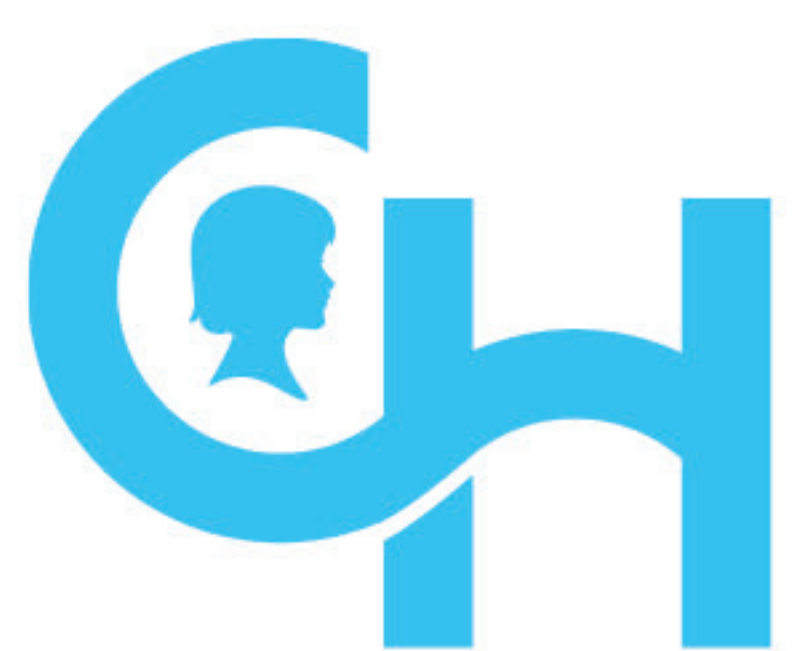




Ventilation Management of Preterm Infants Consensus <32 Weeks in the Delivery Room



**Children's Hospital
of Philadelphia®**

Division of Neonatology

Management of Preterm infants <32 weeks in the Delivery Room

Date: January 12, 2021

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Abstract

Aligned with goals of the division of Newborn Medicine, the CNBC strives to be in the best quartile of all VON key performance metrics, a mission that can be achieved through practice consensus and improvement. Chronic lung disease has been identified as a target outcome, but it has been demonstrated as a particularly challenging measure to improve, given that it's cause is thought to have multiple contributing factors, both pre- and postnatally. The Network has chosen to focus on improvement of delivery room practices for infants <32 weeks as a means to improve long term outcomes, including CLD.

Consensus Goals

- Define practice recommendations:
 - Noninvasive ventilation strategies at delivery for infants <32 weeks
 - goals of optimizing PIP and PEEP
 - starting PEEP
 - starting PIP
 - Oxygen saturation parameters for the first 10 minutes after birth
 - Timing of surfactant administration
- Define equipment recommendations:
 - ECG monitoring
 - T piece resuscitator

Background

Variation in delivery room practices and key performance outcomes across the Network have been identified by evaluating CHOP Newborn Care Network data submitted to the Vermont Oxford Network data repository and data collected during the CNBC Delivery Room Euthermia project. As a Network, combined CNBC data over the past 10 years shows CLD rates between 15-20%, which falls above the bottom (or best) quartile when compared to all VON sites. Quality Index VON CLD Targets reached 26% of the time for better than 50% of VON sites and 12% of the time for better than 75% of VON sites. Our Network and Division goals are to have cumulative Network rates that consistently fall below the bottom quartile for VON.

Variation in practice across Network sites likely contributes to higher cumulative rates of CLD. Practice variation with delivery room ventilation practices for infants <32 weeks has also been identified during quality improvement initiatives evaluating delivery room practices.

Literature Review

Title	Author	Level of Evidence	Primary Outcome	Results	Key Findings/Conclusions
Outcomes of oxygen saturation targeting during DR stabilization of preterm infants	Oei	Level 1	Relationship between SpO ₂ at 5 min, death and intraventricular hemorrhage (IVH) >grade 3 in infants exposed to lower (<0.3) and higher (>0.6) FiO ₂	8RCTs with pooled data showed decreased likelihood of reaching O ₂ sat of 80% if resuscitation was initiated with FiO ₂ <0.3	Decreased cumulative risk of death for infants whose HR>100 and take shorter time to reach oxygen saturations of 80%
HR Monitoring in Babies	Anton	Level 3	Accuracy in methods to detect HR in the NICU and DR	ECG and PO more accurate than palpation and auscultation	HR monitoring by ECG is more precise and acquired more quickly than pulse oximetry
Pilot randomized control trial of EKG for neonatal resuscitation	Katheria	Level 1	Time to clinical intervention with blinded and unblinded available bedside EKG monitoring	Interventions started earlier in unblinded EKG group but no significant difference due to small n	ECG provides more accurate HR and pulse oximetry, allowing earlier intervention
ECG is more reliable than pulse oximetry to detect bradycardia during	Iglesias	Level 1	Number of episodes of bradycardia detected from pulse oximetry and ECG	Pulse oximetry did not detect the start of bradycardia in 69% of cases	Pulse oximetry detects start and recovery of bradycardia less accurately than ECG

stabilization at birth of very preterm infants					
Providing PEEP during neonatal resuscitation : which device is best	Dawson	Level 3	measured PIP and PEEP, leak during simulated resuscitation	T piece and self-inflating bag had least leak; T piece most accurate PIP; T piece with most accurate PEEP	T piece most accurately provided PIP/PEEP, flow inflating bag had most variation
Comparison of devices for newborn ventilation in the DR	Carlo	Level 2	Incidence of HR>100 t 2 minutes of life with t piece resuscitator and self-inflating bag	No difference in achieving HR, less DR intubation with t piece	No difference between T piece resuscitator and self-inflating bag in achieving HR>100 at 2 minutes, but T piece decreased intubation rate and maximum pressures used
Oxygen saturation and heart rate ranges in very preterm infants requiring respiratory support at birth	Schmolze r	Level 4	Difference in HR and oxygen saturations between CPAP or PPV at birth	Infants <28 weeks receiving CPAP reached SpO2 and HR targets faster than infants receiving PPV	Infants <28 weeks who received CPAP achieved targeted SpO2 and HR sooner than PPV
COIN	Morely	Level 1	Rate of death or BPD with intubation and ventilation vs. CPAP at 5 minutes after birth	Lower risk of death and need for oxygen at 28 days with infants receiving CPAP	CPAP group spent less time on mechanical ventilation, surfactant need was almost half, lower requirement of postnatal steroids
SUPPORT	Finer	Level 1	Death or BPD with DR CPAP	Infants receiving CPAP	CPAP is alternative to intubation and

			vs invasive ventilation	required less intubation, mechanical ventilation and postnatal steroids	surfactant in DR management
VON DRM, 3 approaches to initial respiratory management of preterm neonates	Soll	Level 2	Difference in mortality and BPD between PS with MV, PS with rapid extubation or CPAP only	RR BPD or death 0.83 (95% CI 0.52-1.29) for CPAP compared to PS	CPAP group had less need of surfactant, intubation and mechanical ventilation
Cochrane review	Soll	Level 1	Surfactant administration within 1-2 h of birth vs delayed surfactant administration	reduction for mortality, air leak syndrome, IVH, PIE and BPD	Early surfactant leads to decreased of acute pulmonary injury, decreased risk of mortality and CLD

Literature summary

CPAP vs. Intubation/surfactant/ventilation as initial respiratory management in the delivery room – randomized trials

Three randomized clinical trials have compared delivery room CPAP to mandatory intubation and ventilation. In the COIN trial, Morley, et al. studied 610 infants born at 25-28 weeks' gestational age. They found a non-statistically significant trend toward decreased rate of the primary outcome, death or BPD at 36 weeks corrected age, in the CPAP group (33.9% vs. 38.9%, OR 0.80, 95% CI 0.58, 1.12) (Morley, et al., NEJM, 2008). In the SUPPORT trial, the NICHD Neonatal Research Network randomized 1316 infants born at 24-27 6/7 weeks to early CPAP in the delivery room or intubation and surfactant (Finer, et al., NEJM, 2010). Again, the authors found a non-statistically significant trend toward decreased rate of the primary outcome, death or BPD at 36 weeks, in the CPAP group (47.8% vs. 51.0%, RR 0.95, 95% CI 0.85, 1.05). In this study, there were more infants in the CPAP arm alive and extubated at 7 days of life (55.3% vs. 48.8%, $p=0.01$) and fewer infants in the CPAP arm who received steroids for BPD (7.2% vs. 13.2%, $p<0.001$). Finally, a Vermont Oxford Network study randomized 648 infants born at 26-29 6/7 weeks' gestation to intubation/prophylactic surfactant/mandatory ventilation, intubation/prophylactic surfactant/extubation to CPAP, or CPAP alone (Dunn, et al., E-PAS, 2010). They also found a non-statistically significant trend toward decreased of death or BPD at 36 weeks in the CPAP group, when compared to the group who

received mandatory ventilation in the delivery room (30.5% vs. 36.5%, OR 0.83, 95% CI 0.64, 1.09). When the 2358 infants from these studies are combined, there is a highly significant reduction in the odds of death or BPD at 36 weeks corrected age associated with the use of CPAP in the delivery room, odds ratio 0.80 (95% CI 0.68, 0.94).

Per the most recent guidelines from the AAP Committee on the Fetus and Newborn (2014), “the early use of CPAP with subsequent selective surfactant administration in extremely preterm infants results in lower rates of BPD/death when compared with treatment with prophylactic or early surfactant therapy.”

Heart Rate Monitoring in the Delivery Room

Improvement in a ELBW infant’s heart rate is the most reliable indicator of improving ventilation. Bradycardia has been shown to be the most frequent indication for delivery room intubations, with 34% of documented reasons for intubations per Kakkilaya et al (Pediatrics 2019). Two studies in 2015 demonstrated that HR measurement by pulse oximeter relayed lower HR as compared to ECG (Narayan et al, van Vonderen et al).

Intubation and Surfactant Administration

Cochrane’s meta-analysis in 2012 compared outcomes of premature infants who received surfactant within 2 hours of life and those who received delayed surfactant (after 2 hours of life). Evidence showed that early selective surfactant administration given to infants with RDS requiring assisted ventilation leads to a decreased risk of acute/subacute pulmonary injury (air-leak syndrome, pulmonary interstitial emphysema, pulmonary hemorrhage), mortality and chronic lung disease compared to delaying treatment of such infants until they develop worsening RDS.

Previous Consensus Statement or Data from Division of Neonatology

CHOP/HUP 2010, Management of the Extremely Low Birthweight Infant in the Delivery Room

Consensus statement and clinical recommendations

- These recommendations refer specifically to the immediate resuscitation period after delivery, in the first 10 minutes of life
- These recommendations apply to infants <32 weeks
- ECG monitoring as soon after birth as possible is recommended
- T piece resuscitator for initial resuscitation is recommended over other ventilation devices

Oxygen Saturation Targeting:

Follow NRP standards for oxygen saturation targeting goals 7th Ed:

1 minute	60-65%
2 minutes	65-70%
3 minutes	70-75%
4 minutes	75-80%
5 minutes	80-85%
10 minutes	85-95%

1. Pulse oximeter is placed on a preductal location on the right upper extremity, usually wrist or palm, as soon as possible.
2. Oxygen concentration is started at 21-30%. The oxygen concentration should be adjusted to achieve the targeted SpO₂ levels, monitored by the pulse oximeter.
3. If Chest compressions are initiated, oxygen concentration is increased to 100% and weaned rapidly when the heart rate recovers and compressions are no longer needed.
4. Oxygen concentrations are adjusted to maintain saturations that match recommended range for each minute after birth.

Respiratory support:

1. Non-invasive respiratory support is the first line therapy for all spontaneously breathing infants <32 weeks.
2. HR assessment is critical and ECG monitoring is recommended.
3. Immediately initiate CPAP 5cm H₂O and titrate (max 8-10cm H₂O) to reduce work of breathing and O₂ requirement
4. If PPV is required, gentle ventilation is provided with initial PIP 20cm H₂O, with increase to 25-30cm H₂O as needed.
5. Avoid using RAM cannula for initial resuscitation; nasal CPAP or facial CPAP is recommended

Intubation and surfactant administration:

1. Intubation criteria:
 - a. Persistent apnea at 5 minutes of life
 - b. Bradycardia <100 despite optimal CPAP/PPV support
 - c. Note: FiO₂ requirement in the DR/OR should NOT be a primary indicator for intubation/surfactant administration

2. Check ET tube placement with auscultation, colorimetric CO₂ detector, and/or chest x-ray
3. Surfactant administration per institutional guidelines/practices
Note: ETT should not be suctioned for 2 hours following surfactant administration unless signs of significant airway obstruction

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