Clinical Safety & Effectiveness
Cohort # 16
Implementation of T-Piece Resuscitator (Neopuff) in University Hospital NICU

CENTER FOR PATIENT SAFETY & HEALTH POLICY
UT Health Science Center™
San Antonio
Background

- ~10% neonates require resuscitative efforts at birth

- Positive Pressure Ventilation (PPV) is key to successful resuscitation
  - Positive pressure support should be commenced at 30-60sec
Newborn Resuscitation Algorithm

John Kattwinkel et al. Pediatrics 2010;126:e1400-e1413
Choice of Device for PPV

- Depends on availability of gas supply
- Skills of resuscitator
- Desire to deliver pressures:
  - Peak inspiratory pressures (PIP)
  - Positive end expiratory pressures (PEEP)
Basics of Positive Pressure Support

Ideally, PPV should be given with PEEP

• More rapid acquisition of functional residual capacity
• Improved oxygenation and lung compliance
• Decreased lung injury
Effect of PEEP on Alveolar Volume

Without PEEP

- In the absence of PEEP, airway pressure equals atmospheric pressure at end-expiration.
- Weight of the lung and its elastic recoil compresses the airways and the alveoli, de-recruiting them.
- The elastic recoil of the chest wall pulls the airways and the alveoli open.
- These isolated alveoli do not participate in gas exchange.

With PEEP

- PEEP maintains a pressure in the airway at the end of expiration which counters the elastic recoil of the lung, preventing collapse of these airways.
- The alveoli maintain their communication with the atmosphere and continue to contribute to gas exchange.

Use of Positive Pressure Support

• International guidelines state that PEEP is likely to be beneficial in stabilization of preterm neonates
  – 76% of units use PEEP
Resuscitation Devices

1. Anesthetic Rebreathing Bag
   (Current standard of care at UH)

2. Self-Inflating Bag
   (Standard of care in some NICUs)

3. T-Piece Resuscitator (Neopuff)
   (Proposed standard of care at UH)
T-Piece Resuscitator (Neopuff)

- Intrinsically provides PEEP
- Delivers more accurate and consistent PIP
- Produces more effective tidal exchange than bag-and-mask systems
Does PPV affect subsequent neonatal outcomes?
PPV “Double Edge Sword”

– Too high of pressure
  • Over-distention
  • Increase risk of PTX & PIE
  • Histological injury to lungs

– Too low of pressure
  • Decrease HR
  • Chest compressions
  • Intubation
Recommendation by NRP

- According to the American Academy of Pediatrics / Neonatal Resuscitation Program (NRP) Guidelines
- The T-piece resuscitator should be used during DR neonatal resuscitation
Quality Improvement Cycle
AIM Statement

To implement the use of Neopuff in the delivery room for resuscitation of preterm infants in NICU from 0% to 50% by May 20th, 2015
Project Milestones

- Team Created: January 2015
- AIM statement created: January 2015
- Weekly Team Meetings: Feb 2015
- Background Data, Brainstorm Sessions, Workflow and Fishbone Analyses: Feb 2015
- Interventions Implemented: March 2015
- Data Analysis: March-May 2015
- CS&E Presentation: June 5, 2015
Ishikawa Diagram

People

- Resistance to change
- Varying degrees of hand strength
- Need to educate on NeoPuff use
- High pressure environment
- Resistance to change by controlling Dept
- Space controlled by OB Dept

Physical Plant

Equipment

- Had to purchase NeoPuff
- Current practice is use of anesthesia bag
- Requires training to utilize
- Sterilization issues
- High pressure situation
- Multiple HC teams involved

Environment

Adverse Neonatal Outcomes in Pre-Term Infants <32 wks
PLAN: Intervention

• Met with stakeholders and reviewed the literature about the use Neopuff; clarified the concerns of the providers

• 5 Neopuff machines were ordered by the department of Pediatrics, Neonatology division

• Planned on the use of Neopuff for PPV according to the neonatal resuscitation guidelines
PLAN: Intervention

Education of the health care providers:

• Developed the checklist and protocol for the use of Neopuff
• Respiratory therapist did in-service for all the nurses
  Organized hand on experience on the use of Neopuff for residents, NP’s, fellows and attendings
• Had weekly NICU tours and answered the questions about the use of Neopuff
• Had meeting with OB-team and clarified their concerns
DO: Implementing the Change

Started the use of Neopuff on March 1st, 2015

Encountered problems:

• Missing patient supplies
• Reminders for HCP’s
• Technical issues
• Follow up on overnight admissions
• Monthly meetings / Journal club discussion
CHECK: Results/Impact

• Reviewed all the charts of babies less than 32 weeks gestational age and required PPV in the DR

• Pre intervention group 28 patients

• Post intervention group 11 patients

• Relatively more premature babies in Neopuff group
CHECK: Results/Impact

- Neonatal outcomes:
  - Apgar scores at 1 & 5 mins, DR intubations,
  - RDS, pneumothorax, PIE, mechanical ventilation days in first week, IVH > grade 2, hydrocephalus
- Developed check list for data extraction
- Data were collected from chart reviews over a three month period: Dec, Jan and Feb 2015
Apgar scores at 1 min
Pre and Post Neopuff
Apgar scores at 5 mins
Pre and Post Neopuff

Apgar scores at 5 mins
Date of Birth
Mechanical ventilation days in first week
Pre and Post Neopuff
Neonatal Outcomes in Pre and Post Neopuff

- Hydrocephalus
- IVH > Grade 2
- Pneumothorax
- PIE
- RDS
- Surfactant
- DR Intubation

Comparison between Post and Pre conditions.
Combined Neonatal Outcomes
Pre and Post Neopuff
ACT: Sustaining the Results

- The use of Neopuff was 100% in the DR
- DR use of Neopuff guidelines, will be a part of NICU manual
- In-service will be provided to new employees (residents, NNP’s and fellows during NICU orientation)
- Respiratory therapist structured note will be embedded in the EMR which will help in the data extraction
- Every month the data will be analyzed and discussed in the NICU QI meeting
Return on Investment (ROI)

• In NICU we do “Bundle Billing” on the basis of the severity of illness and not on the basis of individual problems list like Pneumothorax, IVH etc. That is why it is difficult to determine ROI

• It will be interesting to look at the Length of stay (LOS) and will determine the ROI; but most of the babies in post-intervention group are still in-house
Return on Investment (ROI)

• What will be the LOS in babies with hydrocephalus and further neurodevelopmental outcomes?

• Days on mechanical ventilation is associated with Bronchopulmonary Dysplasia (BPD); need to know how many babies develop BPD at the time of discharge?
Conclusion/What’s Next

We observed that in the post-intervention group

• The Apgar scores were improved or not worsened
• Babies stayed on the mechanical ventilator for less number of days
• Less number of babies developed PIE, Pneumothorax, IVH grade 2 and Hydrocephalus
• RDS and intubation rate were higher in those babies; that may be due to being more immature?
The Team

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Sponsor Department: Department of Pediatrics, Neonatology Division
Questions ? Comments....

Thank you!
Anesthetic
Rebreathing Bag

• Delivered pressure and tidal volume depend on how hard bag is squeezed
  – Pressure-limiting valve
  – Manometer

• PEEP delivered by controlling rate of gas escaping from back of bag during expiration
Self-Inflating Bag (SIB)

• Depends on flow of air or O2

• Peak pressure dependent on operator
  – Valve limits maximum pressure delivered
T-Piece Resuscitator (TPR) (Neopuff)

- Requires continuous gas supply to generate set peak pressure and set PEEP

- Two ports attach to TPR
  - One port goes to oxygen (green tubing)
  - One port goes to patient (white tubing)
Literature Evidence

- Compared PPV during DR resuscitation in neonates with Neopuff (40 pts) and self-inflating bag (50 pts)
- The duration of PPV in delivery room was significantly less in Neopuff group (p < 0.001)
- A fewer neonates required DR intubation in Neopuff group (p = 0.04)
- In the Neopuff group, a higher proportion of neonates resuscitated with room air only (p = 0.001)

Literature Evidence

- Studied 31 operators using a Neopuff, a self-inflating bag and a flow-inflating bag during 30 s of ventilation on a neonatal manikin.
- Compared the delivery of consistent PIP of 20 or 40 cm of cm H2 O and a PEEP of 5 cmH2 O.
- The Neopuff delivered the desired pressures more accurately than the two other devices.