# Implementation and Evaluation of "Golden Hour" Practices in Infants Younger Than 33 Weeks' Gestation

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Upon review of Vermont Oxford Network data, a Midwest level III neonatal intensive care unit noted increased levels of chronic lung disease (CLD) in infants born at less than 33 weeks gestation. Initial analysis of delivery room practices with these infants showed great variance based on each provider's experience and knowledge. In an effort to standardize processes and to reduce the level of CLD within this subpopulation of infants, providers adopted "golden hour" practices focused on providing respiratory support (use of an inspiratory hold, early continuous positive airway pressure, and intubation criteria), oxygen targeting, thermal regulation, and teamwork. Compliance was tracked via delivery room documentation. Although this is an ongoing quality improvement project, examination at 3 and 6 months postpractice shows increasing compliance with the golden-hour practices. Furthermore, after 6 months of using golden-hour practices, there is a decreased incidence of CLD.

**Keywords:** Chronic lung disease; Golden-hour practice; Infant; NICU; Delivery room; CETEP model

Prematurity is a leading cause of infant mortality. The cost of care for infants born prematurely in the United States is more than 26 billion dollars annually.[1] Prematurity is associated with long-term morbidities that include chronic lung disease (CLD), neurodevelopmental impairments (cognitive and motor delays), and visual disturbances. A review of Vermont Oxford Network (VON) data for a Midwest level III neonatal intensive care unit (NICU) revealed increased levels of CLD in very-low-birth-weight (VLBW) infants, defined as birth weight less than 1500 g (Table 1). A quality improvement project was developed to evaluate practices that could potentially reduce the incidence of CLD, to format and implement an educational plan, and to evaluate compliance with the established protocol.

Use of the Clinical Excellence Through Evidence-Based Practice model guided this quality improvement project.[2] In step 1, the clinical practice questions were identified from the VON data. To analyze the problem, an assessment of key components was undertaken (step 2). This assessment included evaluation of patient factors and clinical setting factors including an assessment of key stakeholders who were essential to the project's success. Furthermore, research into the potential causes of CLD and evidence-based practices to reduce its incidence was evaluated. This appraisal process led to the decision to promote "golden hour" stabilization practices and guided the process for protocol development, implementation, and evaluation.

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1527-3369/1202-0461$36.00/0
doi:10.1053/j.nainr.2012.03.008

## Assessment of the Problem and Key Components

In the search for better performance, golden-hour practices, the standardization of infant care practices during the first hour of life, were identified as a potential means for the reduction of CLD. The golden-hour practices focus on minimizing stress in infants at birth and during the first hour of life.[3] Consistencies in delivery room stabilization practices have been shown to improve patient outcomes.[4-6] Neonatologists and neonatal nurse practitioners (NNPs) are the lead providers of delivery room stabilization in this hospital. Inquiry into provider practices with VLBW infants showed great variance based on each provider's experience and knowledge. Nurses in the NICU (registered nurses) who attended deliveries with the providers voiced frustrations about the variations in the delivery room management practices.

No protocol for the golden-hour practice could be located despite an extensive literature review; however, key components of respiratory management, oxygen targeting, thermal regulation, and teamwork were identified. These items became the focus of developing the golden-hour practice protocol used for this project.

### Respiratory Management

Neonatal lung function changes immediately upon delivery to the extrauterine environment. The VLBW infant is impaired in this transition because of the immature structure of the chest wall and lungs. Delivery room care practices are contributing factors to long-term infant development and influence the

**Table 1. The VON Data for Infants Born Less Than or Equal to 33 Weeks' Gestation at This Midwest Level III NICU**

| | 2008 | 2009 | 2010 |
|---|---|---|---|
| CPAP before intubation | 34.0% | 27.5% | 36.2% |
| Delivery room oxygen administration | 94.6% | 93.1% | 79.2% |
| Delivery room surfactant administration | 32.1% | 41.4% | 25.0% |
| Delivery room endotracheal ventilation | 53.6% | 64.0% | 40.3% |
| Admission temperature within euthermic range | 10.9% | 39.7% | 31.9% |
| Incidence of CLD | 52.5% | 31.9% | 31.1% |

incidence of CLD.[7-12] Lung tissue function can be altered within the first few breaths based on delivery room management.[13-15] Surfactant, a protein substance that helps sustain compliance of the lungs and is crucial in maintaining airway integrity, is readily depleted in the VLBW infant. Therefore, respiratory support methods are needed.

Lung injury can occur due to atelectrauma, volutrauma, barotrauma, and biotrauma,[16-20] and respiratory management varies with each type of injury. Atelectrauma is caused by mechanical shear stress to the lung tissue when the alveoli sacs are recruited but then collapse during the breathing cycle. Methods to reduce atelectrauma include recruitment maneuvers (inspiratory hold and positive end-expiratory pressure), optimizing the functional residual capacity (FRC) of the lung, and high-frequency mechanical ventilation.[17,20,21] Volutrauma is excessive stretching of the lung tissue caused by aggressive positive pressure ventilation, whereas barotrauma is the combination of fluid overload, high ventilation pressures, and pulmonary air leak.[17,21,22] Both of these types of injury can be reduced by avoiding high airway pressures and large lung volumes. Ventilatory methods that reduce volutrauma and barotrauma include opening the lungs with an inspiratory hold, providing continuous positive airway pressure (CPAP), maintaining low tidal volumes, and maintaining inspiratory pressures that adequately inflate the lungs without overdistension but assist in the evacuation of lung fluid. These methods will optimize FRC and will reduce atelectrauma, volutrauma, and barotrauma.[17,19,23] Biotrauma is the release of free radicals and cytokines that alter the interstitial tissue of the lung, thereby altering lung function.[16,24] Reduction of biotrauma can be achieved by any method that reduces the inflammatory markers, cytokines, and free radicals that alter lung function and includes the reduction of oxygen exposure.

Multiple research studies and clinical trials have been conducted to evaluate the optimal respiratory support for VLBW infants in the delivery room to reduce CLD without causing other long-term sequelae.[8,25-32] A review of the findings of these trials indicates the benefits of CPAP initiation shortly after birth because it stabilizes lung inflation at the end of expiration and allows the next breath to further recruit lung volume and improve gas exchange. Respiratory management strategies such as the use of an inspiratory hold (recruitment maneuver) and early surfactant administration help reduce the incidence of CLD. Snyder et al[20] found that infants born at the lowest gestation age of viability are at increased risk for respiratory failure. These infants benefit from the InSurE (*in*tubation-*sur*factant-*ex*tubation) method.[8,33-35]

## Oxygen Targeting

Oxygen has been one of the most readily available and most liberally used medicines in the neonatal field.[36-37] The propensity of premature infants to oxidative stress damage from oxygen exposure is higher because of the reduced antioxidant defenses, more free radical ions, and the higher risk of exposure to high oxygen concentrations.[17,38-40] In utero, the arterial oxygen pressure of the fetus is 22 to 24 mm Hg.[41] Fetal development of the eyes and brain is affected by oxygen-regulated vascular endothelial growth factor and non–oxygen-regulated insulinlike growth. After delivery, administration of supplemental oxygen can set the stage for vaso-obliteration of existing vessels and arrest the vascularization in the eyes, setting the infant at potential risk for retinopathy of prematurity (ROP). There is a speculation that these same factors have similar effects on the developing brain tissue, leading to alterations in cortical vascularization and cellular differentiation. Studies have linked hyperoxia or oxygen toxicity to a variety of negative consequences including ROP, CLD, and long-term neurodevelopmental complications.[40,42-45] Tin and Gupta[40] found that hyperoxia doubled the incidence of periventricular leukomalacia and, subsequently, the development of cerebral palsy in preterm infants.

The normal physiologic process after birth in healthy infants shows that oxygen saturations in the first minutes after birth can be as low as 60% to 70%, and it can take up to 10 minutes for these infants to reach a stable oxygen saturation level.[38,46,47] Dawson et al[48] described the oxygen ranges for newborn infants within the first 10 minutes of life during normal transition. The median amount of time for all infants to reach an oxygen saturation of 90% or greater was 7.9 minutes. Several studies using room air for delivery room resuscitation showed no negative sequelae.[47,49-54] Furthermore, studies have shown inaccuracies with clinical interpretation of color and heart rate when compared with pulse oximetry readings.[11,55,56]

## Thermal Regulation

Thermal regulation is controlled by the hypothalamus. The stimulated hypothalamus activates norepinephrine release that affects pulmonary and peripheral vasculature and stimulates glycolysis. Normally, glycolysis occurs through an aerobic process, but VLBW infants readily convert glycogen to glucose via an anaerobic process when the infant is stressed. Infants who have VLBW are more at risk for heat loss due to their large body surface area, limited development of the epidermal layers of the skin, superficial vasculature, limited brown adipose tissue deposits, poor glycogen stores, high body water content, and poor tone with