Optimizing Your NIV Program

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Disclosures

- Research Grants
  - Respironics/Philips
  - Breathe Technologies
Early Experience with NIV: Rhode Island Hospital late ’80s

- PB 7200 with face mask – 6 consecutive failures
- Moratorium declared
- Support from Resp Therapy Director, for Research on NIV
- Therapists, pulm fellows buy-in
NPPV Technique; 7200 Ventilator with Full Face Mask
Lessons from early experience

- Resistance - need evidence to drive change
- Buyin benefits from support from the top, favorable experience
- Need for “Champions”
- Research generates enthusiasm
- Team undertaking – Docs, Therapists, Nurses all play important roles
New Technology: Adopter Behavior

Innovators 2.5%
Early Adopters 13.5%
Early Majority 34%
Late Majority 34%
Laggards 16%

Time to Adoption (SDs From Mean)

French ICU NIV Utilization

Carlucci et al, AJRCCM, 2001; Demoule et al, ICM, ‘06
Distribution of Utilization Rates

Maheshwari et al, Chest 2006
Distribution of Utilization Rates

% of utilization of NIV in ARF vs invasive ventilation

Maheshwari et al, Chest 2006
Use of NIV according to Diagnosis

Maheshwari et al, Chest 2006
Use of NIV according to Diagnosis

Maheshwari et al, Chest 2006
Reasons for Low Utilization

Maheshwari et al, Chest 2006
Study to Enhance Utilization of NIV

Rationale/Hypothesis

- An intensive in-servicing/educational intervention will enhance appropriate use (COPD, CHF) at low utilizing centers

Methods

- Block Design at 8 centers randomized to intervention or control
Overall Approach (cont)

- **Intervention**
  - Intensive in-servicing of physicians (ED & ICU), therapists, nurses for administration of NPPV according to guideline.

- **Track utilization on-site for several months before and after intervention or control period**
Interventions

- Physicians: Champion identified. Ppt presentation, Grand rounds, conferences to ED, ICU, video tape, order sheet
- Therapists: Champions identified. Hands-on In-servicing by therapist at each shift, laminated guidelines, PDA uploadable
- Nurses: Ppt In-servicing to ED, ICU, select wards, instructions on monitoring
Overall Approach (cont)

- Guidelines based on:
  - Published guidelines (Chest, 2003), but modified
  - Literature review
  - Selection criteria with recommendations on settings, monitoring and criteria for failure
Application of Noninvasive Ventilation For Acute Respiratory Failure

**Patient Selection**

**Moderate to Severe Respiratory Distress in Patient Breathing Spontaneously**
- Any of the Following (Moderate to Severe):
  - Dyspnea
  - Accessory Muscle Use
  - Paradoxical Breathing
  - RR > 24 (hypercapnic)
  - RR > 30 (hypoxemic)

**Gas Exchange Criteria**
(Do not await ABG results in severely dyspneic patient)
- Hypercapnic Respiratory Failure/COPD
  - pH < 7.35
  - PaCO₂ > 45 mm Hg
- Hypoxemic Respiratory Failure
  - PaO₂/FiO₂ < 300
  - If SAPS II ≥ 34 OR P/F < 100 — Consider Intubation

**No Contraindications such as:**
- Cardiac/Respiratory Arrest
- Medically Unstable (Hypotensive Shock, Uncontrolled Cardiac Ischemia or Arrhythmias)
- Unable to Protect Airway (Impaired Cough or Swallowing)
- Excessive Secretions
- Facial Surgery, Trauma, Burns, or Deformity preventing Mask Fit
- Severe UGI bleeding
- Agitated or Uncooperative
- Unable to Fit Mask
- Undrained Pneumothorax

**Choose Alternative Therapy**

**Choose Ventilator**
- Bilevel Ventilator
- Critical Care Ventilator in PSV mode

**Choose Proper Location**
- Transfer Patient to ICU or Step down Unit, while acutely ill

**Consider Adjuncts**
- Humidification if > 2-3 hrs.
- Insert Nasogastric Tube Only if High Risk of Aspiration

**Initial Settings**
- In S/T Mode, Set IPAP/EPAP = 8-12/4-5.
- In PSV Mode, Set PSV/PEEP = 4-8/4-5.
- Set Rate = 12 (If Rate Can Be Set on Ventilator)

**Choose and Fit Appropriate Interface**
- Full Face Mask (1st Choice for Initiation)
- Nasal Mask (If Full Face Mask Not Tolerated)
- Total Face Mask
- Other

**Chooses Alternative Therapy**

**Application of Noninvasive Ventilation For Acute Respiratory Failure**

**Patient Selection**

**Favorable Diagnosis**
- STRONG EVIDENCE
  - COPD Exacerbation
  - Acute Pulmonary Edema/CHF
  - Immunocompromised Patients
  - Facilitate Weaning—COPD

**INTERMEDIATE EVIDENCE**
- Asthma
- Community-Acquired Pneumonia in COPD Patients
- COPD & CHF Patients with DNR/DNI Status
- Post-Operative Respiratory Failure (Lung Resection, Bariatric, CABG)
- ARDS--Single-Organ Involvement
- Community-Acquired Pneumonia—Non-COPD Patients
- Cystic Fibrosis
- Neuromuscular Disease/Scoliosis
- OSA/Obesity Hypoventilation
- Upper Airway Obstruction

**WEAKER EVIDENCE (Caution)**
- End-Stage Pulmonary Fibrosis
- Severe ARDS--Multi-organ Failure
- Upper Airway Obstruction

**NOT RECOMMENDED**
- End-Stage Pulmonary Fibrosis
- Severe ARDS--Multi-organ Failure
- Upper Airway Obstruction

**Upper Airway or Esophageal Surgery**

Continues on Next Page
ADJUST IPAP OR PSV IF PERSISTENT RR > 24 OR ELEVATION OF PaCO₂ OR RESPIRATORY DISTRESS OR EXCESSIVE USE OF NECK MUSCLES
• Increase IPAP by 2-3 cm H₂O q5-10 mins as tolerated.
• If intolerant, check for air leaking and/or poor mask fit.
• If patient is still intolerant of increased pressure, consider lowering inspiratory pressure.

ADJUST EPAP or PEEP (and IPAP or PSV)
If:
• Inadequate oxygenation
• Significant Auto-PEEP
Then:
• Increase EPAP by 1-2 cm H₂O q5 min watching FIO₂/effort.
• Titrate FIO₂ or Oxygen Flow to maintain O₂ Sats > 90%.
• May lower EPAP if intolerant but not < 4 cm H₂O

* Note: When Increasing EPAP, Increase IPAP by Same Amount to Maintain Same Level of Pressure Support.

Questions?
Contact On-Call Pulmonologist or Pulmonary Fellow.

Does Patient Demonstrate Clinical Evidence of Respiratory Distress? (outlined on reverse side)

Restart NPPV at Previous Settings.

Discontinue NPPV Or Consider Long-Term NPPV.

WEANING
• Attempt Trial Off NPPV with O₂ adjusted for sat ≥ 90% and gradually extend weaning periods as tolerated
• Resume Use of NPPV If Initiation Criteria Return
-OR- Slowly Titrate IPAP or PSV Downward by 2-3 cm H₂O

CONTINUE MONITORING
• Repeatedly Reassess Alarm and Ventilator Settings.
• Assess If Patient Meets Weaning Guidelines, Including Clinical Stability, Adequate Response of Underlying Disease, RR < 24, HR < 110 b/m, Compensated pH > 7.35, O₂ Sats > 90% on ≤ 50% FIO₂ or 6 l/m O₂.

MONITORING
• Patient Comfort and Tolerance.
• Vital Signs, Especially Respiratory Rate.
• Neck Muscle Activity.
• Interface Fit and Air Leaking.
• Patient/Ventilator Synchrony.
• Tidal volume (6-7 ml/Kg).
• Continuous Pulse Oximetry.
• ABG at Baseline, after 1-2 Hours and then as needed.

PREDICTORS OF SUCCESS
• Lower SAPSII / APACHE II Score
• Willing and Able to Cooperate
• Good Mask Fit
• RR < 36/Min
• Improvements in Gas Exchange, pH, HR, RR and in First 2 Hours.

Weaning

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Weaning
Overall Approach (cont)

- Major outcome variables:
  - Utilization rate of NIV
  - NPPV success rate
  - Adherence to guidelines; appropriate patient selection, ventilator settings
Use of NIV for COPD
Massachusetts and Rhode Island

% of Vent starts for COPD exacerbations treated with NIV

- 2002: 25.00%
- 2007: 80.00%
Impact of Educational Intervention on NPPV Utilization

Intervention vs Control

* p < 0.05
Practice guidelines as multipurpose tools: A qualitative study of noninvasive ventilation*

Tasnim Sinuff, MD, PhD; Kamyar Kahnamoui, MD, MSc; Deborah J. Cook, MD, MSc; Mita Giacomini, PhD

- Defined clinical responsibilities, improved clinician comfort with technology, increased patient safety, reduced variability
- Barriers included lack of awareness, unclear guideline presentation, reluctance about changing practice
- Guideline did not limit clinical autonomy
- Clinicians used guideline as educational resource, to access monitored beds, to avoid clinical conflict, or to leverage professional credibility

Crit Care Med 2007; 35:776–782
Dealing with Resistance and Unrealistic Expectations

- Outcomes better for some diagnoses (ie COPD/CHF) than others (ie ARDS/PNA)
- NIV fails not infrequently (batting average of .600 to .800 is acceptable)
- Need to know when to start, but also when to stop
- Complications occur but often can be avoided
Optimization of a NIV Program: Resources

- **Equipment**
  - Interfaces of various types and sizes
    - “Mask bag”
  - Ventilators that work well for NIV
    - Bilevel vs “Critical Care” (alarms, FIO₂)

- **Personnel**
  - Time; adequate staffing
  - Retraining, new staff
Respiratory Therapist Time

Kramer et al, AJRCCM 1995;151:1799-1806
### Respiratory Therapist Time

<table>
<thead>
<tr>
<th>Time</th>
<th>NPPV</th>
<th>Control</th>
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<td>112.5 min</td>
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<tr>
<td>140.0 min</td>
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First 8 h

Second 8 h

Kramer et al, AJRCCM 1995;151:1799-1806
Summary: Optimizing Your NIV Program

- Evidence and experience, use Guidelines
- Champions – not only MDs, but also RTs, RNs
- Education: Provide in-service training (local), successful hands-on experience
- Resources: personnel, time and equipment
- Culture of Confidence: improves with time
- Monitor outcomes, reinforce guidelines