Scope: Respiratory Care Department, Physicians, Advanced Nurse Practitioners (APRN), Physician Assistants (PA)

Population: Patients receiving rescue or non-rescue non-invasive positive pressure ventilation.

Outcome:

1. Avoid need for mechanical ventilation and associated risks for patients in acute respiratory failure or hypoxemic respiratory failure
2. Facilitate weaning and extubation
3. Reduce work of breathing while giving time for medications to work in acute cardiogenic pulmonary edema
4. Relieve sleep apnea

Definitions:

- Non-invasive positive pressure ventilation (NPPV): ventilation without an artificial airway. May be used as CPAP or bi-level PAP.
- Continuous positive airway pressure (CPAP): Positive airway pressure during spontaneous breaths. No mechanical breaths.
- Bi-level positive airway pressure (BiPAP): provides two pressure levels, IPAP and EPAP. CPAP is active when IPAP = EPAP.
- Inspiratory positive airway pressure (IPAP): controls the peak inspiratory pressure during inspiration
- Expiratory positive airway pressure (EPAP): controls the end expiratory pressure. Used as CPAP when IPAP = EPAP. Used as PEEP when IPAP > EPAP.
- Positive end expiratory pressure (PEEP): pressure maintained at the end of exhalation

Content:

I. Initiation
   A. Adult patients should be on the NPPV Protocol with a physician's order
      1. An order for non-invasive ventilation per protocol should be placed into the electronic health record (EHR) by a physician or APRN/PA.

      2. Initial parameters and subsequent parameter changes made based on the NPPV protocol should be documented on the Respiratory Care ICU Flow Sheet or Respiratory Care Record.

      3. Physician/APRN/PA NPPV parameter orders and physician/APRN/PA orders not covered by the protocols should be entered into the electronic health record (EHR) by the Physician/APRN/PA.

   B. The physician/APRN/PA may enter an order to "discontinue NPPV protocol" at any time.

   C. The patient may also meet NPPV exclusion criteria and be managed outside the protocol at the ordering physician's discretion.

II. Inclusion Criteria
   Candidates for NPPV include COPD exacerbation, acute pulmonary edema, congestive heart failure, immunosuppressed patients, and weaning failure (COPD). Other considerations include hypercarbic respiratory failure in neuromuscular disease or chest wall deformity, asthma exacerbation, post-extubation failure, patients with DNR/DNI status, decompensated obstructive sleep apnea and postoperative respiratory failure.

   A. Acute
      1. Moderate to severe dyspnea, accessory muscle use, paradoxical breathing, respiratory rate >25/min

      2. Moderate to severe acidosis and hypercapnea (pH <7.35, $PaCO_2$ >50 mmHg)

      3. Moderate to severe hypoxemia (PaO_2 <60mmHg, PaO_2/FiO_2<200

   B. Non acute
      1. Known or suspected obstructive sleep apnea

2. Palliative care/end of life patients

III. Automatic exclusion from the NPPV protocol includes the following:

A. Patient less than 16 years old
B. A physician/APRN/PA elects to enter NPPV orders outside of protocol or terminate NPPV outside of protocol. All changes in parameters need to be entered by the physician/APRN/PA in such situations.
C. Excessive secretions or inability to clear secretions
D. Altered level of consciousness (e.g. from the use of sedatives and narcotics preventing patient from maintaining their airway)
E. Facial trauma or abnormalities/deformity of the face
F. Intolerance/failure/inability to cooperate
G. Inability to fit mask
H. Intractable anxiety
I. Severe upper GI bleed
J. Unstable cardiac dysrhythmia or hemodynamic instability (BP <90 mmHg)
K. Life threatening refractory hypoxemia
L. Respiratory or cardiac arrest
M. High risk for aspiration
N. Recent upper airway or gastrointestinal surgery
O. Multisystem organ failure
P. Untreated pneumothorax

A physician/APRN/PA may override exclusion criteria by entering NPPV orders outside of protocol.

IV. Interfaces to Consider

Evaluate the patient for the proper type and size mask/headgear to minimize leak, maximize comfort and control costs.

A. Nasal Mask: most common interface. A nasal mask has a soft cushion that surrounds and makes contact with the nasal area. A minor leak is acceptable. Sizes: small, medium, large

B. Facial Mask: soft cushion that surrounds and makes contact with the patient's nasal and oral area. Regurgitation and aspiration are potential problems. Asphyxiation can also occur in the event of ventilator failure or electrical or gas source disconnection. First choice in rescue setting. Sizes: small, medium, large.
   1. Performatrak™ SE Full face mask: select ventilators only (840, LTV, ventilators with active exhalation valves), sizes: medium and large. Has blue elbow- standard elbow with no built in exhalation

2. Total Full Face Mask (FitLife) (Performax EE face mask): provides a seal over the less sensitive area of the face. Alternative for patients who cannot tolerate a nasal or full face mask. Large and small sizes are available. Mask of choice for patients with facial hair, dentures, facial irregularities, skin breakdown or claustrophobia. Cannot be used with a ventilator due to the exhalation elbow.

C. Nasal pillows: resemble nasal masks but are smaller. Two small cushions fit under the nose. Primarily used in CPAP, not as effective if used in the BiPAP mode

V. Devices to Consider for NPPV

Several factors influence the best device for the situation. Factors include the goal of the therapy (oxygenation vs. ventilation or both), patient diagnosis, patient location, rescue vs. non-rescue and limitations of the device.

Device	Rescue vs. Non Rescue	CPAP or BiPAP	Mask Type	Able to use with trach pts	Whisper swivel	Use on the floor?
Whisper Flow	Rescue only	CPAP only		NO	N/A	No
Remstar	Non rescue only	Both	Exhalation elbow	NO	N/A	Yes
KnightStar	Both	Both	Exhalation elbow	Yes	Yes	Yes
Vision	Both	Both	Exhalation elbow	Yes	Yes	Yes, but not preferred
V60	Both	Both	Exhalation elbow	Yes	Yes	No
840 Ventilator	Both	Both	Standard elbow	Yes	No	No
Avea	Both	Both	Standard elbow	Yes	No	No
LTV 1000/1200	Both	Both	Standard elbow	Yes	No	No

VI. Acute NPPV Management

A. Rescue NPPV is limited to the Intensive Care Unit/Step Down and the Emergency Department. Patients moved out of the Emergency

Department should be in a room with external alarm capability and/or close to the main desk for closer monitoring.

B. Patients may initially be rescued in a non-critical care area while awaiting an ICU or Step Down bed. The patient requires 1:1 care by a Respiratory Therapist until the patient is transferred to an ICU/SD.

C. Settings:
   1. Mode: CPAP or BiPAP
   2. IPAP 10-16 (max 25) cmH_2O
   3. EPAP 4-6 (max 10) cmH_2O
   4. FiO_2 titrated to keep SpO_2 >92%

D. Explain the therapy to the patient and provide reassurance.

E. Keep HOB >30 degrees

F. NPPV titration based on patient assessment
   1. Assessment will include evaluation of the patients general appearance, blood pressure, heart rate, breath sounds, SpO_2, ventilating pressures/volumes and when appropriate, ABG values

   2. Allow time for the patient to adjust to the feel of the mask gas flow

   3. Initially start with lower settings and titrate to levels that reduce work of breathing and allow a reduction in FiO_2. This will improve patient tolerance and cooperation.

   4. NPPV titration
      a. To improve ventilation, increase IPAP in increments of 2-3 cmH_2O every 5 minutes until a max of 25 cmH_2O is reached

      b. To improve oxygenation, increase EPAP in increments of 2 cmH_2O until a max of 10 is reached. Keep pressure support ventilation > 5 cmH_2O

      c. To improve oxygenation, increase FiO_2

      d. When increasing EPAP, increase IPAP by same amount of pressure to maintain the same level of pressure support.
   5. Ensure the set pressures are obtained and the patient is comfortable with minimal WOB and/or acceptable leak

6. If the patient is not comfortable, assess for the following:
    a. Work of breathing: titrate settings to improve distress
    b. Optimize tidal volume >6-7mL/kg
    c. Adjust rise time and inspiratory time
    d. Leak: re-adjust mask or change mask size
    e. Consider lower pressures

G. If necessary, obtain an ABG 20-30 minutes after settings have been stabilized (no more than 60 minutes after initiation of NPPV). If ABG values are within normal limits (a decreasing $PaCO_2$ resulting in a pH >7.30), continue to monitor the patient q4 hours.

H. If the ABG values are not within normal limits or show no improvement over pre-NPPV and/or patients clinical condition not improved, titrate settings for patient improvement until maximum settings are reached.

I. If max settings are reached with no improvement, the physician must be contacted for further orders i.e. intubation

J. Document final resting settings within 20 minutes of initial application

K. A complete assessment performed every 30minutes x2 then every 4 hours and as needed. Document assessments on the Respiratory Care ICU/SD flow sheet or Respiratory Care Flow sheet if patient is outside of the ICU. Add the proper device parameter.

L. The physician is to be contacted at any time if the assessments reveal a worsening patient condition despite NPPV. Clinical conditions requiring MD notification:

    1. IPAP > 25 cmH2O
    2. EPAP > 10 cmH2O
    3. RR > 30 bpm
    4. SpO2 < 92%
    5. Worsening ABG
    6. Hemodynamic instability

M. The efficacy of NPPV is often made in the first hour or two of therapy. If there is no physiologic improvement, intubation and mechanical ventilation should be considered.

VII. Acute NPPV/CPAP management via the Whisper Flow of patient in CHF/Pulm Edema

A. CPAP 5cm, 7.5cm or 10 cmH_2O

B. FiO_2 titrated to keep SpO_2 >92%

C. Caution is advised in patients with hemodynamic instability or active, ongoing myocardial ischemia

D. In patients with concurrent respiratory acidosis, BiPAP would be preferred therapy

VIII. Comfort Measures Only (CMO)

Patients with CMO or do not resuscitate/intubate (DNR/I) orders on non-invasive ventilation can be admitted or transferred to a non-monitored bed without pulmonologist approval.

IX. Weaning NPPV

Reversal or sufficient resolution of underlying cause of respiratory failure is the most important factor in complete liberation from noninvasive ventilation. With a rapidly reversible problem (i.e. cardiogenic pulmonary edema and atelectasis due to hypoventilation), simple discontinuation of NPPV is generally all that is required.

For other causes of respiratory insufficiency, periodic breaks from noninvasive ventilation should begin once the FiO_2 has been decreased to 35-40%, IPAP $\leq$18 cmH_2O, EPAP $\leq$12 cmH_2O and patient is able to sustain effective spontaneous ventilation.

These periods off NPPV allow for expectoration and/or intake of oral nutrition, fluids, improved airway humidification and provide time for reperfusion of mask to skin pressure points. The number and duration of breaks should gradually increase until the patient is able to maintain adequate oxygenation and ventilation with their normal work of breathing.

A. Clinically stable
   1. RR <24
   2. HR <110
   3. Compensated pH > 7.35
   4. SpO_2 > 90% on <50% or 5 LPM

B. Trial off NPPV
   1. Remove mask and put on same oxygen level OR
   2. Slowly titrate IPAP or PSV in 2 cmH_2O increments

X. NPPV Discontinuance

A. Place patient on oxygen therapy

B. Monitor SpO_2 and work of breathing

C. NPPV ventilators may be removed from the patient's room 24 hours after the last use or sooner if the patient's condition has improved significantly and further need for NPPV is unlikely.

D. NPPV may be reinstituted without an additional physician's order within 24 hours of being removed from a patient's room, unless otherwise ordered by a physician.

E. Nocturnal NPPV can be discontinued and the equipment removed 3 days of non-use/refusal by the patient.

XI. Non acute NPPV Management

A. Place patient on home settings, if known

B. Patient's with unknown settings will be placed on Auto CPAP or Auto BiPAP

C. Patients may use their own NPPV equipment. The device must have a current Biomedical Engineering sticker. Call Biomed at x52670 or page 1200.

D. Post op patients with NPPV orders will use the CPAP/BiPAP with any recumbence and any sleep for the first 24hrs. After 24hrs, may resume wearing with sleep only.

E. Settings

1. CPAP, BiPAP or Auto
2. IPAP
3. EPAP
4. FiO2 titrated to keep SpO_2 >92%

XII. Skin Integrity

A. Patients on continuous non-invasive ventilation must have the mask removed for 5-10 minutes every four hours around the clock at which time the skin is inspected for redness or irritation.

B. Any patient anticipated to be on continuous NIV for greater than 10hrs, must have silicone dressing applied.

C. Patients on nocturnal or intermittent non-invasive ventilation do not need to have the mask removed every four hours (6-10 hrs of continuous nocturnal use is acceptable) unless there is evidence of skin irritation/breakdown or patient comfort issues arise.

D. If pressure necrosis appears to be developing, the nurse and physician must be notified and the physician must write an order to continue therapy in light of this relative contraindication.

E. If pressure redness or irritation develops, apply silicone dressing to the bridge of the nose.

XIII. Tracheostomy Patients

A bi-level ventilatory device may be used on a patient with a tracheostomy by placing a WHISPER SWIVEL adaptor between the circuit and the tracheostomy. The use of a bi-level device and whisper swivel on a tracheostomy patient requires the order to be written by pulmonologist, except under emergent circumstances when an Emergency Physician, Anesthesiologist, or Intensivist may order.

Cross reference: Clinical Practice Guideline “Noninvasive positive pressure ventilation (BiPAP)/continuous positive pressure ventilation (CPAP)”, Patient Home CPAP/BiPAP Equipment Policy, NIV Equipment Procedure at the Institute of Living

Key Word Search: Non-invasive ventilation, NIV, NPPV, CPAP, BiPAP, ventilation, Whisper Flow, Remstar, Knight Star, Vision, 840, Avea, LTV 1000, LTV 1200