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EVALUTION OF A QUALITY IMPROVEMENT INITIATIVE TO UTILIZE GLUCOSE GEL FOR THE MANAGEMENT OF NEONATAL HYPOGLYCEMIA

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EVALUATION OF A QUALITY IMPROVEMENT INITIATIVE TO UTILIZE GLUCOSE GEL FOR THE MANAGEMENT OF NEONATAL HYPOGLYCEMIA

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An Abstract of the Scholarly Project by
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The purpose of this retrospective project is to assess the effectiveness of a completed quality improvement project via chart review. The project utilized glucose gel as a first line therapy for the management neonatal hypoglycemia in at-risk infants. Neonatal hypoglycemia is the most common metabolic abnormality and is associated with many undesirable side effects. Current treatment methods such as formula feeding and IV therapy are costly, invasive, and disruptive to family bonding. This study consisted of a retrospective chart review of a pre-glucose gel group, six months prior to the introduction of glucose gel, as well as a post-glucose gel group, fifteen months after introduction of glucose gel. A survey tool was utilized during chart reviews of the pre and post groups to determine if an infant was considered "at-risk" (small for gestational age, large for gestational age, infants born prior to 37 weeks gestation, and infants born to diabetic mothers), to which "at-risk" category the patient belonged to, if glucose gel was utilized, if an IV start was necessary, and if the IV was started for management of hypoglycemia. The data collected was assessed using descriptive statistics to determine if the intervention of glucose gel decreased rates of infant IV therapy in the post group as compared to the pre group. If data analysis supports the use of glucose gel for treatment of neonatal hypoglycemia this would suggest the need for practice change to include glucose gel as a viable treatment method for neonatal hypoglycemia.

TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

LIST OF FIGURES

FIGURE PAGE

Chapter I

Introduction

Hypoglycemia is a state of low blood glucose in the body which can be attributed to many disease processes (Mayo, 2018). Hypoglycemia is the most frequent metabolic abnormality in the newborn (Lang, 2014) and is increasingly more common, affecting one in every three live births in the United States (MedlinePlus, 2019). Glucose is crucial to the daily function of adults and newborns, serving as the primary source of energy for every cell in the body. While still in the womb infants receive glucose from the placenta and umbilical cord, however, following birth, the infant must transition to the use breast milk or formula as the primary source of glucose (Paediatrics Child Health, 2004). When glucose levels cannot be maintained, infants may experience many undesirable side effects that without prompt treatment may lead to neurodevelopmental disturbances.

Varying definitions exist to define an exact glucose level which constitutes hypoglycemia of the newborn. There is much deliberation regarding what glucose value too low, and at which point treatment should occur to protect the neurologic health of the newborn. The American Academy of Pediatrics (AAP) defines neonatal hypoglycemia in a term neonate as "A blood glucose value of less than (<35 mg/dL) or as a plasma glucose value of less than (<40 mg/dL)" (Thompson-Branch & Havranek, 2017, p. 147). Treatment of neonatal hypoglycemia is pertinent to avoid adverse neurological effects.

Neonatal hypoglycemia is further broken down into two separate classifications. According to Dysart (2018), Neonatal hypoglycemia can be classified as transient, lasting twenty-four to forty-eight hours following birth, or persistent, lasting greater than forty-eight hours. Transient hypoglycemia in the neonate may be caused by "inadequate glycogen, transient hyper-insulinemia, and immature enzyme function leading to deficient glycogen stores" (Dysart, 2018). In the same study it was also noted that persistent hypoglycemia was caused by "hyperinsulinism, defective or ineffective production and secretion of counter-regulatory hormones such as growth hormones, catecholamines, glucagon, and corticosteroids, and inherited disorders of the metabolism" (Dysart, 2018, paras. 4-5). Treatment will vary depending on the type of hypoglycemia the infant is experiencing and the causative factor.

Clinical Issue

Low levels of blood glucose caused by hypoglycemia can lead to shakiness, hypothermia, poor muscle tone, lethargy, apnea, poor feedings, and cyanosis (Stanford children's health, 2019). Research performed by Karla et al., (2017) highlighted increasingly severe effects such as long-term neurological delays, impaired cardiac function, seizures, comma, and sudden death. The consequences associated with hypoglycemia provide evidence for the necessity of quick and effective treatment to correct the underlying cause.

Routine screened is not recommended in full term infants without any risk factor's present (Stanford Medicine, n.d.). Specific subgroups have an increased risk for experiencing neonatal hypoglycemia based on a combination of weight, gestational age and maternal health during pregnancy and therefore should be screened following birth.

The subgroups at-risk include infants who are small for gestational age, infants who are large for gestational age, premature infants (<37 weeks), infants of diabetic mothers, and infants who experience perinatal asphyxia (Dysart, 2018). Screening for glucose levels after delivery depend on associated risk factors and facility policy but typically occur no later than two hours following birth (Paediatric Child Health, 2004).

Research by Stomnaroska-Damcevski, Petkovska, Jancevska, & Danilovski (2015), reported "transient low blood glucose concentrations are frequently encountered in the majority of healthy newborns and are the reflections of normal metabolic adaptation processes" (Stromnaroska-Damcevski et al., 2015, p. 93). Although a periodic low glucose in the first forty-eight hours is expected, the primary treatment methods can be invasive and disruptive to the mother and newborn. The threshold for treatment varies based on facility and protocol. After an at-risk infant has been screened for hypoglycemia and fallen below treatment thresholds, the options for treatment are limited. The current treatment modalities for infants with low blood sugar include supplementation of feedings via additional breast milk or the introduction of formula, as well as intravenous (IV) administration of a dextrose solution (Medline Plus, 2017).

Due to the invasive nature, IV therapy is associated with many complications. When initiating IV therapy, the accommodation of the infant elevates, increasing charges incurred by the patient and making care more costly. IV starts can be time consuming and require to the newborn to be taken from the bedside decreasing bonding and skin to skin time. Approximately 35-50% of all IV starts end in failure, resulting in the multiple breaks in the skin (Helm et al., 2015). Breaks in the skin from insertion attempts increase the infant's risk for infection. IV therapy can be complicated to manage for the family

and hospital staff, dictating how the infant must be handled to avoid loss of IV access. Other complications of IV therapy include infiltration, extravasation, and phlebitis (Bonsall, 2015). Lastly, the introduction of formula decreases rates of exclusive breastfeeding and can lead to trouble maintaining breastfeeding. Considering all of the complications related to treatment of hypoglycemia, a less invasive, cost-effective alternative would be beneficial to all parties involved.

Significance

According to Hegarty et al., (2016, p.10), "Approximately 30% of newborn babies require multiple blood tests for screening of neonatal hypoglycemia and 50% will go on to develop hypoglycemia". Research published by the American Diabetes Association and written by Voormolen et al, (2018) reports that glucose passes freely through the placenta during pregnancy leading to increasing glucose levels and an elevated production of insulin. Following birth, the supply of glucose from the mother has ceased, leaving the infant with limited sources of sugar and an elevated production of insulin, resulting in hypoglycemia (Voormolen, 2018). Control of blood sugars during pregnancy will aide in the prevention of hypoglycemic episodes in the newborn (Medline Plus, 2017). It is the responsibility of the DNP prepared clinician to educate patients and teach primary prevention strategies that benefit mother and baby, such as the logging of blood sugars.

Cost effective care is becoming increasingly important to consumers and providers. According to Alemu et al., (2018) all hospital costs for inpatients births in the United States totaled 7.69 billion dollars in 2012. The hospital costs incurred for treatment of infants with neonatal hypoglycemia totaled 821 million dollars in 2012,

accounting for 11% of the total hospital costs for inpatient births (Alemu et al., 2018). As stated by Alemu et al., (2018, p.4) “Hypoglycemic infants utilize 11% of resources associated with hospital births while accounting for only 1.5% of hospitalizations”, presenting the DNP clinician the duty to seek out more cost-effective treatment modalities to support the patient population. There are many areas regarding the treatment of neonatal hypoglycemia that could use improvement which the DNP graduate is most prepared to provide.

Purpose

This research study aims to assess the effectiveness of a completed health improvement project performed at Hutchinson Regional Hospital in Hutchinson Kansas that was initiated on April 1st 2019. The goal of this health improvement project performed by the hospital was to decrease the rate of IV therapy for treatment of hypoglycemic infants by implementing treatment protocols that utilize oral dextrose gel. This research will look to assess the effectiveness of this health improvement project, and more specifically, determine if the use of glucose gel decreased the rates of invasive IV therapy for “at risk infants”. IV therapy is associated with many undesirable side effects that, if avoided, will lead to a greater overall experience by infants and their families. The goals of this research are as listed:

1. To determine if SGA infants experience reduced rates of IV therapy with the use of glucose gel.
2. To determine if LGA infants experience reduced rates of IV therapy with the use of glucose gel.

3. To determine if infants born before 37 weeks gestations experience reduced rates of IV therapy with the use of glucose gel.
4. To determine if infants born to diabetic/gestation diabetic mothers experience reduced rates of IV therapy with the use of glucose gel.

A decrease in IV therapy is safer and cost saving for patients, decreasing the newborn's risk developing complications related to intravenous treatment. In a study performed by Glasgow, Harding, & Edlin (2018), the use of glucose gel treatment as opposed to the current standard of care was found to save an average amount of $1,314.44 per patient. The project goes on to note that although a wide range of costs may be incurred by various glucose gel substances, differing neonatal intensive care unit fees, expenses for laboratory tests and delivery rates per facility; glucose gel remained cost effective compared to the current standard of care. (Glasgow, Harding, & Edlin, 2018). This research determining the effectiveness of the quality improvement project provides the opportunity to advocate for practice change if the intervention has determined to be effective.

Theoretical Framework

The theoretical framework that best supports the utilization of glucose gel is represented by Nola J. Pender's Health Promotion Model. The Health Promotion Model focuses on improving a patient's health and environment as well as the perception of health by the individual and their family (Alligood, 2018). The framework presented by this model places a large emphasis on promoting healthy behaviors and the effect that health behaviors create in relation to the patient's quality of life. This model considers that each patient has different needs and faces these experiences on an individual basis,

including factors such as age, environment and health status. The health promotion model is based on four major assumptions:

1. Individuals seek to actively regulate their own behavior.
2. Individuals, in all their biopsychosocial complexity, interact with the environment, progressively transforming the environment as well as being transformed over time.
3. Health professionals, such as nurses, constitute a part of the interpersonal environment, which exerts influence on people through their life span.
4. Self-initiated reconfiguration of the person-environment interactive patterns is essential to changing behavior (Petiprin, 2016).

As listed by Petiprin (2016, para. 3-6), the major assumption most closely related to this research is that; "Health professionals, such as nurses, constitute a part of the interpersonal environment, which exerts influence on people through their life span." Health care professionals are closely interwoven with the patients, their families and the perception of their experience while receiving care. The opportunity to administer a treatment modality that is less invasive provides a positive method for the DNP clinician to impact patient care. The framework can be further broken down into the thirteen theoretical statements that are representative of the Health Promotion Model. These statements aide the framework by allowing for a direct link to health behaviors presented within the clinical situation. The thirteen theoretical statements are as follows:

1. Prior behavior and inherited and acquired characteristics influence beliefs, affect, and enactment of health-promoting behavior.

2. Persons commit to engaging in behaviors from which they anticipate deriving personally valued benefits.
3. Perceived barriers can constrain commitment to action, a mediator of behavior as well as actual behavior.
4. Perceived competence or self-efficacy to execute a given behavior increases the likelihood of commitment to action and actual performance of the behavior.
5. Greater perceived self-efficacy results in fewer perceived barriers to a specific health behavior.
6. Positive affect toward a behavior results in greater perceived self-efficacy, which can, in turn, result in increased positive affect.
7. When positive emotions or affect are associated with a behavior, the probability of commitment and action is increased.
8. Persons are more likely to commit to and engage in health-promoting behaviors when significant others model the behavior, expect the behavior to occur, and provide assistance and support to enable the behavior.
9. Families, peers, and health care providers are important sources of interpersonal influence that can increase or decrease commitment to and engagement in health-promoting behavior.
10. Situational influences in the external environment can increase or decrease commitment to or participation in health-promoting behavior.

11. The greater the commitments to a specific plan of action, the more likely health-promoting behaviors are to be maintained over time.
12. Commitment to a plan of action is less likely to result in the desired behavior when competing demands over which persons have little control require immediate attention.
13. Persons can modify cognition's, affect, and the interpersonal and physical environment to create incentives for health actions (Petiprin, 2016, para. 3-6).

The theoretical statements that best applies to the aims of this research include: "Persons commit to engaging in behaviors from which they anticipate deriving personally valued benefits", and "Greater perceived self-efficacy results in fewer perceived barriers to a specific health behavior" (Petiprin, 2016, para. 6-9). New mothers are more likely to accept treatment using glucose gel-based treatment due decreased invasiveness and the promotion of exclusive breastfeeding. Lastly, the treatment is something mothers may participate in alongside nursing staff. The perceived self-efficacy results in decreased perception of barriers to care and increased perceptions of health outcomes. Overall, the Health Promotion model provides a strong foundation for the research study.

Research Questions

1. Do SGA infants experience reduced rates of IV therapy with the use of glucose gel?
2. Do LGA infants experience reduced rates of IV therapy with the use of glucose gel?

3. Do infants born before 37 weeks gestations experience reduced rates of IV therapy with the use of glucose gel?
4. Do infants born to diabetic/gestational diabetic mothers experience reduced rates of IV therapy with the use of glucose gel?

Key Terms

The following terms for the research project are described below:

1. **American Academy of Pediatrics (AAP)** – "An organization of 67,000 pediatricians committed to the optimal physical, mental, and social health and well-being for all infants, children, adolescents, and young adults" (AAP, 2019, para. 1).
2. **Preterm Infant – "**A premature infant is a baby born before 37 completed weeks of gestation, more than 3 weeks before the due date" (Medline Plus, 2019, para. 5).
3. **Small for gestational age (SGA)** - Infant with a birthweight below the 10th percentile for babies of the same gestational age (Children's Hospital of Philadelphia, 2019).
4. **Large for gestational age (LGA)** – Infant with a birthweight greater than the 90th percentile for babies of the same gestational age (Children's Hospital of Philadelphia, 2019).
5. **Infiltration** - When I.V. fluid or medications leak into the surrounding tissue (Bonsall, 2015).
6. **Extravasation** - the leaking of vesicant drugs into surrounding tissue (Bonsall, 2015).

7. **Phlebitis –** the inflammation of a vein (Bonsall, 2015).
8. **Glucose Gel** – A dextrose-based gel solution that may be administered to the buccal cavity for treatment of hypoglycemia.

Logic Model

The primary inputs for this research study include researcher time, garnering hospital approval, IRB approval to begin the project, the time involved to collect the data, the technology necessary to collect the data, and expert professor time and skills to aide in data analysis. The activities of this logic model include the development of a survey tool to allow for anonymous data collection, the act of collecting data, and the preparation and organization of data sheets to be analyzed by a data analysis program. The outputs for the logic model consist of a data assessment and interpretation to determine if the use of glucose gel as a primary method of treatment decreased IV start rates for at risk infants. The short-term outcome is to answer the research questions posed by the project and to present the effectiveness of the glucose gel. The long-term outcome involves a change in the current standard of practice to support the use of glucose gel for first line treatment of neonatal hypoglycemia. The logic model in Figure 1 below provides a visual representation of these relationships.

Project: The Utilization of Glucose Gel for Management of Neonatal Hypoglycemia

Logic Model

Goal: To assess the effectiveness of glucose gel in decreasing IV start rates in infants at risk for neonatal hypoglycemia

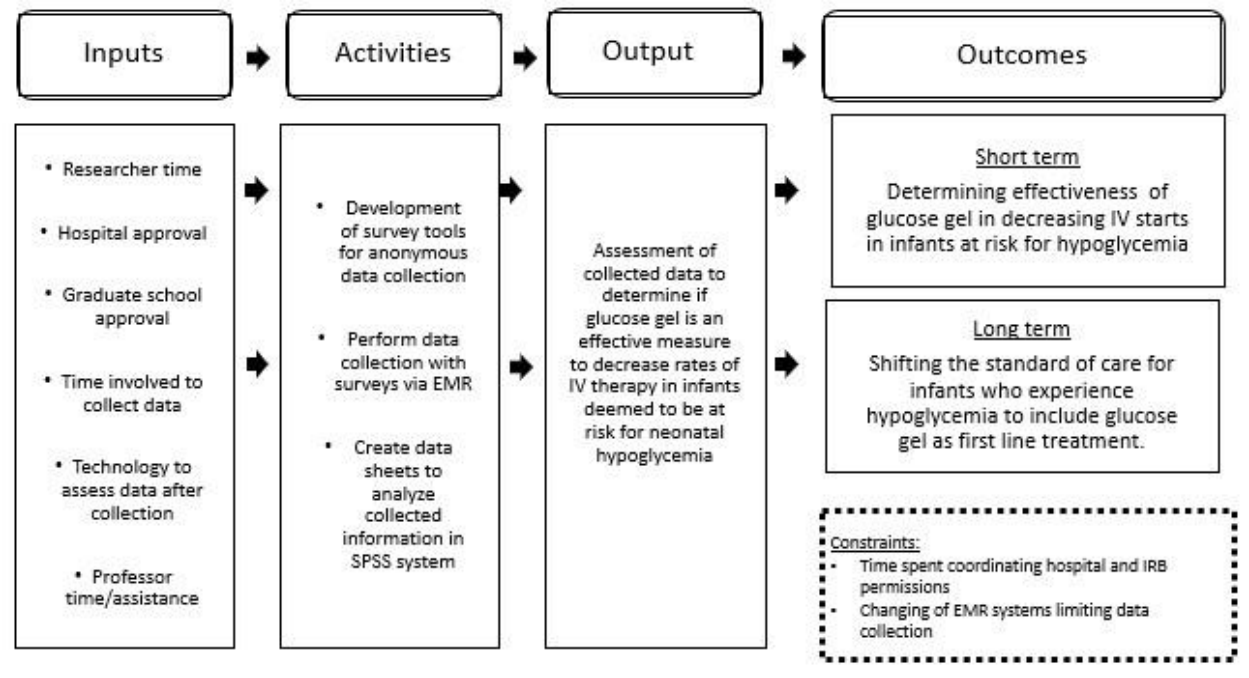

Figure-1. Logic Model – The Utilization of Glucose Gel for Management of Neonatal Hypoglycemia.

Summary

Neonatal hypoglycemia is the most frequent metabolic disorder encountered by the clinician when providing care for neonates. Effective glucose management will prevent serious neurological disturbances in the hypoglycemic newborn. Although much controversy exists regarding what exactly defines hypoglycemia of the neonate, the importance of quick and effective treatment is agreed upon by all. Identification of at-risk groups, timely screening, and parental education are vital steps in caring for hypoglycemic infants. The ability to assess risk factors and manage glucose levels by the DNP clinician is critical to ensuring safe patient care.

Current treatment methods are invasive, costly, and disruptive to the feeding and bonding process following birth. New research suggests the introduction of oral glucose gel to aide in managing glucose levels. Glucose gel is non-invasive and can be

administered to the buccal cavity without any break to the skin or time away from the bedside. Glucose gel has also been shown to be more cost efficient in treating newborn hypoglycemia as opposed to intravenous glucose therapy. Overall, the introduction of glucose gel offers a management solution for glucose while providing a multitude of benefits to the mother/baby couplet not offered by IV therapy.

The quality improvement project performed by Hutchinson hospital provides the opportunity to assess the effectiveness of this intervention firsthand. If deemed to be an effective method of mitigating neonatal hypoglycemia, glucose gel has the potential to provide many benefits to all involved in the treatment of neonatal hypoglycemia.

Chapter II

Literature Review

This literature review was developed by use of the CINHAL database as well as the Pittsburg State University AXE library search engine summons, in order to establish the most current literature and standards of practice in regard to this scholarly project on the utilization of glucose gel for management of neonatal hypoglycemia. Search phrases included: *neonatal hypoglycemia, treatment of neonatal hypoglycemia, glucose gel for treatment of neonatal hypoglycemia, infection risk associated with peripheral venous catheter and cost effectiveness of glucose gel.*

Established Standard of Care

There are several categories of infants who are at a significantly higher likelihood of developing neonatal hypoglycemia. These groups include small for gestational age infants, large for gestational age infants, infants of diabetic mothers and infants born prior to 37 weeks gestation (Abramowski et al., 2020). These infants currently have very few established treatment methods to manage low glucose. The first line management for low blood sugars requires increased breastfeeding. However, breastfeeding is known to be poorly established in the first few days of life and the availability of milk may be limited due to reasons such as poor latch, inability to nurse due to oxygen therapy, and low milk supply during the first week postpartum (Abramowski et al., 2020). Therefore, when treating neonatal hypoglycemia, methods include the introduction of formula and/or the administration of IV dextrose. The two methods mentioned are both associated with numerous complications that affect the mother and infant adversely.

Complications Associated with Current Standard of Care

Physiologic

The long time standard of care for management of neonatal hypoglycemia includes intravenous infusion of fluids that aid the body in sustaining glucose levels. This method of management, while effective, may not always be necessary and poses many risks. According to Columbia University's Center for Teaching and Learning (n.d., para. 7), known complications of IV therapy include: "Infiltration, hematoma, air embolism, phlebitis and thrombophlebitis, extravascular injection, and infection". These complications may cause pain for the patient and damage the skin and surrounding structures, causing further harm.

Along with the many physiologic complications that are incurred by the patient, other complications include difficulty obtaining intravenous access. Regarding intravenous treatment methods, therapy cannot begin until vascular access is obtained. According to a study performed by Hess (2010, p. 236), "In emergency settings, approximately 25% of first IV attempts fail in adults, and this number jumps significantly to a 51% first time fail rate when attempting to initiate access within the pediatric patient population. Further investigation revealed the number of attempts for a pediatric patient (ranging from one day old to twenty years of age) by a practitioner equated to 2.35 attempts for successful cannulation" (Hess, 2010). As the number of attempts increases, so does the risk for infection due to multiple breaks in the skin. Multiple attempts may also lead to patient fear and apprehension.

Delay of Care

The difficulty in obtaining IV access described above creates many other pitfalls, leading to delayed treatment. When there is difficulty establishing IV access, patients cannot receive needed therapies in a timely manner. According to Armenteros-Yeguas et al., (2017, para. 12), "In highly complex patients, difficult venous access may lead to serious consequences at various different levels". Delays caused by difficult venous access include delayed medication administration, loss of prescribed doses, the necessity for more invasive access methods such as central venous catheters which pose more significant risks than traditional IV therapy, and delayed lab results that lead to delayed diagnosis (Armenteros-Yeguas et al., 2017). This is especially problematic for the pediatric population suffering from hypoglycemia. Delays in treatment leading to prolonged hypoglycemia may results in serious neurological consequences including

developmental delays, learning disabilities, cerebral palsy, vision disorders and epilepsy (Glasgow et al., 2021).

Increased Cost of IV Therapy

Intravenous therapy leads to increased cost compared to other less invasive methods of treatment. The time taken at the bedside by multiple nursing staff to establish IV access in an infant directly relates to loss of nursing time and increased cost on part of the hospital. Multiple attempts to obtain access also increases costs due to increased use of supplies. Costs continue to increase as more failures in placement occur, more staff is required to restrain infant/attempt access, and more supplies are utilized (Van Loon et al., 2020). Infants who receive IV therapy are at an increased risk for adverse physiologic outcomes such as infection, phlebitis, infiltration and extravasation (Hess, 2010), which may also lead to more costly hospital stays. A study published by Glasgow et al., (2021), estimated that upon discharge infants who develop neonatal hypoglycemia have a hospital bill that on average, totals $66,000 more with current treatment modalities, than an infant who does not develop neonatal hypoglycemia. Once IV therapy has been initiated, an infant's status changes within hospital billing systems. The elevation in status results in higher incurring costs by the day related to the deemed acuity of care incurred by IV therapies (Glasgow et al., 2021)

Increased monitoring

Monitoring of blood glucose for the infant requires breaking the skin with a needle and drawing capillary blood to perform point of care testing via bedside glucometers (Klonoff, 2014). Infant glucose monitoring for at risk populations is initiated within two hours of birth and must be continued until stabilized glucose levels have been

achieved for a minimum of 24 hours (MedlinePlus, 2019). An infant with glucose monitoring every two to three hours is being poked on average twelve times a day. If values recorded via point of care testing are deemed significantly low (below 30) they must be confirmed via laboratory testing which involves additional poking and increased blood volume that must be sent to lab for analysis. The frequent breaks in skin create the opportunity for infection and injury to the child. Infants who are treated using IV fluids must be gradually weaned off IV fluids and require additional monitoring which increases the risk of experiencing an adverse event related to the multiple breaks in the skin.

Effectiveness of Glucose Gel

In a single hospital study performed by Romald et al., (2019), hypoglycemic infants were treated with dextrose gel as an alternative to IV therapy. The results of this study concluded that 76% percent of infants with hypoglycemia were successfully treated using dextrose gel as monotherapy and therefore were able to avoid more invasive therapy such as IV dextrose. Of the 24% that ultimately necessitated IV therapy, many suffered from additional morbidities including sepsis, hemorrhage and adrenal disorders (Romald et al., 2019). Greater than two thirds of the infants within the study received treatment for low blood sugar while also avoiding invasive therapies that could impact breastfeeding and maternal boding.

Research performed by Rawat et al., (2016) supported the use of dextrose gel for asymptomatic treatment of neonatal hypoglycemia. The results of the study revealed that the use of glucose gel played large role in decreasing NICU admissions and increasing exclusive breastfeeding rates. According to Rawat et al., (2016), after the introduction of

glucose gel, NICU admissions for treatment via IV dextrose therapy dropped from 42% to 26%. Another conclusion of this study included a decrease in the number of infants transferred to the NICU which dropped from 35/1,000 live births to 25/1,00 live births after the initiation of glucose gel (Rawat et al., 2016). Lastly this study concluded that exclusive breast-feeding rates which started at 48%, increased to 70% after glucose gel treatment was introduced (Rawat et al., 2016). The ability to maintain exclusive breastfeeding is very beneficial and offers many advantages to the mother and newborn.

Safety of Gel Administration vs. IV Therapy

Current standard of care guidelines utilizes IV therapy with dextrose infused fluids. Therapies such as this require access inside veins via peripheral venous catheters. Glucose gel as an alternative to IV therapy is administered through the buccal cavity and does not require an IV site. IV sites can easily be dislodged and require very careful handling that can impact care and bonding as well as the integrity of the surrounding skin. According to an article published by the Journal of Infusion Nursing, "Maintaining patients' vascular access throughout treatment is difficult because a number of complications including phlebitis, infiltration, extravasation, and infections can occur (Dychter et al., 2012, p. 87)". The opportunity to avoid IV's is beneficial to the hospital staff, infant caregivers, and the infant.

Although peripheral venous catheters are frequently used, they are not entirely benign. According to Zhang et al., (2016, p. 48), "The high number of PVCs inserted annually has resulted in serious catheter-related bloodstream infections and significant morbidity, prolonged hospital stay and increased healthcare system costs." Glucose gel does not require any breaks in the skin. And is therefore safer because it is less invasive.

Without any breaks in the skin, the introduction of many pathogens to the bloodstream cannot occur, which decreases the potential for infections and further complications to the neonate.

Cost effectiveness

The largest possible impact that could be made by introducing the use of glucose gel involves the avoidance of NICU admissions by early and cost-effective treatment of neonatal hypoglycemia. According to the March of Dimes (2012, para. 4), "On average, hospital charges for infants admitted to a special care nursery totaled $76,164 for the initial hospital stay following delivery which does not include physician fees, rehabilitation expenses or follow up care." This is in great contrast with the average cost of a term infant with an uncomplicated delivery who's cost of stay averages $800 (Cheah, 2019).

Current methods of treatment for neonatal hypoglycemia are known to be costly and have many associated risks. According to research performed by Glasgow et al., (2021, p. 188), "Even under the most conservative of conditions, our estimation of the cost of neonatal hypoglycemia both over childhood and over a lifetime shows that neonatal hypoglycemia contributes a significant financial burden to the health system". Moving forward, more and more health care decisions are made with fiscal responsibility in mind. According to a study published by the American Academy of Pediatrics, the average cost of a tube of glucose gel is $3.00 (Romald et al., 2019). This is far cheaper than the average cost of IV therapy which can range from hundreds to thousands of dollars based on duration of therapy and hospital billing policies. The utilization of

glucose gel for the infant population would provide a more cost-conscious model of treatment.

Increased Parental Satisfaction

There are many complications incurred by mothers and infants when current treatment modalities, such as formula feeding, and IV dextrose infusions are utilized. Common complications associated with formula feeding/supplementation include early mother-infant separation, increased breastfeeding discontinuation rates, and decreased maternal confidence in nursing abilities (Haninger & Farley, 2017). Research by Barber et al., (2018), supports continuous contact between mothers and their infants, which is found to increase milk production, facilitate longer feeds, and increase rates of exclusive breastfeeding. In a study performed by Hammer et al., (2018), exclusive breastfeeding rates increased by 6.5% for infants who were treated with glucose gel. Allowing mothers to establish breastfeeding without introducing supplementation via formula increases parental confidence and satisfaction. According to research published by the American Academy of Pediatrics during a quality improvement study, mothers were pleased with the use of glucose gel as an alternative treatment modality that did not disrupt breastfeeding practices (Cacioppo, 2019).

Other benefits of glucose gel that increase parental satisfaction compared to traditional therapies include: increased skin to skin time, avoidance of invasive procedures for the infant, decreased parental anxiety related to invasive IV therapies for infant, decreased NICU admissions, decreased infant/parental separation and shorter hospital stays (Barber et al., 2018). According to a randomized control trial performed by Scheans et al., (2017, p. 62) “Admission rates to the NICU for NH decreased by 73

percent. Exclusive breastfeeding rates for this population increased to 49 percent and 40 additional families remained together on the mother baby unit". All of the above outcomes improve parental satisfaction, while safely managing the infant's condition.

Barriers To the Use of Glucose Gel

Several barriers exist to the implementation of new practice standards. The first barrier includes staff education. Staff must be educated on the process of giving glucose gel to newborns as a first line therapy for hypoglycemia. The second barrier includes the use of standardized protocols. Implementing flow sheets that delineate what infants should be screened for hypoglycemia, at what point glucose gel is indicated to be given, and appropriate medication dosing creates a smooth workflow. Lining out the indications and standardizing them provides benefits to nursing staff and physicians, allowing all parties to perform their duties without multiple phone calls, delays, or disruptions. Lastly, glucose gel has not served as a preexisting order in the current charting system. Adding standardized order sets for glucose gel to the electronic health record will allow for seamless placing of orders and pharmacy review of medication dosing to prevent delays in care.

Recommendations

Glucose gel is commonly used in adults; however, it has not yet been widely studied in infants. Several small-scale studies have been conducted and results have shown that glucose gel is in cost effective, easily accessible, easily administered, and non-invasive (Seattle Children's Hospital, 2017). However, more studies supporting the use of glucose gel need to be performed to establish a change in current practice guidelines.

Glucose gel in early studies has shown to be a viable method of treating neonatal hypoglycemia. Not only is it an alternative method, but it provides many benefits that current treatment modalities do not offer. The use of glucose gel could provide many benefits to mothers and babies such as: increased skin to skin time, improved rates of exclusive breastfeeding, prevention of non-invasive procedures, increased parental satisfaction, cost conscious care, and decreased NICU admissions. Performing additional studies that highlight the effectiveness of glucose gel will aid in creating standardized practice changes to improve mother-baby care throughout the healthcare system. The data presented by this retrospective chart review creates the opportunity to assess the effectiveness of this very intervention. If found to be effective, it has widespread practice implications and supports a change in the current standard of care for neonates who experience hypoglycemia.

Chapter III

Methodology

Prior to the introduction of glucose gel, any infants deemed “at-risk” (small for gestational age, large for gestational age, born prior to 37 weeks gestation, or born to diabetic/gestational diabetic mothers) for hypoglycemia were to undergo blood sugar monitoring per hospital policy. Glucose was to be assessed every 2-3 hours following delivery. If three glucose levels above 50 were achieved the monitoring would cease. Some infants were able to sustain their blood sugars independently and did not require any intervention, while others needed medical interventions to maintain safe glucose levels. Any infant experiencing glucose levels below 40mg/dl required treatment. Sole treatment prior to the implementation of this protocol consisted of a continuous IV dextrose infusion. Once deemed stable by a pediatrician the weaning process was initiated to decrease the rate of IV infusion until the infant could successfully sustain acceptable glucose levels independently, which required additional monitoring.

Project Design

Hutchinson Regional Hospital implemented the use of glucose gel as first line treatment for neonatal hypoglycemia on April 1st, 2019, with the approval the overseeing pediatric physicians. After the introduction of glucose gel, all infants continued to be screened in the same manner as prior to the introduction. Following the new protocol,

infants who were not able to sustain acceptable glucose levels (above 40), were treated with a single weight-based dose of oral glucose gel administered to the buccal cavity as first line therapy rather than an IV infusion. Glucose levels continued to be assessed every two to three hours. If the infant was able to maintain three blood sugars without the use of glucose gel, the infant was considered stable, and monitoring was ceased. If after the administration of glucose gel, glucose levels continued to remain below an acceptable level, then an IV infusion of dextrose was started.

For this scholarly project, a retrospective study design was utilized. This study is an evaluation of a completed quality improvement project performed at Hutchinson Regional Hospital that changed the standard from IV glucose to glucose gel, to determine if the use of glucose gel for the treatment of neonatal hypoglycemia resulted in a lower IV therapy rate.

This project will consist solely of a chart review to collect data which will enable the DNP student to answer the following questions:

1. Do SGA infants experience reduced rates of IV therapy with the use of glucose gel?
2. Do LGA infants experience reduced rates of IV therapy with the use of glucose gel?
3. Do infants born before 37 weeks gestations experience reduced rates of IV therapy with the use of glucose gel?
4. Do infants born to diabetic/gestation diabetic mothers experience reduced rates of IV therapy with the use of glucose gel?

The retrospective data collected was utilized for descriptive statistical analysis. The comparative data was utilized to determine if IV rates were lowered in at-risk categories including: LGA, SGA, under 37 weeks gestation and infants of diabetic mothers, by using glucose gel as first line therapy for the treatment of hypoglycemia in newborns.

Target Population

The target population for this research includes infants born with risk factors for hypoglycemia. The four identified risk factors that require glucose screening due to an increased risk for hypoglycemia include: Small for gestational age infants, large for gestational age infants, infants born prior to 37 weeks, and infants of diabetic/gestational diabetic mothers. The project will consist of infants born at Hutchinson Regional Hospital between October 1st 2018 and July 1st of 2020. Chart reviews were performed dating back six months prior to the initiation of glucose gel to determine baseline IV start rates for at-risk infants. Due to changes in the electronic medical record, it was not possible obtain any further data to create a larger baseline population. The pre-glucose gel group consisted of 60 medical records that met the criteria for at-risk infants born between October 1st, 2018, and March 31st 2019. The glucose gel group consisted of 148 medical records in which patients met criteria to be considered at-risk between the dates of April 1st, 2019, and July 1st, 2020.

Target population recruitment

Convenience sampling served as the target population for this project. Subjects at Hutchinson Regional were a population available for assessment, as they were treated with glucose gel first line for the management for hypoglycemia between the above dates,

and their outcomes can be readily observed. The pre group at Hutchinson Regional was also subject to similar screening policies prior to the initiation of glucose gel, making the outcomes favorable for comparison.

Inclusion and exclusion criteria

For inclusion into the project, the subject had to be born between October 1st of 2018, and July 1st of 2020 at Hutchinson Regional Hospital. The subjects must have met criteria to be classified as one of the four categories of infants at risk for developing hypoglycemia. These categories of increased risk include:

1. Infants who are large for gestational age (birth weight above the 90th percentile)
2. Infants who are small for gestational age (birth weight below the 10th percentile)
3. Infants who were born prior to 37 weeks gestational age
4. Infants born to diabetic/gestational diabetic mothers

Any infant who was not born within the timeline described above, was not born at the facility above, or did not meet any of the four at risk criteria were not considered for this project. Other exclusion criteria include any infant who falls within an at-risk category who had an IV started for reasons not pertaining to blood sugar.

Protection of Human Subjects

IRB approval was obtained from the Irene Ransom Bradley School of Nursing and Pittsburg State University on November 2, 2021. Permission was already obtained from Hutchinson Regional Hospital to review available data and collect anonymously via survey (See Appendix A). These permissions will be used to perform chart reviews and collect relevant data regarding the number of at-risk patients, what at-risk category the

patient belongs to, if glucose gel treatment was used, IV start rates, and reason for IV start. Identifying patient information will not be collected, allowing for complete anonymity. Due to the retrospective nature of this study, minimal risk is posed to the target population by this project as there are no interventions being performed on or experienced by patients.

Instruments

An assessment by chart review was performed to assess the effects of the variable (glucose gel) on the pre- and post-glucose gel groups. A survey tool was utilized to assist with the chart reviews and obtain pertinent data for each at risk infant. The survey included:

1. The absolute number of infants born and considered at risk for hypoglycemia
2. The risk group in which the infant was classified
3. If glucose gel was used
4. If an IV start was necessary
5. If the IV started for reasons other than hypoglycemia

(See Appendix B)

This tool provided the data for statistical analysis via SPSS. Descriptive statistics were then utilized to determine if there is a notable difference in the rate of IV starts between the pre- and post-glucose gel groups.

Procedure

After receiving IRB approval and hospital permissions, chart reviews were performed. The initial chart review consisted of infants born between October 1st of 2018 to March 31st of 2019 prior to the initiation of glucose gel, compromising the pre-glucose

gel group. Data was then collected during that time frame to delineate the subject, at-risk group, and baseline IV start rates within the at-risk groups prior to the introduction of glucose gel. This provided six months of data prior to the onset of the intervention. A second chart review was then performed and provided data for subjects born between April 1st of 2019 and July 1st of 2020 comprising the post-glucose gel group. Data included the number of subjects, the at-risk category of each subject, the treatment used for low blood sugar (glucose gel or IV), if the infant was later treated with IV to further manage blood sugars, and any additional reasons for an IV start not related to glucose management. This provided fifteen months of data after the intervention was performed, allowing for a total of 21 months of data for comparison. To minimize the risk of violating confidentiality patient information will be deidentified during the data collection process. The deidentified data will then be stored in a fire safe for 5 years following the completion of the project, where it will then be destroyed.

Evaluation Methods

After data collection was completed, the data was assessed by statistical analysis via SPSS. The analysis was performed using descriptive statistics, frequencies, and comparison of means.

Data collected in the surveys throughout the chart review were coded to provide numerical data and allow for comparative studies between the pre- and post-glucose gel groups. Once the data was coded and input into SPSS software, the rate of IV starts in the pre- and post-glucose gel groups was determined. This data was then analyzed to determine if there was a notable difference between the two groups. This process was

repeated to answer the following questions: Does the use of glucose gel decrease the rate of IV therapy for:

1. *Infants who are small for gestational age?*
2. *Infants who are large for gestational age?*
3. *Infants born prior to 37 weeks gestation?*
4. *Infants born to diabetic/gestational diabetic mothers?*

The purpose of the statistical analysis was to determine if the use of glucose gel decreased the necessity for IV therapy in infants with low blood sugar based upon certain risk factors. If the use of glucose gel is found to be an effective method of treating neonatal hypoglycemia and therefore decreased IV start rates in at risk infants, it could be determined that the quality improvement activity was successful and should be continued. The benefit would be extended to many involved in infant care including mothers, infants, and hospitals, suggesting a need for practice change to include the use of glucose gel as a viable treatment option. This project is structured as a chart review and therefore does not meet criteria to develop a plan for sustainability. All review of records was performed and there were no fees or fiscal considerations for this project.

Chapter IV

Results

The overall purpose of this project was to assess the ability of glucose gel to decrease IV start rates for infants with hypoglycemia based upon their individual risk factors. Hutchinson Regional Hospital implemented an improvement project utilizing glucose gel for at-risk infants. This project assessed IV start rates in at-risk infants six months prior to the health improvement project and fifteen months after the introduction of the health improvement project utilizing glucose gel to determine if the intervention of gel decreased the rate of IV starts in at-risk infants. Data was collected via chart review to determine the at-risk categories for hypoglycemia, the usage of glucose gel, necessity of the IV, and for what reason an IV was started. The data was collected in order to answer the following questions.

1. Do SGA infants experience reduced rates of IV therapy with the use of glucose gel?
2. Do LGA infants experience reduced rates of IV therapy with the use of glucose gel?
3. Do infants born before 37 weeks gestations experience reduced rates of IV therapy with the use of glucose gel?

4. Do infants born to diabetic/gestation diabetic mothers experience reduced rates of IV therapy with the use of glucose gel?

Description of Sample

The pre-glucose gel intervention group consisted of the medical records of infants born at Hutchinson Regional Hospital in Hutchinson Kansas between the dates of October 1st, 2018 and March 31st 2019. To be included in this group, the infants must have been classified as at-risk for hypoglycemia (SGA, LGA, under 37 weeks gestation, of diabetic mothers). Data was collected to determine baseline IV rates for at risk infants prior to the introduction of glucose gel. Permissions were received from the hospital to perform this data collection. After receiving IRB and hospital approval, data collection for the pre-glucose gel group took two weeks to complete. All personal information relating to the patients including name, ethnicity, gender, gestation, date of birth and any additional identifying information were intentionally excluded when collecting data, resulting in deidentified data to protect patient anonymity. After the completion of the data collection there were a total of 56 infants in the six-month period who were determined to be at risk for hypoglycemia and included in this project.

The population of the post-glucose gel intervention group consisted of a medical records review for infants born at Hutchinson Regional Hospital in Hutchinson Kansas between the dates of April 1st, 2019, and June 31st, 2020. To be included in this group, infants must have been classified as at risk for hypoglycemia (SGA, LGA, under 37 weeks gestation, of diabetic/gestational diabetic mothers). Data were collected to determine the rates of IV therapy following the addition of glucose gel as a first line treatment for neonatal hypoglycemia. Following IRB and hospital permissions, the data

collection was completed over a period of six weeks, from January 1st, 2022 to February 15th, 2022. The same deidentifying methods were used in the post-glucose gel group as the pre-glucose gel group data collection to protect patient identity. Once data collection was completed, it was determined that 148 infants were classified as at-risk during the fifteen-month period and would be included in this project.

Analysis of Data

Data analysis was completed using SPSS software. The pre- and post-glucose gel group IV rates were assessed in comparison to the use of glucose gel to determine the frequency of IV starts. Descriptive statistics were utilized for the project to summarize and condense information related to the data collected and to bring awareness to differences between variables, such as glucose gel and decreased IV start rates.

Analyses of Project Questions

- Do SGA infants experience reduced rates of IV therapy with the use of glucose gel?

Following data entry into the SPSS software system, descriptive statistics were used to determine the rate of IV starts for infants classified as small for gestational age (Table 1). Nine infants in the pre-glucose gel group were determined to be SGA, of which one infant required IV therapy. 11 infants classified as SGA in the post-glucose gel group, of which two required IV starts. For those participants that had an SGA risk factor, the baseline IV start rate was 11.1% in the pre-glucose gel group. The post-glucose gel group's IV start rate was determined to be 18.2%. There was a higher percentage of SGA infants in the post-glucose gel group that required an IV start.

Table 1

Comparison of IV Start rates for SGA Infants in the Pre-Glucose Gel and Post-Glucose Gel Groups

IV start rates in pre-glucose gel SGA infants		Frequency	Percent
Valid	Yes	1	11.1
	No	8	88.9
	Total	9	100.0
IV start rates in post-glucose gel SGA infants		Frequency	Percent
Valid	Yes	2	18.2
	No	9	81.8
	Total	11	100.0

- Did the use of glucose gel decrease the rate of IV glucose therapy for large for gestational age infants?

Descriptive statistics were utilized to determine the rate of IV starts for infants classified as large for gestational age (Table 2). Seventeen infants in the pre-glucose gel group were determined to be LGA, of which two infants required IV therapy. Sixteen infants classified as LGA in the post-glucose gel group, of which none required IV starts. For those participants that had an LGA risk factor, there was a noticeable difference in the percentage of IVs started between the pre-glucose gel group (11.8%) and the post-glucose gel group (0%). There was a lower percentage of LGA infants in the post-glucose gel group that required an IV start.

Table 2

Comparison of IV Start Rates for LGA Infants in the Pre-Glucose Gel and Post-Glucose Gel Groups

IV start rates in pre-glucose gel LGA infants		Frequency	Percent
Valid	Yes	2	11.8
	No	15	88.2
	Total	17	100.0
IV start rates in post-glucose gel LGA infants		Frequency	Percent
Valid	Yes	0	0.0
	No	16	100.0
	Total	16	100.0

- Did the use of glucose gel decrease the rate of IV glucose therapy for infants born prior to 37 weeks gestation?

Following data entry into the SPSS software system, descriptive statistics were utilized to determine the rate of IV starts for infants born prior to 37 weeks gestation (Table 3). Six infants in the pre-glucose gel group were determined to be under 37 weeks gestation, of which four infants required IV therapy. Eleven infants classified as under 37 weeks gestation in the post-glucose gel group, of which six required IV starts. For those participants that had a risk factor of under 37 weeks gestation, there was a notable decrease (12.2%) in the percentage of IVs started between the pre-glucose gel group (66.7%) and the post-glucose gel group (54.5%). There were a lower percentage of infants born prior to 37 weeks in the post-glucose gel group that required an IV start.

Table 3

Comparison of IV Start Rates for Infants Born Prior to 37 Weeks in the Pre-Glucose Gel and Post-Glucose Gel Groups

IV start rates in pre-glucose gel infants under 37 weeks		Frequency	Percent
Valid	Yes	4	66.7
	No	2	33.3
	Total	6	100.0
IV start rates in post-glucose gel infants under 37 weeks		Frequency	Percent
Valid	Yes	6	54.5
	No	4	36.4
	Total	10	90.9
Missing	9	1	9.1
Total		11	100.0

- Did the use of glucose gel decrease the rate of IV glucose therapy for infants born to diabetic/gestational diabetic mothers?

Descriptive statistics were utilized to determine the rate of IV starts for infants born to diabetic/gestational diabetic mothers (Table 4). 24 infants in the pre-glucose gel group were determined to be of diabetic mothers, of which seven infants required IV therapy. 52 infants were born to diabetic mothers in the post-glucose gel group, of which nine required IV starts. For those participants that had the risk factor of diabetic mothers, there was moderate decrease in the percentage of IVs started between the pre-glucose gel group (29.2%) and the post-glucose gel group (17.3%).

Table 4

Comparison of IV Start Rates for Infants Born to Diabetic/Gestational Diabetic Mothers in the Pre-Glucose Gel and Post-Glucose Gel Groups

Pre-glucose gel of diabetic mothers- Was an IV Started		Frequency	Percent
Valid	Yes	7	29.2
	No	17	70.8
	Total	24	100.0
Post-glucose gel of diabetic mother- Was an IV started		Frequency	Percent
Valid	Yes	9	17.3
	No	43	82.7
	Total	52	100.0

Additional Statistical Analyses

After the four initial research questions were answered, there seemed to be a discrepancy between the expected findings and the actual findings. During the data analysis every record for which an infant classified as at-risk was considered when performing the data analysis. However, it wasn't initially considered that many infants were able to maintain glucose levels without any form of treatment or intervention, and those infants were included in the study although they never required any form of treatment. This led to a more in-depth assessment of infants who required treatment (Table 5). In the pre-glucose gel group, of the 56 at risk infants, only eight necessitated any form of treatment. All eight of the infants in the pre-glucose gel that needed a form of treatment were treated with IV therapy (100%). In the post-glucose gel group of the 148 at-risk infants, only 90 infants required treatment. Of the 90 that required treatment, all received glucose gel. Of these 90 that required treatment and were given glucose gel, only 11 infants required additional IV therapy for blood sugar control (See Table 6). This indicates that 79 participants in the post group successfully treated with glucose gel alone did not necessitate any IV starts. The IV start rate for treatment of low blood sugar in at

risk infants that required treatment in the post-glucose gel group was (12.2%). Overall, the post-glucose gel group experienced a much lower rate of IV starts.

Table 5

Usage of Glucose Gel for Treatment of Low Blood Sugar in the Post-Glucose Gel group

Post-glucose gel group – Participants that received gel for treatment		Frequency	Percent
Valid	Yes	90	60.8
	No	58	39.2
	Total	148	100.0

Table 6

Assessment of Post-Glucose Gel Group and Reasons for IV Starts VS. Glucose Gel Usage

Reason for IV start and Glucose gel usage crosstabulation					
			Was Glucose Used		
			Yes	No	Total
Reason for IV Start	Resuscitation	Count	2	2	4
		Expected Count	2.8	1.2	4.0
	Elevated Bilirubin	Count	2	0	2
		Expected Count	1.4	.6	2.0
	Antibiotic Administration	Count	2	3	5
		Expected Count	3.5	1.5	5.0
	Suspected illness	Count	1	3	4
		Expected Count	2.8	1.2	4.0
	Blood sugar Control	Count	11	0	11
		Expected Count	7.6	3.4	11.0
Total		Count	18	8	26
		Expected Count	18.0	8.0	26.0

Summary

The purpose of this project was to assess the ability of glucose gel to decrease IV start rates for infants with hypoglycemia based upon their individual risk factors. SPSS

system was utilized to determine the rates of IV starts in infants before and after the implementation of glucose gel. Descriptive statistics were utilized to report the findings. All at risk groups experienced a decreased rate of IV starts, except those in the SGA group. Additional analysis was performed to assess the IV start rates in the pre and post group of the subjects that necessitated treatment, which indicated a decrease in IV starts overall for at-risk infants. This information could not be collected and assessed for every individual risk factor due to small or non-existent sample sizes. The findings in the project highlight the need for additional investigation with larger sample sizes to solidify the findings and provide additional support for the use of glucose gel.

Chapter V

Discussion

The purpose of this scholarly project was to assess the effectiveness of glucose gel in decreasing IV rates for infants at-risk for neonatal hypoglycemia. More specifically, it asks if use of glucose gel decreased the rate of IV starts for infants born to these four identified at-risk groups: small for gestational age, large for gestational age, under 37 weeks gestation and of diabetic/gestational diabetic mothers. The infants classified as large for gestational age, under 37 weeks and of diabetic/gestational diabetic mothers all experienced a decrease in the rates of IV starts. Small for gestational age infants experienced an opposite effect, experiencing an increase in IV start rates with the use of glucose gel.

Relationship of Outcomes to Research

- Do SGA infants experience reduced rates of IV therapy with the use of glucose gel?

Infants who qualified as small for gestational age experienced an increase in IV start rates. This was an unexpected finding and in opposition of the hypothesis. One thought is that this may be due to a small sample size. There were a total of nine infants who qualified as SGA in the pre-glucose gel group, of which one required treatment. The post-glucose gel group only had 11 participants classifying as SGA, of which two

required treatment. There is only one IV start difference between the pre- and post-glucose gel group. This is the only at-risk category in which the post-glucose gel experienced an increase in IV therapy. Larger sample sizes would be beneficial to determine if glucose gel increase the rates of IV starts in infants who are small for gestational age. An additional consideration is that infants of this size may have required more aggressive treatment and therefore experienced more IV starts.

- Do LGA infants experience reduced rates of IV therapy with the use of glucose gel?

Infants who qualified as large for gestational age experienced a decrease in IV start rates following the use of glucose gel. In the pre-glucose gel group two infants of the 17 identified required IV treatment. In the post-glucose gel group, there were 15 infants identified as at risk of which none required IV treatment to further manage their glucose levels. This is an expected finding and is in support of the hypothesis. Although these results are in support of the hypothesis, larger sample sizes would solidify the findings.

- Do infants born before 37 weeks gestations experience reduced rates of IV therapy with the use of glucose gel?

Infants who qualified as born prior to 37 weeks gestation in the post-glucose gel group experienced a decrease in IV start rates. This group experienced the largest decrease in IV start rates of all the at-risk groups. The pre-glucose gel 37-week gestation risk factor group had six total subjects, of which four required IV's. The post-glucose gel 37-week gestation risk factor group had a total 11 subjects, of which six required IV's and four did not. There is a discrepancy as one of the patients in this group did not have data for the IV start results. This could be due to an error in coding the data. This could

also be that it was not able to be determined if the infant had an IV or did not have an IV during the data collection portion of the project. Due to the small sample size, the one unaccounted for infant IV start in the post-glucose gel 37-week group represents 9% of the overall post-group sample and could sway the data either way. Overall, 37-week gestation infants experienced reduced IV rates which seems to support the use of glucose gel, although larger sample sizes would provide more reliable data.

- Do infants born to diabetic/gestational diabetic mothers experience reduced rates of IV therapy with the use of glucose gel?

Infants born to diabetic or gestational diabetic mothers experienced an overall decrease in IV start rates in the post-glucose gel group. There were 24 infants in the pre-glucose gel group of which seven required IV therapy. There were a total of 52 infants in the post-glucose gel group, of which nine required IV therapy. This at-risk group experienced the second largest decrease in IV starts with the use of glucose gel. This result seems to support the hypothesis and while it is an expected finding it was thought that this group might experience a greater decrease than what was truly represented by this data.

A possible explanation for the less than expected effectiveness of glucose gel may be due to physician behaviors. Although all physicians were on board with the implementation of glucose gel, there is close monitoring and follow up required with use and it was still not guaranteed to be 100% effective. When using glucose gel, if at any point when blood glucose dropped below the established acceptable threshold a physician would need to be called for updates and further orders to determine the plan of care. Initiating IV therapy may serve as a convenience when heading into long stretches

overnight. Physicians may utilize IV therapy to stabilize glucose levels and leave the IV running overnight to prevent multiple phone calls at inconvenient hours, then during waking and office hours, weaning off the IV can begin at the physician's discretion. Another possible explanation is the multifactorial complications some infants face. Many infants have several risk factors that require close monitoring and assessment. Having an IV in place to use as needed may be reassuring to physicians when closely monitoring high risk infants and may lead to unnecessarily high IV start rates.

While three of the four at-risk groups showed a decrease in the percentage of infants who required IV's, the data didn't show the effectiveness to the degree expected by the researcher. This led to a closer analysis of the data collected. As stated previously in the project, every infant who was determined to be at-risk for hypoglycemia had blood sugar monitoring performed. Many at-risk infants were stable and did not require any form of treatment, sustaining blood sugars greater than 40mg/dl without any intervention. When determining the baseline IV rates in the pre-glucose gel group, every infant who was considered at risk was included in the total subject number, and then the number of IV starts were calculated to determine the average rate of IV starts, meaning that infants who did not require treatment were included in the sample number, the only form of treatment at this time consisting of IV therapy. When determining the baseline IV rates for infants in the post-glucose gel group, only infants who received glucose gel – as this was the intervention we were looking to assess were included, as glucose gel was the intervention the research questions were assessing.

The observation was made that by focusing on the infants who received glucose gel, infants that tested out of treatment were not included in the post-glucose gel sample.

This led to much smaller sample sizes. Had all the infants that tested out of treatment been included in the post-glucose gel group, as they were in the pre-glucose gel group, the rates of IV starts would have been considered much lower in the post-glucose gel group. To offset this, data was reassessed to focus solely on infants who required treatment in the pre-glucose gel group to make the data more comparable. It was not possible to assess by risk factor in the pre-glucose gel group when excluding those that didn't necessitate treatment due to small sample sizes or non-existent data as the research questions initially proposed. However, it felt necessary to have some way to view the data, although it was not one of the initial research questions posed by the project. This led to the assessment of IV start rates for only those that required treatment in the pre- and post-glucose gel groups as a whole, regardless of risk factor. These values excluded any infants that tested out of treatment to allow for more comparable data in the pre- and post-glucose gel groups. In the pre-glucose gel group, there were a total of eight patients who necessitated treatment, of which eight received IV's. In the post-glucose gel group, a total of 90 patients necessitated treatment, of which 11 received IV's. This established that, in patients needing treatment in the pre-glucose gel group, the rate of IV starts was 100%. In the post-glucose gel group including all at-risk infants, the overall rate of IV starts was 12.2%. Therefore, when assessing patients of all risk factors that required treatment, the post-glucose gel group experienced a significant decrease in IV start rates.

Observations

There were many observations made by the conclusion of the project that were not foreseen. Many of the challenges were tied to data collection. During the process of data collection, it was noted that several patients fell into one or more category of risk

factor such as being born to a diabetic mother while also classifying as large for gestational age. Another challenge was determining the reason for IV start. During the process of reviewing medical records retrospectively it was not always made clear why the IV was started. The data survey collection tool was revised during data collections. The initial draft of the data collection survey simply included the number of IV starts. As the data collection began, the survey was revised to include a reason for IV start since many infants had IV starts not associated with blood sugar control. Lastly, some IVs were started for multifactorial reasons such as foreseen need for antibiotics, blood sugar issues, and prematurity.

Evaluation of Theoretical Framework

The theoretical framework for this project was the Health Promotion Model by Nola J. Pender. This theoretical framework provided a great basis for this project. The framework places emphasis on improving patient health and environment, as well as patient and family perception of their healthcare (Alligood, 2018). While this project focused on data collection in order to answer the research questions, the essence of the project is about improving patient health and environment. Determining the effectiveness of glucose gel creates an opportunity for practice change to support better patient care and improve perception of the hospital experience. Those infants in the post-glucose gel group who needed treatment of their blood sugar experienced an 87.2% decrease in IV rates. The ability to continue care without an IV improves the family's perception of the experience by alleviating painful procedures and keeping the infant from being at the bedside and bonding. Overall, this theoretical framework fit well with the main theme of the project.

Evaluation of Logic Model

The project followed the logic model presented in chapter one concisely. The inputs were correctly identified as time to develop the project, hospital and graduate school approval, time to collect data, data assessment technology and professor time, assistance, and expertise. The activities included development of the data collection survey tool, data collection via an electronic medical record chart review, and the development of data sheets for data analysis. The data tool did require some revision during the data collection process to best capture the necessary data. The output consisted of data to answer the research questions. It became apparent that more data would have been very beneficial to provide a better insight into the research questions. The short-term outcome to determine the effectiveness of glucose gel was determined per risk factor – as asked by the research questions posed in this project. Three of the four infant risk groups experienced an overall decrease in IV start rates for the post-glucose gel group. The long-term goal has not yet been achieved but the data presented by this project does support the need for additional studies and a change in the standard of care to support the use of glucose gel for the treatment of neonatal hypoglycemia. The developed logic model did an excellent job of demonstrating the relationships between the proposed concepts and the project overall.

Limitations

There were several limitations that presented themselves over the course of the project. The first limitation included the time needed to obtain permissions and begin the project. There was an extensive amount of time spent communicating back and forth between administrators to obtain permissions to access and collect data, and ensure it was

being done in a manner which best protected patient privacy. Once permissions were obtained from the hospital as well as the institutional review board, data collection could begin which was a timely process.

An additional limitation included the convenience sampling. Initially this was thought to be ideal as the selected subject population had already experienced the intervention and their outcomes could be readily observed. However, due to a change in the hospitals electronic medical record system, there was a limit of how far back the medical records could be accessed. The initial plan was to have 15 months of data for both the pre- and post-glucose gel groups; however, the pre-glucose gel group was limited to six months of data due to this change.

Another limitation posed by the convenience sampling includes the sample size itself. This was possibly the greatest limitation of the project. Due to the pre-glucose gel group being limited to six months of data collection, the sample size was smaller creating an increased risk for data to be misrepresented with higher or lower rates than what may be experienced in a typical 15-month period. An additional sample size limitation was the number of subjects included. Initially the pre-glucose gel group consisted of 56 participants, but after removing infants that did not require treatment, it was not possible to assess IV start rates by risk factor due to some risk factors not having applicable subjects.

Lastly, the retrospective nature of study did pose some limitation. Although the outcomes were available for assessment, there was no additional insights able to be observed in real time such as parental satisfaction, the impact on exclusive breastfeeding,

and time spent at the bedside vs time spent in the nursery. These observations would be interesting to note in future studies.

Implications for Future Research

Glucose gel was found to be effective at decreasing the rate of IV starts for infants classifying as LGA, under 37 weeks gestation and of diabetic/gestational diabetic mothers. However, an increase in IV starts was noted with SGA infants, who actually experienced an increase rate of IV starts. There is no clear explanation for this result, and it should warrant further investigation.

There is a definite need to replicate this study or perform similar studies with larger sample populations. This will increase the validity of the findings. There was a significant amount of data collected that was unnecessary and created confusion when assessing the data. In the future it would be beneficial to focus data collection on infants that needed treatment in both the pre- and post-glucose gel groups. When infants that were considered at-risk but did not require treatment were included in the sample, it created the potential to skew the findings and doesn't provide any insight into the effectiveness of glucose gel itself. Another challenge was the posing of the research questions. The research questions in this project solely looked at effectiveness of glucose gel based on risk factor. It was not realized until data collection that assessing the data based on risk factor alone greatly limited data and sample sizes. Future research would be greatly benefited by studies focused on the use of glucose gel in all at-risk infants regardless of individual risk factor. These studies should be performed at urban hospitals which care for a greater number of patients allowing for large sample sizes to be obtained.

Implications for Practice and Policy

The clinical significance of these findings is particularly important to the newborn patient population, such as those in labor and delivery units. The changes to nursing practice suggested by this project include training and education on the proper use and administration of glucose gel. The gel is primarily administered by nursing staff. The administration consists of massaging gel into the buccal cavity of the infant to allow for rapid absorption. The use of glucose gel is particularly relevant to nurse practitioners working in the neonatal and pediatric fields as they will be highly involved in managing conditions such as neonatal hypoglycemia. It will be pertinent to provide training and education to nursing staff and provider staff to ensure all parties understand how and when to appropriately use the gel and how to dose it correctly.

Educational materials should be updated on the uses and benefits of glucose gel and introduced to the role it serves in the workplace. Educators may also play an essential role in facilitating trainings with staff and providers to ensure competency. Health care policy changes include the use of glucose gel as first line treatment for low glucose levels in newborns. Making this change involves the development of policies such as the one implemented at Hutchinson Regional Hospital which includes an algorithm for the use of glucose gel when an infant's glucose has been screened and is deemed below an established threshold. All these considerations are important to the success of introducing glucose gel as a primary treatment method for neonatal hypoglycemia. The use of glucose gel is still being utilized at Hutchinson Regional hospital where the quality improvement project took place, due to its favorability among parents, staff and pediatricians.

Conclusion

Current literature has supported the use of glucose gel for treatment of neonatal hypoglycemia in several small-scale studies. Although it is gaining popularity as a method of treatment it is not yet the standard of practice. The overall goal of this project was to determine if the use of glucose gel decreased rates of IV therapy for infants at-risk for hypoglycemia (SGA, LGA, Under 37 weeks gestation and of diabetic/gestation diabetic mothers). This project determined that the use of glucose gel successfully decreased rates of IV therapy in large for gestational age infants, infants of diabetic/gestation diabetic mothers, and infants born prior to 37 weeks gestation. An increase in IV starts was noted in the small for gestational age risk group. When assessing only infants that needed treatment, there was a significant decrease in IV start rates when using glucose gel. The findings of this project support the use of glucose gel for at risk infants. Future research should include replication of the project on significantly larger scale to increase validity and support practice change.

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APPENDIX

HUTCHINSON

9/1/2021

To Whom it May Concern,

Hutchinson Regional Medical Center does not object to the use of the de-identified data set by Cassie McCarthy.

Sincerely,

Jill White BSN, RN

Hutchinson Regional Medical Center

1701 E 23rd

Hutchinson, KS 67502

620-513-3535

Appendix B

Chart review: Data collection for statistical analysis

Subject # A – Pre GG B – Post GG	At risk subcategory 1. SGA 2. LGA 3. Under 37 weeks gestation 4. Maternal Diabetes	Was glucose gel used	Was an IV started Yes	Reason for IV start 1. Resuscitation 2. Elevated Bilirubin 3. Antibiotic admin 4. Suspected illness 5. Blood sugar control
1. A or B	1. 2. 3. 4.	1=Yes 2 = No	1=Yes 2 = No	1. 2. 3. 4. 5.
2. A or B	1. 2. 3. 4.	1=Yes 2 = No	1=Yes 2 = No	1. 2. 3. 4. 5.
3. A or B	1. 2. 3. 4.	1=Yes 2 = No	1=Yes 2 = No	1. 2. 3. 4. 5.
4. A or B	1. 2. 3. 4.	1=Yes 2 = No	1=Yes 2 = No	1. 2. 3. 4. 5.
5. A or B	1. 2. 3. 4.	1=Yes 2 = No	1=Yes 2 = No	1. 2. 3. 4. 5.
6. A or B	1. 2. 3. 4.	1=Yes 2 = No	1=Yes 2 = No	1. 2. 3. 4. 5.