Neonatal Epinephrine: Reducing Calculations Errors

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Abstract

Performing the steps of resuscitation is challenging, especially when the patient is a tiny baby. Calculating minute doses of Epinephrine in haste without careful deliberation is stressful when seconds are crucial. Epinephrine calculation errors during neonatal resuscitation of low birth weight and very low birth weight babies can significantly affect outcomes in terms of mortality and morbidity. An extensive review of literature concluded that medication errors in the calculation of Epinephrine during resuscitation can occur when providers rely on memory, lack access to needed information, safety features or standardized procedures (Benner, Sheets, Uris, Malloch, Schwed, & Jamison, 2002; Karlsen, 2006).

A quantitative quasi-experimental pilot research study measured the effectiveness of a researcher-designed Epi Chart©, a pre-calculated intravenous and endotracheal Epinephrine dosage chart, specific to low birth weight and very low birth weight babies weighing less than three kilograms used during neonatal resuscitation. The study comprised of 86 healthcare professionals working in Labor and Delivery, Newborn Nursery, Neonatal Intensive Care, and the Postpartum Unit of a large tertiary center. A significant difference was anticipated in the responses of subjects using the Epi Chart© (experimental group) and subjects relying on memory (control group), when asked the same Epinephrine dosage calculation question.

The results of Chi-square test demonstrated the effectiveness of the researcher designed Epi Chart© in the accuracy of responses in Epinephrine doses in the experimental group at the 0.01 alpha level (99% statistical confidence). The experimental group who used the Epi Chart© had significantly more correct dosages than in the control group (p-value <0.0001). Utilization of this researcher developed Epi Chart© will result in a reduction of medication errors during
neonatal resuscitation. **Keywords: Epinephrine, neonatal resuscitation, medication errors, memory, safety**
# TABLE OF CONTENTS

## CHAPTER 1: Introduction
- Background of the Problem ........................................................................... 8
- Problem Statement ............................................................................................ 10
- Purpose Statement ............................................................................................ 10
- Research Question ........................................................................................... 10
- Definition of Terms .......................................................................................... 10
- Theoretical Framework ..................................................................................... 11

## CHAPTER 2: Review of Literature
- Introduction ........................................................................................................ 13
- State of the Science .......................................................................................... 14
- Epinephrine ......................................................................................................... 15
- Medication Errors ............................................................................................. 15
- Related Research ............................................................................................... 18
- Unique Instruments ........................................................................................... 19
- Topic Difficulties ............................................................................................... 20
- Strengths and Weaknesses ................................................................................. 21
- Ideas and Approaches ....................................................................................... 25
- Delphi Technique ............................................................................................... 29
- Summary ............................................................................................................ 30

## CHAPTER 3: Methodology ................................................................................. 33
- Design ................................................................................................................. 33
- Sample ................................................................................................................ 33
- Setting ................................................................................................................. 34
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Results</td>
</tr>
<tr>
<td>5</td>
<td>Discussion</td>
</tr>
<tr>
<td>6</td>
<td>References</td>
</tr>
<tr>
<td>7</td>
<td>Appendix</td>
</tr>
<tr>
<td></td>
<td>A. NRP Algorithm</td>
</tr>
<tr>
<td></td>
<td>B. Epi Chart®</td>
</tr>
<tr>
<td></td>
<td>C. Delphi Panel of Experts</td>
</tr>
<tr>
<td></td>
<td>D. Demographics and Scenarios</td>
</tr>
<tr>
<td></td>
<td>E. Written Solicitation</td>
</tr>
<tr>
<td></td>
<td>F. Statement of Participation</td>
</tr>
</tbody>
</table>
G. Written Script ................................................................. 81
H. Scenario Answers Key ....................................................... 83
Chapter 1

The most vulnerable time in a person’s life is as a patient. During illness or injury the patient is at the mercy of the healthcare providers coordinating and administrating procedures and medications within a complex health system and with multiple interfacing staff (Karlsen, 2006). The Institute of Medicine (1999) proclaimed “to err is human”. However, error often results in incident, injury and sometimes death (Bates, Cullen, & Laird, 1995; Lee, Cousens, Wall, Niermeyer, Darmstadt, Carlo, & Lawn, 2011; Meaney, M. 2004; O’Donnell, Gray, & Rogers, 1998). Those incidents may require the implementation of cardiopulmonary resuscitation (CPR) (Topjian, Berg, & Nadkarni, 2008). The resuscitation of a neonate is considered the most complex (Broselow, Luten & Schuman, 2008; Broussard, 2010; Dennison, 2007; Kattwinkle, 2011; Lee et al., 2011).

According to the Emergency Nurse Association (ENA) a neonate is a newborn baby, defined from birth to twenty eight days of life or twenty eight days after the due date (Emergency Nurse Pediatric Course, 2005). Resuscitation of infants and children according to Pediatric Advanced Life Support (PALS) 2010 guidelines requires ventilations and chest compressions to be of high quality, intubation and vascular access to be obtained in less than two minutes and in addition Epinephrine doses are required and must be calculated and administered accurately for best outcomes. Epinephrine, is a powerful vasopressor, and when administered in the presence of high quality CPR, will help reestablish blood flow to the heart and brain (Jukkala, & Henly, 2009; Kattwinkle, 2011).

The process of resuscitation moves more quickly when the pediatric patient is a neonate. The Neonatal Resuscitation Program (NRP) guidelines (2010) requires the neonate to be re-evaluated every thirty to sixty seconds during the resuscitation process before proceeding to the
next level of advanced treatment. The NRP time frame is one minute faster than the standard for infants (older than 28 days) and pre-pubescent children. Team collaboration is a crucial element in a resuscitative effort and would be helpful in verifying precision to rapid patient response procedures, if time permits (Sredl, 2006).

To ensure accuracy of intervention in pediatric resuscitation, PALS (2010) advocates resources such as; the Pocket PALS reference card and the Broselow Tape (Broselow et al., 2008). The standard of practice is the use of the Broselow Tape, a length/weight based measurement tool that correlated written pre-calculated medication doses, joules for electrical therapy and equipment sizes to the size of the infant/child (Schuman, 2007). Pre-calculated intravascular and endotracheal Epinephrine doses, in exact milliliters were prescribed on the Broselow Tape for patients weighing three to thirty six kilograms (Broselow et al., 2008).

Most neonatal resuscitation occurs in premature and small for gestational age infants weights of less than three kilograms (3000 grams). However, those weights were not included on the Broselow Tape (Hosokawa, 2011). Without the availability and use of written pre-calculated references, medications, such as Epinephrine, administered in emergencies, may result in serious life threatening calculation errors (Broselow et al., 2008).

In a large metropolitan medical center in a mid western city, a neonatal resuscitation expert reviewed all neonatal resuscitation records as part of the American Heart Association (AHA) data collection of life-saving events. Medication errors in the doses of Epinephrine administration during neonatal resuscitation were discovered. Incorrect Epinephrine dosage amounts were administered via both intravascular and endotracheal modes. The majority of Epinephrine errors occurred in the very low birth weight newborns weighing less than 1500 grams and the errors were made by both experienced physicians and nurses. The patient’s
medical record could not specify the NRP training status of the resuscitation team. The medical charts reviewed indicated that all Epinephrine dosage errors were ordered by experienced physicians and administered by experienced nurses.

**Problem Statement**

The problem was that Epinephrine calculation errors during neonatal resuscitation of low birth weight and very low birth weight babies can significantly affect outcomes in terms of neonatal mortality and morbidity. Therefore the research study was needed.

**Purpose Statement**

The purpose of this research study was to determine if the utilization of a researcher developed pre-calculated intravenous and endotracheal Epinephrine dosage chart, specific to low birth weight and very low birth weight babies weighing less than three kilograms, used during neonatal resuscitation reduced medication errors.

**Research Question**

Does the utilization of the pre-calculated intravenous and endotracheal Epinephrine Dosage Chart reduce medication errors in neonatal resuscitation?

**Definition of Terms**

Epinephrine: Also known as Adrenalin is the medication indicated by the Emergency Cardiovascular Care (ECC) 2010 guidelines, to be given during resuscitation to increase myocardial and brain perfusion.

Epi Chart©: A researcher developed mathematically pre-calculated reference to accurate Epinephrine dosage specific to neonatal weights less than three kilograms.

Medication errors: Errors that occur during the prescribing, preparing and administering phase of medication delivery (Wheeler, Remoundos, Whittlestone, House, & Menon, 2004).
Bag-Mask ventilations: A hand-held piece of equipment used to provide positive pressure ventilations, with or without oxygen, to a patient requiring resuscitation (NRP, 2010 guidelines).

Low birth weight: A neonate weighing less than 2500 grams, may or may not be associated with prematurity (March of Dimes Peristats, 2012).

Very low birth weight: A neonate weighing less than 1500 grams and associated with prematurity (March of Dimes Peristats, 2012).

Root Cause Analysis: A step by step problem solving technique used to identify the origin of a critical event or set or errors (Benner, 2001).

Surfactant Deficiency: Surfactant is a filmy little substance produced at the lower end of the bronchus inside the alveolar sacs. Surfactant begins to be produces around 34 weeks of gestation and is used in ventilation or gas exchange of breathing (NRP, 2010). Surfactant deficiency is a major cause of neonatal respiratory distress syndrome common in prematurity (Karlsen, 2006).

**Relevant Conceptual Framework**

The model, posited by Benner et al., (2002) “Individual, practice, and system causes of error in nursing; a taxonomy” identified medication errors as a chief threat to patient safety. Epinephrine is listed as a high alert medication and supports the incorporation of protocols, charts and simple standardized processes as decision aids to eliminate the reliance on memory and reduce calculation errors (Benner et al., 2002; Bernius et al., 2008; Broselow et al., 2008; Karlsen, 2005). The conceptual framework for this research study stemmed from the breakdown of nursing errors derived in the taxonomy of patient safety (Benner, Sheets, Uris, Malloch, Schwed, & Jamison, 2002). Individual, practice, and system causes of errors in nursing were evaluated in 21 different cases from nine different state boards of nursing to develop categories of possible nursing causes and the contributing factors. “Medication errors”, reported Benner et
al., (2002, p.512) were deemed as a cause for unsafe patient care. Inserted in the taxonomy (Benner et al., 2002) was the American Pharmaceutical Associations (APA, 2007) list of high alert medications which included the drug Epinephrine, the focus of this research study.

Benner et al. (2001) used the engineering approach, of root cause analysis, to determine healthcare situations that lead to mistakes, and affirmed development on effective methods of prevention (Benner, et al., 2002). Predominant causes which qualified use of error reduction strategies were: reliance on memory, lack of information access, error-proof processes and standardized tasks (Benner et al, 2002, p. 511). During a resuscitative event, memory is considered fallible and subject to grave error and contraindicated in drug calculations (Broselow et al., 2002; Karlsen, 2005). Obtainable information and safe guards are the security to eliminating calculation errors and should be created and routinely used for dangerous procedures and high alert medications (Benner et al., 2002; Bernius et al., 2008; Broselow et al., 2008).

Benner’s theory transforming novice nurses to expert providers has relevance to this proposed research. As nursing practice examines errors, develops strategies, researches and implements practice change to improve outcomes, the individual and professional identity of nursing is esteemed (Benner, 2001; Cronenwett, Sherwood, Barnsteiner, Disch, Johnson, Mitchell, et al. 2007). However; the co-authored taxonomy of patient safety and philosophical thinking on error reduction strategies is what forms the bases of knowledge for this research study on Neonatal Epinephrine: Reducing Calculation Errors (Benner et al., 2002). Therefore the conceptual framework of the 2002, taxonomy of patient safety was specific to the problem and research question projected by this research study.
Chapter 2: Literature Review

Errors in healthcare have been escalating to epidemic proportions (Institute of Medicine, 1999) and were recently considered the eighth leading cause of death (Riley, 2009). These errors cost the United States government approximately 38 billion dollars annually (Chenot & Daniel, 2010). Medication errors were the most common medical mistakes identified (Broussard, 2010).

Medication administration was traditionally viewed as a nursing responsibility. Nurses relied on physicians for accuracy in the ordering of medications. However, Broselow et al, (2008) argued “prescribing error rate of experienced attending pediatricians at medical centers was only exceeded by first year interns” (p.35). Errors in medication calculations were made by experienced physicians and nurses much too often (Papastrat & Wallace, 2003; Wheeler et al., 2008). Medication practice errors not only adversely affect patient safety but, “damage the profession of nursing” reported Benner et al., (2002, p. 154). Medication errors frequently occur in pediatric and neonatal intensive care units, where patient care is complex and patients are most vulnerable (Benner, 2001; Broselow et al., 2008). Weight-based and fractional doses calculated for neonates, infants and children have been identified with the highest incidence for error and adverse outcomes (O'Donnell, Gray, & Rogers, 1998).

Multiple computerized data bases: CINAHL, Health Source: Nursing/Academic Edition and Medline from Ebscohost were utilized to obtain a comprehensive review of the literature. The key topics investigated were neonatal resuscitation, Epinephrine and medication errors. The investigated topics were synthesized through the subheadings of: state of the science, relationship to previous research, unique approaches to overcoming calculations, topic
difficulties, strengths and weaknesses, new ideas and the gap in knowledge. Topics consistently discussed were: reliance on memory, lack of accessible information, lack of security systems for high risk procedures and medications and the lack of specific standardized safety processes.

State of the Science

One hundred and thirty-six million babies were born in the world each year. Approximately ten million neonates required some form of resuscitation (Lee, et al., 2011). Epinephrine (adrenalin) was the drug of choice in resuscitation and was recommended for neonatal use by the American Academy of Pediatrics and American Heart Association in the Neonatal Resuscitation Program (NRP) guidelines, (2010). The International Liaison Committee on Resuscitation (ILCOR) researches and updates the guidelines every five years. Epinephrine calculations and administration errors were frequently identified in the literature and were considered common (Bernius, et al., 2008; Broselow et al., 2008; Broussard, 2010; Karlsen, 2005).

NRP is the practice standard for all medical, nursing and respiratory providers working in neonatal settings, and NRP training is recommended within six months of employment (Karlsen, 2005; Kattwinkel et al., 2011; Lee et al., 2011; Jukkala & Henly, 2009; Lemoine, & Daigle, 2010; Neal, Stewart & Grant, 2008). NRP guidelines provide the standards for the administration of Epinephrine and suggest that resuscitation (mock code) training should be practiced every two weeks to six months and outcomes evaluated to improve processes in the neonatal setting (Lemoine & Daigle, 2010). The NRP algorithm (see Appendix A) directs the use of Epinephrine in specific sequence of resuscitation events if the:

- newborn was apneic or gasping or has a heart rate less than 100 beats per minute positive pressure ventilations (PPV) must begin.
• heart rate is re-evaluated after 30 seconds of effective PPV

• heart rate is less than 60 beats per minute chest compressions are initiated in conjunction with positive pressure ventilations

• cardio pulmonary resuscitation (CPR) is performed for 45-60 seconds

• If the heart rate remains below 60 beats per minute after 45-60 seconds of CPR, Epinephrine is administered via the umbilical vessel or endotracheal route (NRP, 2010 guidelines).

Approximately two minutes from the initiation of chest compressions, Epinephrine administration is recommended (NRP, 2010). The state of science is precise to the process of neonatal resuscitation and to the administration of the drug of Epinephrine itself (Lee et al., 2002-2011; Jukkala & Henly, 2009; Lemoine, & Daigle, 2010).

Epinephrine

Epinephrine, a powerful vasoconstrictive medication, accompanied by high quality CPR, could increase systemic vascular resistance and improve blood flow supporting myocardial function and cerebral blood flow (O’Donnell, et al. 1998; Topjian et al., 2008). The dose of Epinephrine was 0.1-0.3 ml/kg (0.01-0.03 mg/kg) of body weight in a 1:10,000 concentration administered in the preferred umbilical venous catheter followed by 1-3 milliliters of sterile normal saline (Kattwinkel et al., 2011; NRP, 2010). When the only available route for Epinephrine administration was the endotracheal route, the dose of Epinephrine was five times higher (0.5-1.0 ml/kg) followed by normal saline (0.5-1 ml) and positive pressure ventilations (Kattwinkel et al., 2011; NRP, 2010). Epinephrine was administered every 3-5 minutes until a heart rate greater than 60 beats per minutes was established. The timeline during resuscitation for
the invasive procedures of intubation or venous access was less than 45-60 seconds to administer the first dose of Epinephrine (NRP, 2010 guidelines).

Epinephrine 1:10,000 concentrations were available in a pre-filled, single use (10 ml) syringe formulated and packaged for adult doses of 1.0 mg/10 ml (Broussard, 2010). A multi-step process from preparation to administration of Epinephrine in less than 45-60 seconds included the following; while CPR was in process and vascular access or intubation occurred:

- weighing or guesstimating neonatal weight
- converting pounds to kilograms (if measured in pounds)
- calculating weight (kilograms) to milligrams of Epinephrine
- converting milligrams of Epinephrine to milliliters
- transferring Epinephrine from adult pre-filled syringe to a 1.0 ml TB syringe
- administrating the correct amount of Epinephrine for vascular or endotracheal amounts (each have different doses)
- flushing the venous catheter or endotracheal tube with sterile normal according to the route administered (NRP, 2010 guidelines).

Although there was consensus in the literature pertaining to the dosing requirements there were controversies regarding medication availability packaged for adult dosing (Bernius et al., 2008; Broselow et al., 2002; Kattwinkel et al., 2011).

Epinephrine, though powerful was critically dangerous. NRP (2010) guidelines, warned providers to never administer doses higher than 0.1 – 0.3 ml/kg of Epinephrine intravenously. O'Donnell, et al. (1998) reported that infants less than 29 weeks gestation, receiving Epinephrine in large doses, were particularly vulnerable to adverse outcomes such as neurodevelopmental disabilities and death. Low birth weight neonates (less than 2500 grams or 5 ½ pounds) were
more commonly associated with morbidities and illness requiring resuscitation (Broselow, et al. 2002, March of Dimes, 2012). Neonates weighing less than 2500 grams received tiny volumes of Epinephrine, which was less than 0.5 mls for vascular administrated routes (Brousard, 2010).

The Institute for Safe Medication (2011) warned that approximately 20 drugs, including Epinephrine, were responsible for 80% of medication error fatalities. The instruction for the use of Epinephrine in a neonatal resuscitation was precise (Kattwinkel et al., 2011; NRP, 2010). The time frame for best outcomes from administration of Epinephrine was to administrate the drug after 60 seconds of high quality chest compression and ventilations (NRP, 2010). Preparation for complex calculations of Epinephrine must be anticipated and collaborated by a neonatal team (Benner et al., 2002; Broselow et al., 2008; Broussard, 2010; Chenot & Daniel, 2010; Cronenwett et al., 2007; Dennison, 2007; Hronek, & Bleich, 2002; Jukkala & Henly, 2009; Karlsen, 2005; Murray, Douglas, Girdley & Jarzemsky, 2010; Neal et al., 2008). Epinephrine has remained a high alert drug, (Institute of Safe Medicine Practices, 2011) and required mathematical protection techniques to ensure accuracy. However, no studies were located regarding neonatal Epinephrine calculation errors (Benner et al., 2007; Broselow et al., 2008; Bernius, 2008; Dennison, 2007, Zino, 2011).

**Medication Errors**

Diaz, (2008) and Brousard, (2010) reported mistakes regarding medications were due to defective processes and systems, as well as work conditions that were not supported within a coalition of quality patient care. Bates, Cullen, and Laird (1995) noted that 90% of preventable errors were the result of initial errors in the ordering phase of the administering medication. Antecedent causes of medication errors that were questioned in the taxonomy of patient safety (Benner, et al. 2002); were rooted in the historical culture of nursing. Traditionally nurses
assumed the medication orders to be correct from the physician; not considering physician stress or anxiety in an emergency (Benner, et al., 2002). Nurses were also placed in critical decision making roles and leading more acute situations including administering the drug Epinephrine (Spunt et al., 2004).

Multiple studies reported that calculating weight-based drugs for pediatric patients was difficult with minimal safety features in place (Benner et al., 2002; Bernius, 2008’ Broselow et al., 2008; Dennison, 2007; Lee, 2011; Lemoine, & Daigle, 2010; Riley, 2009; Spunt, Foster, & Adams, 2004; Wheeler et al., 2008; Zino, 2011). Complex expressions of Epinephrine, small volumes and several step computations, created obstacles to producing correct doses in the limited timeframe (Broselow et al., 2008; Broussard, 2010; Pentin, & Smith, 2006). Root causes of nursing errors were; reliance on memory, unavailable information or resources, lack of safety techniques for accurate weight-based doses and need for a standardized process (Benner et al., 2002; Bernius, 2008; Broselow et al., 2008; Dennison, 2007; Lee, 2011; Lemoine & Daigle, 2010; Riley, 2009; Spunt, Foster, & Adams, 2004; Zino, 2011). The model of patient safety according to Benner et al. (2002), implored providers to scrutinize mistakes and develop processes focused on quality care and patient safety. Although no studies were found exclusively addressed neonatal Epinephrine calculation errors, all evident in the literature related research regarding pediatric Epinephrine calculations errors was available.

**Related Research**

Medication administration was shown to be the responsibility for error reduction and the development of strategic plans were assumed to be a primary function of the individual and/or nursing organization (Benner, et al. 2002). Papastrat and Wallace (2003) studied nursing students by addressing the responsibility of ensuring safety in medication administration during
clinical practice. The researchers utilized the principles of problem-based learning (PBL) theory as the framework to support an interactive learning model. Baccalaureate nursing students were encouraged to be creative, investigate options, develop hypothesis, use research, prose solutions to medication error problems (Papastrat & Wallace, 2003). The PBL theory developed solutions to actual clinical problems and was an alternative to punitive action for medication infractions. The PBL theory was similar to the conceptual framework used in the taxonomy of patient safety and root cause analysis. Both research studies analyzed causes for mistakes and development of strategic plans focusing on quality care and patient safety (Benner et al., 2002; Papastrat & Wallace, 2003).

Bernius et al., (2008), argued the difficulty in calculating pediatric weight-based drug doses and proposed the use of a protocol specific pediatric code card for pre-hospital practice. The emergency medical study addressed the same issues in the taxonomy of patient safety by reducing reliance on memory, increasing access to information, creating safety techniques and standardized processes for high risk procedures and medications (Benner et al., 2002; Bernius et al., 2008). The pre-hospital healthcare providers developed pre-calculated information, pediatric weight-based drug doses and equipment sizes, to have readily available as a safeguard to reduce mistakes in pediatric calculations (Lee, 2011). Bernius et al. (2008) concluded the use of the pediatric code card allowed providers to determine correct equipment sizes, joules for defibrillation and drug doses without performing any calculations more accurately than peers without access to the code card. Organization or system flaws lead to harm not individual errors (Bernius et al. 2008). However, individual errors did occur.

Wheeler et al., (2004) observed British medical student’s anxiety about ordering wrong volumes of Lidocaine and Epinephrine (the focus of this study). Concerned that a lack of formal
training on mathematical computations for drug dosing may result in deficiency, the researchers developed a web-based multiple choice examination (Wheeler et al., 2004). The research study asked 168 medical students three questions regarding the concentrations of Lidocaine and Epinephrine. The results indicated a significant majority of medical students were unable to calculate medications correctly (Wheeler et al., 2004).

Wheeler et al., (2008) charged that converting ratios, percentages, micrograms and milligrams appeared simple but was difficult and proposed that emergency drug calculations must be made easy. A randomized, single-blinded controlled trial used ampules of Epinephrine and emergent pediatric scenarios for anaphylaxis. Each scenario forced a calculation situation. The findings concluded that physicians were more likely to give a wrong dose when the medication was expressed in a ratio and delayed calculations (Wheeler et al., 2008). Broselow et al., (2002) agreed that when physicians are hurried, such as during resuscitation, the potential for calculation error and patient injury exists.

Hosokawa (2011) agreed that resuscitation should be made simple but without compromise to the standards of NRP. In a research study measuring the confidence obtained after NRP training, Hosokawa (2011) took NRP to caregivers in Mongolia. Where inadequate equipment and medication existed, simple standardized knowledge and skills for neonatal resuscitation were taught. NRP increased confidence, knowledge and techniques through simple standardized training and procedures Hosokawa (2011). Numerous studies related to resuscitation and Epinephrine calculations indicated simple approaches for safety techniques were needed to be developed (Benner et al., 2002; Bernius et al., 2008; Broselow et al., 2002; Hosokawa, 2011; Karlsen, 2005; Wheeler et al., 2008 ).
Unique Instruments

The Broselow Tape, a length/weight based pediatric emergency reference guide, has been the most widely used design for locating correct Epinephrine doses, joules of electricity for defibrillation and synchronized cardio version, endotracheal tube and laryngoscope blade sizes, for pediatric emergencies (Bernius et al., 2008; Broselow et al., 2008). The pediatric length and weight-based measurement was designed to correlate with a color coded schematic of the accessible information created to improve patient safety by the reduction of chaos and happenstance of memory reliance (Benner et al., 2002). The highly acclaimed Broselow Tape provided healthcare practitioner with the desired information and is a staple with many pre-hospital transport services (Schuman, 2010).

The Broselow system expanded to include color coded crash carts that correlated the same color drawers of equipment and medications for specific pediatric sizes (Broselow et al., 2002). The Broselow design allowed the provider accessible information that increased safety in a simple, standardized process reducing reliance on memory (Broselow et al., 2008; Schuman, 2007; Benner et al., 2002; Karlsen, 2005).

Advances in technology have been responsible for the development of the e-Broselow system and has been described as the wave of the future (Chenot, & Daniel, 2010; Cronenwett, Sherwood, Barnsteiner, Disch, Johnson & Mitchell, 2007). The e-Broselow system was initiated from the original Broselow emergency length and weight based colored-coded tape, and transferred to the computerized version (Broselow et al., 2008). Designed for large screen monitor viewing in emergency departments, the e-Broselow will broadcast correct doses, equipment sizes and alarm for time interval medication. The e-Broselow system provided resources to eliminate memory reliance and places crucial information in the area needed
(Benner et al., 2002). The e-Broslow in prototype was reviewed as a very efficient system with marked reduction in resuscitation error and projected for market in late 2011.

Another reference technology was designed by Precision Dynamics Corp (2005) designed color-coded wristbands to help clinicians deliver pediatric drugs and equipment safer and quicker. The Pediatric Code Readiness system, (Precision Dynamics Corp, 2005) provided security by referring providers to a reference list of pre-calculated drug doses and infusion rates. The Pediatric Code Readiness system was so successful that the product later developed into medication and equipment pouches to coordinate with the Broselow tape color code. The super wristbands reduce reliance on memory and provide a safety net for patient care, but do not indicate references for low birth weight neonates (Broselow et al., 2008).

Pediatric medications that are administered to the neonate based on weight (milligrams or milliliters per kilograms) and are challenging to calculate and can be dangerous even in small discrepancies. Sredl (2006) reminded clinical nurses that a good standard of nursing/medical practice was recognizing and determining safe therapeutic dose range before administering medication. In response to nursing student’s complaints about math anxiety, the Triangle Technique was developed for teaching pediatric medication calculations. The Triangle Technique was grounded in adult learning principles of education and a simple format to identify pediatric therapeutic range (Sredl, 2006).

Review of literature noted numerous unique ideas for providing information, methods for eliminating the reliance on memory and uses of simple standardized processes like the Broselow and related systems, Pediatric Emergency Code Cards, Triangle Technique and use of a calculator (Bernius et al., 2008; Broselow et al., 2002; Precision Dynamics Corp., 2005; Pentin & Smith, 2006). However unique the approaches for pediatric emergencies, the absence of
reference tools for pre-calculated Epinephrine in low birth weight neonates continued to be an obstacle (Bernius et al., 2008; Broselow et al., 2002; Lee et al., 2010; Precision Dynamics Corp (2005; Srdl, 2006). Exploration of this subject obstacle was essential to utilizing root analysis.

**Topic Difficulties**

A continuous topic challenge was the level of acuity required to care for a neonate in resuscitation situation (Brousard, 2010). Critically ill babies in neonatal intensive care units, and those receiving intravenous medications, were more likely to have detrimental consequences (Broselow et al., 2008; Broussard, 2010; Dennison, 2007; Lee et al., 2011). Extremely premature neonates less than 28 weeks gestation and very low birth weights less than 1500 grams were described as more acute with surfactant deficiency, limited thermo regulation and immature brain function resulting greater incident for resuscitation and the consequences thereof (March of Dimes peristats, 2012; Karlsen, 2005; Kattwinkle, 2011; Lee et al., 2011). Basic resuscitation training and poor communication was lacking among staff members who did not know how to use bag-mask ventilation or who were not trained in the NRP protocol (Lemoine, & Daigle, 2010; Murray, Douglas, Girdley, & Jarzemsky, 2010; Neal, Stewart, & Grant, 2008).

Dennison (2007) noted that additional pressure was placed on the clinical nurses to obtain knowledge and skills beyond the status quo to work in neonatal settings in order to respond to critical situations (Benner et al., 2002; Cronenwett et al., 2007; Neal, 2008; Papastrat & Wallace, 2003; Spunt, Foster & Adams, 2004). The review of literature noted that nursing practice was more directly involved in patient care and could more readily intervene in emergent situations and immediate decision making (Benner et al., 2002). A heavy responsibility for nurses was the liability for carrying out inappropriate orders. However, the presence of direct care nurses could avert practice breakdown (Benner et al., 2002). The lack of mathematical skills to accurately
determine drug management was a topic difficulty and cause of medication errors. “Nurses need to be aware of their own mathematical ability” and a calculator may or may not be the answer (Pentin & Smith, 2006, p.780).

A paucity of data collection, a tool for practice modification, was a topic challenge for the subject of neonatal medication errors (Benner et al., 2002). Medication mistakes were grossly under reported by physicians, nurses and pharmacists (Broselow et al., 2008). “Quality improvement begins and ends in data collection” says Murray et al. (2010, p.467). Errors must be reported promptly and responsibility must be assumed for quality improvement (Murray et al., 2010).

Dennison (2007) argued organization systems should support a non punitive culture, yet remain an atmosphere that adheres to policies and procedures. Healthcare organizations which demonstrated support from formal (management) and informal (clinical instructors) leaders and a job climate promoting new ideas also demonstrated a pattern of change in knowledge (Benner, et al. 2002; Diaz, 2011). However, according to Dennison (2007), knowledge did not necessarily produce a change in practice. Environments that stimulated creativity were more likely to produce quality improvement processes, and documentation of strategic implementation for change was the data needed (Murray et al., 2010).

The time frame in which the neonatal Epinephrine doses were to be administered continued to be a topic obstacle (Broselov, 2008; Dennison, 2007; Kattwinkle, 2011; Lee et al., 2011; NRP Guidelines, 2010). The potential for Epinephrine dosing was in 45-60 seconds after the initiation of chest compression. Accessing an umbilical vein for catheterization or intubation of the trachea took time and expertise (Neal, 2008). Patient acuity and environment conditions can inhibit the process of securing a route for the administration of Epinephrine in the optimal
timeframe (Broselow, 2008; Dennison, 2007; Kattwinkle, 2011; Lee et al., 2011). The availability of Epinephrine manufactured and packaged specifically for adult patients accelerated the preexisting stress and anxiety of calculating the medication. Drug doses and equipment sizes were accessed faster and more safely with information references designed for patient populations (Broselow et al., 2002; Precision Dynamics Corp., 2005). Multiple studies described unique approaches and numerous topic difficulties, yet an assessment of the overall merits and limitations of the available literature must be discussed (Bernius et al., 2008; Broselow, 2008; Dennison, 2007; Kattwinkle, 2011; Lee et al., 2011; Neal, 2008; Pentin & Smith, 2006).

**Strengths and Weakness**

Neal et al., (2008), proposed in their study of rural hospitals, that nurses could be taught skills by apprenticeship. In outlying facilities, pediatricians are often not readily available for neonatal emergencies and nurses were often as proficient as physicians at the low risk skills of stimulation, assessment and positive pressure ventilation of the newborn (Neal et al., 2008). Therefore, difficult situations should not have been a surprise. The majority of neonatal resuscitation should be anticipated by the healthcare providers by reviewing maternal risk factors (Karlsen, 2006). Hosokawa, (2011), declared neonatal teams must be well trained, prepared for any anticipated event and work collectively, succinctly and simultaneously to achieve the desired neonatal response.

Neonatal resuscitation is a standard of practice for all persons who work in neonatal settings. These individuals include: nurses, midwives, respiratory therapist and physicians (Hosokawa, 2011; Karlsen, 2005; Lemoine & Daigle, 2010; Neal et al., 2008; Spunt Foster, & Adams, 2004). Kattwinkel et al., (2011) and Lee et al., (2011) noted that NRP is not the practice of neonatology but rather the discipline of the neonatal resuscitation program guidelines with
evidence-based outcomes. Learning by repetitive scenarios practice, video feedback, simulation and debriefing has been recommended as an effective technique for retaining cognitive skills (Lemoine & Daigle, 2010; Foxhall, 2010; Kilmon, Brown, Ghosh, & Mikittuk, 2010; NRP, 2010; Spunt et al., 2004).

Hosokawa’s (2010) participants after being involved in mock code training reported feeling more confident and secure about the life-saving protocols used in their clinical area. Healthcare providers experienced extreme challenges in delivery rooms. Such challenges included coordinating resuscitation efforts with team members lacking in NRP training and practice. These factors often result in unsafe patient care (Chenot & Daniel, 2010; Cronenwett et al., 2007; Hosokawa, 2011; Karlsen, 2006; Lemoine & Daigle, 2010; Murray et al., 2010). Studies did not specifically indicate how frequent mock code practices were occurring but the lack of neonatal resuscitation training was problematic (Spunt, 2004).

Underutilization of ethics committees for addressing the culture of blame was a unique approach of cause identification (Meaney, 2004). Diaz (2011) advocated focusing on the development of domains of quality rather than finding fault. Karlsen (2006) noted that human mishap, the occurrence of medical, nursing or system errors involved a complex entanglement of issues. Diaz (2008) proposed system groups; risk management, compliance, administration, clinical educators and healthcare providers, should merge with the ethics committees for problem solving and redesigning of safe nursing cultures. Meaney (2004) agreed that all stakeholders should share in the common values and beliefs of error reduction and improvement of client outcomes.

Another strength reported was the high-reliability theory organizational team design (Riley, Davis, Miller, & McCullough, 2010). High-reliability concepts that noted the traditional
practice of autonomy (physician rule) led to medical errors. The autonomous practice of a one-way communication team was especially prevalent in perinatal areas such as labor and delivery and NICU (Riley et al., 2010). Team collaboration suggested mutual respect and accountability for reduction of errors (Chenot & Daniel, 2010; Cronenwett et al., 2007; Murray et al., 2010; Karlsen, 2005; NRP guidelines, 2010). Quality, safety, education in nursing known as QSEN, an education framework, also supports the high-reliability concept of team collaboration for improving patient safety through error reduction (Cronenwett et al., 2007).

Other strengths conveyed were the non-technical abilities such as team collaboration and communication. Team collaboration was more crucial to producing safe practices (Diaz, 2011). Interprofessional teams was the new phrase, for describing the Institute of Medicine’s charge (2010) to the healthcare community to take ownership of individual profession and purpose to work, train and effectively communicate a union of quality and safe care (Chenot & Daniel, 2010; Cronenwett et al., 2007; Diaz, 2010; Karlsen, 2005; Murray et al., 2010). The high reliability system (HRS) of cognitive processing and interpersonal dynamics supported more technical skills (Riley et al., 2010). There were many ideas and approaches discovered in the literature regarding utilization of Neonatal Epinephrine: and Reducing Calculation Errors, but a reliable tool to utilize clinically to reduce error was not discovered appropriate for emergency care of the neonate (Chenot & Daniel, 2010; Cronenwett et al., 2007; Diaz, 2011; Hosokawa, 2011; Karlsen, 2006; Lemoine, & Daigle, 2010; Meaney, 2004; Murray et al., 2010; Neal, 2008; Riley et al., 2010).

**Ideas and Approaches**

Broussard, (2010) a neonatal nurse, suggested that perhaps we should stop counting medication errors and instead invest time developing strategies that were process-oriented and to
create non-formal quality unionization in healthcare organizations (Diaz, 2011, p. 475).

Strategies should be actionable and prevention focused for organizations to be highly reliable (Riley, 2009). A contemporary approach to a sphere of merit was the amalgamation of leadership with the educational paradigm shift (Chenot & Daniel, 2010). Utilizing frameworks such as quality, safety education in nursing (QSEN) would encompass the competencies of patient-centered care, teamwork, collaboration, evidenced-base practice, quality improvement, safety and informatics, (Chenot & Daniel, 2010; Cronenwett et al., 2007; Murray et al., 2010). These authors also encouraged officiating boards of health, directors, managers and clinical instructors to be held accountable for meeting safety goals by implementing practice changes to ensure the quality care was delivered.

Quality improvement strategies were lacking among the inter-professional education curriculums (Chenot & Daniel, 2010; Cronenwett et al., 2007; Murray et al., 2010). New approaches to quality improvement included the facilitation of students from healthcare professionals and related disciplines (medicine, respiratory, pre-hospital and nursing) learning together about improving quality via working effectiveness (S.E. Plunkett, personal communication, December 1, 2011). Stimulus monies for hospital reimbursement will be dependent on new approaches to quality care (Plunkett, 2011) as Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) publically report survey findings. Quality improvement could be obtained by alternative methods for resuscitation training seeded in science fictional simulation technology (Kilmon, Brown, Ghosh, & Miktuk, 2010). Educational opportunities for learning competencies were seen in virtual realms such as the highly individualized stimulations called Second Life or full scale simulations resulted in feasible alternatives to current scenario practices (Kilmon el al., 2010).
New strategic system wide computerized application programs such as Computerized Patient Order Entry (CPOE) that were programmed to recognize and prevent dosing errors were especially helpful (Chenot & Daniel, 2010; Cronenwett et al., 2007). Multiple researchers indicated that simple standardized processes to eliminate reliance on memory and make information readily available had minimal expense such as: check lists, protocols, and decision aids could be created to ensure patient safety (Bernius et al., 2008; Brenner et al., 2002; Broselow et al., 2002; Karlsen, 2006; Lee et al., 2010). Simple or complex processes should be in place to protect innocent infants and children from adverse consequences of error in drug therapy (Benner et al., 2002; Bernius et al., 2008; Broselow et al. 2008; Hronek & Bleich, 2002; Karlsen, 2005). In the absence of population specific references, security techniques must be developed and validated for accuracy and safe usage (Hannah, 1998).

**Delphi Technique**

The Delphi technique or method was a means of achieving agreement on an issue or newly developed instrument commonly used to validate or perform nursing research (Keeney, Hasson, & McKenna, 2006). According to Burns & Grove (2009) the Delphi technique is implemented for the purpose of decision making by measuring the opinions of experts regarding the subject of interest. The term “Delphi” comes from the Greek oracles for which the Greek sought regarding advice about the future and remains applicable to current research practices (Wiener, Chacko, Brown, Cron, & Cohen, 2009). Hannah (1998) described the process of instrument development as a sequence of steps that arose from the thorough review of the literature denoting pertinent concepts. The conceptual framework created the building blocks (constructs) of the tool and was validated by a panel of experts (Hannah, 1998).
The collaboration of experts was determined by the needs of the researcher, and were persons in decision-making positions who could contribute relevant knowledge to the subject or research. Panel members remained anonymous from each other and were contacted by the researcher to complete a means of open-ended questions for feedback or questionnaires (Burns & Grove, 2009). Information received from the experts was evaluated by the researcher and used to amend the newly developed tool until a consensus of expertise was achieved. A benefit of the Delphi method to establish instrument reliability attainment was that expert opinions and suggestions were individual and a dominant persuasion could be deferred (Keeney, Hasson, & McKenna, 2006).

The Delphi method of validation was a time and cost efficient technique for the input and agreement of experts (Wiener, Chacko, Brown, Cron, & Cohen, 2009). Limitations to the Delphi technique include definition of “expert”, number of panel members, and criteria for consensus development. Most experts concur that a variable is best measured by a valid and reliable preexisting instrument (Hannah, 1998). However; a Delphi technique would produce the needed validation for instrument development.

Summary

The review of literature included the AHA and AAP (2010) standards guiding neonatal resuscitation and the criteria and procedure for Epinephrine administration (Kattwinkel et al, 2010; NRP, 2010). Numerous studies described provider difficulty calculating Epinephrine in emergent situations and placed Epinephrine on the American Pharmaceutical Association (2010) list of high risk for error medications (Bernius et al., 2008; Broselow et al., 2008: Broussard, 2010; Sredl, 2006). Research studies reported challenges of pediatric Epinephrine calculations by a plethora of healthcare providers that included nursing and medical students, physicians and
pre-hospital emergency care providers (Bernius et al., 2008; Broselow et al., 2005; Papastrat & Wallace, 2003; Wheeler et al., 2004; Wheeler et al., 2008).

Diverse security techniques have been developed to reduce Epinephrine calculation errors. However, these security techniques did not include any specific tool or instrument designed for neonatal weights less than three kilograms (Bernius et al., 2008; Broselow et al., 2008; Broussard, 2010; Sredl, 2006; Wheeler et al., 2009). The pressure nurses endured in emergent situations, ensuring accuracy of medication dosages ordered by physicians, working with team members lacking in training and defective in communication skills were well documented and supported (Dennison, 2007; Lee et al., 2011; Neal, 2008; Spunt et al., 2004).

Patient safety taxonomy and causes were woven throughout the literature (Benner et al., 2002) and included the reliance on memory, lack of accessible information and standardized safety techniques (Benner et al., 2002). These causes were specific to Epinephrine calculation in neonatal resuscitation that resulted in error. However, good nursing care goals were the prevention (Benner et al., 2002; Bernius et al., 2008; Broselow et al., 2002; Lee et al., 2011). Nursing practice was considered responsible to develop strategies for error reduction and enhancement of the nursing practice integrity (Benner et al., 2002; Brann & Cefalo, 1979; Cronenwett et al., 2007; Foxhall, 2010; Jukkala & Henly, 2009; Neal et al., 2008; Riley, 2009).

Simple standardized drug dosing systems such as pre-calculated Epinephrine dose reference charts were recommended but none were found for neonatal weights less than three kilograms (Bernius et al. 2008; Broselow et al., 2008; Lee et al., 2011; Zino et al., 2002). Such reference charts must be created, studied and adapted to practice (Benner et al., 2002; Broselow et al., 2008; Karlsen, 2005; Lee et al., 2011; Zino, Davies, & Davis 2002). The value of the Delphi Method for expert support will help develop the tools needed (Hannah, 1998).
The use of Epinephrine in neonatal resuscitation has not been rigorously studied in the neonatal populations or patient weights less than three kilograms (Lee, et al., 2011; Ziino et al., 2002). Research regarding the use of pre-calculated Epinephrine dose reference charts for pediatric resuscitation has specifically excluded low birth weight babies less than three kilograms where much resuscitation resides (Broselow et al., 2002; Lee et al., 2011; Zino et al., 2002). There was a gap in research regarding LBW and VLBW neonates and the utilization of Epinephrine. Therefore this research study was needed.
Chapter 3: Methodology

Design

The pilot research study was a quantitative quasi-experimental design. The quasi-experimental design provided an alternative means to assessing and assisting in the search for knowledge, cause and effect (Burns & Groves, 2010). Design characteristics compared and described the accurate responses (dependent variable) between the control group and the experimental group measuring the effectiveness of the researcher-developed Epi Chart© (independent variable) during neonatal resuscitation.

Sample

The subjects were a convenience sample of 86 healthcare professionals working in the Labor and Delivery (L&D), Newborn Nursery (NBN), Special Care Nursery (SCN), Neonatal Intensive Care Unit (NICU), and Postpartum Unit of a large tertiary healthcare facility in a Midwestern city of the United States. Subjects included in the research study were required to be licensed practical nurses (LPN), registered nurses (RN), advanced practice nurses (APRN), physicians, and respiratory therapists (RT) who had been previously trained in Neonatal Resuscitation Program (NRP) and wearing a facility name badge that was visible.

Although nurses comprised the majority of the sample population (76 total nurses), the convenience sample included physicians and RTs, who provided care for the neonate at the healthcare facility. Exclusion criteria included healthcare professionals who were not a LPN, RN, APRN, physician or RT and were not identified by wearing a visible facility name badge. Subjects who did not work in L&D, NBN/ SCN, NICU or the Postpartum unit or who have never trained in NRP were also excluded from the research study.
Setting

The setting in which the study was conducted was the L&Q, NBN/SCN, NICU and Postpartum units of a large tertiary healthcare facility. Specific areas that were included in the research study were the break room, nurses’ station, unoccupied patient room, meeting room, and classroom. The research study was conducted in areas which were excluded from direct patient care.

Ethical Considerations

The proposed research study was submitted to the Institutional Review Board (IRB) of Southern Nazarene University (SNU). The research study was submitted to the Nursing Research Council (NRC) of the healthcare facility for approval prior to submission to the healthcare facility IRB. Approval from the IRB of SNU as well as the healthcare facility’s NRC and IRB was obtained prior to conducting the research study. Each LPN, RN, APRN, physician and RT working in L&D, NBN/SCN, NICU and Postpartum Unit of the large tertiary healthcare facility was notified by a Written Solicitation of the research study (Appendix E).

The Written Solicitation (Appendix E) was sent by e-mail to all nursing staff in L&D, NBN, SCN, NICU and the Postpartum Unit of the healthcare facility. The Written Solicitation was conspicuously posted in the restrooms, break rooms, conference rooms of L&D, NICU, NBN/SCN and Postpartum Unit for medical and respiratory staff. The Written Solicitation publicized the title, purpose, dates and times the research study would be concluded and invited prospective subjects to participate. The Written Solicitation stated that the NRC and IRB of the facility had approved the research study and that participation in the research study was voluntary. No identifying information was requested or associated to the research study.
The researcher trained four volunteers in a private room prior to the beginning of the research study on the purpose of the research study. The researcher instructed the volunteers on the usage of the Epi Chart© and the scenarios. The researcher explained the Written Script, Statement of Participation, confidentiality and the storage of the completed scenario responses. Each volunteer subsequently practiced the Written Script, instructions, demonstration of the use of the Epi Chart© and stopwatch, as well as sealing and storing the completed scenario. The trained volunteers provided a return demonstration to the researcher of all instructions and procedures that were conducted.

Each trained volunteer was instructed to adhere to the Written Script (Appendix G) and communicate to prospective subjects that participation is voluntary and participation or non-participation would not affect their employment status. There was no penalty to withdraw from the research study, and no identifying information, such as names, were requested. The identity of each subject remained anonymous.

The Statement of Participation form (Appendix F) was read to all potential subjects by the trained volunteer and subjects were offered a copy if desired. The Statement of Participation form included the name and contact information of the researcher, title and purpose of the study and name and contact information of SNU. The volunteer explained that participation was voluntary, and completion and submission of the research study was considered consent to participate.

Demographic data includes level of licensure, area of primary neonatal practice, years of experience and if NRP training was current within the last two years. The Special Care Nursery (SCN) is a subsidiary of the Newborn Nursery (NBN). The same staff worked in both areas. The demographic questionnaire was specific to area of practice. The staff worked both areas and
chose NBN, since SCN was not an option. Each subject placed and sealed their selected completed scenario in an envelope provided by the volunteer at the end of the one-minute time allocation. The volunteer collected the sealed envelopes and gave them to the researcher. The completed scenarios were locked in a file cabinet in the researcher’s private and locked office. Only the researcher has a key to the office and file cabinet. Data was stored on an excel spreadsheet, on a password-protected computer and viewed only by the researcher and a statistician. The researcher had no direct contact with the subjects. All completed scenarios will continue to be secured in a locked file cabinet for one year, and then shredded by the researcher. All compiled data on the Excel spreadsheet will be deleted by the researcher one year after completion of the research study.

**Instrumentation**

After a comprehensive review of literature regarding the use of Epinephrine in neonatal resuscitation, no instrument was located that could be utilized as a reference for pre-calculated Epinephrine doses specifically for low birth weight (LBW) and very low birth weight (VLBW) neonates weighing less than 3,000 grams (Benner et al., 2002; Bernius, 2008; Broselow et al., 2008; Dennison, 2007; Lee, 2011; Lemoine, & Daigle, 2010; Riley, 2009; Spunt, Foster, & Adams, 2004; Zino, 2011). A common practice for obtaining a dose of Epinephrine during neonatal resuscitation by healthcare providers is recalling the dosage range from memory and then mentally calculating the needed dose, while amidst the verbal cadence of “one and two and three, bag” and while repeatedly counting the chest compression to ventilation ratio.

Numerous research studies have indicated that calculation errors were reduced by the elimination of memory reliance, making needed information readily available, providing safety techniques for high risk procedures and medications, and using simple standardized processes for
the nursing practice. Since no instrument specific to LBW and VLBW neonates was discovered (Benner et al., 2002; Bernius, 2008; Broselow et al., 2008; Dennison, 2007; Lee, 2011; Lemoine & Daigle, 2010; Riley, 2009; Spunt, Foster, & Adams, 2004; Zino, 2011), a researcher-designed instrument entitled Epi Chart© (Appendix B), a pre-calculated intravenous and endotracheal neonatal Epinephrine dose reference for neonatal weights of 400-4,000 grams, was created based on NRP (2010) guideline standards and Delphi technique of validation (Burns & Grove, 2009).

The Epi Chart© (Appendix D) provided the subjects with the accurate response (dependent variable) to one written case based scenario requesting the amount of Epinephrine to be given. Doses of Epinephrine vary according to milliliter per kilogram of body weight and by the route of administration. The dose for an Umbilical Venous Catheter (UVC) or other vascular route is 0.1-0.3 ml/kg, and the dose for an Endotracheal Tube (ETT) is 0.5-1.0 ml/kg. The Epi Chart© (Appendix B) includes both potential routes of administration (UVC and ETT) and ranges of weights for LBW and VLBW neonates.

There was one written scenario describing a resuscitation of a neonate with only a vascular route available for the administration of Epinephrine (Appendix D). The scenario was designed in order that each subject would determine the amount of Epinephrine to be administered according to the route and specific weight of the neonate. The experimental group received the scenario with the Epi Chart© (independent variable) printed on the back (Appendix D). The control group received the identical scenario without the Epi Chart© (Appendix D).

Equal numbers of the two identical case based scenarios were placed in an envelope. Each subject was instructed by the trained volunteer to select only one scenario. The identification of the control or the experimental group was determined by the presence or absence of the Epi Chart© printed on the back of the scenario. The experimental group was instructed by the
volunteer to use the Epi Chart© (independent variable), which was printed on the back of the scenario to determine the Epinephrine dose. The control group did not have the Epi Chart© printed on the back of the scenario. The control group was instructed by the volunteer to calculate the Epinephrine dose according to each subject’s individual practice. The accurate responses (dependent variable) to the scenarios (Appendix D) was compared between the two tested groups (experimental and control).

**Establishing Instrument Validity**

Content validity was determined through the extensive review of literature and the identification of the specific concepts related to memory reliance, unavailable needed information, lack of simple standardized processes, and safety techniques (Benner et al., 2002; Brann & Cefalo, 1979; Cronenwett et al., 2007; Foxhall, 2010; Jukkala & Henly, 2009; Neal et al., 2008; Riley, 2009). The researcher-designed Epi Chart© was reviewed for face and content validity by using the Delphi Technique to obtain consensus by a panel of experts (Appendix C).

The experts utilized by the researcher were a Neonatal Clinical Nurse Specialist and a Neonatal Resuscitation Program Regional trainer. Both nurses were Master’s prepared nurses and each nurse had over 30 years experience in neonatal settings in two different regions of the United States. A doctorate of pharmacy and an accountant carefully examined all mathematical calculations. Corrections in mathematical calculations and modifications regarding a consistent pattern of “rounding” in the one-hundredth position were corrected by the researcher. The expert statistician recommended that a numerical value be applied to the “yes and no” simple tabulations chart for the data collection of correct responses. Modifications were adapted to include 100% for correct responses and 0% for incorrect responses (Appendix C). All experts
agreed that the Epi Chart© was free from bias and was a valid instrument for determination of a correct neonatal Epinephrine dose.

**Procedure**

An extensive review of the literature, relevant to neonatal resuscitation and the use of Epinephrine, was conducted by the researcher. However, no instruments were identified that were a reference for Epinephrine doses specific to both the LBW and VLBW neonates (Benner et al., 2002; Broselow et al., 2008; Karlsen, 2005; Lee et al., 2011; Zino, Davies, & Davis 2002). Therefore, the design and development of an instrument for administration of Epinephrine for the LBW and VLBW neonate was necessary for this research study.

Prior to the research study implementation, approval was obtained from the IRB of SNU, the NRC and the IRB of the healthcare facility. Written solicitation (Appendix E) was e-mailed to facility nurses in L&D, NBN, SCN, NICU and Postpartum Unit, and also conspicuously posted in break rooms, meeting rooms, and bathrooms for physicians and respiratory therapists one week prior to the start of the research study. The Written Solicitation (Appendix E) communicated the title and purpose of the research study, name of researcher, and inclusion criteria with time and date, and invited all potential subjects to participate in the research study.

A trained volunteer requested voluntary participation from potential subjects working in L&D, NBN, SCN, NICU or Postpartum Unit, who are identified as an LPN, RN, APRN, physician or RT via visible facility name badge. The trained volunteer inquired if the subject had previously trained in NRP and if the subject would be willing to volunteer for the research study. Only those subjects working in L&D, NBN, SCN, NICU or the Postpartum Unit, who could be identified as an LPN, RN, APRN, physician or RT via facility name badge, and who verbally acknowledge they have trained in NRP would meet the inclusion criteria to participate in the
research study. Exclusion criteria included potential subjects who did not work in L&D, NBN, SCN, NICU or the Postpartum Unit; subjects could not be identified as a LPN, RN, APRN, physician or RT via facility name badge, and subjects who had never trained in NRP.

The trained volunteer read the Statement of Participation (Appendix F) form to the individual subject who met the inclusion criteria and agreed to volunteer to participate in the research study. The Statement of Participation (Appendix F) form stated the title of the research study, validated the name of researcher, and described the purpose of the research. The Statement of Participation (Appendix F) included a confidentiality agreement, no penalty clause, and privacy and security measures for the data collection and storage (Burns & Grove, 2010).

**Control Group**

After the Statement of Participation (Appendix F) form was read aloud by the trained volunteer, the subject was instructed to select a scenario (Appendix D) from the envelope. Subjects who selected a scenario without an Epi Chart© were included in the control group. The trained volunteer read the Written Script (Appendix G) and instructed the subjects to complete the demographic data at the top of the scenario. The subjects were also advised to respond to the scenario according to their standard practice. The subjects were instructed that the use a calculator or any other resources normally used in an actual resuscitation was acceptable. The research study was based on an individual response to the scenario; collaboration with another person (including the trained volunteer) was not permitted.

**Experimental Group**

After the Statement of Participation (Appendix F) form was read aloud by the trained volunteer, the subject was instructed to select a scenario (Appendix D) from the envelope. Subjects who selected the scenario with the Epi Chart© printed on the back were included in the
experimental group. The trained volunteer read the Written Script (Appendix G) for the experimental group explaining the use of the Epi Chart©. The trained volunteer instructed on the use of the actual Epi Chart© printed on the back of the scenario that the subject had selected. The volunteer pointed to the neonatal weights on the vertical plane and pointed to the routes of administration on the horizontal plane. The location of the dose of Epinephrine on the Epi Chart© were seen by intersecting the weight and the route as demonstrated by the volunteer.

The trained volunteer read the Written Script instructing each subject to complete the demographic data at the top of the scenario. Each subject was instructed to respond to the scenario question by exclusively using only the Epi Chart©.

**Timed Study**

Subjects in both the experimental and control groups were informed by the volunteer that there was a one-minute allocation to determine the response to the scenario. The subjects were timed with the AHA-provided stopwatch by the trained volunteer. The trained volunteer instructed each subject that if a response could not be determined in one minute, the subject was to place and seal their blank response in the provided envelope for submission.

The trained volunteer read the following from the Written Script (Appendix G), “This is a one-minute timed research study scenario designed to obtain a response to one question regarding a neonatal resuscitation.” The trained volunteer read the scenario aloud and then said, “Time starts now.” The stopwatch was used by the trained volunteer to simulate a real-life situation as one minute is the actual time frame according to the neonatal resuscitation algorithm (Appendix B). The volunteer then said, “Time. You must stop and submit your scenario, with or without a completed response.” The time was not recorded on the scenario, but rather was used only to ensure accuracy of the time allocation as well as for the notification to start and stop the
scenario. Each subject was instructed by the trained volunteer to fold and seal their response in the envelope provided.

Sealed scenario responses were given to the researcher by the trained volunteer. At the completion of the research study, the researcher reviewed and compiled the responses and recorded the data on an Excel spreadsheet saved on a password-protected computer. The research study was designed so that there is only one correct response to the scenario. The correct answer was assigned 100% and an incorrect or blank answer was assigned 0%.

The researcher and the statistician were the only individuals who had access to all of the data. The researcher compiled the statistics for data analysis by the statistician. Interpretation of the statistical analysis was conducted by the researcher. No personal identifiers were requested of the research study subjects. All research study data will be stored for one year and then destroyed by shredding and deleting files from the computer by the researcher.

**Data Analysis**

All data was compiled and interpreted by the researcher. Data was analyzed by the statistician using Statistical Package for the Social Sciences 2009 (SPSS) software. All subjects were anonymous and no identifiers were associated with any data. All results were interpreted by the researcher.
Chapter 4: Results

The purpose of this quantitative, quasi-experimental pilot research study was to determine if the utilization of a pre-calculated intravenous and endotracheal Epinephrine dosage chart, specific to low birth weight and very low birth weight babies weighing less than three kilograms, used during neonatal resuscitation would reduce medication errors. Based on the literature review and Delphi panel of experts, the postulation was that a significant difference would result between the experimental and control groups when subjects responded to the same Epinephrine dosage calculation question. Eighty-six subjects participated in the study. The experimental group (41) used the Epi Chart© for the response; and the control group (45) answered according to their routine practice. The data was processed using the Statistical Package for the Social Services (SPSS).

The results of Chi-square test indicated that use of the researched designed Epi Chart© by the experimental group resulted in significantly more correct responses than expected at the 0.01 alpha level (99% statistical confidence). The control group had significantly more incorrect responses than expected.
Demographics

Eighty-six subjects (41 in the control group, 45 in the experimental group) participated in the research study. The sample included: three Licensed Practical Nurses, six Respiratory Therapists, 73 Registered Nurses, and four Physicians. No APRN’s participated in the research study. (Table 1, Figure 1).

Table 1

<table>
<thead>
<tr>
<th>Level of Licensure</th>
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<tbody>
<tr>
<td>LPN</td>
<td>3</td>
</tr>
<tr>
<td>RT</td>
<td>6</td>
</tr>
<tr>
<td>RN</td>
<td>73</td>
</tr>
<tr>
<td>PHYSICIAN</td>
<td>4</td>
</tr>
<tr>
<td>APRN</td>
<td>0</td>
</tr>
</tbody>
</table>
Figure 1. Level of Licensure

All subjects were solicited from Neonatal Intensive Care Unit (NICU), Labor and Delivery (L&D), Postpartum Unit, and Newborn Nursery (NBN). Subjects included: 36 NICU, 19 L&D, 16 Postpartum, 15 NBN (Table 2, Figure 2).

Table 2

<table>
<thead>
<tr>
<th>Primary Area of Practice</th>
<th>Count</th>
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<tbody>
<tr>
<td>1</td>
<td>NICU</td>
</tr>
<tr>
<td></td>
<td>36</td>
</tr>
<tr>
<td>2</td>
<td>L&amp;D</td>
</tr>
<tr>
<td></td>
<td>19</td>
</tr>
<tr>
<td>3</td>
<td>POSTPARTUM</td>
</tr>
<tr>
<td></td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>NBN</td>
</tr>
<tr>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>
Research subjects reported the following years of experience. Nine subjects had less than one year, 20 had two to five years, 16 had six to ten years, and 41 had over 11 years of experience (Table 3, Figure 3).

Table 3

<table>
<thead>
<tr>
<th>Years of Experience in Neonatal Setting</th>
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<tbody>
<tr>
<td>1 year of less</td>
<td>9</td>
</tr>
<tr>
<td>2 to 5</td>
<td>20</td>
</tr>
<tr>
<td>6 to 10</td>
<td>16</td>
</tr>
<tr>
<td>11 or &gt;</td>
<td>41</td>
</tr>
</tbody>
</table>
Figure 3. Years Experience in Neonatal Setting

Inclusion criteria required all subjects to have been previously trained in the Neonatal Resuscitation Program (NRP). Seventy-three subjects reported being current in NRP in the last two years and 13 reported their NRP training had expired (Table 4, Figure 4).

Table 4

<table>
<thead>
<tr>
<th>Completed NRP in last 2 years</th>
<th>YES</th>
<th>73</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>YES</td>
<td>73</td>
</tr>
<tr>
<td>2</td>
<td>NO</td>
<td>13</td>
</tr>
</tbody>
</table>
Figure 4. Completed NRP in last 2 years
Data Analysis

The Pearson Chi Square Statistic was conducted to calculate the differences in expected frequencies and observed frequencies of the two test groups to determine if the use of the Epi Chart© by the experimental group resulted in a significant increase in accurate responses. As indicated in Table 5, there was a significant increase in correct responses.

Table 5

Chi-square Frequencies for Experimental Group

<table>
<thead>
<tr>
<th>Responses</th>
<th>Observed N</th>
<th>Expected N</th>
<th>Residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect</td>
<td>3</td>
<td>20.5</td>
<td>-17.5</td>
</tr>
<tr>
<td>Correct</td>
<td>38</td>
<td>20.5</td>
<td>17.5</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Chi Square statistic was performed to determine if not using the Epi Chart© resulted in an increase in the number of incorrect responses as compared to expected frequencies. As indicated in Table 6, there was a significant increase in the number of incorrect responses.

Table 6

Chi-square Frequencies for Control Group

<table>
<thead>
<tr>
<th>Responses</th>
<th>Observed N</th>
<th>Expected N</th>
<th>Residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incorrect</td>
<td>39</td>
<td>22.5</td>
<td>16.5</td>
</tr>
<tr>
<td>Correct</td>
<td>6</td>
<td>22.5</td>
<td>-16.5</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Summary

The Chi Square Test Statistics Summary indicated statistical difference in each tested group based on observed and expected frequencies. The test statistic of $X^2=29.878$ was obtained for the experimental group. The test statistic of $X^2 = 24.2$ was obtained. As indicated in Table 6, there was a significant association between not using the Epi Chart© and obtaining an incorrect dosage, $X^2(1, N = 45) = 24.2, p < 0.01$.

Table 7

*Chi-square Test Statistics Summary*

<table>
<thead>
<tr>
<th>Responses</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>$29.878^{a}$</td>
<td>$24.200^{b}$</td>
</tr>
<tr>
<td>df</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.5.

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 22.5.

The results indicated that based on these two tested groups the experimental group had a significant increase in correct responses. The control group had a significant increase in the number of incorrect responses than expected. Results indicated that utilization of the Epi© Chart would contribute to reduction of medication errors.
Chapter 5

Discussion

Chapter five will discuss results, implications, limitations and recommendations for this research study. The purpose of this research study was to determine if the utilization of the research designed Epi Chart© would reduce medication errors in neonatal resuscitation. The statistical significance was determined by the results of the Chi-square test. The research strongly indicated that the use of the Epi Chart© increased accuracy in medication calculations for low birth weight and very low birth weight neonates, weighing less than three kilograms during resuscitation.

Implications for Nursing

There is a traditional reliance and assumption in the practice of nursing that the physician will prescribe the correct dose of medication (Benner, et al. 2002). The same responsibility is placed upon the nurse to administer the correct dosage of medication while under a substantial amount of stress. In the case of a neonatal resuscitation, when the time factor is 45-60 seconds, the nurse has the other tasks of assisting with umbilical catheterization and/or intubation, or performing the peripheral vascular access. Since a pre-calculated reference for neonatal Epinephrine doses specific to LBW and VLBW neonates could not be found in the literature, the Epi Chart© was developed by the researcher. The Epi Chart© has extensive potential to improve patient care and patient outcomes. Nurses and other healthcare providers nationally and internationally can have assurance in obtaining and administering accurate Epinephrine doses during neonatal resuscitation and reduce the stress typically endured.

Memory is especially weak during the chaos of resuscitation. The research on Neonatal Epinephrine: Reducing Calculation Errors is a reminder of the need for readily available
information, safety techniques and adhering to standards, policies and protocols for the improvement of quality care and improved patient outcomes in all aspects of nursing and healthcare. Implementation of the Epi Chart© in neonatal resuscitation will be beneficial in expediting accuracy in practice and presents significant potential for reduction of calculation errors and positive outcomes in saving the lives of fragile neonates.

**Limitations**

The following limitations of the research study included:

- One healthcare facility utilized
- One geographical area included
- Newly developed instrument
- Newly developed demographic questionnaire
- Convenience sample

**Recommendations**

- Replicate the study in other facilities
- Replicate the study in other geographic regions
- Refine the demographic questionnaire
- Adapt use of the Epi Chart© to nursing practice

This research study should be replicated in other healthcare facilities, in other geographical regions and in scenario training of the Neonatal Resuscitation Program. Extended studies may be used to determine if the Epi Chart© needs expansion to include more neonatal weights. Additional research will provide rigor to support the Epi Chart© as a standing order for nurses in to administer Epinephrine in the absence of a physician during neonatal resuscitation. The Epi Chart© has the potential to enhance the body of knowledge in nursing though posters,
publications, lectures and as a protocol in the NRP curricula. The Epi Chart© is not limited to the practice of nursing; rather, a multi disciplinary, non-English dependent tool which can be applied to any area where Epinephrine is used in neonatal resuscitation. The desire of the researcher is that all healthcare professionals working in a neonatal resuscitation would use the Epi Chart© as a reference and not rely on memory for the administration of this medication.

Demographic data includes level of licensure, area of primary neonatal practice, years of experience and if NRP training was current within the last two years. The Special Care Nursery (SCN) is a subsidiary of the Newborn Nursery (NBN). Since the same staff works both areas, and the demographic statement was specific to primary area of practice, the staff that worked both areas chose only NBN. The omission of SCN from the demographic questionnaire did not affect the results of this research study. The demographic questionnaire needs to include SCN as the NBN/SCN for more accuracy and clarity if the study is to be replicated at the same healthcare facility in the future.

The research study was limited to one large tertiary center in one geographical area of the mid-western United States. The Epi Chart© is a researcher-designed instrument based on extensive review of literature and the response of the panel of experts from the Delphi technique. The Epi Chart© may require further revisions and refinement through further utilization and psychometric testing. Additional research is needed for instrument reliability particularly in actual neonatal resuscitation.
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Appendix A

NRP Algorithm
February 13, 2012

Gaye,

Thank you for this additional information.

With this e-mail, permission is granted for the inclusion of the NRP algorithm in your thesis. This permission is granted nonexclusively, for educational purposes only, for print and electronic use only, and for one-time use only.

Thank you!

Jason Crase
Editorial Specialist
Division of Publishing and Production Services
Department of Marketing and Publications
American Academy of Pediatrics
141 Northwest Point Blvd
Elk Grove Village, IL 60007-1019
Phone: 847/434-7924
Fax: 847/434-8780
E-mail: jcrase@aap.org
Birth

Term gestation? Breathing or crying? Good tone?

No
-Warm, clear airway if necessary, dry, stimulate

HR below 100, gasping, or apnea?

No
-Labored breathing or persistent cyanosis?

Yes

Clear airway SPO₂ monitoring
Consider CPAP

Yes

PPV
SPO₂ monitoring

HR below 100?

No

Take ventilation corrective steps

No

HR below 60?

Yes

Consider intubation
Chest compressions
Coordinate with PPV

No

Take ventilation corrective steps
Intubate if no chest rise!

Consider:
- Hypovolemia
- Pneumothorax

No

HR below 60?

Yes

IV Epinephrine

Routine Care
- Provide warmth
- Clear airway if necessary
- Dry
- Ongoing evaluation

Targeted Pre-ductal SPO₂ After Birth
1 min 60-85%
2 min 65-70%
3 min 70-75%
4 min 75-80%
5 min 80-85%
10 min 85-85%

NRP Guidelines (2010)
Appendix B

Epi Chart ©
## Epi Chart

<table>
<thead>
<tr>
<th>Weight (gms)</th>
<th>Vascular 0.1-0.3 mL/kg</th>
<th>Endotracheal 0.5-1.0 mL/kg</th>
<th>Weight (gms)</th>
<th>Vascular 0.1-0.3 mL/kg</th>
<th>Endotracheal 0.5-1.0 mL/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>0.04 - 0.12 mls</td>
<td>0.20 - 0.40 mls</td>
<td>1900</td>
<td>0.19 - 0.57 mls</td>
<td>0.95 - 1.90 mls</td>
</tr>
<tr>
<td>450</td>
<td>0.04 - 0.13 mls</td>
<td>0.22 - 0.45 mls</td>
<td>2000</td>
<td>0.20 - 0.60 mls</td>
<td>1.00 - 2.00 mls</td>
</tr>
<tr>
<td>500</td>
<td>0.05 - 0.15 mls</td>
<td>0.25 - 0.50 mls</td>
<td>2100</td>
<td>0.21 - 0.63 mls</td>
<td>1.05 - 2.10 mls</td>
</tr>
<tr>
<td>550</td>
<td>0.05 - 0.16 mls</td>
<td>0.27 - 0.55 mls</td>
<td>2200</td>
<td>0.22 - 0.66 mls</td>
<td>1.10 - 2.20 mls</td>
</tr>
<tr>
<td>600</td>
<td>0.06 - 0.18 mls</td>
<td>0.30 - 0.60 mls</td>
<td>2300</td>
<td>0.23 - 0.69 mls</td>
<td>1.15 - 2.30 mls</td>
</tr>
<tr>
<td>650</td>
<td>0.06 - 0.19 mls</td>
<td>0.32 - 0.65 mls</td>
<td>2400</td>
<td>0.24 - 0.72 mls</td>
<td>1.20 - 2.40 mls</td>
</tr>
<tr>
<td>700</td>
<td>0.07 - 0.21 mls</td>
<td>0.35 - 0.70 mls</td>
<td>2500</td>
<td>0.25 - 0.75 mls</td>
<td>1.25 - 2.50 mls</td>
</tr>
<tr>
<td>750</td>
<td>0.07 - 0.22 mls</td>
<td>0.37 - 0.75 mls</td>
<td>2600</td>
<td>0.26 - 0.78 mls</td>
<td>1.30 - 2.60 mls</td>
</tr>
<tr>
<td>800</td>
<td>0.08 - 0.24 mls</td>
<td>0.40 - 0.80 mls</td>
<td>2700</td>
<td>0.27 - 0.81 mls</td>
<td>1.35 - 2.70 mls</td>
</tr>
<tr>
<td>850</td>
<td>0.08 - 0.25 mls</td>
<td>0.42 - 0.85 mls</td>
<td>2800</td>
<td>0.28 - 0.84 mls</td>
<td>1.40 - 2.80 mls</td>
</tr>
<tr>
<td>900</td>
<td>0.09 - 0.27 mls</td>
<td>0.45 - 0.90 mls</td>
<td>2900</td>
<td>0.29 - 0.87 mls</td>
<td>1.45 - 2.90 mls</td>
</tr>
<tr>
<td>1000</td>
<td>0.10 - 0.30 mls</td>
<td>0.50 - 1.00 mls</td>
<td>3000</td>
<td>0.30 - 0.90 mls</td>
<td>1.50 - 3.00 mls</td>
</tr>
<tr>
<td>1100</td>
<td>0.11 - 0.33 mls</td>
<td>0.55 - 1.10 mls</td>
<td>3100</td>
<td>0.31 - 0.93 mls</td>
<td>1.55 - 3.10 mls</td>
</tr>
<tr>
<td>1200</td>
<td>0.12 - 0.36 mls</td>
<td>0.60 - 1.20 mls</td>
<td>3200</td>
<td>0.32 - 0.96 mls</td>
<td>1.60 - 3.20 mls</td>
</tr>
<tr>
<td>1300</td>
<td>0.13 - 0.39 mls</td>
<td>0.65 - 1.30 mls</td>
<td>3300</td>
<td>0.33 - 0.99 mls</td>
<td>1.65 - 3.30 mls</td>
</tr>
<tr>
<td>1400</td>
<td>0.14 - 0.42 mls</td>
<td>0.70 - 1.40 mls</td>
<td>3400</td>
<td>0.34 - 1.02 mls</td>
<td>1.70 - 3.40 mls</td>
</tr>
<tr>
<td>1500</td>
<td>0.15 - 0.45 mls</td>
<td>0.75 - 1.50 mls</td>
<td>3500</td>
<td>0.35 - 1.05 mls</td>
<td>1.75 - 3.50 mls</td>
</tr>
<tr>
<td>1600</td>
<td>0.16 - 0.48 mls</td>
<td>0.80 - 1.60 mls</td>
<td>4000</td>
<td>0.40 - 1.20 mls</td>
<td>2.00 - 4.00 mls</td>
</tr>
<tr>
<td>1700</td>
<td>0.17 - 0.51 mls</td>
<td>0.85 - 1.70 mls</td>
<td>4500</td>
<td>0.45 - 1.35 mls</td>
<td>2.25 - 4.50 mls</td>
</tr>
<tr>
<td>1800</td>
<td>0.18 - 0.54 mls</td>
<td>0.90 - 1.80 mls</td>
<td>5000</td>
<td>0.50 - 1.50 mls</td>
<td>2.50 - 5.00 mls</td>
</tr>
</tbody>
</table>

Appendix C

Delphi Panel of Experts
February 21, 2012

To Gaye Rotramel  
Re: Calculating Neonatal Epinephrine

I have reviewed your research instrument (Rotramel Epi Chart© and scenarios) and found them to have validity. Nice work!

Dawn Reimann, RNC-NIC, MS, APN/CNS  
NRP Regional Trainer # 1162273  
Education Coordinator  
Rush Perinatal Center - Suite 617 Murdock  
Rush University Medical Center  
1653 W. Congress Parkway  
Chicago, IL 60612  
(O) 312-942-8275  
(Fax) 312-563-4140  
page 312-942-6000, pager #5663

February 24, 2012

Dear Gaye,

I have reviewed your research proposal and feel you address ongoing issues in neonatal resuscitation. Your designed instrument demonstrates validity and will be a measurable asset to any healthcare provider.

Good luck and please contact me if I can be of further assistance.

Larcile White, MS, RN  
NRP Regional Instructor  
White.Larcile@sjmc.org  
744-2725, NICU
February 16, 2012

Gaye,

The instrument looks good to me. let me see if I understand it.

You say, "The individual scores will be obtained on a simple yes or no accuracy tabulation chart. The percentage of accuracy computation will be the outcome of the data collection." do you have a percent accuracy that would determine: yes = accurate and, No = not accurate?
if so you should tell that in your paper.

Ha: chart group is more accurate than non chart group (sample)
Ho: chart group is equal or less accurate than non chart group.

how about this thought (I am just thinking of a way to measure this)
don't use the yes/no criteria.

1 -just use the percent of accuracy number for each person,
2 - then determine the mean "percent of accuracy" for each group (chart group mean percent and no chart group mean percent)
3 - test the statistical difference between the two means.
a one way two sample t test

this would be better than testing the yes/no because that is nominal data and you could not use the t test.

with individual people's percent of accuracy you could further test differences between other groups - example male/female, different years of experience, NRP 2 years vs no NPR 2 years.

I hope this helps. Let me know if I can be of assistance

Tom Gerard
Statistician Southern Nazarene University
didymus777@gmail.com
5/22/2012

There are 2 inconsistencies: [1] 1300 gm .65-1.3 [2] 2900 gm 1.45-2.90 mls. The chart on the other amounts did have a number other than zero as the second number. .60-1.3, and 1.4-2.9 would be consistent with your mode of operation. It's accurate throughout.

Dr. Lois Jacobs
Pharmacy

5/24/12

To Ms. Gaye Rotramel,

Per your request all mathematical calculations have been reviewed for accuracy according to the following Epinephrine dosage:

Vascular route 0.1 – 0.3 ml/kg
Endotracheal route 0.5 -1.0 ml/kg

All calculations are correct.

Sincerely,

Sarah Caldwell
Accountant
Appendix D

Demographics and Scenario
Demographic Data

Please check the following:

1. Level of licensure
   ___RN   ___LPN   ___APN   ___RT   ___Physician

2. Area of primary practice
   ___NBN   ___SCN   ___NICU   ___L&D   ___Postpartum

3. Years of experience in the neonatal setting
   ___1 or less   ___2-5   ___6-10   ___11 or more

4. Have you completed NRP in the last two years?   ___yes   ___no

Scenario

Instructions

If you chose a scenario with the Epi Chart© printed in the back, please use the Epi Chart© for your dosing answer. If the Epi Chart© is not included you may use a calculator if you normally use one for calculation. In order to simulate an actual resuscitation you will be given one minute to complete this activity. You may discontinue the scenario at any time you feel uncomfortable. Write the Epinephrine dose for this scenario below. Please begin by reading the following question aloud.

Scenario

You are resuscitating a neonate weighing 650 grams. The baby is being ventilated by bag and mask but has an umbilical venous catheter in place. Chest compressions have just begun for a HR < 60 beats per minute. Please indicate the dose of Epinephrine to be given if the heart rate remains < 60 beats after one minute of high quality CPR. The time begins now.

Answer   Epinephrine dose _______
Appendix E

Written Solicitation
Written Solicitation

All LPN’s, RN’s, APRN’s, physicians and RT’s, working in L&D, NBN, SCN, NICU or Postpartum, that have trained in NRP are invited to participate in a research study. *Neonatal Epinephrine: Reducing Calculation Errors* is a one minute timed research study designed to measure the effectiveness of a researcher developed, pre-calculated Epinephrine dosage reference chart for neonatal resuscitation. This research study has been approved by the Institutional Review Board (IRB) of Southern Nazarene University and St. John Medical Center. Thank you for your contribution of time.

**Date:**

**Time:**

**Place:**
Appendix F

Statement of Participation
Statement of Participation

October 2012

My name is Gaye Rotramel; I am a registered nurse and graduate nursing student at Southern Nazarene University Master of Nursing program. The title of this research study is *Neonatal Epinephrine: Reducing Calculation Errors*. The purpose of this study is to determine if a researcher designed, pre-calculated Epinephrine dose reference chart, specific to low birth weight and very low birth weight neonates, is an effective tool for reducing Epinephrine calculation errors during neonatal resuscitation.

Participation in this research study is voluntary. No punitive action will result if you choose not to participate, or if you participate but choose to withdraw during the research study. No names or personal identifiers are written on or associated with the research study. All responses will be confidential and will be immediately sealed in an envelope and secured in the researcher’s locked office. Research study responses will remain confidential and will be only available to the researcher and statistician.

Please complete the demographic statements and answer the one scenario question regarding neonatal resuscitation. Completion and submission of the demographic data and scenario question will be considered consent to participate in this research study. Thank you for your support of this research study.

Gaye Rotramel B.S., RN

grotramel@sjmc.org

Graduate Student

Southern Nazarene University, Tulsa, Oklahoma

Submitted to:
Southern Nazarene University Institutional Review Board
6729 N.W. 39th Expressway, Bethany, OK 73008; (405) 491-6360

Location of this research study is Labor and Delivery, Newborn Nursery, Special Care Nursery, Neonatal Intensive Care Unit and Postpartum Unit of St. John Medical Center.

Contact Information:
Gaye Rotramel
St. John Medical Center
1923 S. Utica
Tulsa, Oklahoma 74104
918-744-3939

“For questions about your rights as a research participant, contact Kevin Steck, V.P. Chairman of the St. John Medical Center Institutional Review Board (which is a group of people who review the research to protect your rights) at 918-744-3072”
Appendix G

Written Script
**Written Script**

Hello, Do you work in this (L&D, NBN, SCN, NICU, Postpartum) area? What is your position please? Have you ever trained in NRP? Would you volunteer to participate in the one minute research study? Please read with me the statement of participation (read Appendix F). Without looking please select a research scenario from this envelope.

Control Group (no Epi Chart ©)

“This is a one minute timed scenario designed to obtain a response to one question regarding Epinephrine administration during a neonatal resuscitation. Please complete the demographic statements and instructions and I will read the scenario aloud. You may read along if you like.

I (the volunteer) will say “time starts now”. The stopwatch will be used to simulate a real life situation. When I (the volunteer) say “time”, “you must stop and seal your response in this envelope, with or without a written answer”. Time will not be recorded rather used only to start and stop the scenario. This research study is based on individual responses and confirmation with another person is not permitted.

Experimental Group (Epi Chart© printed on the back)

“This is the Epi Chart© to be used for obtaining the response to the scenario question”. Volunteer will point to demonstrate and say “Neonatal weights are on the vertical plane and routes (point to Vascular and Endotracheal) of administration on the horizontal plane”. “The location of the dose on the Epi Chart© will be seen by intersecting the weight and the route”. Please do not use memory or mentally calculate an answer. Use the Epi Chart© for your response.
“This is a one minute timed scenario designed to obtain the answer to one question regarding Epinephrine administration during a neonatal resuscitation. Please complete the demographic statements and instructions and I will read the scenario question aloud. You may read long if you choose. The volunteer will say “time starts now”. The stopwatch will be used to simulate a real life situation. When I (the volunteer) say “time”, “you must stop and seal your response in this envelope, with or without a written answer”. Time will not be recorded on the scenario rather used only to ensure accuracy of the timing allocation for the start and stop the scenario.

This research study is designed to compare responses. To help ensure the integrity of this research study, please keep your scenario and response confidential. “Thank you for your support in this research study”.
Appendix H

Scenario Answer Key
Scenario Answer Key

Scenario Answer: 0.06 – 0.18 ml Umbilical Venous Catheter or Vascular