (10 ml/kg)
- Set Inspiratory Time (typically 0.7 – 1.0 sec)
- Set PEEP (typically start at 5cwp)
- Determine Sensitivity (set based on pressure below PEEP)
- Set Alarms

CIRCUIT SET UP



OXYGEN DELIVERY

- Lower FiO_2 can be bled from front of vent
- Higher FiO_2 require oxygen enrichment kit and is bled in from back
- Requires external analyzer to measure

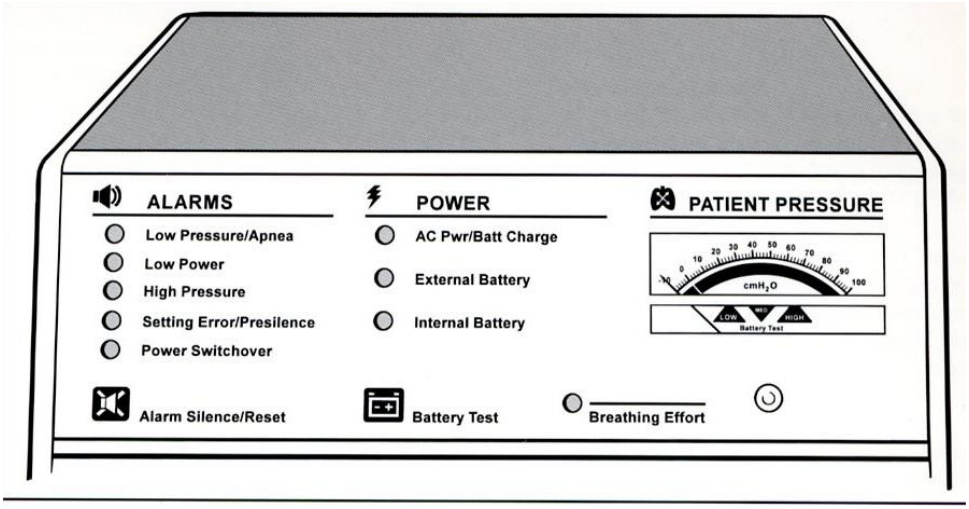
TIDAL VOLUME CONSIDERATIONS

- Set at 10 ml/kg
- Some volume lost to circuit
- Volume measured with spirometer
- Minimum 100 ml
- Can limit using pressure limit control (volume no longer guaranteed)
- Peak pressure measured on manometer

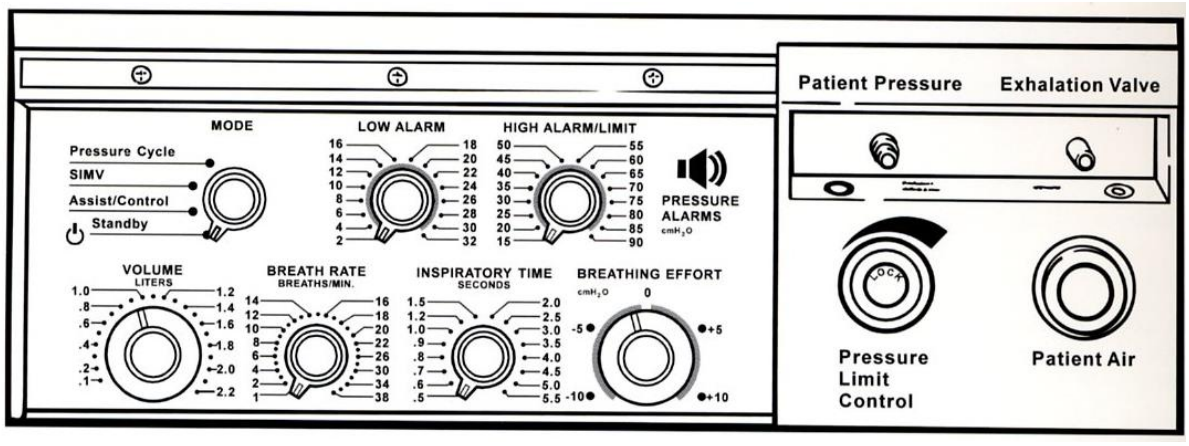
PEEP

- Set on external valve
- Turn spring loaded valve to set desired PEEP
- Value seen on manometer

UPPER FRONT PANEL



LOWER FRONT PANEL



LP- 10 Ventilator "Quick Set Up"

Mode
- SIMV or Assist Control

Volume
- 10ml/kg (measured by spirometer)

Breath rate
- Set age appropriate

Inspiratory Time
- (0.7-1.0 second)

FiO_2
Back of machine- O2 enrichment kit
- Capable of delivering 100%
- Set liter flow (not > 10 lpm)
- Analyze FiO_2

Front of machine- Bleed O2 into circuit
- Highest FiO_2 approximately 40%
- Adjust liter flow and analyze

PEEP
- External PEEP valve located on circuit exhalation valve; dial in desired PEEP pressure

Alarms
- Set based on average Peak Inspiratory Pressure

Low Alarm Limit
- 5 cwp below Peak Inspiratory Pressure

High Alarm Limit
- 10 cwp above Mechanical Breaths Peak Inspiratory Pressure

Battery Life
- Internal Battery 30 minutes to 1 hour; External battery 10 hours

LTV 1200 Ventilator

ADVANTAGES

- Portable
- Easy to set up
- Electrical or battery powered
- Can ventilate without high pressure source
- Can volume or pressure ventilate
- Has pressure support
- Allows for non-invasive ventilation
- **Can use in patients greater than 5 kg**

BATTERY LIFE

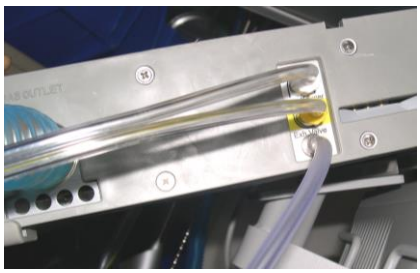
- Internal battery lasts approximately 60 minutes
- Small external battery pack lasts approximately 3 hours
- Large external battery pack lasts approximately 9 hours

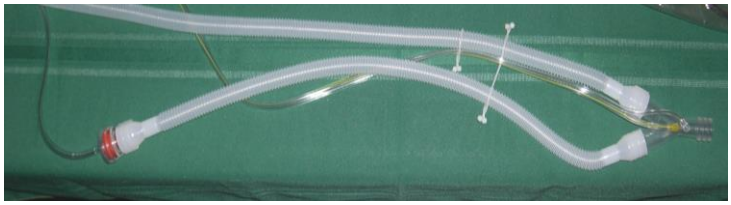
FILTERS

- Fan filter should be cleaned or replaced when soiled
- Inlet filter should be cleaned or replaced when soiled

CIRCUITS

- Adult and pediatric circuits available
- External exhalation valve





OXYGEN DELIVERY

- Can run off internal turbine at 21%
- Low oxygen source provides oxygen based on liter flow and minute volume; requires oxygen analyzer
- High pressure oxygen source allows precise FiO_2 to be set on ventilator

POWER SOURCE

Source and charge levels

- External Power : Green – external power acceptable; Amber – external power level low
- Charge Status: Green – internal battery fully charged; Amber – battery not fully charged; Red – battery cannot be charged
- Battery Level: Green – battery fully charged; Amber – battery low; Red – battery empty

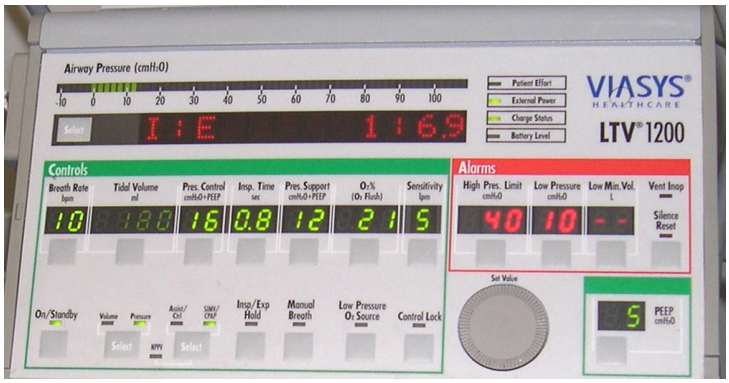
VENT CHECKOUT MENU

- Ventilator checkout test required before placing on patient
- Press and hold select button and press on/standby button
- Remove PTNT appears; clear alarm and display will read Vent Ck
- Press select for each test
- Alarm – verify audible alarm
- Display – verify all lights and LED displays
- Control – press each control button and verify control name displayed; turn control knob
- Leak – occlude proximal end and press select
- Vent inop test

BUTTON CONTROLS

On/Standby, Breath & Mode Selection, Manual Breath, Silence Reset, Manual Breath, Low Pressure O_2, Insp/Exp Hold, Control Lock

- Turn a feature on or off (i.e. Control Lock)
- Toggle between two features (Volume or pressure ventilation)
- Perform a function (manual breath)



CHANGING PARAMETERS

Rate, Tidal Volume, Pres. Control cmH_2O + PEEP, Insp. Time sec, Pres. Support cmH_2O + PEEP, PEEP

- Push button of parameter to be changed
- Turn Set Value knob to desired change
- Push button of parameter a second time to confirm change

MODES

Assist Control – Volume or Pressure, SIMV – Volume or Pressure, CPAP/PSV, NPPV

VOLUME VENTILATION

- Assist Control or SIMV
- SIMV has pressure support for spontaneous breaths
- Inspiratory Time set
- Set PEEP on ventilator

PRESSURE VENTILATION

- Assist Control or SIMV
- SIMV has pressure support for spontaneous breaths
- Inspiratory Time set. If set time limits at a lower than desired value, switch mode to volume ventilation and increase tidal volume. Return to pressure mode and increase inspiratory time.
- Set PEEP on ventilator

PRESSURE SUPPORT/CPAP

- Set mode to SIMV
- Turn rate off
- Set pressure support
- PEEP

NPPV

- PEEP is EPAP
- Pressure Support is IPAP

ALARMS

- High Pres. Limit
- Low Pressure
- Low Min. Vol.

SENSITIVITY

- Breaths are flow triggered
- Values set 1 to 9
- The lower the number, the easier the vent is to trigger
- If the O_2 Conserve feature is on, the vent is pressure triggered

EXTENDED FEATURES

Alarm options, Presets, Transducer Autozero, Real-Time Transducer Data, Event Trace, Ventilator Maintenance, Ventilator Checkout Tests, Ventilator Options and Spontaneous Breathing Trial.

Access menus by pressing and holding the Select button; turn the Set Value Knob until you reach the desired menu. Press select. Use the Set Value Knob to advance through the choices within the menu and press select to choose value to set. When finished, scroll until you reach the Exit option.

The following three Extended Feature menus are commonly used for setting up the ventilator:

VENTILATOR OPTIONS

- Variable Rise Time – Rise time settings 1-9 (1 = fastest rise time; 9 = slowest rise time).

- Variable Flow Termination – Allows user to select percentage of peak flow used to cycle Pressure Support breaths to exhalation. Range: 10% to 40%
- Variable Time Termination – Allows user to select maximum inspiratory time allowed for Pressure Support breath to cycle to exhalation. Breath cycles based on time if reached before flow reaches set peak flow percent.
- Pressure Control Flow Termination – Allows Pressure Control breath to cycle to exhalation based on percentage of peak flow instead of inspiratory time if that flow is reached before the set time. Range: 10% to 40%.
- Leak Compensation – When enabled, compensates for leak up to 6 lpm if leak is stable and there is no autocycling.
- O_2 Flush – Allows operator to increase FiO_2 to 100% for up to 3 minutes.

ALARM OPTIONS

Allows user to set additional alarm options.

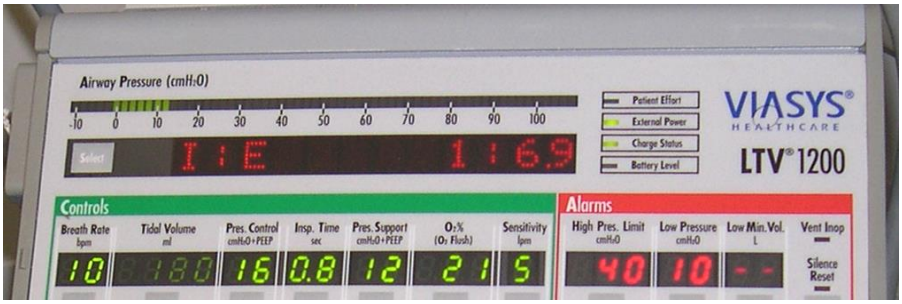
- Alarm Volume
- Apnea Interval
- High Pressure Alarm Delay
- Low Peak Pressure Alarm
- High frequency
- High PEEP
- Low PEEP

PATIENT QUERY

- Patient Query can be turned on or off
- Patient Query On gives choice for Same Patient or New Patient when vent powered on
- Select New Patient to choose patient size: Infant, Pediatric or Adult

VIEWING MEASURED PARAMETERS

Pressing selecting button once allows you to view monitored values such as PIP, MAP, PEEP, f, Vte, VE, I:E



LTV-1200 "Quick Set Up"

Preuse
- Vent Op/Leak test/New Patient/Patient Size

Mode
- SIMV, Assist Control (A/C), Pressure Support-CPAP, NPPV

Volume
- 10 ml/kg

Breath Rate
- Set age appropriate

PEEP
- Set on Machine

FiO_2
- High pressure source – set oxygen on vent (capable of delivering 100%)
- Low pressure source – adjust liter flow and analyze

Alarms
- Low Pressure – Set 5 cwp below average spontaneous Peak Inspiratory Pressure
- High Pressure – Set 10 cwp below average Peak Inspiratory Pressure
- Low Min. Vol. – Set 1 lpm below average minute volume

Ext. Features
- Safe to use defaults provided appropriate size patient selected

Battery Life
- Internal Battery 1 hour; Small external battery 3 hours; Large external battery 9 hours

UNI-VENT® Eagle™ Portable, Self-Contained Ventilation System

- Volume ventilator (A/C or SIMV)
- Volume (set/delivered) is measured on LCD screen
- Minimum Vt – 10ml
- Can limit breath by using pressure plateau control (volume is no longer guaranteed)
- No pressure support
- Peak airway pressures measured on LCD screen
- PEEP is set on vent (each push of button = 1 cwp)

BATTERY LIFE

- Compressor use – 3 hours
- External gas source – 12 hours

CIRCUIT SET UP:

- Connect 22mm corrugated hose to ventilator GAS OUT fitting
- Connect green TRANSDUCER HOSE to ventilator TRANSDUCER hose barb (Green)
- Connect clear EXHALATION VALVE HOSE to Ventilator EXHALATION VALVE hose barb (clear)

OXYGEN DELIVERY

- Can run off internal compressor for 21%
- High pressure air/O2 hose for oxygen delivery
- FiO_2 set on control panel
- Measured on screen

BASIC SET UP

1. Select a Mode of Operation

2. Set a Ventilation Rate

3. Set an Inspiration Time, or I:E Ratio default

4. Set a Tidal Volume

5. Set an $Fi0_2$

6. Set the High and Low Limit Pressure Alarms

TIDAL VOLUME CONSIDERATIONS

- Set at 10 ml/kg
- Some volume lost to circuit
- Can set lower tidal volumes than the LP10 (as low as 10 ml)
- Set/Delivered measured on screen

PEEP

- Set directly on vent
- Each push of button equals 1 cwp of PEEP

ASSESSMENT

- Chest rise
- Breath sounds
- Respiratory Rate
- Work of Breathing
- Pressures required to deliver volume
- ABG/TCM/SaO_2

UNI-VENT® Eagle™ Ventilation System "Quick Set-Up"

Mode
- SIMV, Assist Control (A/C), CPAP

Volume
- 10 ml/kg (displayed on LCD above control)

Breath rate
- Set age appropriate (dial is sensitive, 1-150 bpm)

Inspiratory Time
- (0.7-1.0 Combination of Inspiratory time and I:E ratio is displayed on LCD (I:E ratio default 1:1 preset)

FiO_2
- Dial desired FiO_2 (21% to 100%) value displayed on LCD

PEEP
- Pushbutton switch: each push = 1 cwp

Alarms
- Set based on average Peak Inspiratory Pressure

Low Alarm Limit
- 5 cwp below spontaneous Peak Inspiratory Pressure

High Alarm Limit
- 10 cwp above Mechanical Breaths Peak Inspiratory Pressure

Battery Life
- 3 hours maximum using internal compressor; 12 hours using external gas source

SELECTED ADDITIONAL NON-SNS VENTILATOR

VersaMed iVent

ADVANTAGES

- Portable
- Easy to set up
- Electrical or battery powered
- Can ventilate without high pressure source
- Can volume or pressure ventilate
- Has pressure support
- Allows for non-invasive ventilation

BATTERY LIFE

- Internal battery lasts approximately 1-2 hours
- External battery lasts 6-8 hours

AIR INLET FILTER

- Replace every 500 hours or every 30 days
- Chemical, Biological, Radiological, and Nuclear filters available

CIRCUITS

- One size circuit used for peds/adults
- External exhalation valve
- Has one way valve (located on patient "wye")
- Fisher & Paykel makes a heated wire circuit for Versamed iVent (remove one way and place it on the dry side of the heater between vent tubing and heater chamber)
- Must use bacterial filter at vent/circuit interface

POWER & WEIGHT SCREEN

- Ideal body weight screen
- Selecting body weight sets default parameters
- If you don't like the default parameters, you can set parameters from the main screen

OVT

- OVT is the short circuit test that takes approximately 12 seconds.
- You must perform the OVT if you are reconnecting a patient circuit or using a new one
- Need to cap the circuit at the "wye" and expiratory valve
- Follow the directions on the screen

HARD BUTTONS
Alarm Silence, Increase O_2, Manual Break, Hold Clear

MAIN SCREEN
Mode, Pressure Limit, PEEP, Minute Volume, I-time, Trigger, Pressure Support, FiO_2, Vt, Rate

CHANGING PARAMETERS
Rate, VT, Pressure Control, Pressure Support, PEEP, FiO_2, etc. can be changed from the default settings by turning the dial to highlight parameter to be changed

- Push the dial; then rotate the dial to change the parameter
- Push the dial again to accept the change

MODES
Assist Control – Volume or Pressure, SIMV – Volume or Pressure, CPAP/PSV, Adaptive Bi-level

VOLUME VENTILATION

- Assist Control or SIMV
- SIMV has pressure support for spontaneous breaths
- Breath can be pressure limited (if the target pressure is reached, the breath will be held at set pressure until I-time is reached)

ADAPTIVE I-TIME

- Active in volume ventilation
- Allows patient to be in control of their inspiratory time
- Maintains an I:E ratio of 1:2
- If patient's rate increases, vent decreases I-time in an attempt to keep 1:2 ratio
- Adaptive I-time can be turned off and I-time can be manually set

ADAPTIVE FLOW

- Allows for variable peak flow in a volume mode
- Delivers flow needed to reach target tidal volume within the allotted time, while maintaining an I:E of 1:2
- Adaptive flow can be turned to manual and flow rate can then be set

SENSITIVITY

- Adjusting Trigger Sensitivity – two sliding numeric gauges appear (one for pressure; one for flow)
- Dial knob to select the desired pressure value, then press to enter
- Dial knob to select flow value, then press knob to confirm and enter

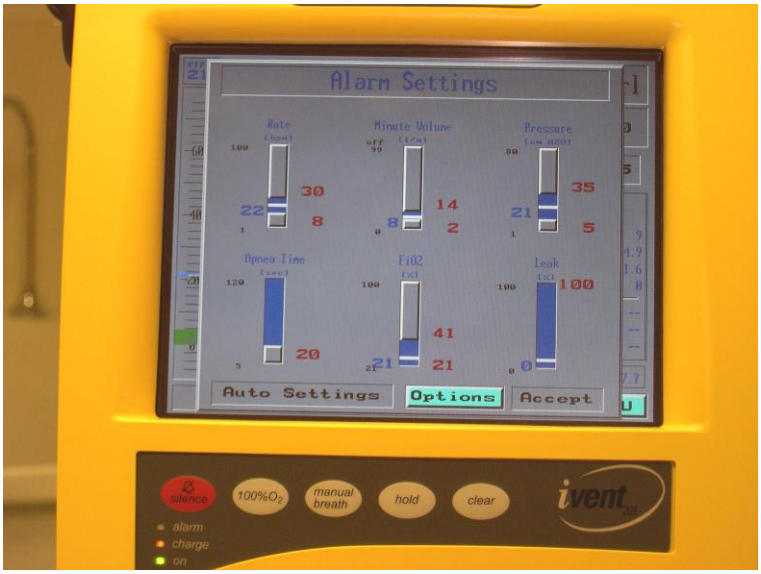
PRESSURE VENTILATION

- Can be Assist Control or SIMV
- SIMV has pressure support for spontaneous breaths
- I-Time is set
- Volume limit can be set in this mode

PRESSURE SUPPORT/CPAP

- Breath terminates when:
  - Flow decreases to 25% of peak flow
  - Airway pressure greater than 5% of target pressure
  - Three seconds or two breath periods have elapsed, whichever occurs first
- Apnea back up ventilation (SIMV)
- Patient must take 3 consecutive breaths within one minute to return to CPAP

ALARMS



ADVANCED SETTINGS

Found in main menu:

- Sigh breath (1.5 times set Vt)
- Rise time level (mid, high, max or auto)
- Easy exhale
- Oxygen supply (high pressure/low pressure)
- Adaptive Peak Flow (on-off/low/mid/high)
- Purge sensors (on-off/interval)
- Nebulizer device
- Set date and time

EASY EXHALE

- Patient comfort feature
- Unloads all resistance from expiratory valve at beginning of exhalation
- Once baseline PEEP is met, PEEP is reapplied
- Reduces WOB increasing patient comfort

ADDITIONAL ADVANCED SETTINGS

- Show Graphics
- Show Trends (stores for 72 hours)
- Show Loops (Volume/Flow, Pressure/Flow, Pressure/Volume or all three)
- Show Mechanics (MAP, Resistance, Compliance, RR/Vt, Static Compliance, Auto-PEEP, and Time Constant)
- Show Log Book (300 events)

ADDITIONAL INFORMATION

Trouble-shooting

HIGH PRESSURE ALARM **Look at patient!**

- Coughing or other high-flow expiratory efforts
- Inspiratory resistance or compliance changes
- Airway obstruction
- Increased secretions
- Water in tubing
- Crimped tubing
- Malfunction of the exhalation manifold
- A sticky Pressure Limit control
- Pressure limit setting is higher than the High Alarm setting

LOW PRESSURE ALARM/APNEA ALARM **Look at patient!**

1. Sounds when 2 breaths do not reach the selected limit or if pressure does not return to selected limit
2. Will continually sound when patient becomes disconnected; you must manually reset the low pressure alarm by pushing silence button
3. The patient is not breathing
4. Water in small bore tubing or crimped
5. The patients breathing effort is less than the Breathing Effort control setting
6. Patient's speech or other activities lower patient airway pressure
7. Low alarm setting is higher than Pressure limit setting
8. Pressure Limit level is set too low
9. Leak or obstructions in the patient circuit

Concepts of Rapid or Volume Based Pediatric Ventilation

- If volume ventilating, start at 10 ml/kg (unless protective lung strategy ventilation required)
- Volume lost to circuit must be replaced unless measurements taken at "wye"
- Set I-time generally between 0.7 – 1.0 sec.

NORMAL RESPIRATORY RATES

- Infant 30-60
- Toddler 24-40
- Preschooler 22-34
- School-age child 18-30
- Adolescent 12-16

ASSESSMENT

- Chest rise
- Breath sounds
- Respiratory Rate
- Work of Breathing
- Pressures required to deliver volume
- ABG/TCM/SaO_2

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Practice Scenarios

The following scenarios were created for use with any of the SNS ventilators outlined in this document. While the scenarios are very similar, each provides an opportunity to practice different adjustments to ventilator parameters in response to a clinical situation.

Scenarios were created for three different aged pediatric patients; a nine month old infant, a three year old child and a preadolescent. Some scenarios provide orders for ventilator settings, while other scenarios provide just enough information to determine starting ventilator settings. Don't be afraid to try the scenarios requiring you to choose ventilator settings. Answers have been provided so that you can see how you did.

You are encouraged to go through each scenario using each SNS ventilator outlined in this document. Please note that the adjustments to the ventilator parameters that are made will differ based on the ventilator that is used.

SNS VENTILATOR SCENARIO 1
NINE MONTH OLD PATIENT
(Without Ventilator Settings Ordered)

Instructions

Using the following scenario, place the patient on one of the SNS Ventilators. This scenario requires the practitioner to determine ventilator settings based on information provided in the scenario. Additional adjustments to ventilator parameters are required in the scenario to provide practice making ventilator changes.

Scenario

A nine month old infant has presented with flu-like symptoms to the emergency department. The patient is irritable and not easily consoled. A temperature has been taken and the infant is febrile. Color is pale pink. The patient is tachypneic and tachycardic but otherwise hemodynamically stable. Capillary refill is 3 seconds. The infant has moderate subcostal retractions. Nasal flaring is also noted. Listening to breaths sounds reveal bilateral crackles with decreased aeration to the bases bilaterally. Periodically, the patient has a congested cough. Saturations are only 90% despite supplemental oxygen.

The decision is made to intubate for impending respiratory failure. Due to the high number of patients presenting to your emergency room over the last couple of days, as well as to other hospitals throughout the metropolitan area, it has become impossible to rent ventilators. Your hospital has received ventilators from the Strategic National Stockpile.

The infant is now intubated with a 4.0 oral endotracheal tube which is secured at 12 at the lip. The patient weights 10 kg. Set up one of the stockpile ventilators for use with this patient.

1. Set up the ventilator with the appropriate size circuit. Determine if a pretest is needed. If required perform this test.
2. Select a mode of ventilation. The decision is made to use SIMV/Volume.
3. Select initial parameters
    a. Set an appropriate rate.
    b. Set an appropriate tidal volume.
    c. Set an appropriate PEEP.
4. What other parameters need to be set?
5. Once initial parameters have been set and the patient placed on the ventilator, identify appropriate alarms to be set.
6. Set an FiO_2 of 0.40.
7. What other settings need to be considered on the VersaMed iVent and the LTV1200?

The patient has now been placed on the ventilator. Saturations continue to read 90-91%. Increase the FiO2 to 0.45. Saturations have increased to 95%.

An arterial blood gas has been drawn 30 minutes after the patient was placed on the ventilator. The results are:

pH	7.43
PCO_2	57
PO_2	94
SBE	5.0
$cHCO_3$	30.0
sO_2	95%

What change can you recommend based on this gas? Make that change.

Two hours later the patient is once again desaturating to the high 80s despite increases in FiO_2. The physician is now asking that you increase the PEEP to +7. Make that change.

The patient is now stable.

Conclusion

It is now three days later and the patient has weaned off the ventilator and is now extubated.

How did you do? Not sure if what you did was the right thing? Check the table on the next page for some suggestions on how to set up the ventilator for this scenario.

SNS VENTILATOR SCENARIO 1
ANSWER SHEET

	LP10	LTV 1200	Eagle Univent	VersaMed iVent
Circuit	No pretest needed	Pretest required. Select pediatric circuit.	No pretest needed	Pretest required
Mode	SIMV or Assist Control - Volume	SIMV or Assist Control – Volume or Pressure	SIMV or Assist Control - Volume	SIMV or Assist Control - Volume or Pressure
Rate (based on age)	30	30	30	30
Volume = 10 ml/kg (100 ml)	Must be measured with spirometer.	Dialed in. Read on LED screen. If pressure start at 20 cwp and evaluate tidal volume; titrate pressure to achieve appropriate tidal volume.	Dialed in. Read on LED above control.	Dialed in. Read on LED screen. If pressure start at 20 cwp and evaluate tidal volume; titrate pressure to achieve appropriate tidal volume.
PEEP (recommend starting with 5 cwp)	Dialed in on PEEP valve located on circuit. Read on manometer.	PEEP set on ventilator itself	Depress button once for each cwp. Value read below button.	PEEP set on ventilator itself.
Other Parameters	Inspiratory Time (an IT of 0.6 is reasonable for this patient). Breathing Effort is set approx. +2 when PEEP is set at +5.	Inspiratory Time (an IT of 0.6 is reasonable for this patient). Sensitivity is triggered by flow. Set 1 lpm for flow as a starting point. Watch that patient can trigger a breath from vent with spontaneous effort. Pressure Support if using SIMV (10 cwp pressure support is an appropriate starting point).	Inspiratory Time (an IT of 0.6 is reasonable for this patient).	Use Adaptive Inspiratory Time and Flow. Sensitivity is flow and pressure. Set 1 lpm for flow and 2 for pressure as starting points. Watch that patient can trigger a breath from vent with spontaneous effort. Pressure Support if using SIMV (10 cwp pressure support is an appropriate starting point).
Alarms	High/Low Pressure. Watch average peak pressure to determine how to set.	High/Low Pressure set by watching average peak pressure on the LED screen.	High/Low Pressure set by watching average peak pressure on LED screen	You can either set alarms manually or use the auto feature.

	LP10	LTV 1200	Eagle Univent	VersaMed iVent
		Low Min. Vol. set by watching average VE on display screen. Access the extended menu and turn up the high PEEP in the alarms section to +7 as default in pediatric is +5.		
Oxygen	Bleed in front of vent. Set liter flow and analyze. Turn liter flow up or down to adjust FiO_2	If using high pressure oxygen source, set control on ventilator If using low pressure oxygen source, set liter flow and analyze. Turn liter flow up or down to adjust FiO_2	Set by control on ventilator. Read FiO_2 on LED above control.	Set by control on ventilator. Read on LED screen.
Advanced Settings	None	Found in extended features menu. Choose patient size as pediatric. Extended features default settings can be safely left at default settings.	None	These can safely be left at the default settings. Sigh should be left off – not used in pediatrics.

SNS VENTILATOR SCENARIO 2
NINE MONTH OLD PATIENT
(With Ventilator Settings Ordered)

Instructions

Using the following scenario, place the patient on one of the SNS Ventilators. Ventilator settings have been provided in the scenario. Additional adjustments to ventilator parameters are required in the scenario to provide practice making ventilator changes.

Scenario

A nine month old infant has presented with flu-like symptoms to the emergency department. The patient is irritable and not easily consoled. A temperature has been taken and the infant is febrile. Color is pale pink. The patient is tachypneic and tachycardic but otherwise hemodynamically stable. Capillary refill is 3 seconds. The infant has moderate subcostal retractions. Nasal flaring is also noted. Listening to breaths sounds reveal bilateral crackles with decreased aeration to the bases bilaterally. Periodically, the patient has a congested cough. Saturations are only 90% despite supplemental oxygen.

The decision is made to intubate for impending respiratory failure. Due to the high number of patients presenting to your emergency room over the last couple of days, as well as to other hospitals throughout the metropolitan area, it has become impossible to rent ventilators. Your hospital has received ventilators from the Strategic National Stockpile.

The child is now intubated with a 4.0 oral endotracheal tube which is secured at 12 at the lip. The patient weights 10 kg. Set up one of the stockpile ventilators for use with this patient.

The physician has ordered the patient to be placed on the following ventilator settings:
SIMV/Volume, Rate 32, Tidal Volume 100 ml, PEEP +5, FiO_2 0.40.*

*Alternate orders for the Versamed iVent or LTV1200 –
The physician has ordered the patient to be placed on for the following settings:
SIMV/Pressure, Rate 32, Pressure Control 20 cwp, PEEP +5, FiO_2 0.40.

SNS VENTILATOR SCENARIO 2
ANSWER SHEET

	LP10	LTV 1200	Eagle Univent	VersaMed iVent
Set up the ventilator with the appropriate size circuit	Select pediatric circuit.	Pretest required. Select pediatric circuit	Select pediatric circuit.	Only one circuit size available. Perform the circuit pretest.
Set the ordered parameters.	Be sure to measure the tidal volume with a spirometer if using the LP10.	If using pressure, evaluate the tidal volume based on patient weight; titrate pressure as needed.		If using pressure, evaluate the tidal volume based on patient weight; titrate pressure as needed.
Set FiO_2	Bleed in the oxygen on the front of the LP10 ventilator. Dial up the liter flow to the ordered FiO_2.	If using high pressure oxygen source, set control on ventilator. If using low pressure oxygen source, set liter flow and analyze. Turn liter flow up or down to adjust FiO_2	Dial in the set FiO_2	Dial in the set FiO_2
Set the sensitivity	Set sensitivity to +2	Set the sensitivity on the LTV to 1 lpm for flow trigger. Watch that patient can trigger a breath from vent with spontaneous effort.	No Sensitivity setting	Set the sensitivity on the VersaMed iVent to 1 lpm for the flow trigger and 2 for the pressure trigger.
Inspiratory time	Set 0.60 inspiratory time	Set the inspiratory time at 0.6 sec.	Set 0.60 inspiratory time	Set Adaptive Inspiratory time and flow if using VersaMed iVent.
Once initial parameters have been set and the patient placed on the ventilator, alarms are set based on average peak pressures as measured by vent	Set low pressure alarm 5 below peak pressure and set the high pressure alarm 10 above the average peak airway pressure	Set low pressure alarm 5 below peak pressure and set the high pressure alarm 10 above the average peak airway pressure. Set low minute volume alarm 1 lpm below average measured minute volume.	Set low pressure alarm 5 below peak pressure and set the high pressure alarm 10 above the average peak airway pressure	Use auto feature for alarms on VersaMed iVent.
Check advanced	N/A	Access the extended	N/A	It is safe to use the

	LP10	LTV 1200	Eagle Univent	VersaMed iVent
settings		menu and turn up the high PEEP in the alarms section to +7 as default in pediatric is +5. Extended features default settings can be safely left at default **settings**.		default settings, but make sure Sigh is off. This is not used in pediatrics.

The patient has now been placed on the ventilator. Saturations continue to read 90-91%. Increase the FiO_2 to 0.45. Saturations have increased to 95%.

An arterial blood gas has been drawn 30 minutes after the patient was placed on the ventilator. The results are:

pH	7.34
PCO_2	57
PO_2	94
SBE	5.0
$cHCO_3$	30.0
sO_2	95%

Increase the respiratory rate to 34.

Two hours later the patient is once again desaturating to the high 80s despite increases in FiO_2. The physician is now asking that you increase the PEEP to +7. Make that change.

The patient is now stable.

Conclusion

It is now three days later and the patient has weaned off the ventilator and is now extubated.

SNS VENTILATOR SCENARIO 3
THREE YEAR OLD PATIENT
(Without Ventilator Settings Ordered)

Instructions

Using the following scenario, place the patient on one of the SNS Ventilators. This scenario requires the practitioner to determine ventilator settings based on information provided in the scenario. Additional adjustments to ventilator parameters are required in the scenario to provide practice making ventilator changes.

Scenario

A three year old child has presented to the Emergency Department with flu-like symptoms. The patient is tachypneic and tachycardic but otherwise hemodynamically stable. The child has moderate subcostal retractions. Saturations are only 90% despite supplemental oxygen.

An arterial blood gas has been drawn and the results are:

pH	7.30
PCO_2	57
PO_2	63
SBE	5.3
$cHCO_3$	30.1
sO_2	91%

The decision is made to intubate for impending respiratory failure. Due to the high number of patients presenting to your emergency room over the last couple of days, as well as to other hospitals throughout the metropolitan area, it has become impossible to rent ventilators. Your hospital has received ventilators from the Strategic National Stockpile (SNS).

The child is now intubated with a 4.5 oral endotracheal tube which is secured at 13 at the lip. The child weighs 14 kg. Set up one of the SNS ventilators for use with this patient.

1. Set up the ventilator with the appropriate size circuit. Determine if a pretest is needed. If required perform this test.
2. Select a mode of ventilation. The decision is made to use SIMV/Volume.
3. Select initial parameters
    a. Set an appropriate rate.
    b. Set an appropriate tidal volume.
    c. Set an appropriate PEEP.
4. What other parameters need to be set?
5. Once initial parameters have been set and the patient placed on the ventilator, identify appropriate alarms to be set.
6. Set an FiO_2 of 0.30.
7. What other settings need to be considered on the VersaMed iVent?

The patient has now been placed on the ventilator. Saturations continue to read 90-91%. Increase the FiO_2 to 0.35. Saturations have increased to 95%.

An arterial blood gas has been drawn 30 minutes after the patient was placed on the ventilator. The results are:

pH	7.33
PCO_2	55
PO_2	93
SBE	5.0
$cHCO_3$	30.0
sO_2	95%

What change can you recommend based on this gas? Make that change.

Two hours later the patient is once again desaturating to the high 80s despite increases in FiO_2. The physician is now asking that you increase the PEEP to +7. Make that change.

The patient is now stable.

Conclusion

It is now three days later and the patient has weaned off the ventilator and is now extubated.

How did you do? Not sure if what you did was the right thing? Check the table on the next page for some suggestions on how to set up the ventilator for this scenario.

SNS VENTILATOR SCENARIO 3
ANSWER SHEET

	LP10	LTV 1200	Eagle Univent	VersaMed iVent
Circuit	No pretest needed	Pretest required. Select pediatric for patient size. Select pediatric circuit.	No pretest needed	Pretest required
Mode	SIMV or Assist Control - Volume	SIMV or Assist Control – Volume or Pressure	SIMV or Assist Control - Volume	SIMV or Assist Control - Volume or Pressure
Rate (based on age)	24	24	24	24
Volume = 10 ml/kg (140 ml)	Must be measured with spirometer.	Dialed in. Read on LED screen	Dialed in. Read on LED above control.	Dialed in. Read on LED screen.
PEEP (recommend starting with 5 cwp)	Dialed in on PEEP valve located on circuit. Read on manometer.	PEEP set on ventilator itself	Depress button once for each cwp. Value read below button.	PEEP set on ventilator itself.
Other Parameters	Inspiratory Time (an IT of 0.7 is reasonable for this patient). Breathing Effort is set approx. +2 when PEEP is set at +5.	Inspiratory Time (an IT of 0.7 is reasonable for this patient). Sensitivity is triggered by flow. Set 1 lpm for flow as a starting point. Watch that patient can trigger a breath from vent with spontaneous effort. Pressure Support if using SIMV (10 cwp pressure support is an appropriate starting point).	Inspiratory Time (an IT of 0.7 is reasonable for this patient).	Use Adaptive Inspiratory Time and Flow. Sensitivity is triggered by either flow or pressure. Set 1 lpm for flow and 2 for pressure as starting points. Watch that patient can trigger a breath from vent with spontaneous effort. Pressure Support if using SIMV (10 cwp pressure support is an appropriate starting point).
Alarms	High/Low Pressure. Watch average peak pressure to determine how to set.	High/Low Pressure set by watching average peak pressure on the LED screen. Low Min. Vol. set by watching average VE on display screen. Set 1 lpm below average. Access the extended menu and turn up the high PEEP in the alarms section to +7 as default in pediatric range is +5.	High/Low Pressure set by watching average peak pressure on LED screen	You can either set alarms manually or use the auto feature.

	LP10	LTV 1200	Eagle Univent	VersaMed iVent
Oxygen	Bleed in front of vent. Set liter flow and analyze. Turn liter flow up or down to adjust FiO_2	If using high pressure oxygen source, set FiO_2 on ventilator If using low pressure oxygen source, set liter flow and analyze. Turn liter flow up or down to adjust FiO_2	Set by control on ventilator. Read FiO_2 on LED above control.	Set by control on ventilator. Read on LED screen.
Advanced Settings	None	Found in extended features menu. Choose patient size as pediatric. Extended features default settings can be safely left at default settings.	None	These can safely be left at the default settings. Sigh should be left off – not used in pediatrics.

SNS VENTILATOR SCENARIO 4
THREE YEAR OLD PATIENT
(With Ventilator Settings Ordered)

Instructions

Using the following scenario, place the patient on one of the SNS Ventilators. Ventilator settings have been provided in the scenario. Additional adjustments to ventilator parameters are required in the scenario to provide practice making ventilator changes.

Scenario

A three year old child has presented with flu-like symptoms to the emergency department. The patient is tachypneic and tachycardic but otherwise hemodynamically stable. The child has moderate subcostal retractions. Saturations are in the high 80s despite supplemental oxygen.

An arterial blood gas has been drawn and the results are:

pH	7.30
PCO_2	57
PO_2	63
SBE	5.3
$cHCO_3$	30.1
sO_2	91%

The decision is made to intubate for impending respiratory failure. Due to the high number of patients presenting to your emergency room over the last couple of days, as well as to other hospitals throughout the metropolitan area, it has become impossible to rent ventilators. Your hospital has received ventilators from the Strategic National Stockpile (SNS).

The child is now intubated with a 4.5 oral endotracheal tube which is secured at 13 at the lip. The patient weighs 15 kg. Set up one of the SNS ventilators for use with this patient.

The physician has ordered the patient to be placed on the following ventilator settings: SIMV/Volume, Rate 22, Tidal Volume 150 ml, PEEP +5, FiO_2 0.30.

SNS VENTILATOR SCENARIO 4
ANSWER SHEET

	LP10	LTV 1200	Eagle Univent	VersaMed iVent
Set up the ventilator with the appropriate size circuit	Select pediatric circuit.	Pretest required. Select pediatric for patient size. Select pediatric circuit	Select pediatric circuit.	Only one circuit size available. Perform the circuit pretest.
Set the ordered parameters.	Be sure to measure the tidal volume with a spirometer if using the LP10.			
Set FiO_2	Bleed in the oxygen on the front of the LP10 ventilator. Dial up the liter flow to the ordered FiO_2.	If using high pressure oxygen source, set FiO_2 on ventilator. If using low pressure oxygen source, set liter flow and analyze. Turn liter flow up or down to adjust FiO_2	Dial in the set FiO_2	Dial in the set FiO_2
Set the sensitivity	Set sensitivity to +2	Set the sensitivity on the LTV to 1 lpm for flow trigger. Watch that patient can trigger a breath from vent with spontaneous effort.	No Sensitivity setting	Set the sensitivity on the VersaMed iVent to 1 lpm for the flow trigger and 2 for the pressure trigger.
Inspiratory time	Set 0.70 inspiratory time	Set the inspiratory time at 0.7 sec.	Set 0.70 inspiratory time	Set Adaptive Inspiratory time and flow if using VersaMed iVent.
Once initial parameters have been set and the patient placed on the ventilator, alarms are set based on average peak pressures as measured by vent	Set low pressure alarm 5 below peak pressure and set the high pressure alarm 10 above the average peak airway pressure	Set low pressure alarm 5 below peak pressure and set the high pressure alarm 10 above the average peak airway pressure. Set low minute volume alarm 1 lpm below average measured minute volume.	Set low pressure alarm 5 below peak pressure and set the high pressure alarm 10 above the average peak airway pressure	Use auto feature for alarms on VersaMed iVent.
Check advanced settings	N/A	Access the extended menu and turn up the high PEEP in the alarms section to +7 as default in pediatric range is +5. Extended features default settings can be safely left at default settings.	N/A	It is safe to use the default settings, but make sure Sigh is off. This is not used in pediatrics.

The patient has now been placed on the ventilator. Saturations continue to read 90-91%. Increase the FiO_2 to 0.35. Saturations have increased to 95%.

An arterial blood gas has been drawn 30 minutes after the patient was placed on the ventilator. The results are:

pH	7.33
PCO_2	55
PO_2	93
SBE	5.0
$cHCO_3$	30.0
sO_2	95%

Increase the respiratory rate to 24.

Two hours later the patient is once again desaturating to the high 80s despite increases in FiO_2. The physician is now asking that you increase the PEEP to +7. Make that change.

The patient is now stable.

Conclusion

It is now three days later and the patient has weaned off the ventilator and is now extubated.

SNS VENTILATOR SCENARIO 5
PREADOLESCENT PATIENT
(Without Ventilator Settings Ordered)

Instructions

Using the following scenario, place the patient on one of the SNS Ventilators. This scenario requires the practitioner to determine ventilator settings based on information provided in the scenario. Additional adjustments to ventilator parameters are required in the scenario to provide practice making ventilator changes.

Scenario

A ten year old child has presented with flu-like symptoms to the emergency department. The patient is tachypneic and tachycardic but otherwise hemodynamically stable. The child has nasal flaring and tracheal tugging. Saturations are only 89% despite supplemental oxygen.

An arterial blood gas has been drawn and the results are:

pH	7.30
PCO_2	57
PO_2	53
SBE	5.3
$cHCO_3$	30.1
sO_2	89%

The decision is made to intubate for impending respiratory failure. Due to the high number of patients presenting to your emergency room over the last couple of days, as well as to other hospitals throughout the metropolitan area, it has become impossible to rent ventilators. Your hospital has received ventilators from the Strategic National Stockpile (SNS).

The child is now intubated with a 5.5 oral endotracheal tube which is secured at 13 at the lip. The child weighs 30 kg. Set up one of the SNS ventilators for use with this patient.

1. Set up the ventilator with the appropriate size circuit. Determine if a pretest is needed. If required perform this test.
2. Select a mode of ventilation. The decision is made to use SIMV/Volume.
3. Select initial parameters
    a. Set an appropriate rate.
    b. Set an appropriate tidal volume.
    c. Set an appropriate PEEP.
4. What other parameters need to be set?
5. Once initial parameters have been set and the patient placed on the ventilator, identify appropriate alarms to be set.
6. Set an FiO_2 of 0.50.
7. What other settings need to be considered on the VersaMed iVent?

The patient has now been placed on the ventilator. Saturations continue to read 88-89%. Increase the FiO_2 to 0.60. Saturations have increased to 95%.

An arterial blood gas has been drawn 30 minutes after the patient was placed on the ventilator. The results are:

pH	7.33
PCO_2	55
PO_2	93
SBE	5.0
$cHCO_3$	30.0
sO_2	95%

Your patient assessment reveals chest rise to be only fair. Breath sounds are diminished. What change can you recommend based on this gas? Make that change.

Two hours later the patient is once again desaturating to the high 80s despite increases in FiO_2. The physician is now asking that you increase the PEEP to +7. Make that change.

One hour later the patient is saturating 100%. What do you recommend?

The patient is now stable.

Conclusion

It is now three days later and the patient has weaned off the ventilator and is now extubated.

How did you do? Not sure if what you did was the right thing? Check the table on the next page for some suggestions on how to set up the ventilator for this scenario.

SNS VENTILATOR SCENARIO 5
ANSWER SHEET

	LP10	LTV 1200	Eagle Univent	VersaMed iVent
Circuit	No pretest needed	Pretest required. Select pediatric for patient size. Select pediatric circuit.	No pretest needed	Pretest required
Mode	SIMV or Assist Control - Volume	SIMV or Assist Control – Volume or Pressure	SIMV or Assist Control - Volume	SIMV or Assist Control - Volume or Pressure
Rate (based on age)	20	20	20	20
Volume = 10 ml/kg (300 ml)	Must be measured with spirometer.	Dialed in. Read on LED screen	Dialed in. Read on LED above control.	Dialed in. Read on LED screen.
PEEP (recommend starting with 5 cwp)	Dialed in on PEEP valve located on circuit. Read on manometer.	PEEP set on ventilator itself	Depress button once for each cwp. Value read below button.	PEEP set on ventilator itself.
Other Parameters	Inspiratory Time (an IT of 0.8 is reasonable for this patient). Breathing Effort is set approx. +2 when PEEP is set at +5.	Inspiratory Time (an IT of 0.8 is reasonable for this patient). Sensitivity is triggered by flow. Set 1 lpm for flow as a starting point. Watch that patient can trigger a breath from vent with spontaneous effort. Pressure Support if using SIMV (10 cwp pressure support is an appropriate starting point).	Inspiratory Time (an IT of 0.8 is reasonable for this patient).	Use Adaptive Inspiratory Time and Flow. Sensitivity is triggered by either flow or pressure. Set 1 lpm for flow and 2 for pressure as starting points. Watch that patient can trigger a breath from vent with spontaneous effort. Pressure Support if using SIMV (10 cwp pressure support is an appropriate starting point).
Alarms	High/Low Pressure. Watch average peak pressure to determine how to set.	High/Low Pressure set by watching average peak pressure on the LED screen. Low Min. Vol. set by watching average VE on display screen. Set 1 lpm below average. Access the extended menu and turn up the high PEEP	High/Low Pressure set by watching average peak pressure on LED screen	You can either set alarms manually or use the auto feature.

	LP10	LTV 1200	Eagle Univent	VersaMed iVent
		in the alarms section to +7 as default in pediatric range is +5.		
Oxygen	Bleed in front of vent. Set liter flow and analyze. Turn liter flow up or down to adjust FiO_2	If using high pressure oxygen source, set FiO_2 on ventilator If using low pressure oxygen source, set liter flow and analyze. Turn liter flow up or down to adjust FiO_2	Set by control on ventilator. Read FiO_2 on LED above control.	Set by control on ventilator. Read on LED screen.
Advanced Settings	None	Found in extended features menu. Choose patient size as pediatric. Extended features default settings can be safely left at default settings.	None	These can safely be left at the default settings. Sigh should be left off – not used in pediatrics.
High CO_2/poor chest rise	10 ml/kg may not be enough due to volume lost to circuit; increase VT by 20 ml and reassess.	10 ml/kg may not be enough due to volume lost to the circuit; increase VT by 20 ml and reassess.	10 ml/kg may not be enough due to volume lost to circuit; increase VT by 20 ml and reassess.	10 ml/kg may not be enough due to volume lost to circuit; increase VT by 20 ml and reassess.
FiO_2 vs. PEEP	If FiO_2 >50% wean	If FiO_2 >50% wean FiO_2 first; then wean PEEP	FiO_2 first; then wean	PEEP

SNS VENTILATOR SCENARIO 6
PREADOLESCENT PATIENT
(With Ventilator Settings Ordered)

Instructions

Using the following scenario, place the patient on one of the SNS Ventilators. Ventilator settings have been provided in the scenario. Additional adjustments to ventilator parameters are required in the scenario to provide practice making ventilator changes.

Scenario

A ten year old child has presented with flu-like symptoms to the emergency department. The patient is tachypneic and tachycardic but otherwise hemodynamically stable. The child has nasal flaring and tracheal tugging. Saturations are in the high 80s despite supplemental oxygen.

An arterial blood gas has been drawn and the results are:

pH	7.30
PCO_2	57
PO_2	53
SBE	5.3
$cHCO_3$	30.1
sO_2	89%

The decision is made to intubate for impending respiratory failure. Due to the high number of patients presenting to your emergency room over the last couple of days, as well as to other hospitals throughout the metropolitan area, it has become impossible to rent ventilators. Your hospital has received ventilators from the Strategic National Stockpile (SNS).

The child is now intubated with a 5.5 oral endotracheal tube which is secured at 13 at the lip. The child weighs 32 kg. Set up one of the SNS ventilators for use with this patient.

The physician has ordered the patient to be placed on the following ventilator settings: SIMV/Volume, Rate 20, Tidal Volume 320 ml, PEEP +5, FiO_2 0.50.

SNS VENTILATOR SCENARIO 6
ANSWER SHEET

	LP10	LTV1200	Eagle Univent	VersaMed iVent
Set up the ventilator with the appropriate size circuit	Select pediatric circuit.	Pretest required. Select pediatric for patient size. Select pediatric circuit	Select pediatric circuit.	Only one circuit size available. Perform the circuit pretest.
Set the ordered parameters.	Be sure to measure the tidal volume with a spirometer if using the LP10.			
Set FiO_2	Bleed in the oxygen on the back of the LP10 ventilator using the oxygen enrichment kit. Dial up the liter flow to the ordered FiO_2.	If using high pressure oxygen source, set FiO_2 on ventilator. If using low pressure oxygen source, set liter flow and analyze. Turn liter flow up or down to adjust FiO_2	Dial in the set FiO_2	Dial in the set FiO_2
Set the sensitivity	Set sensitivity to +2	Set the sensitivity on the LTV to 1 lpm for flow trigger. Watch that patient can trigger a breath from vent with spontaneous effort.	No Sensitivity setting	Set the sensitivity on the VersaMed iVent to 1 lpm for the flow trigger and 2 for the pressure trigger.
Inspiratory time	Set 0.80 inspiratory time	Set the inspiratory time at 0.7 sec.	Set 0.80 inspiratory time	Set Adaptive Inspiratory time and flow if using VersaMed iVent.
Once initial parameters have been set and the patient placed on the ventilator, alarms are set based on average peak pressures as measured by vent	Set low pressure alarm 5 below peak pressure and set the high pressure alarm 10 above the average peak airway pressure	Set low pressure alarm 5 below peak pressure and set the high pressure alarm 10 above the average peak airway pressure. Set low minute volume alarm 1 lpm below average measured minute volume.	Set low pressure alarm 5 below peak pressure and set the high pressure alarm 10 above the average peak airway pressure	Use auto feature for alarms on VersaMed iVent.
Check advanced settings	N/A	Access the extended menu and turn up the high PEEP in the alarms section to +7 as default in pediatric range is +5. Extended features default settings can be safely left at default settings.	N/A	It is safe to use the default settings, but make sure Sigh is off. This is not used in pediatrics.

The patient has now been placed on the ventilator. Saturations continue to read 88-89%. Increase the FiO_2 to 0.60. Saturations have increased to 95%.

An arterial blood gas has been drawn 30 minutes after the patient was placed on the ventilator. The results are:

pH	7.33
PCO_2	55
PO_2	93
SBE	5.0
$cHCO_3$	30.0
sO_2	95%

Your patient assessment reveals chest rise to be only fair. Breath sounds are diminished. The patient is not receiving the set volume due to volume lost to the circuit. Increase Tidal volume by 20 ml and reassess patient.

Patient assessment reveals improved chest rise and breath sounds are coarse with good aeration.

Two hours later the patient is once again desaturating to the high 80s despite increases in FiO_2. The physician is now asking that you increase the PEEP to +7. Make that change.

One hour later the patient is now saturating 100%. Wean the FiO_2 to 50%.

The patient is now stable.

Conclusion

It is now three days later and the patient has weaned off the ventilator and is now extubated.

Pediatric Ventilator Reference Materials & Bibliography

AHRQ. Project XTREME (Cross-Training Respiratory Extenders for Medical Extenders for Medical Emergencies). Computer software. Agency for Healthcare Research and Quality. Mar. 2007.

American Academy of Pediatric and the American Heart Association. Pediatric Advanced Life Support Provider Manual, 2007.

Clinician's Manual LP6 Plus Volume Ventilator and LP10 Volume Ventilator with Pressure Limit. Pleasanton, CA: Puritan Bennett, 2005. 1-74.

Malatino, Eileen M. "Strategic National Stockpile: Overview and Ventilator Assets." Respiratory Care 53 (2008): 91-95.

Operation Manual UNI-VENT Eagle 700 Series Model 754/754M. West Caldwell, NJ: Impact Instrumentation, Inc, 1997. I-X.

Operator Manual LTV 1200 Ventilator; Minneapolis, MN: Pulmonetic Systems, Inc. June, 2008.

Responding to Biological Events: Pediatric Simulation Using the Strategic National Stockpile (SNS) Ventilators for Resuscitation. Oct. 2007. Children's Memorial Hospital. 15 Sept. 2008 <http://www.childrensmemorial.org/professionals/prepared.aspx>.

Schmidt, Shelley L., Hyzy, Robert C. "Overview of Mechanical Ventilation" version 16.3, Revised October 1, 2008, Official reprint from UpToDate® (www.uptodate.com).

Thomas, Robi "Maintaining Mechanical Ventilation" Skill 7-16 Delmar's Fundamental & Advanced Nursing Skills 2nd ed. (2004).

Weber, E K., Eppich, W J, Chlebanowski, L, Adler, M. "Responding to Biological and Radiological Events: Pediatric Simulation Using the Strategic National Stockpile (SNS) Ventilators for Resuscitation." Prehospital and Disaster Medicine 22, 2 (2007): s94.

Wilgis, John. "Strategies for Providing Mechanical Ventilation in a Mass Casualty Incident: Distribution versus Stockpiling." Respiratory Care 53 (2008): 96-103.