

Organization: Adventist Healthcare Shady Grove Medical Center

Title: Getting to Zero: A Team-Based, Evidence-Based Approach to the Reduction of Necrotizing Enterocolitis in the Shady Grove Medical Center NICU

Background, Project Description and Goals:

Necrotizing Enterocolitis (NEC) is a common and devastating, often fatal disease that occurs in premature newborns. It is characterized by necrosis of the gastrointestinal tract which can lead to sepsis and death even in the face of early, aggressive treatment. The incidence of NEC is significant: ranging from 5-7% in premature babies with a mortality as high as 25-30% in babies who require surgical intervention. In addition, NEC increases length of stay, is associated with worse neurodevelopmental outcome and is a costly disease, accounting for 20% of annual NICU costs.

While the exact etiology of NEC is unknown, the pathogenesis is complex and multifactorial. Over the course of the last two decades, clinical practice has been directed toward prompt, early diagnosis and rapid institution of proper intensive care management including intravenous antibiotics, cardiovascular/blood pressure support, respiratory, metabolic support and, importantly, support of the family. Since the only consistent, independent predictors of NEC are prematurity and formula feeding, more recent and innovative approaches have focused on reducing the incidence by reducing the use of formula feeds in this at-risk population

Process Improvement Methodology

The Adventist Healthcare – Shady Grove Medical Center is a thriving, patient safety-centered, evidence-based, Level 3 perinatal-neonatal unit which delivers 5,000 babies a year with about 150 premature newborns who are at highest risk for NEC. Due to the significant impact that the diagnosis imparts on premature newborns, their families and our clinical team, we chose this outcome as a target for improvement. We extracted data from the Mednax Clinical Data Warehouse data repository which provided our NICU to compare outcomes with over 300 NICUs from across the country to compare both process and outcome measures that impact and define necrotizing enterocolitis.

Solution

A multidisciplinary team comprised of neonatologists, NICU nurses, lactation consultant, dietitian and NICU leadership convened and collaborated to formulate a specific, tailor-made and innovative bundle tool of evidence-based “potentially-better practices (PBPs)” for use in premature babies who weighed under 1250g.

Prior to implementation of the Reduction of NEC Bundle, our NICU team had an extremely restrictive feeding protocol that mandated prolonged gut priming with low volume feeds. Utilizing rapid-cycle improvement methodology (PDSA), we demonstrated that this approach did not have any statistically significant impact on the incidence of NEC in our unit. Hence we worked diligently to revamp our approach based on more recent studies by changing to an exclusive, human milk based feeding protocol and adding babies with antenatally diagnosed, absent end-diastolic blood flow to construct a NEC prevention bundle.

After its construction, the Bundle was implemented by systematically communicating the checklist to all team members via emails, NICU Division Meetings, NICU Staff Meetings, NICU staff lounge education bulletin board and one-on-one meetings. Once the bundle was implemented, the changes in practice were supported by a well-orchestrated and collaborative team approach that was highlighted by the use of the foundational tools and strategies from AHRQ-endorsed, evidence-based teamwork training system, TeamSTEPPS (Team Strategies and Tools to Enhance Performance and Patient Safety) including: understanding everyone’s roles and responsibilities, the ability to feel comfortable speaking up in a “Just Culture” and importantly, leadership’s role in supporting the innovative changes in practice. To build our knowledge and create sustainable change we used PDSA cycles in this project

Specific Measures:

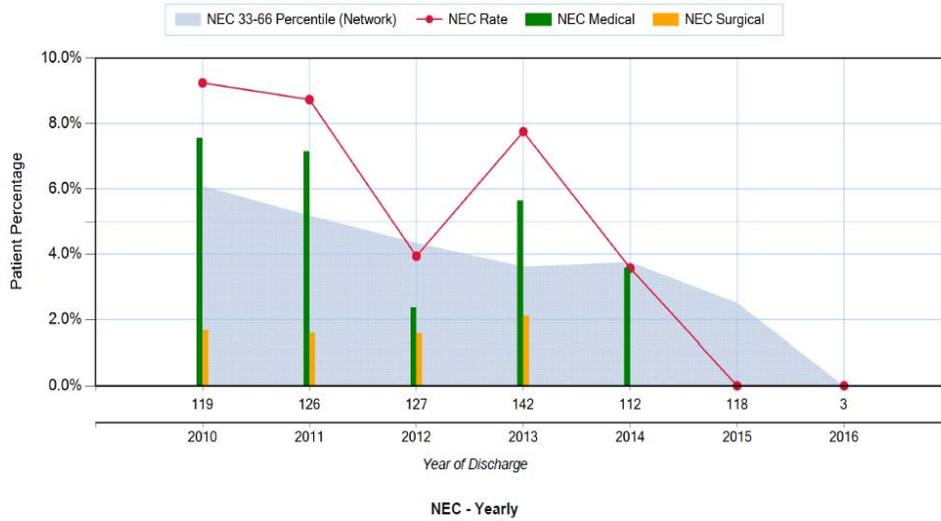
- Discontinuation of antacids/H-2 blockers which reduces the first line of defense in a patient’s ability to fight infection.
- Adoption of an evidenced-based feeding guideline that encourages the early institution and administration of breast milk feeds within 6-12 hours of life.
- Feeding guidelines that encourage the appropriate and consistent advancement of enteral feeds.
- Antibiotic stewardship program. Antibiotics are discontinued on infants who have negative blood culture within 48 hours. This preventative strategy leads to less alteration/reduction of intestinal microbes which has a significant impact on the pathogenesis of NEC.

- Use of donor milk. Babies with birthweights at or below 1250 gm receive donor breast milk if the mother cannot provide enough of her own breast milk. Babies with birthweight at or below 800 gm, or with gestational ages of 26 weeks or less, also receive Prolacta donor milk-based fortifiers when their calorie concentrations are increased. Of note, Shady Grove Medical Center was proud to be the first hospital in the state of Maryland to earn the internationally recognized Baby Friendly status.
- Babies who had abnormal Doppler blood flow in utero are fed only human milk as it has been shown they are at high risk for NEC. Infants with major GI anomalies such as gastroschisis are also treated similarly due to substantially increased risk of NEC.
- Hold feeds during blood transfusion to reduce the risk of transfusion-related NEC.
- A NICU-dedicated, full time, board certified, lactation consultant, who specializes in premature neonates and their specific needs, as well as the needs of their pump dependent mothers.
- Neonatologists and lactation consultations are performed antenatally to prepare, educate and highlight to family members the importance of human milk and the possible risks of not providing it. The NICU team also stresses the benefit of early pumping and hand expression so that we may collect breast milk within 4-6 hours after delivery.
- Oropharyngeal administration of colostrum or fresh breast milk is initiated prior to trophic feeds, and is often given by the parents and family members when at their baby's bedside. This action alone gives parents a sense of pride and purpose as they contribute this daily administering to their infant.

Adherence to the changes was accomplished using a team-based, collaborative approach during our multidisciplinary and family-centered rounds. During the rounds, every member of the team—including the family-- is encouraged and empowered to “Stop the Line” if they are concerned or uncomfortable that the consensus-based care measures are not being followed. Indeed, our entire multidisciplinary team has undergone teamwork training via TeamSTEPPS that enabled us to achieve a culture of safety that allowed necessary challenges if any provider deviated from our bundled processes of care.

Measurable Outcomes

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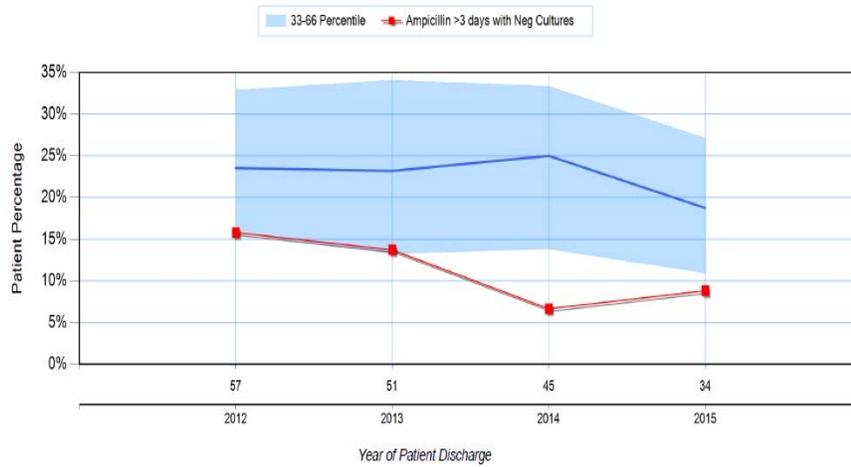
Gestation: < 23 wks, 23 wks, 24 wks, 25 wks, 26 wks, 27 wks, 28 wks, 29 wks, 30 wks, 31 wks, 32 wks; **Birth Weight:** <= 500g, 501 - 1500g, 1501 - 2000g, 2001 - 2500g, 2501 - 3000g, 3001 - 3500g, 3501 - 4000g, 4001 - 4500g, 4501 - 5000g
Patient Status: All; **Admit Group:** All; **Network:** All PDX Sites

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Figure 1. The Reduction of Necrotizing Enterocolitis at Shady Grove Medical Center: Beneficial Effects of Multidisciplinary Approach. Over the last five years, we have successfully reduced the incidence from 9% in 2010 to 0% in 2015 and 2016.

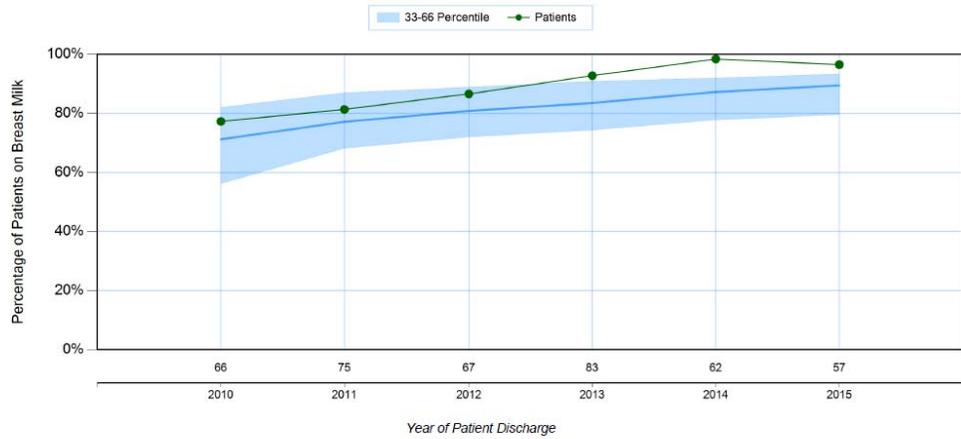


Patients with negative cultures (Blood and/or CSF) collected in the first 3 days (0,1,2,3) who were treated with ampicillin for >3 days

Gestation: 24 wks, 25 wks, 26 wks, 27 wks, 28 wks, 29 wks, 30 wks, 31 wks, 32 wks; Birth Weight: 501 - 750g, 751-1000g, 1001-1250g, 1251-1500g
 Patient Status:All; Admit Group: Inborn; Network: AAP Level 3 + 4 NICUs

Figure 2. Antibiotic Stewardship. Figure demonstrates that SGMC NICU utilizes less antibiotics for >3 days than most of the entire Clinical Data Warehouse Network NICUs and the percentage has decreased from 15% in 2012 to 9% in 2015. (Shaded blue is the middle third percentile, meaning the lower the percentage, the better)

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Breast Milk in the first week - Yearly
 Gestation: 24 wks, 25 wks, 26 wks, 27 wks, 28 wks, 29 wks, 30 wks, 31 wks, 32 wks; Birth Weight: 501 - 1500g, 501 - 750g, 751 - 1000g, 1001-1250g, 1251-1500g
 Patient Status: All; Admit Group: Inborn; Network: AAP Level 3 + 4 NICUs

Figure 3. The Use of Breast Milk in the first week of life. There has been a progressive increase and improvement of breast milk (includes both maternal and donor breast milk) from 80% to 98% from 2010 to 2015, respectively. (Shaded blue is the middle third percentile, and the higher the percentage, the better)

Length of Stay Detail

	2014			2015		
	Patients	Days	LOS(AVG)	Patients	Days	LOS(AVG)
Selected Network	13,978		63.5	14,666		63.6
Selected Site	57	3,010	52.8	51	2,747	53.9
24 wks	1	101	101.0	4	226	56.5
25 wks	4	251	62.8	4	226	56.5
26 wks	8	550	68.8	8	590	73.8
27 wks	4	253	63.3	7	416	59.4
28 wks	17	902	53.1	7	399	57.0
29 wks	10	416	41.6	4	175	43.8
30 wks	3	97	32.3	12	499	41.6
31 wks	5	198	39.6	4	182	45.5
32 wks	5	242	48.4	1	34	34.0

Table 1. NICU Length of Stay. For 2015, the average length of stay was 54 days compared to the Clinical Data Warehouse of 64 days!

GI drugs	H-2 Blockers		
	n	%	Netw
Year: 2010 66 pats.	3	4.5%	9.0%
Year: 2011 75 pats.	3	4.0%	8.1%
Year: 2012 67 pats.	1	1.5%	6.4%
Year: 2013 83 pats.	4	4.8%	5.5%
Year: 2014 62 pats.	1	1.6%	4.6%
Year: 2015 57 pats.	1	1.8%	4.2%

Table 2. The use of H2 Blockers in the SGMC NICU from Year 2010 to 2015. This figure demonstrates a significant reduction from 4.5% to 1.8% use which is significantly less than the Clinical Data Warehouse Network of NICUs reduction from 9.0% to 4.2%.

Solution

Our team of multidisciplinary healthcare professionals consisting of C-suite leadership, physicians, dietitians/nutritionists, nurses, lactation consultants, pharmacists, and families have demonstrated that, by utilizing an evidence-based, team-based approach, we were able to not only improve certain, key process measures that impact the incidence of NEC including avoidance of antacids, prolonged courses of antibiotics and the early initiation of breast milk feeds but we were also able to directly influence and reduce the incidence of this ravaging disease to **ZERO**.

This reduction is extremely impactful not only to the mortality and morbidity that our precious, premature newborns experience but also has extensive ramifications to the costs of care that occur when a patient develops NEC. Indeed, the average increased cost of a patient developing non-surgical (medical) NEC increases the additional financial cost to \$76,000 and surgical NEC to \$196,000 per infant. Of note, these figures do not include any of the post-discharge costs that NEC survivors incur which is extremely impactful to achieving the triple aim/population health goals.

We would be remiss to mention the cost savings gained from this project without recognizing the forward-thinking, open-mindedness SGMC Administrative leaders including, but not limited to our Chief Financial Officer, Dan Cochran. Through our leaders' willingness to have an open mind and to provide funding for the use of Donor Breast Milk and the use of the human milk based fortifier, Prolacta, on the front end, our NICU team was able to achieve these remarkable improvements in quality and safety. The consistency, continuity and collaborative makeup among our interdisciplinary team members enabled us to utilize and sustain each and every one of the preventative strategies and combined the perfect blend of frontline passion, enthusiasm, willingness to improve and the tremendous support of leadership.

Sustainability

Although we recognize that we have achieved remarkable short term success with the reduction of necrotizing enterocolitis, we are fully aware that the heart and soul of Quality Improvement is sustainability: locking in and maintaining the improvements in both process and outcome metrics over time. To that end, our plan is to measure bundle compliance and the incidence of NEC and to continue to follow our non-use of antacids, continued early breast milk feeding, adherence to feeding guidelines and antibiotic stewardship using the rapid cycle improvement methodology.

Another dimension of sustainability will be to take advantage of the six key components that the Institute for Healthcare Improvement identifies for holding gains:

1. **Supportive Management Structure.** We will continue to enlist support from Physician and Nursing leadership and suggest recruiting an Executive Sponsor for this and every QI project.
2. **Structures to “fool proof” Change.** Consider using pre-populated NEC Reduction tools/order sets in Cerner EMR.
3. **Robust, Transparent Feedback System.** We plan to publicly post both process and outcome improvement data in the NICU on easy to read graphs.
4. **Shared Sense of the Systems to be Improved.** We will “over-communicate” to all stakeholder team members to share an understanding of the processes and systems that we are seeking to improve.
5. **Culture of Improvement and a Deeply Engaged Staff.** We will ensure that all team members are clear on the QI project and view improvement as part of their job.
6. **Formal Capacity Building Programs.** We will continue to educate and build upon our staff’s understanding of QI initiatives to evolve to a culture where improvement work is integrated into every day activity in the NICU.

Family Integration

NICU families are central to the provision of safe, high-quality care and we successfully integrated and harnessed their passion and desire to become Champions for this project by educating them about the components of the NEC reduction bundle. Once educated, we witnessed significant improvements in breast milk availability. In addition, we empowered family members to help function as our eyes and ears regarding any sign of feeding intolerance their baby experienced.

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