An Altitude Adjustment: Implementing a Clinical Practice Guideline for Oxygen in the Newborn Nursery at Moderate Elevation

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Significance of Practice Problem

Recent changes in the pediatric care landscape have nurses and providers caring for term (>37 weeks gestation) and late preterm (>35-37 weeks gestation) infants in the normal newborn nursery asking questions around the topic of oxygen administration following delivery and beyond transition. At birth, all infants undergo many complex physiological changes and most do so with relative ease (Hooper et al., 2019). For some, the transition from life inside the uterus to outside presents more of a challenge. Despite continuing research, prescribing parameters for neonatal oxygen therapy remain ambiguous with persistent provider concerns for patient safety and quality of care.

At approximately 6,200 feet elevation, the nurseries at one community-based institution are divided over two campuses. Although within the same hospital system, care was different at each of the nurseries. Several gaps in care were identified:

- In practice, the other normal newborn (Level I) nurseries within this 12-hospital regional system transferred all newborns requiring supplemental oxygen to their NICUs, transferring for a higher level of care, passed through a logistical, one-way door without the ability to return to the mother's room if the infant's condition improved.
- Provider practice variability for the critical congenital heart disease (CCHD) screen, treatment for persistent pulmonary hypertension of the newborn (PPHN), and general initiation, weaning and rooming-in parameters when an oxygen need was demonstrated
- Increased work stressors related to identified care gaps reported by nursing staff

PICOT Question and Answer

PICOT question:

For term and late preterm infants requiring oxygen beyond transition, does a clinical practice guideline (CPG) with nursing education and provider practice advice compared to traditional practice without a guideline, provide evidence-based care, support the mother-infant dyad, and impact nursing perceptions related to practice consistency over a six-week pilot period?

PICOT details:

Term and late preterm infants admitted to the newborn nursery at both the Central and North campuses following delivery served as the intervention's target population. All infants that required oxygen following delivery and beyond transition were candidates for the change implementation. Infants who required more than 250 mL (0.25 L/min) of oxygen via low flow nasal cannula (LFNC), positive pressure of any kind, or transferred to the neonatal intensive care unit (NICU) following delivery were excluded. The nurses who cared for these patients also gave input on occupational stress and engagement perceptions.

Implementing an evidence-based CPG for using oxygen in the normal newborn nurseries at moderate altitude was the intervention. The project developed components for oxygen initiation, weaning parameters, CCHD screening on oxygen with echocardiogram recommendations, and maintaining the mother/infant dyad whenever possible. The CPG produced the desired outcomes of consistency for infant care without a missed diagnosis and reduced nursing stress. Following education, patients who received oxygen utilizing the CPG for four weeks were compared to patients who received oxygen using the current practice without a guideline for a randomly selected two-month period before the CPG implementation. The pilot period was shortened to meet university deadlines. An increased patient census, however, produced relatively equal population numbers for reasonable comparison.

PICOT answer:

Yes, sort of! Data collection continued for a full six months after implementation to assure no unintended consequences resulted from practice recommendations.

Themes from the Evidence with Practice Recommendations

The administration of oxygen in the newborn period immediately following delivery has been well-studied (Dilli et al., 2019; Grazel, 2018; Oster et al., 2016; Tekleab et al., 2019). Practice at moderate altitude, specifically 6,200 feet elevation, presents the newly born with less available oxygen than those delivered at sea level. Several studies have assessed the differences and made recommendations for either adjusting the acceptable target saturations or providing a small amount of nasal cannula oxygen to compensate, referred to as the "altitude adjustment" (Guo et al., 2020; Lueth et al., 2016; Paranka et al., 2018). What is not clear from the evidence is which practice is better since there are no directly comparative studies. There is also no clear evidence recommending specific, acceptable amounts of oxygen based on a particular altitude. However, two of the articles did agree that up to 50 mL of LFNC oxygen is equal to room air at sea level (Hoffman et al., 2016; Lueth et al., 2016). Scientific calculations from the cardiology practice associated with the organization where the project occurred also supported this theory.

For infants born at sea level, oxygen administration in the newborn period typically indicates the need for more observation and a higher level of care (Perrone et al., 2017). The American Academy of Pediatrics statement addressing Level I nursery care leaves a large gray area to interpret the "physiologically stable" nomenclature (2012). With altitude as a qualifier, does oxygen administration, less than or equivalent to sea-level, make the infant unstable? If the infant is not demonstrating any other signs of difficulty, such as respiratory distress or an inability to feed, should they be considered stable?

The evidence for CCHD screening as an acceptable, highly specific, and moderately sensitive tool to evaluate newborns for the presence of critical congenital heart disease was well-established, as evidenced by the Cochrane review and meta-analysis noted on the table in Appendix B. Further support of CCHD screening was provided by the application to practice in 2011 by the AAP (2012) and CDC (2018). What was less clear, however, was the impact of altitude on routine CCHD screening. Some studies reported no differences (Dilli et al., 2019; Tekleab et al., 2019). Others described demonstrable differences and provided recommendations for modifications (Hoffman, 2016; Paranka et al., 2018). The variability in the evidence leads to variability in practice and concerns for patient safety and quality of care. Further evidence produced in the search relates to PPHN, another condition unique to the transitioning newborn (Lakshminrusimha et al., 2016). PPHN relies heavily on the amounts of oxygen necessary for lowering pulmonary pressures through vasodilation during the shift from intrauterine to extrauterine life. With the impact of altitude and a lower oxygen environment delaying transition, infants can present with an illness severity spectrum from mild to critical. While oxygen administration remains the gold standard for treating PPHN, elevating care needs with increasing symptom severity is also noted in the literature, and recognizing those needs is essential for favorable infant outcomes (Lakshminrusimha et al., 2016).

Recommendations

The evidence for general oxygen use in the newborn period has evolved in recent years. What has not been as well studied are two issues addressed by this project: altitude and organizational geography. Creating a clinical practice guideline (CPG) was proposed to direct care, facilitate practice consistency, impact outcomes for optimal patient safety, and maintain the mother/infant dyad. Creating a guideline with practice recommendations was intended to reduce variability and to add to the pool of existing evidence for others to apply in practice.

The pilot CPG discussed risk factors commonly associated with an oxygen need following delivery. The CPG then detailed specifics for initiating oxygen, continuous monitoring, and notifying the MD/NP for escalating needs as a shared-practice model. Two areas unique to this project are the CCHD screening with echocardiogram (ECHO) parameters and the ability for an infant on LFNC to remain at the mother's bedside during the inpatient hospital stay after monitoring for safety. An algorithm for easy, bedside reference was also created.

Project Overview

With the organizational mission, vision, and values in mind, this project was created to bring evidence-based practice to the bedside for newborn care. The project mission was to develop a CPG for oxygen use in the newborn nursery. The project's vision had several objectives. First was providing optimal, evidence-based care for term and late preterm infants in the newborn nursery. Next, the impact of altitude on neonatal transition from intrauterine to extrauterine life and supporting this transition while safely minimizing mother and infant separation was addressed. Finally, focusing on nursing concerns for practice variability, a shared practice model guideline engaging both nurses and providers in the care of the newborn was created.

Application of the Iowa Model

Since it is currently in use at the organization where the project took place, the Iowa Model was chosen for this project (Iowa Model Collaborative, 2017).

Identify Triggering Issues, Opportunities: As previously noted, the concept for this project began with the identification of several gaps in practice. An analysis of the strengths, weaknesses, opportunities, and threats (SWOT) of the practice environment was conducted and documented. Nurses and providers identified practice variations and expressed concerns for patient safety during an organizational transition. Nurses further expressed increased work-related stress related to inconsistencies in practice for this population.

State the Question or Purpose, Decide Priority: The question was posed in PICOT format. During a pediatric hospitalist provider retreat, the need to address the gap in practice was identified, and a consensus decision was made to have a workable solution within six months. The unit's nursing management acknowledged the priority for completion.

Form a Team: With interprofessional collaboration in mind, stakeholders were identified. Preliminary meetings with stakeholders during the first two weeks established the direction for the evidence search and current practice. Meetings with nursing management and hospital quality during the first month provided an opportunity for introductions and networking for the project. Existing relationships with providers were exploited throughout the project development phase for discussions and information gathering.

Assemble, Appraise, and Synthesize Body of Evidence, Decide Adoption into Practice: An exhaustive search for evidence was conducted. The literature synthesis and practice recommendations also supported this step for the model. The project was presented at the monthly Women and Infants Service Line (WISL) meeting to inform the appropriate stakeholders about the project. The topic was then referred to the Neonatal Safety and Quality (NSQ) Committee for review and implementation approval. This multidisciplinary group comprises pediatric, neonatal, obstetrical, perinatal, emergency providers, advanced practice nurses, respiratory therapists, nursing, and management representation for each of these areas.

Integrate and Sustain the Practice Change: The project manager requested a peer review of the CPG from the pediatric hospitalist group and nursing management within the unit before implementation. Distributing the nursing educational offering began the implementation phase of the model. Nursing knowledge and perceptions were assessed at two points after the practice change. Final review of the project and results will be brought to the NSQ committee at the conclusion of the project for permanent inclusion in practice approval. The CPG will become part of nursery policy, included in new employee orientation, and incorporated in annual nursing competencies per unit management's request as evidence for sustainability.

Disseminate Results: This project will be submitted to the SOAR and Sigma repositories as part of the USAHS DNP program. This organization is also on the journey toward achieving Magnet® status. The DNP mentor determined that this project may also be included as part of the organization's application process. Lastly, the project will be submitted to the 32nd Rocky Mountain Research and Evidence-Based Symposium. Submission to the Academy of Neonatal Nursing national conferences is also planned.

Project Evaluation and Results

Data analysis continued monthly until the project's completion when CPG ownership, data retrieval, and analysis were surrendered to nursing management.

Measures

This project collected two data sets for analysis: term and late preterm infants requiring oxygen following delivery and the nursing staff caring for these infants. The project manager performed all data collection and analysis. The CPG education and nursing assessments will be included in annual nursing competencies as a measure of sustainability.

Population

In the pre-implementation phase (PrIP) for this project, infants admitted to the nursery and placed on oxygen during two randomly selected months before the project started were analyzed and determined the practice recommendations included in the final CPG. The CPG was implemented as an EBP project and applied to all newborns requiring oxygen following delivery at the post-implementation phase (PoIP) . Infants who did not require oxygen during their initial hospital stay were excluded from the analysis. Infants who transferred to NICU were noted for safety tracking but did not permit full data collection and were excluded from reporting. All nursery and mother-baby nurses employed in August 2020 at the organization participated in the virtual education and knowledge assessments.

Comparative Data

A review of the electronic medical records (EMR) for all term and late preterm infants determined those infants requiring oxygen following delivery. Those born during January and February 2020 established the PrIP. Beginning on the implementation date, infants requiring oxygen following delivery became the PoIP. Interim analyses during the first four weeks of the PoIP were performed weekly to identify any concerning trends for infant safety. Nursing data points were collected and analyzed using SurveyMonkey® software to gather demographic information, assess knowledge acquisition, and engagement perceptions. The pre-educational assessment with questions highlighting the practice recommendations addressed in the CPG was administered two weeks before the nursing educational offering was distributed. The post-educational assessment included the same questions eliminating the demographic information and was distributed four weeks after the nursing education.

Statistical Analysis

The information to determine data points was assembled from project exemplars (Lueth et al., 2016; Paranka et al., 2018) and a statistics course text. A research statistician from the target organization was also consulted for data analysis advice. The PrIP included 659 infants, 39 required oxygen beyond the delivery room. The PoIP included 441 babies, 32 required oxygen beyond the delivery room. Data of collected characteristics were not assessed for significance as they were not included in the PICOT question. Similarly, nursing demographics for gender, age, education, and experience were collected for potential future reporting. Nursing responses included 106 for the pre-implementation assessment and 62 for the first post-implementation assessment. A SurveyMonkey® question was added to the educational offering to track completion of the presentation with 90 responses.

SPSS software was utilized with paired samples t-tests for the questions in the nursing assessments. Results for individual question responses are presented as means with standard deviations (+SD) for significance . Of note, only two questions from the assessment demonstrated statistically significant differences in nursing knowledge.

Discussion & Implications

With its limited population of interest, this project never achieved the definition of statistical significance but did attain several measures of clinical significance.

- With the evidence recommending an ECHO for any oxygen at the time of screen (an indeterminate screen), it was concluded that the CPG should include an ECHO for infants on any LFNC at the time of CCHD screen. The number of infants on LFNC before or at the CCHD screen before and after implementation was relatively equal and created a reasonable comparison for both groups. The PoIP demonstrated an increase in the number of ECHOs performed, 16 compared to four in the PrIP for raw score, appearing to confirm concerns for unnecessary tests. In the PoIP group, two infants demonstrated persistent pulmonary hypertension of the newborn. These two infants were subsequently treated with oxygen and had normal ECHOs for age at discharge. One of these infants was evaluated by a provider who would have obtained an ECHO and one by a provider who would not have obtained an ECHO if the infant had passed the CCHD screen on LFNC. Although no determination if these infants could have passed CCHD on LFNC, an identified limitation for the project, it may be reasonable to predict these infants might have been "missed" if an ECHO had not been obtained. Considering the pathophysiology and potential for decompensation, these infants may have worsened if discharged without treatment or required rehospitalization with enhanced/escalated care, demonstrating more clinical significance for the project pathway.
- With nursing empowerment as an outcome for this project, the data appeared to show statistical significance. What may be more critical, however, is the high rate of empowerment expressed by nurses *before* this EBP project asked the question. Nurses in practice at this organization felt enabled to give input, with management support, in the care they provide, a hallmark for Magnet® designation (American Nurses Credentialing Center, 2020). The project also established a channel for nurses to bring future concerns forward in an atmosphere of collegial practice to provide the best evidence-based care for optimal patient outcomes. Although the participant numbers are too small to show true statistical significance, the clinical practice value cannot be ignored (Raganathan et al. 2015). Lean principles include many examples of improved patient outcomes directly associated with employee engagement (Graban, 2016). Patients benefit when the staff providing their care are engaged.

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