Non-invasive Ventilation (NIV)

- Evidence is heterogeneous
- Works well in patients with reversible conditions and acts as a bridge while allowing medical therapy to take effect
- Close monitoring and F/U is crucial
- Need to be prepared to proceed to "plan B" if patient deteriorates.

NIV definitions

- Continuous Positive Airway Pressure (CPAP) = Expiratory Positive Airway Pressure (EPAP) = Positive End Expiratory Pressure (PEEP)
- Bi-level Positive Airway Pressure (BIPAP) = EPAP + Inspiratory Positive Airway Pressure (IPAP)
- IPAP - EPAP = pressure support
- NIV = NPPV

Advantages of NIV

- Avoids complications associated with invasive mechanical ventilation (airway and lung trauma, nosocomial pneumonia).
- Decreases work of breathing
- Improves oxygenation and alveolar ventilation
- Preserves airway defenses
- Decreases need for intubation
- Shortens hospital stay
- May decrease mortality

Disadvantages of NIV

- Gastric distension
- Facial pain
- Nose dryness
- Eye irritation
- Patient discomfort/ claustrophobia

Indications for NIV
Keenan et al. CMAJ 2011: 183 (3) E195 – 214

- Severe exacerbation of COPD (grade 1A)
- Cardiogenic pulmonary edema in the absence of shock or ACS requiring urgent PCI (grade 1 A).
- Immunosuppressed patients who have acute respiratory failure (grade 2 B)
- Asthma
- Weaning
- DNI
- RSI /PS

Contraindications of NIV

- Cardiorespiratory arrest
- Severe UGI bleeding

- Hemodynamic instability
- Facial trauma/deformity
- Upper airway obstruction
- Patient unable to cooperate
- High risk for aspiration

Factors contributing to success of NIV

- Careful patient selection
- Properly timed intervention
- Comfortable, well fitting interface
- Coaching and encouragement
- Careful monitoring

Equipment needed for NIV

- A microprocessor controlled blower regulates gas flow into the patient's circuit to maintain the pre-set pressure.
- An intentional leak port allows patient exhalation.
- All devices need a power source and have limited portability.
- High gas flow needs to match peak inspiratory flow.
- There are many designs of masks. Nasal masks are used in sleep apnoea but in acute care, full-face and helmet masks are often used.
- Some newer NIV devices can actually be used as ventilators.

Initial Settings

- Start low to maximize patient compliance and comfort, then increase to alleviate respiratory distress.
- IPAP 10 - 12 cm H2O (20 cm H20)
- EPAP 4 - 5 cm H2O (10 – 12 cm H2O)
- Maintain gradient of > 5 cm H2O
- Leaks, increased mask pressure with higher IPAP/EPAPs.

Physiology of NIV

- NIV has numerous physiological benefits in the patient with respiratory failure:
  - Augmentation of alveolar ventilation reversing hyper-carbia.
  - Alveolar recruitment via PEEP (reduces intrapulmonary shunt)
  - Increased FiO2
  - Reduction in the work of breathing
  - Stabilisation of the chest wall in the presence of trauma
  - Reduction of LV afterload and preload that may improve cardiac function
  - Overcomes intrinsic PEEP

Complications of NIV

- Appropriately trained medical and nursing staff need to be involved.
- Patients need to be nursed in a 1:1 ratio ideally as in some respects they require more care than those invasively ventilated.
- The fitting of the mask is very important as pressure areas can develop.
- Can cause raised intraocular and raised intracranial pressure.

- Can also result in hypotension (increased intra-thoracic pressure results in decreased venous return).

Monitor for:

- Patient tolerance of NIV
- Increase in secretions
- Mental status change
- Synchronous breathing with the ventilator
- Air leaks
- Respiratory rate
- Tidal volume changes in relation to respiratory rate

NIV and Cardiogenic Pulmonary Oedema

- This is a common cause of potentially reversible respiratory failure.
- Increased lung water causes an increase in elastic and resistive workload.
- Over 20 prospective RCTs have demonstrated the effectiveness of NIV in APO. There is a reduction in all endpoints (intubation, mortality, length of stay).
- CPAP alone is generally sufficient. Adding pressure support has not been shown to be associated with any advantage and has been shown to increase the rate of AMI (although there are doubts about this).
- Improves preload and afterload.

NIV and COPD

- This is probably the most common use of NIV in the ED.
- Parenchymal lung disease causes airway resistance (mucosal oedema, bronchospasm, loss of elastic support of small airways) and reduced elastic recoil (decreases expiratory airflow).
- Thus there is an increase in the work of breathing and PEEPi
- In some patients acute exacerbations may be reversible.
- At least 14 RCTs support the use of NIV in hyper-carbic exacerbations of COPD (ie in those with an acute respiratory acidosis).
- The NNT to avoid intubation or death is about 5 and 10 respectively.
- The reduced rate of mortality may also be explained by avoiding invasive ventilation (via avoiding the risk of ventilator associated pneumonia).
- No particular mode has shown to be better but in those with hyper-carbia, some inspiratory support should be added.
- Early prediction of success is with improvement in the pH and CO2 and a response early in treatment (first 2-4 hours).
- A severe acidosis (pH < 7.25) is associated with NIV failure.
- Late failure (i.e. after an initial improvement) can occur (and carries a high mortality rate).
- NIV in these patients needs to part of well developed management plan.
- This treatment should be started early and will 'buy time' to make treatment decisions.

NIV and asthma

- There is a paucity of data supporting the use of NIV in asthma.

- It does however make physiological sense (reduces work of breathing and overcomes PEEPi).
- It would be reasonable to consider trialing NIV in a patient who fails to respond to bronchodilator therapy.
- Nebulised salbutamol can be delivered with appropriate circuits.

NIV and ARDS

- There is little evidence for the use of NIV in these patients and its use is associated with a high failure rate.
- NIV has also been disappointing in those with type 1 respiratory failure due to community acquired pneumonia.
- It does have a role in those who also have a component of COPD.
- It is also very likely to be a better treatment than mechanical ventilation in those are significantly immunocompromised.

NIV in chest trauma

- Chest trauma is a significant risk factor for respiratory failure (dependent atelectasis, impaired chest wall mechanics, poor cough etc.)
- Mask CPAP consistently improves physiological parameters in cardiothoracic surgical patients. It also reduces the need for intubation/ re- intubation.
- It has also been shown to be superior to mechanical ventilation in those with severe chest trauma.

Tips on the use of NIV

- Use this early in managing patients where it may be indicated (the harms and contraindications are minimal) as it can easily be withdrawn.
- Always have a plan if the patient does not respond to NIV (i.e. palliate or intubate).
- Explain to the patient what is happening and how important it is that they try to tolerate the mask.
- Most patients in whom this will assist their work of breathing can tolerate the mask for long periods of time.
- Pre-empt the development of pressure areas due the mask.
- Start with low pressures and increase as tolerated.
- Avoid high inspiratory pressures (>24 mmHg).
- Ensure that the patient is nursed in a one to one fashion.
- Try to avoid sedatives but the use of a small amount of morphine or ketamine is reasonable.
- Have an ‘end-point’ for treatment and repeat blood gases.
- During weaning, allow the patient to have short breaks off NIV.
- Consider the need for invasive ventilation if the patient needs to be transported.