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Reducing Intraventricuar Hemorrhage

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The neonatal intensive care unit (NICU) specializes in the care of infants that are born prematurely or ill. Infants born prematurely are at high risk for neonatal complications, and these complications are markedly increased in very low birth weight (VLBW) infants, defined as a weight less than 1500 grams and the extremely low birth weight (ELBW) infant defined, as a birth weight of less than 1000grams. The survival rate of the VLBW infant is increasing due to advances in technology, particularly management of ventilation. While decreased mortality is a desired outcome, morbidity among this weight group has increased (Schmid, Mayer, Hopfner, Fuchs & Humier, 2013) Long-term adverse outcomes for this population include: developmental delays, visual problems, hearing impairment and chronic lung disease and brain injury (Singh, Gorstein, Bednarek, Chou, McGowan & Visintainer, 2013) Multiple strategies exist in the literature to optimize outcomes among these infants particularly in the area of neuroprotection. Neuroprotection aims to improve neurodevelopmental outcomes through the implementation of evidence-based interventions beginning with delivery room management through the first seven days of life.

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Clinical Leadership Theme

Members of the leadership team in the NICU at a women's hospital in the United States operate under the framework of consistently delivering safe and effective patient care through continuous clinical quality improvement initiatives. Between September 2017 and September 2018 we aim to reduce the rate of grade III and grade IV intraventricular hemorrhage (IVH) in infants less than or equal to 32 weeks gestation, or less than or equal to 1500 grams from 11% to 5% . The process begins with initiating guidelines for prevention of IVH. The process ends with

compliance of NICU protocols for care of the low birth weight infants and evaluation of IVH rates. By working on this process, we expect to (a) establish IVH prevention guidelines (b) develop guidelines for pre-medication prior to non-emergent intubation (c) Develop a protocol for admission management of LBW infants to the NICU. It is important to work on this now because we have identified the need to (a) create evidence based guidelines for the prevention of IVH (b) collaborate with respiratory therapy to decrease trauma related to intubation for resuscitation or Survanta™ administration (c) increase team member education related to the admission management of the at risk infant, through the development of an admission of LBW or VLBW infant bedside tool.

Statement of the Problem

Prematurity is defined as a birth prior to 37 weeks gestation (Adcock, 2014). These infants suffer from a range of diseases that affect multiple systems. The survival of premature infants has risen over the years, but not without long-term implications, including brain hemorrhage. IVH is a result of bleeding within the periventricular structures, specifically the germinal matrix. (Pettorini, Keh, Ellenbogen, Williams, & Zebian, 2014). In the premature infant the germinal matrix is very vascular and fragile. Unlike adults, premature infants do not yet have the capacity for autoregulation. These authors go on to attest that fluctuations in blood pressure directly affect these blood vessels in the brain and can lead to rupture in the form of a bleed. (Pettorini, Keh, Ellenbogen, Williams, & Zebian, 2014). Depending on the size and location of the bleeding these events are graded using Papile's classification, with grade III and IV defined as severe and associated with significant long-term neurodevelopment impairment in preterm infants ((Singh, Gorstein, Bednarek, Chou, McGowan & Visintainer, 2013). IVH is associated with adverse short and long-term outcomes including Post-Hemorrhagic Hydrocephalus (PHH),

Periventricular Leukomalacia (PVL), Cerebral Palsy, global developmental delay, and death (Christ et al). Abnormalities associated with IVH can create stress on family, educational, health, societal, and financial resources (Adcock, 2014). Intraventricular hemorrhage (IVH) occurs in 20% to 25% of neonates born before 32 weeks gestation or weighing less than 1500 grams at birth. Of these infants born, 3% to 10% receive a diagnosis of severe IVH (grade III or grade IV) during their NICU stay (Christ et al). Although there is no single preventive measure for eliminating IVH other than prevention of pre-term birth, we can implement practices to minimize adverse outcomes. When used collectively these potentially best practices can help reduce the rate of IVH in the NICU (Vermont Oxford, 2016).

Project Overview

A multidisciplinary team will be assembled to review current literature, assess current practice, and develop an action plan and timeline for implementation of identified strategies. Multiple PDSA cycles will be used with the implementation of each strategy. Audit tools will be developed to assess compliance and identify barriers to successful implementation. Three goals were established specific to this project:

Goal 1: Develop a best practice bundle for the Prevention of Intraventricular Hemorrhage and brain injury for Infants less than or equal to < 32 weeks gestation or less than or equal to 1500 grams.

Objective: Identify strategies that are currently in place in the NICU and areas that need improvement.

Goal 2: Minimize Pain and Stress for the infant ≤32 weeks or ≤1500 grams

Objective: Develop Guidelines for pre-medication prior to non-emergent intubation

Goal 3: Develop guidelines for team members for the admission management for the of the low birth weight infant

Objective: Revise existing Admission Data Checklist to include best practice for admission of the low birth weight infant.

Aim: Between September 2017 and September 2018 I aim to reduce the rate of grade III and grade IV intraventricular hemorrhage in infants less than or equal to 32 weeks gestation, or less than or equal to 1500 grams from 11% to 5%.

Rationale

Intraventricular hemorrhage (IVH) is a significant factor in adverse long-term developmental outcomes of low birth weight infants. Team-based, brain-focused care to monitor, diagnose, and treat neurologic conditions of the developing brain has the potential to improve outcomes in neonates with brain injuries (Glass, 2015). Our NICU participates in the Vermont Oxford national database and the private Clinical Data Warehouse for the participating Neonatology Mednax companies. The Clinical Data Warehouse is a neonatal outcomes database utilized to guide neonatal quality improvement efforts. The NICU Advisory Committee reviews data quarterly, specifically what is referred to as the "big five." In neonatology, this refers to the 5 diagnoses that carry the greatest morbidity and mortality. Among the big five is IVH, with the risk of the poorest outcomes among infants diagnosed with grade III or grade IV hemorrhages. The rate of grade severe IVH (grade III & IV combined) was compared to the rate of grade of severe IVH among similar high volume high acuity NICUs around the country that report to the Mednax Clinical Data Warehouse. The overall reported network rate for similar facilities was and 8.8% compared to SJWH site rate of 11.9% (See Appendix A). There was also discussion among team members during multidisciplinary rounds that IVH seemed to be trending up. As a

result of this needs assessment, it was determined that total IVH numbers were increasing with the most significant increase among grade III and IV bleeds. Both the high reliability of the data and problem identification by the team led to the advisory's consensus on the need to develop an IVH Prevention Quality Initiative aimed at reducing grade III and IV IVH. Between September 2017 and September 2018 I aim to reduce the rate of grade III and grade intraventricular hemorrhage in infants less than or equal to 32 weeks gestation, or less than or equal to 1500 grams from 11% to 5%.

Monthly meetings were held to develop this quality initiative. As with all quality initiative it is critical to have the support of the hospital administration. A cost analysis was performed in order to determine the required budget to implement this project. A review of the literature showed that in addition to the cost of infant's hospitalization, there is an estimated additional cost of $53,602 if the infant is diagnosed with IVH. (Adcock, 2014) This does not include the cost of long-term treatment and follow-up these infants require in order to achieve the highest quality of life. The estimated cost of the proposed IVH project is $7874.00 (See Appendix B). The value that this project would add to the NICU extends beyond dollars, it improves neurologic outcomes, which decrease the burden of care on family members. This will add to team member's satisfaction through the provision of evidence-based initiatives for best outcomes. The projected return on investment significantly outweighs the cost of the proposed IVH reduction initiative. Reducing IVH both improves patient outcomes and decreases the financial burden of the institution and family.

Methodology

A multidisciplinary team was formed to discuss the incidence and prevalence of IVH in the neonatal intensive care unit. The neonatal work group consisted of the director of quality

from the neonatology group, the NICU quality coordinator (project champion), patient care coordinator for the NICU (administration), pharmacy, respiratory therapy, 2 bedside nurses and the NICU nurse manager. A review of the literature was performed using keywords from the project's PICO question: intraventricular hemorrhage, neonates, reduction, education, and protocol. Cochrane database, CINAL complete, Johanna Briggs Institute, and an educational learning site were used to retrieve relevant literature. The articles ranged from the pathophysiology and definitions of IVH to the management and care of affected infants. A total of nine research articles spanning 2012 to 2017 were selected for use based on applicability to the defined goals of this project.. Christ et al. (2015),discussed a model of improvement related IVH that would be easily adaptable to the IVH reduction project. The authors outlined their strategy and had a similar aim statement to the SJWH NICU team. They aimed to reduce IVH in infants less than 30 from 8% to 4%, during a one year time frame. Outcome measures included number of severe IVH, overall by birth month, and fiscal year rate. Through their efforts and implementation of best practice IVH rates were decreased from 8.3% to 5.1%.

In a topic review by Adcock (2014), prevention measures for IVH are discussed. The author details the management of infants that are affected by a brain hemorrhage and recommendations for the management of these infants. Complications associated with IVH are outlined, and the paper has a section with information that can be used for discussion with families and provided caregivers. The outcomes for infants with grade I to grade IV IVH are listed along with the associated delays as a result of the injury. In 2015, Afsharkhas, Khalessi, & Panan performed a study on 30 full term neonates admitted to the neonatal intensive care unit of Ali-Asghar Hospital between March 2005 and April 2011. This study evaluated clinical the characteristics, pathophysiological features, and early outcome of term neonates with IVH in a

referral neonatal center in Iran. In the study the majority of IVH events occurred within the first week of life, and in both term and pre-term neonates, almost 90% of IVH occurred within the first 72 hours.

Ashmeade, Haubner, Collins, Mildinovic, and Fugate,(2016) performed a quality improvement project that supported the conclusion that most bleeds occur in the first 72 hours, and, in fact found, the highest risk to be in the first hour of life. These authors suggested a standardized approach to the care of the ELBW infant in first hour of life, often referred to as the golden hour. The infants were <28 weeks gestation and/or birth weight <1000 grams.

Based on a comprehensive review of literature to identify care practices, their team developed a multidisciplinary pathway for the management of the VLBW infants in the first hour of life. It concluded that a standardized approach to the care of the ELBW infant, in the first hour of life, lead to more efficient care delivery that contributed to improved outcomes. More specifically Rabe, Diaz-Rossello, Duley, and Dowswell (2012), assessed the short and long term effects of early, rather than delayed cord clamping of the umbilical cord, for infants born at less than 37 weeks gestation. Randomized controlled trials were used to compare early and delayed cord clamping. The researchers discussed other strategies to influence placental transition for births before 37 weeks gestation. Delayed cord clamping allows for stabilization of blood pressure at birth rather an abrupt pressure change associated with immediate cord clamping. Loooking for even earlier IVH prevention strategies Chevallier et al. (2017), investigated the association between the primary causes of pre-term delivery and intraventricular hemorrhage. This was an interesting study suggesting that brain injury can occur prior to birth based on the hemodynamics of the placenta. It was hypothesized that IVH is affected by pregnancy complications including vascular placental diseases, maternal hemorrhage, and inflammation.

The infants in the study were in France during 2011, and were between 22-31 weeks gestation. The study included 3495 pre-term infants from the national EPIPAGE 2 cohort study. EPIPAGE is a nationwide epidemologiacl study on small gestational ages. The infants were admitted to neonatal intensive care units and had at least one cranial ultrasound assessment. Multinomal logistic regression models were used to study the relationship between risk of IVH and the leading causes of pre-term delivery. This study would lend itself to the practice of the mother receiving Indomethicin prior to delivery for its associated neuroprotective benefits to the fetus.

Adverse long-term outcomes of these infants was described in a regional cohort study by Bolisetty, Dhawan, Abdel-Latif, Bajuk, Stack, and Lui (2014). The study was designed to identify moderate to severe neurosensory impairment at 2 to 3 years corrected age among these infants born at 23 to 28 weeks gestation and admitted to the NICU between 1998 and 2004. This study highlights the significance of IVH and the long term consequences that are seen beyond the infants stay in the NICU. The impairments were defined as developmental delay, cerebral palsy, bilateral deafness, or bilateral blindness. 1472 infants were assessed, 93 with grade III-IV, 336 with grade I-II, and 1403 having no IVH. Grade I-II is associated with adverse neurodevelopmental outcomes and grade III-IV had higher rates of developmental delays. Similarly, in 2014, Pettorni, Keh, Ellenbogan, Williams, and Zebian discussed prematurity and low birth weight as the important risk factors for IVH. A key point of the research was the sequela of the initial IVH insult. These infants are at risk of developing post-hemorrhagic hydrocephalus, often suffering from neuromotor deficits in the long-term. They found that management of IVH is a combination of medical and surgical treatments and these treatments further advance the risk of co-morbidities in the pre-term infant.

An excellent resource in the development of this quality initiative was the Vermont Oxford network. This is internet based collaborative available to hospitals that enroll in their quality initiative programs. It is action-oriented, interdisciplinary focused hybrid model of web based, virtual, and in-person collaborative events offered throughout the year. The network offers innovative approaches to care with a variety of toolkits applicable to the NICU.

Based on this review of the literature, a guideline was developed describing the eight evidence based best practice strategies identified for the prevention of IVH in infants ≤32 weeks gestation or ≤1500 grams (See Appendix C). With best practices identified, the committee reviewed existing unit protocols related to the prevention of IVH. Three strategies from the literature were identified as being absent in the NICU's current practice. Midline positioning, minimal stimulation, and pre-medication prior to intubation were identified as areas of focus, and led to the development of the three goals for this quality initiative.

The first goal was to develop a best practice bundle for the prevention of intraventricular hemorrhage and brain injury for infants less than or equal to 32 weeks gestation or less than or equal to 1500 grams. The second goal is to minimize pain and stress for the infant less than or equal to 32 weeks or less than or equal to 1500 grams. Finally, the development of guidelines for team members for the admission management for the low birth weight infant will be created. An aim statement was developed with input from all committee members. A process diagram was developed to identify the primary drivers of the 3 of the identified missing interventions. (See Appendix D). A SWOT analysis revealed the suspected area of weakness in the lack of evidence based unit guidelines and protocols. (See Appendix E). Audit tools will developed for each of the three best practice strategies and the choice of evaluation for effectiveness of interventions was a PDSA cycle. This allows for small tests of change to be evaluated over short periods of

time. The PDSA cycle has been shown to work well in the NICU, providing small bites of education for the team, and gaining team engagement through team member feedback.

The theory used to guide the project implementation was Lippitt's change theory. This theory uses seven steps that focus on the person serving as the change agent (Harris, Roussel, & Thomas, 2014). The first step in the change theory is the diagnosis of the problem. This step includes all members of the group that will be affected by the change. A member of each discipline was involved in the meetings to establish their responsibility in the process implementation. The next step in the change theory is assessing motivation for the change and meeting in group setting to discuss the implementation pros and cons. The group will meet monthly to discuss finding from the literature and project goals based on best practice. During the group meetings, resources will be assessed for the project and documented. The procedure, education, and protocols will be developed with a projected timeline for the implementation. Leaders will be identified to lead the change and manage any conflicts that may be identified. After the process is implemented, the change is maintained, and protocols are adhered evaluated and revised based on data from PDSA cycles.

Timeline

The project will be implemented in three phases corresponding with each IVH reduction strategy (See Appendix F). Potentially best practice number one will begin with a presentation of the Quality Initiative to NICU leadership and the delivery team. This presentation will include baseline data, aim statement and identified strategies reduce IVH. The NICU delivery team is a dedicated group of nurses and respiratory therapists with advanced training in delivery room management of the high- risk infant. Many strategies aimed at the prevention of IVH begin in the

delivery room including mid line head positioning. This education will be followed by team member education and implementation of the Tortle™ midline positioning aid (See Appendix H). A tri-fold poster board will be available in the NICU break room describing the Tortle™ and handouts will be distributed at all NICU morning and evening huddles describing the rationale for the Tortle™ and its correct use. The delivery room nurses and respiratory therapists will serve as "super users" and resources during staff education. The representative from the company will be on the unit for the first week of use, and available to team members for questions and clarification. An audit tool designed to evaluate the Tortle™ will be provided to the team located in each bedside chart. Audits will be reviewed weekly and changes will be made based on team member feedback (See Appendix I). This will be ongoing for the first three months of the project, and, as needed if any issues are identified.

Best practice number two will be the second phase of this project, and it will begin in January of 2018. This begins with the development of Guidelines for Premedication Prior to Non Emergent Intubation. This will require the development of a Rapid Sequence Intubation Kit (RSI), available in the NICU medication dispensary system. Team member education will be provided in the form of an RSI algorithm with an audit tool on the back of the document. This algorithm will be placed in all bedside admission charts and therefore available to the bedside nurse and respiratory therapist for quick reference. Audits will be collected weekly and organized into one document for review by QI committee, this information will result in adjustments to PDSA cycles. This data will be collected monthly until September 2018. The Gantt chart (See Appendix G) shows project timeline.

Best practice number three will be a revision the existing Admission Data Checklist (ADC). The ADC currently provides a timeline of task needed to be completed within the first

24 hours of life. This portion of the initiative is expected to take the most time, since there are multiple team members involved. This practice change is noted on the timeline for May 2018.

Expected Results

The expected result of this quality initiative is to reduce IVH from 11% to 5% by September of 2018. As with all quality projects it is extremely important to monitor for unintended consequences of an initiative. Monitoring allows for the team to determine whether changes need to be made to the project. Monitoring also shows consistency in care practice. Organized audit reviews are extremely important as well as unit discussions during multi-disciplinary rounds. The monthly audits will be discussed at staff meetings and huddles. During rounds, the physician will discuss infants gestational age, weight, and if they qualify for midline positioning. They will also determine when the infants can receive their first head ultrasound, usually at day seven of life, to determine if IVH is present. Two lessons learned from the project to this point include the importance of staff buy in and 100% collaboration of the entire NICU team. Posting monthly IVH rates with each new strategy will be helpful in maintaining staff motivation.

Nursing Relevance

Evidence Based practices are the cornerstone for the promotion of changes in practice. The neonatal nurse caring for the premature infant will need to use evidence based practice methods to successfully implement practice changes. Neonates are a vulnerable population and require staff to change practices based on best practice evidence. Lippett's steps for change are detailed in the IVH reduction process. Knowledge, skills, caring, and compassion are all necessary competencies of the nurses working in the NICU. Protocols help guide the nurse in the proper management of the ELBW infant. Providing IVH education enables the nurse to identify

risk factors that are associated with IVH and implement strategies to reduce grade III and grade IV hemorrhages.

Summary

Between September 2017 and September 2018 we aim to reduce the rate of grade III and grade IV intraventricular hemorrhage (IVH) in infants less than or equal to 32 weeks gestation, or less than or equal to 1500 grams from 11% to 5%. A best practice bundle was developed for the Prevention of Intraventricular hemorrhage with implementation of best practice of midline lead positioning for infants less than or equal to 32 weeks gestation or less than or equal to 1500 grams in October 2017. The population setting is a Level III, 64 bed Neonatal Intensive Care Unit, in Florida. In August 2017, it was determined that total IVH numbers were increasing with the most significant increase among grade III and IV bleeds. This data combined with problem identification by the team led to the identification of a quality gap in existing strategies to reduce IVH. Team based, brain focused care to monitor, diagnose, and treat neurologic conditions of the developing brain has the potential to improve outcomes in neonates with brain injuries (Glass, 2015). In addition the cost of the infant's hospitalization, there is an estimated additional cost of $53, 602 if the infant is diagnosed with IVH (Adcock, 2014). Based on the review of literature, a guideline was developed describing the eight evidence based best practice strategies identified for the prevention of IVH in infants $\leq$32 weeks gestation or $\leq$1500 grams (See Appendix C). With best practices identified, a committee reviewed existing unit protocols related to the prevention of IVH. Three strategies from the literature were identified as being absent in the NICU's current practice. Midline positioning, minimal stimulation, and pre-medication prior to intubation were identified as areas of focus, and led to the development of the three goals for this quality initiative.

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projected timeline for each phases implementation. Leaders were identified to lead the change and manage any conflicts that may be identified. After each process is implemented, the change is maintained, and protocols are adhered evaluated and revised based on data from PDSA cycles.

The first phase of the implementation is completed. The mid-line positioning aid has been in use for over a month. An audit is done once a month to determine if the IVH guideline is present at the bedside of infants less than or equal to 32 weeks or less than 1500 grams. The auditor is also looking to make sure the Tortle™ mid-liner is being utilized correctly. We used a testing and adaption PDSA for the IVH prevention bundle and the Tortle™ Mid-liner Implementation. There has been one PDSA cycle (see Appendix J) for the mid-liner. The second PDSA cycle will include further education on the use of the Tortle™, adoption of the mid-liner, and continued testing of tool. The first PDSA for the bundle included design of the bundle for testing. The second PDSA was the bundle being placed at the bedside. The next PDSA, which we are currently in the process of completing, is placing the bundle on the quality board for staff review and feedback. The last PDSA will include a review of staff feedback and revision based on the feedback. Within the first cycle 20 babies were noted to meet the criteria. The results (see Appendix L) show 80% of the infant's had the IVH guidelines at the bedside and 100% had the Tortle™ in place. 80% of the infants had an evaluation form completed. The next phase of the project is to minimize pain and stress in these infants by pre-medicating them prior to intubation. This phase is planned for January 2018. The continuation of audits, education, and staff feedback will assist with staff engagement through phase 2 and 3. Successful implementation of each phase, with reporting data to the team, will help sustain each phase of this project and maintain change, resulting in improved outcomes.

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Appendix A

Pediatric Medical Group: Clinical Data Warehouse

NICU

Very Low Birth Weight (VLBW) Infants

2016

YEARLY INTRAVENTRIUCAL HEMORRHAGE (IVH)

	PATIENTS	EXAM DOCUMENTED	NORMAL/ NO BLEED	GRADE 1 DOCUMENTED	GRADE 2 DOCUMENTED	GRADE 3 DOCUMENTED	GRADE 4 DOCUMENTED	EXAMINED BUT NO GRADE DOCUMENTED
2016	135	93.3%	68.1%	10.4%	3.0%	1.5%	10.4%	0.0%

SEVERE IVH

	PATIENTS	SEVERE IVH PATIENTS	SITE RATE	NETWORK RATE	SITE PERCENTILE
Women's Hospital NICU	135	16	11.9%	8.8%	22.2%

Comparison Network: High Volume Pediatrix Sites

Appendix B

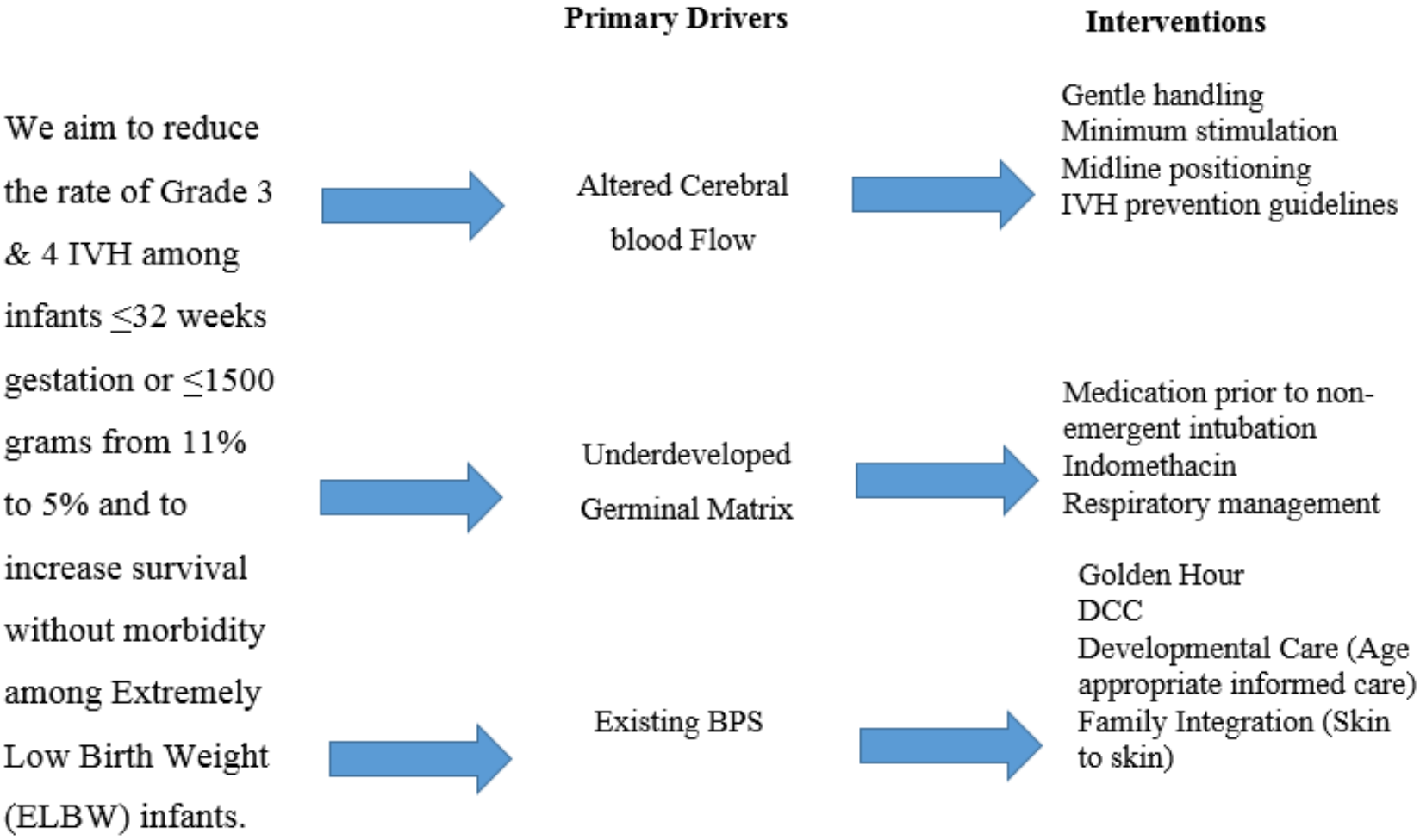
Cost Analysis	
On site meetings with IVH workgroup	1 hour meeting per month X 8 months 8 work group members (salary approximately $31/HR) = $1984.00
Purchase of midline positioning aids (average number of infants in this group (90 from Jan-Aug)	Case of 10= $390.00 X 9=$3510.00
Staff education: use of mid-line positioning aide	20 HRS X $35/HR= $700.00
Staff education: Admission of ELBW infant	20 HRS X $35/HR= $700.00
Staff education: Pre-medication prior to non-emergent intubation	20 HRS X $35/HR=$700.00
Drug costs associated with Pre-medication prior to non-emergent intubation	$0
Staff education: Hours required of educator to assist/escort vendor with team member education on use of the midline positioning aid	8 HRS X $35/HR= $280.00
	TOTAL $ 7,874.00

Appendix C

IVH Prevention Guidelines (Infants ≤30 OR ≤1500 grams)	
SIVH Risk Score	
Maintain Midline Head Position	• Maintain midline positioning for the first 5-7 days of life using Tortle™ Midliner • Place in supine or side lying position with tip of nose and umbilicus in a straight line • Avoid prone positioning • Turn using "log roll" to avoid significant twisting of neck and head
Elevate Head of Bed	• Elevate head of bed to maximum tilt (30°) setting on all GE products for the first 7 days of life • May briefly be placed flat for X-rays or procedures as needed • Avoid Trendelenburg position during care and diaper changes, do not raise feet and legs above the head: lift knees to the chest while supporting the back and buttocks, slide diaper in from the side
Maintain Normothermia 36.5-37	• Assure correlation between skin and patient temperature by optimizing probe placement • Maintain humidity per guidelines • Use heat shield button on incubator during cares or procedures requiring portholes to be opened
Slow Administration of Fluid Boluses	• Administer boluses over >30 minutes (except in arrest situations) • Administer FFP, albumin, platelets and PRBC at the rate of approximately 10ml/kg over 1 hour • D10W, 2ml/kg, boluses for hypoglycemia should be given over 5 minutes • Avoid use of Sodium Bicarbonate. If needed give 1-2 mEq/kg over at least 30 minutes • Avoid hypovolemia or hypotension- keeping MAPs in the range ordered by healthcare provider
Slow Withdrawal/Flushing of UACs and PALs	• Closed system for all lab samples
Respiratory Interventions	• Avoid prolonged suctioning • Avoid routine suctioning, especially in the first 72 hours • Prior to administration of surfactant, insure hemodynamic stability (stable VS & B/P) • Avoid hyper/hypocapnia and rapid fluctuations in PCO2 • Monitor end tidal CO2 and notify RT if ETCO2 >55 • Notify RT and/or MD/NNP if infant has poorly synchronized mechanical ventilation
Minimal Stimulation	• Reduce environment noise around bedside • Keep cell phones on silence mode (educate visitors) • Silence pumps and alarms immediately • Cluster cares by coordinating with MD, NNP, and RT • No baths for the first 7 days of life unless medically necessary (HIV+, Hep + mother) • Avoid routine abdominal girths during the first 72 hours of life (exception admission girth) • Limit use of flash photography, minimize lighting • Gently wake infant with a "hand hug" for 10 seconds before initiating cares or any procedure • Limit hands on care-every 6 hours • Avoid changing the bed linens for the first 72 hours (unless wet or soiled)
Minimize Pain and Stress	Avoid interventions that induce prolonged crying Consider pain medications for painful procedures or intubated infants who are agitated and/or fighting the ventilator. Continuous infusion is preferred over bolus administration

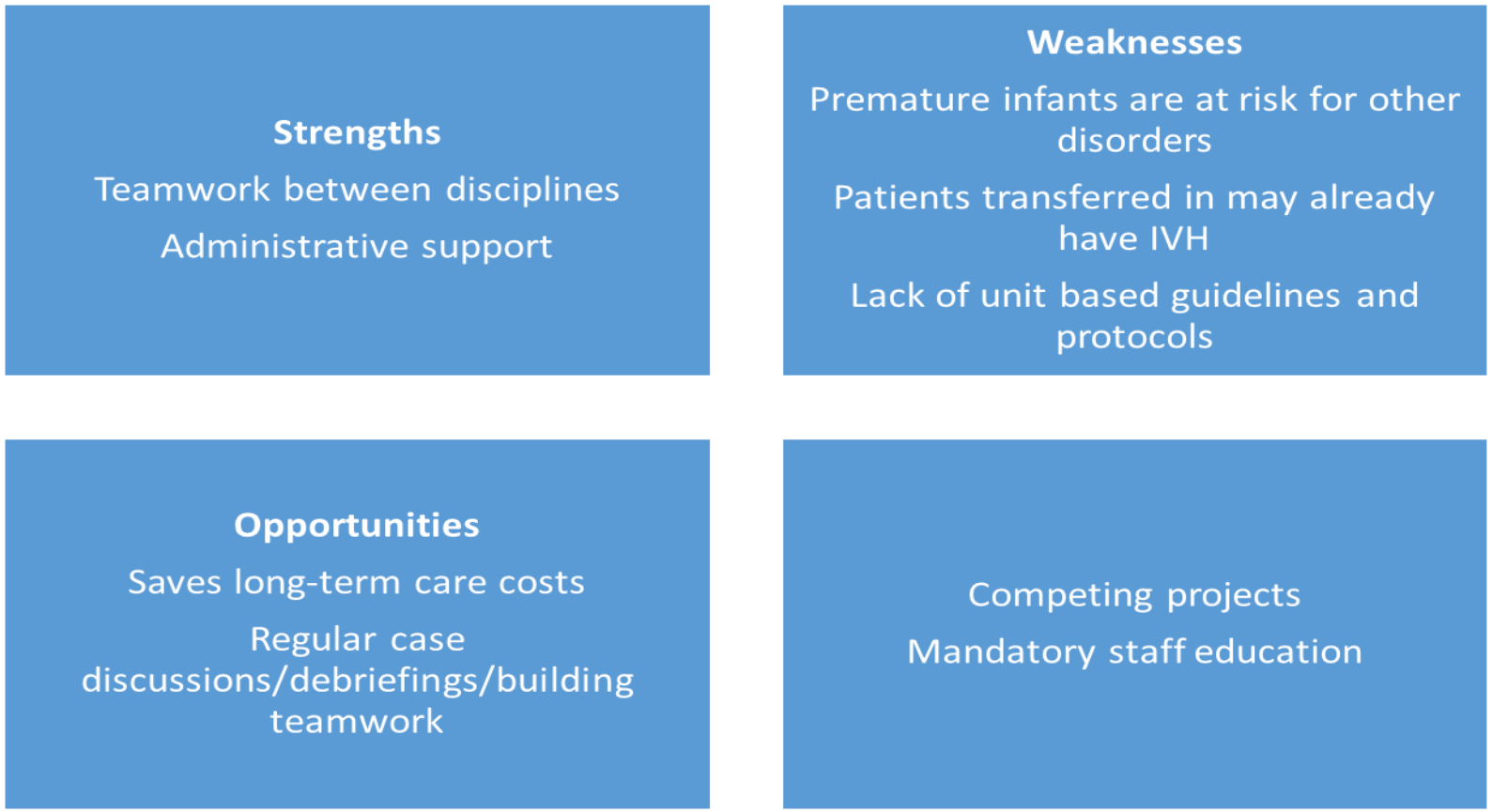
Appendix D

PROCESS MAP



Appendix E

SWOT ANALYSIS

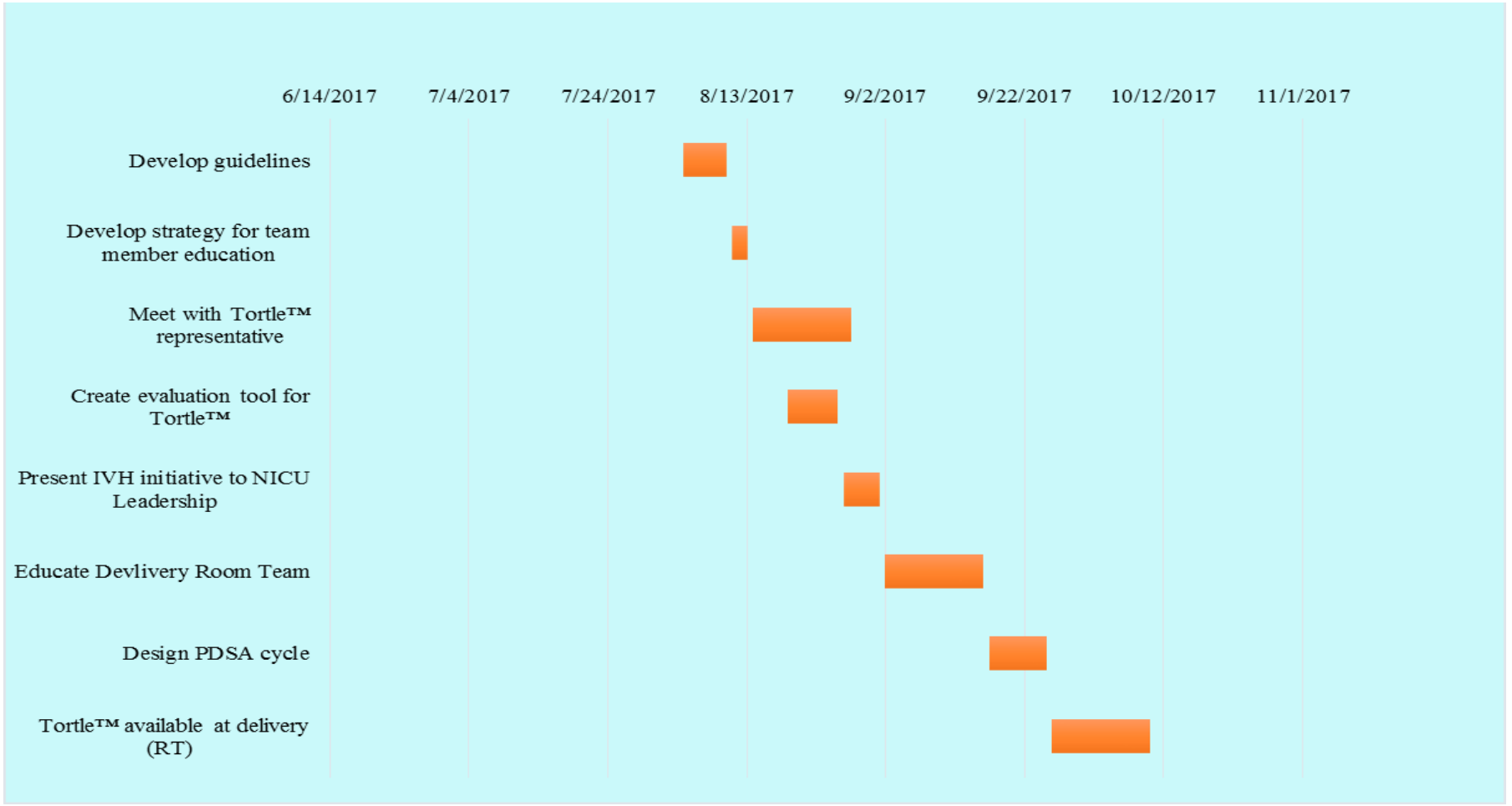


IVH Timeline

	TASK	START DATE	END DATE	DURATION	RESPONSIBILITY	STATUS	COMMENTS/MONITORING
Best Practice 1	Develop guidelines	8/13/2017	8/19/2017	6	N. Green, J. Saw	☑	Completed and in use
	Develop strategy for team member education	8/19/2017	8/21/2017	2	NICU IVH Team	☑	Completed
	Meet with Tortle™ representative	8/24/2017	8/24/2017	1	NICU IVH Team	☑	Representative in unit weekly
	Create evaluation tool for Tortle™	9/01/2017	9/08/2017	7	F. Louis	☑	Completed and in use
	Present IVH initiative to NICU Leadership	9/03/2017	9/03/2017	1	J. Alonso	☑	Leadership agrees with plan
	Educate Devlivery Room Team	9/04/2017	9/18/2017	14	N. Green, P. Shuga	In progress	Team education in progress
	Design PDSA cycle	9/15/2017	9/23/2017	8	S. McCoy	☑	Complete; Cycle 2 in phase 2
	Tortle™ available at delivery (RT)	9/24/2017	On-going		A.Size, R. Soste	☑	RT lead responsible for stock
Best Practice 2	Develop Pre-Medication prior intubation	05/2018	05/2018		Pharmacy		
	Obtain approval from Neonatology Team	05/2018	05/2018		J. Alonso		
	Develop of education tool	06/2018	06/2018		S. Sample		
	Rapid Sequence Intubation (RSI) Kits	07/2018	07/2018		Pharmacy		
	Development of audit tool	08/2018	08/2018		F. Louis		
Best Practice 3							
Administrative							
Purchase							
Charges							
Stakeholders meeting							
Education							
Staff Education							
RT-Transport							

Appendix G

IVH TIMELINE: Gantt Chart



Appendix H

Information on the Tortle™ Head Positioning Product
Who is this for? Babies <1500 grams OR 32 weeks GA
Why? The device is intended to keep the head midline for 7 days. This is for prevention
What about CPAP/ET? The midliner interfaces with CPAP, and ventilator tubing. It also has extra tabs inside for securing Bilimeter mask
Where are they kept? Midliners are on the 2nd floor in the clean supply room. RT has the CPAP interface
When do I put it on? This placed at delivery. If not, please place on admission
How often do I change it? Each baby should have one in place and a clean one in the RT bag at the bedside. Please label the bag with the infant's name. Please keep all parts of the kit in the bag provided. You can change the device when soiled, and wash by hand (mom may do this) OR it can be washed in the washing machine
What about Kangaroo Care? An IVH prevention guideline is in process of development and review. At this time the neonatologists would prefer to hold kangaroo care until the baby is 7 days of age.
**** More information to come, along with change/update to Kangaroo policy and procedure**
**** Remember: The baby can be positioned supine, right or left side lying when using the Tortle™ and still be midline. A good way to check, is to make sure the tip of the nose in line with the umbilicus**

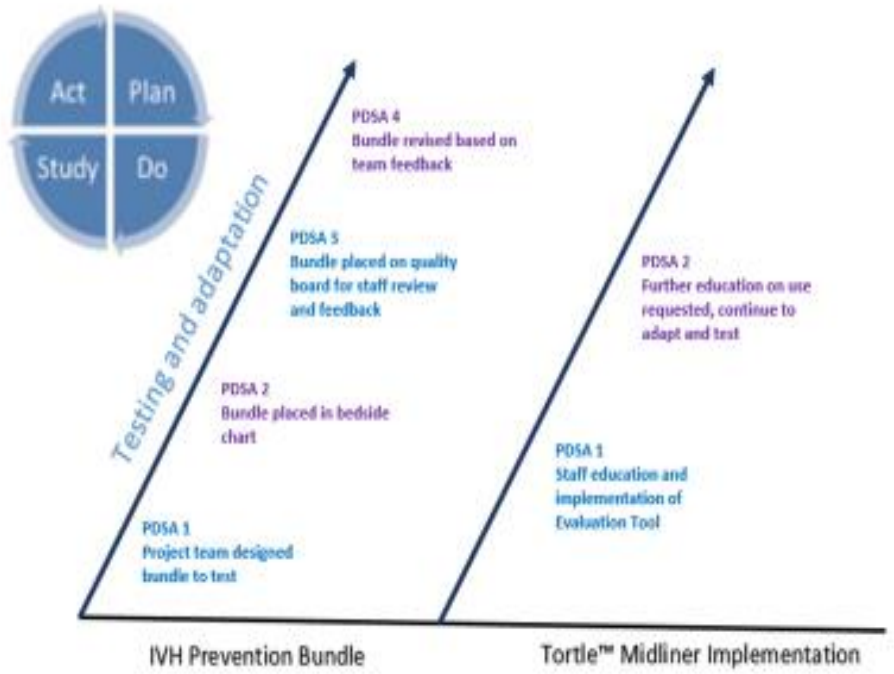
Appendix I

Evaluation Form

Tortle™ Midliner

Caregivers name:	**Date:**
Circle One: RT RN PT/OT Neo	**Gestational Age of Infant:**
Number of days on CPAP therapy?	**Was it easy to position in the following positions?** **Sidelying Yes No** **Prone Yes No** **Supine midline Yes No** **Partial sidelying Yes No**
Is the CPAP interface position stable when using the Tortle™ midliner even when the patient moves?	**Yes No** **If no, please explain:**
Are you noticing any skin breakdown or pressure sores with use of Tortle™ midliner with the CPAP interface?	**Yes No** **If no, please explain:**
Does the seal remain consistent when using CPAP with the Tortle™ midliner? **(Check hourly to see if the CPAP generator is bubbling)**	**Yes No** **If no, please explain:**
Does the Tortle ™ midliner fit well	**Yes No** **If no, please explain:**
Does the Toploader and its straps fit the CPAP easily?	**Yes No** **If no, please explain:**

Appendix J


Act
Plan
Study
Do
Testing and adaptation
PDSA 4
Bundle revised based on team feedback
PDSA 3
Bundle placed on quality board for staff review and feedback
PDSA 2
Bundle placed in bedside chart
PDSA 1
Project team designed bundle to test
PDSA 2
Further education on use requested, continue to adapt and test
PDSA 1
Staff education and implementation of Evaluation Tool
IVH Prevention Bundle
Tortle™ Midliner Implementation

Appendix K

Measures

	Measure Definition	Data Collection Source	Goal
Outcome Measures			
Average of IVH guideline in bedside chart	N = Number in chart D= Total number of infants meeting criteria for bundle	Bedside chart review	80%
Use of Tortle™ positioning aid	N= Number of infants with midliner in use D=total number of eligible infants	Evaluation Form Tortle™ Midliner	80%
Process Measures			
IVH Prevention Guideline Approval	N= stakeholders approving D= stakeholders consulted	Project team	100%
Use of Tortle™ Midliner Approval	N= Neonatologist approving D= Neonatologist consulted	Project champion	100%
Balancing Measures			
Team completion of Tortle™ Evaluation Form	N= number of evaluations completed D=total amount of audits	Tortle™ Evaluation	80%

Appendix L

Results

	Measure Definition	Data Collection Source	Goal
Outcome measures			
Average of IVH guideline in bedside chart	N = number in chart D=total number of infants meeting criteria for bundle	Bedside chart review	80%
Use of Tortle™ positioning aid	N=number of infants with midliner in use D=total number of eligible infants	Evaluation Form Tortle™ Midliner	80%
Process Measures			
IVH Prevention Guideline Approval	N= stakeholders approving D= stakeholders consulted	Project team	100%
Use of Tortle™ Midliner Approval	N= Neonatologist approving D= Neonatologist consulted	Project champion	100%
Balancing Measures			
Team completion of Tortle™ Evaluation Form	N= number of evaluations completed D=total amount of audits	Tortle™ Evaluation form	80%