

Designing and Implementing a Skin Care Protocol for Infants With Neonatal Abstinence Syndrome to Decrease Rates of Diaper Dermatitis

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ABSTRACT

Background: Infants with neonatal abstinence syndrome (NAS) are at an increased risk for diaper dermatitis, which can cause skin breakdown and lead to significant pain and potential infection exposure. Skin care protocols in the neonatal intensive care unit (NICU) setting seldom specifically address the needs of this at-risk population, leading to inconsistent skin care management.

Purpose: The goal was to support a decrease in the rate of diaper dermatitis for infants with NAS by designing and implementing an evidence-based skin care protocol.

Methods: A retrospective medical record review was used to examine outcomes of 25 infants preintervention and 8 infants postintervention. The skin care protocol was a bundle of 5 evidence-based interventions: (1) a specific diaper dermatitis assessment tool; (2) frequent diaper changes with superabsorbent diapers; (3) application of petroleum jelly and alcohol-free wipes; (4) infant bathing in pH neutral soap; and (5) application of zinc oxide barrier cream for erythema.

Results: There was an overall 80.5% decrease in diaper dermatitis from pre- to postimplementation ($P \leq .01$) as noted when comparing positive cases of diaper dermatitis with negative cases from pre- to postintervention.

Implications for Practice: Expanding the skin care protocol to all neonates in the NICU and nursery could aid in maintaining skin integrity and decreasing diaper dermatitis in the NICU. More research is needed following this study for the data to be generalizable to other NICUs. This study offers key takeaways including using a specific diaper dermatitis assessment tool and consistently using the bundle of interventions.

Video Abstract Available at: <https://journals.lww.com/advancesinneonatalcare/Pages/videogallery.aspx?autoplay=false&videoid=47>.

Key Words: diaper dermatitis, NAS, neonatal abstinence syndrome, skin assessment tool, skin care interventions

Diaper dermatitis affects between 4% and 35% of infants in the United States, and these rates can be 3 times higher in the presence of frequent loose stools.¹ Infants experiencing neonatal abstinence syndrome (NAS) are at higher risk among those infants who experience diaper dermatitis. Neonatal abstinence syndrome is a condition that affects infants who are born to mothers with substance use disorders who used narcotics during pregnancy. Infants begin to withdraw shortly after birth and may be subsequently diagnosed with NAS if their withdrawal is more severe. A common withdrawal symptom of the NAS population is frequent loose stools, leading to skin breakdown.² Excessive

skin breakdown caused by diaper dermatitis is painful and can exacerbate the symptoms of withdrawal.

Diaper dermatitis is an irritant contact dermatitis characterized by an erythematous macular or papular rash on the buttocks and thighs and around the anus of an infant. This rash is caused by chemical irritants, mechanical friction, and poor hygiene.³ Compared with the epidermis of adults, an infant's stratum corneum is approximately 30% thinner and the basal layer is approximately 20% thinner.⁴ The stratum corneum is the outermost layer that provides a critical barrier because it continuously sloughs dead skin cells. The dermis is less dense with short collagen fibers compared with a mature dermis. These immature skin characteristics of neonates leave their skin at high risk for injury.⁵ Skin barrier function of a neonate can be assessed by the level of transepidermal water loss, the pH of the skin, stratum corneum hydration, and sebum content. Deficiencies in any of these categories cause skin barrier compromise that can lead to increased risk of diaper dermatitis.⁶ The skin of a neonate after the first few days of life typically has a pH of 5.5. Fecal bacteria breakdown urine

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and produce ammonia, which raises the pH. The presence of urine and feces creates moisture that increases skin permeability. This alkalotic environment triggers fecal enzymes (proteases and lipases) to breakdown fat and proteins of the skin barrier, leading to inflammation in the diaper area.⁷

Complications of diaper dermatitis include potential progression to secondary skin infections. Fungal infections in the diaper area are typically caused by *Candida albicans* that can require both topical and oral antifungal medications. In addition, breakdown of the skin can lead to bacterial infections caused by *Staphylococcus* and other organisms that are frequently treated with topical and oral antibiotics.¹ Furthermore, the pain associated with diaper dermatitis can cause behavioral changes in the neonate including increased crying, alterations in eating and sleeping patterns, and increased agitation.⁸

Diaper dermatitis in infants with NAS is very painful and can potentially influence their treatment in the neonatal intensive care unit (NICU), which ultimately affects their length of stay in the hospital. The Finnegan Neonatal Abstinence Scoring Tool (FNAST) is the most commonly used tool for evaluating drug exposure withdrawal symptoms. Infants are scored with caregiving (usually every 3 hours) in multiple categories, including skin excoriation, which is specific to the face, elbows, knees, chin, and nose.⁹ These surface areas become broken down due to excessive, uncontrolled movements related to tremors, agitation, and rooting. The diaper area is also scored for excoriation but not specific to diaper dermatitis (caused by loose stools). This area is scored for breakdown in the gluteal folds for excessive motor movements.² Infants are also scored on how long they sleep. The skin breakdown on their buttocks and anus causes severe pain and discomfort, leading to frequent awakenings and poor sleep patterns, thus indicating the need for pharmacological interventions. These interventions include the initiation or increase of morphine, which potentially leads to a slower weaning process and potentially a longer stay in the NICU.¹⁰ Although infants with NAS have a higher risk for increased pain and sleep deprivation associated with diaper dermatitis, the risks can be reduced if nursing staff use evidence-based skin care interventions that positively affect diaper dermatitis rates.

Up to approximately 55% of the infants admitted to the level III NICU at a community hospital in southeastern Louisiana are treated for NAS annually. In 2018, 80% of NICU patients with NAS presented with diaper dermatitis at some point during their hospitalization. Data for this project were collected through in-depth chart audits of infants with NAS in 2018. All comments related to skin care were reviewed, and the skin assessment in the electronic medical record (EMR) was also analyzed to

determine whether diaper dermatitis was present during the patient's admission. Diaper dermatitis was accepted as a typical withdrawal symptom among this population at this NICU study site. Therefore, the high rate was not considered a problem or previously addressed. The unit lacked a skin care protocol and did not routinely use a specific diaper dermatitis assessment tool.

LITERATURE REVIEW

A review of the literature provided evidence that supported implementation of skin care interventions to prevent diaper dermatitis in at-risk populations at the study site as follows. In a double-blind randomized clinical trial conducted in Spain, researchers found that the application of petroleum jelly with each diaper change decreased rates of diaper dermatitis by 22%. This study evaluated the relationships between different types of treatments and degree of diaper dermatitis.¹¹ A study conducted in Shanghai, China, found improved skin assessment scores in the diaper areas using superabsorbent diapers. These superior diapers in addition to frequent diaper changes were shown to prevent disturbances in the skin barrier function.¹² The researchers also recommended using pH neutral soap during infant bathing to maintain and lower the skin pH, which provides more skin protection against urine, feces, and other irritants.¹² Researchers at the Children's Hospital of Philadelphia recommended multiple interventions including frequent diaper changes, using superabsorbent diapers, the application of petroleum jelly, and applying zinc oxide barrier cream when erythema occurs in the diaper area.¹³ These authors also recommended educating nursing staff on the potential risks of improper skin care. That education consisted of training to implement the interventions and seeking nursing feedback for ease of implementation. Another recommendation included nominating a skin care champion because this role was crucial in the improvement of neonatal skin care through diaper dermatitis prevention. In 2018, the Association of Women's Health, Obstetric and Neonatal Nurses in conjunction with the National Association of Neonatal Nurses published updated evidence-based clinical practice guidelines regarding neonatal skin care. These recommendations for preventing diaper dermatitis are as follows: Use a valid and reliable tool to assess the diaper area of the neonate, encourage and support breastfeeding, use superabsorbent disposable diapers, use dye-free diapers, change wet and soiled diapers frequently, gently cleanse the diaper area with mild soap and/or water, avoid vigorously rubbing the skin, and use petroleum-based ointments or zinc oxide-based barrier creams.¹⁴

The findings and recommendations from these studies and evidence-based guidelines provided

support for a bundled approach using multiple interventions in the development and implementation of a skin care protocol to prevent diaper dermatitis.¹³

PURPOSE

The NICU at this community hospital lacked consistency in using skin care interventions. There was no use of a specific assessment tool for diaper dermatitis, which ultimately was why a complete protocol was developed.

The purpose of this project was to determine whether a skin care protocol with multiple evidence-based interventions could prevent diaper dermatitis among infants with NAS in the NICU at a small community hospital in southeastern Louisiana. The skin care protocol included a new assessment tool, preventive interventions, education for the staff nurses, and evaluation of the protocol.

METHODS

Setting and Population

The skin care protocol was implemented in the NICU at a community hospital in southeastern Louisiana, a 16-bed unit with separate pods for each infant. There are 30 nurses on staff, 2 nurse supervisors, and 8 charge nurses. Providers for the unit include 2 neonatologists and 8 neonatal nurse practitioners. The most common diagnoses on this unit are apnea of prematurity, respiratory distress, and NAS.

This project focused on a population of infants who were affected by NAS and had an increased risk of diaper dermatitis due to frequent loose stools. Infants with NAS typically represent 25% to 50% of the NICU population at the project site, which generally is admission of 3 to 6 infants every 3 weeks. Infants with NAS included in the project were more than 36 weeks' gestation at birth, less than 3 months old, and did not have any skin conditions or diagnoses. Infants with NAS born less than 36 weeks' gestation were excluded from the study because there are other skin factors to consider in premature infants.

Theoretical Framework

The Knowledge-to-Action (KTA) model combines the creation and application of knowledge into practice. This model permits knowledge to be refined and focused to allow for easy application when implemented. The model includes 7 phases, and adaption and feedback are important at each phase as the cycle develops.¹⁵

This KTA model is appropriate for the research and implementation of a new assessment tool and diaper dermatitis prevention protocol because it allows the opportunity to research different interventions and tools, apply this knowledge to the NAS population in the NICU, implement these

TABLE 1. Knowledge-to-Action Framework^a

Identify the problem
Identify and review knowledge
Adapt knowledge to the problem and setting
Assess barriers to using the knowledge
Select and customize interventions
Monitor the implementation
Evaluate outcomes of the interventions
Determine how to sustain knowledge and interventions

^aThe Knowledge-to-Action is a cyclical framework that can move forward or backward depending on barriers encountered or achieved successes.

interventions, and then evaluate the outcomes of the knowledge put to use. Most importantly, it allows for adaptations and feedback throughout each phase (see Table 1).

Interventions

A bundle of several interventions was used to prevent diaper dermatitis in the NAS population. The interventions included using a specific diaper dermatitis assessment tool, bathing with a pH neutral soap, using superabsorbent diapers, applying a thick layer of petroleum jelly and using alcohol-free wipes with every diaper change, zinc oxide barrier cream in the presence of erythema, and providing education to the nursing staff to promote protocol adoption and to increase consistency.

The NICU staff was primarily educated one-on-one through a guided session that provided step-by-step directions for implementing each skin care intervention. A printed handout was distributed, and it included the location of the protocol supplies, a description of each intervention, and directions about completing the assessment tool on the end-of-shift form. During the one-on-one sessions, questions were asked to ensure the interventions and assessment tool were thoroughly understood. After the education was provided, a roster was initialed to indicate completion. A charge nurse on the unit was appointed diaper dermatitis champion in order to answer questions, help oversee the interventions, and ensure assessments were documented correctly.

The Scoring System for Diaper Dermatitis Scale (SSDDS) was used to assess the skin at each diaper change in order to establish their risk and present skin condition.¹⁶ The scale is divided into 4 different categories: A. Severity of erythema and irritation; B. Extent of diaper dermatitis; C. Papules and pustules; and D. Open skin. The severity category ranges from 0 to 3, where diaper dermatitis is not present at a score of 0, mild erythema is present at a score of 1, and mild to moderate diaper dermatitis is present at a score of 2 or greater, and then increases in severity

up to 3. The remaining category scores range from 0 to 1, and the total score is determined by adding each category together up to a score of 6.¹⁶ An end-of-shift form containing the scoring tool and the intervention checklist was provided for all nurses with NAS patients. The SSDDS was found to be both reliable and valid in detecting the presence and severity of diaper dermatitis.¹⁶ The interrater reliability had positive results for providers who were familiar with the assessment tool ($ICC = 0.949, P < .001$) as well as for those who were unfamiliar ($ICC = 0.850, P < .001$). The test-retest reliability was also positive using the Cohen κ values when comparing raters' original scores with those again at 2 weeks ($\kappa = 0.603, P < .001$). Internal consistency was assessed using the Cronbach α .¹⁶ Because the SSDDS is easy to use, valid, and reliable in detecting and determining the severity of diaper dermatitis, it was the ideal choice for assessing outcomes in this project.

The infants were bathed daily with a pH neutral soap to rinse off the urine and feces that remained on the skin. The pH neutral soap aids in the restoration of the infant's normal skin pH.¹⁵

Superabsorbent diapers versus standard diapers allow for greater absorption of moisture. The increased number of loose stools requires a more absorbent diaper.¹² These superabsorbent diapers were provided for all NAS patients. The expectation was that the diapers should be changed every 3 hours (at least 8 times per day) or more frequently with thorough assessments of the diaper area.¹¹

Alcohol-free wipes were used with each diaper change. The wipes were used to blot the diaper area versus rubbing to avoid friction causing further skin breakdown.¹⁴ Previous visible applications of an emollient or barrier cream were not completely wiped off the skin. When the area was thoroughly dried, a thick layer of petroleum jelly was applied with each diaper change. In the presence of erythema in the diaper area, a zinc oxide barrier cream was applied with each diaper change, followed by an application of petroleum jelly. This provided extra protection for irritated skin.¹⁷

Outcome and Process Measures

The primary outcome measure for this project was the rate of diaper dermatitis. Secondary outcome measures were the rate of completion for petroleum jelly application, the rate of expected number of diaper changes met, the usage rate of alcohol wipes, and the usage rate of pH neutral soap. Preimplementation data were collected from the medical records between August 2019 and January 2020 as follows: patient length of stay, number of petroleum jelly applications, number of barrier cream applications, number of total diaper changes, and documentation of diaper dermatitis incidence. Postimplementation data were collected during biweekly audits based on the SSDDS

and the end-of-shift forms documented by the nurses between February 2020 and June 2020 as follows: patient length of stay, number of petroleum jelly applications, number of barrier cream applications, number of total diaper changes, whether alcohol wipes and pH neutral soap were used, and documentation of diaper dermatitis incidence.

The pre- and postimplementation rates of diaper dermatitis were calculated as the number of infants with NAS who had diaper dermatitis (numerator) and the total number of infants with NAS during each data collection time period (denominator). The statistical differences in the pre- and postimplementation rates of diaper dermatitis were compared using the chi-square statistic.

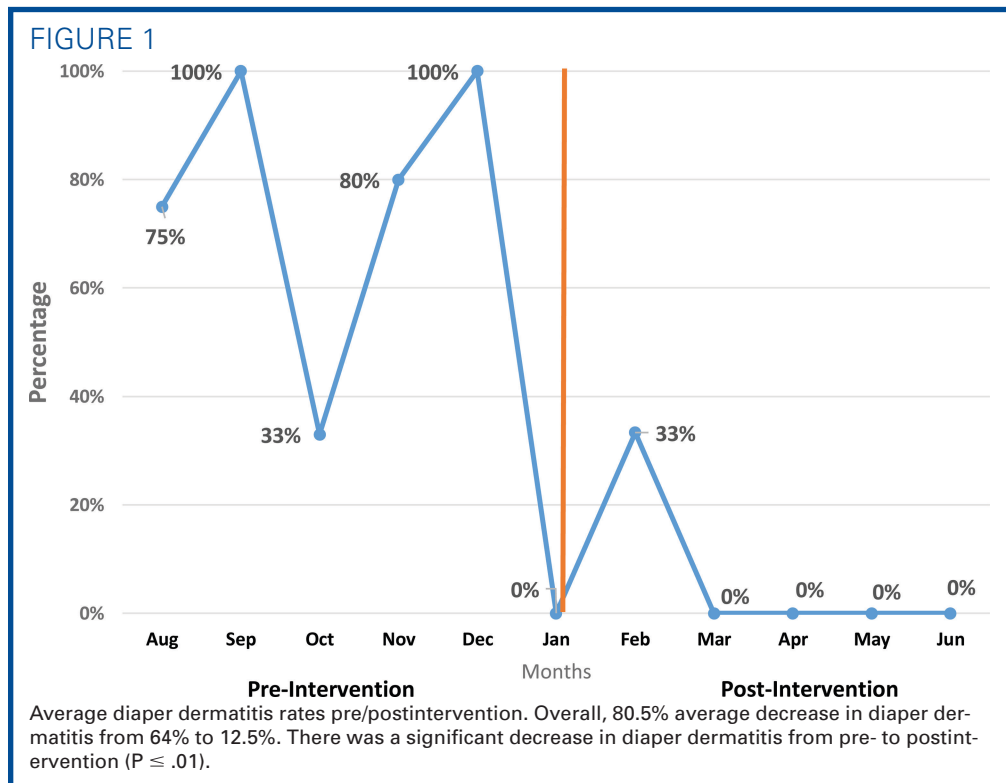
Ethical Considerations

The interventions encompass the standard of care. There was minimal risk associated with the interventions. Therefore, consent was attained through the initial consent signed upon admission to the NICU. This project was designed to promote consistent evidence-based skin care to an at-risk population. The confidentiality of this population was maintained by using unique numeric identifiers, and all patient information was saved on a password-protected laptop. The patient information data were accessed via the laptop on an encrypted home wireless network and were not shared with anyone who was not involved with the study. This study population was small. Patient and family privacy was monitored with extreme caution. No conflicts of interest existed for the author or key stakeholders involved in this project. The project was deemed exempt from review by the institutional review board at the facility.

RESULTS

There were 25 patients preimplementation from August 2019 through January 2020. There were 8 patients postimplementation. During the preimplementation phase of the skin care protocol, 64% of infants with NAS in the NICU study site had documented diaper dermatitis. Based on the SSDDS assessment tool, a score of more than 1 indicated a positive case of diaper dermatitis. A score of 1 or less indicated no presence of diaper dermatitis. During the postimplementation phase of the protocol, 12.5% of the infants with NAS had documented diaper dermatitis (with a score >1) (see Figure 1). A chi-square test was performed confirming that there was a significant decrease in diaper dermatitis from pre- to postintervention ($P \leq .01$). The total number of positive diaper dermatitis cases and the total number of negative diaper dermatitis cases were compared for both the preintervention and postintervention periods.

The expectation for routine diaper changes was 8 or more diaper changes per day. There was an



increase in meeting that expected number of diaper changes from total monthly averages of 59% preimplementation to monthly averages of 88% postimplementation. Monthly averages of petroleum jelly application per number of diaper changes were collected. The preimplementation rate of petroleum jelly applications per diaper change was 24%, and the postimplementation rate of application was 92% (see Figure 2). Postintervention, there was 100% compliance in using the superabsorbent diapers, alcohol-free wipes, and pH neutral soap.

Implications for Practice

Based on the results of this project, consistent use of the evidence-based interventions in the skin care protocol can support a significant decrease in rates of diaper dermatitis in future infants with NAS. The specific intervention yielding a significant measurable change was the consistent application of petroleum jelly (average rate of application per diaper change increased by 283% from pre- to postintervention). These findings suggest that consistent use of the petroleum jelly with each diaper change could be a significant intervention related to the decrease in rates of diaper dermatitis.

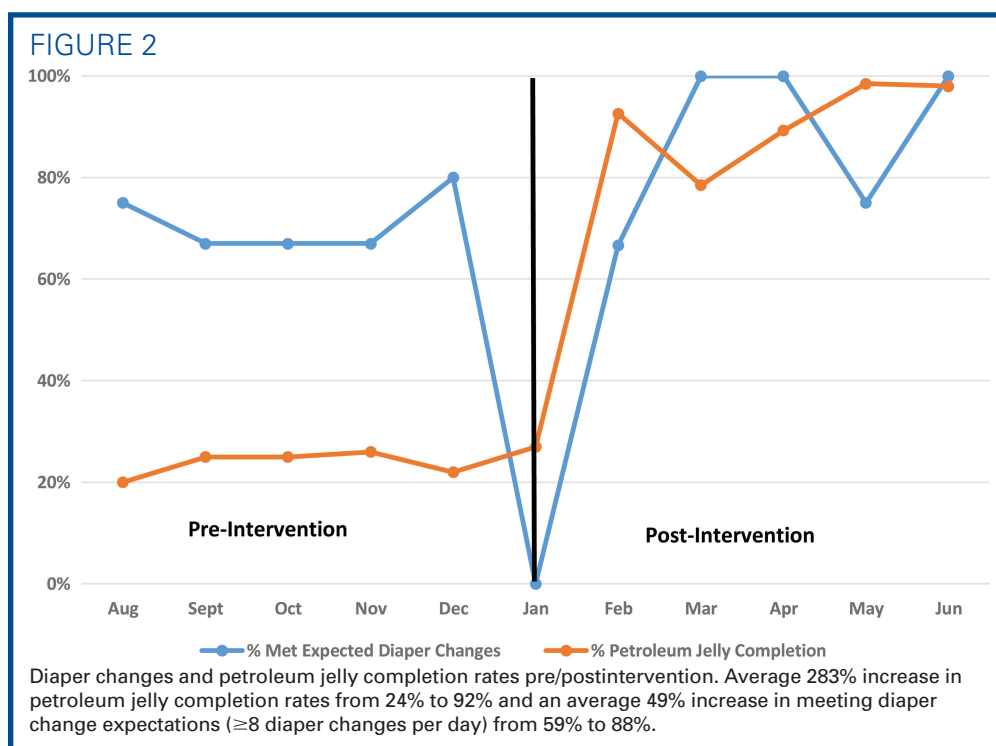
The superabsorbent diapers, pH neutral soap, and alcohol-free wipes most likely contributed to the decrease in diaper dermatitis, but because no preimplementation data for these interventions were collected, it is difficult to determine whether one of these interventions in particular had a substantial

influence on the skin condition of the infants with NAS at this NICU or whether it is truly the combination of interventions that had the greatest effect.

The nursing staff were very committed to improving the skin condition of infants with NAS despite the COVID-19 outbreak during the initiation of this project. The appointed diaper dermatitis skin care champion was critical to the success of this project. Moreover, an additional point person was designated to troubleshoot and answer questions regarding the interventions and documentation, which contributed to nursing staff buy-in and compliance with the skin care protocol.

The SSDDS assessment tool allowed the nurses to assess the diaper area properly and to document specific findings regarding diaper dermatitis. Previously, the nursing staff documented all skin assessment using the Neonatal Skin Condition Score, which is a very broad skin assessment tool. The SSDDS, a more specific, validated tool, led to prompt recognition of any mild skin irritation and prompt subsequent treatment with the skin protocol to prevent worsening diaper dermatitis.

Ultimately, the success of this project initiated the permanent adoption of the skin care protocol and the assessment tool into the nurses' daily assessments at this NICU. The unit is now consistently using each of the recommended interventions in addition to the diaper dermatitis-specific assessment tool. Recognizing the high rates of diaper dermatitis and seeing actual results created a shift in



attitude on the unit. There was a sense of responsibility and passion for skin care in this population, which was reflected in the positive verbal and written feedback received after the study. The diaper dermatitis champion continues to oversee and troubleshoot the skin care protocol, and the unit continues to see success in decreased rates of diaper dermatitis. Prior to the implementation of the protocol at this NICU study site, diaper dermatitis related to loose stools in infants with NAS was considered an accepted condition and part of the withdrawal process. The dedication and diligence in preventing diaper dermatitis, a common but painful condition, continue to be a priority in the care of this population on the unit.

Strengths

An important strength in this project was the ease of skin care protocol implementation. The necessary supplies used for the interventions were already on hand. As needed, other supplies were easily ordered at minimal additional cost. Thus, use of the skin care protocol can lead to significant patient care outcomes as well as significant cost saving. Despite the additional work this project created for the nursing staff, the buy-in was strong early in the postimplementation process. The general consensus on this small unit was that the nurses were very eager to help these infants in any way they could. There was positive feedback from many nurses related to the encouraging results they were seeing on a daily basis.

Limitations

Although the skin care interventions in this project are easily replicable, the small sample size rules out the possibility of generalizing the findings to similar NICU settings. Also, there were more than 3 times as many infants in the preimplementation group versus the postimplementation group. However, there was no way to control the number of NAS patients other than extending the postintervention data collection period.

The SSDDS tool used to specifically assess for diaper dermatitis was available to the nurses on the unit in paper charting form. This created the perception of additional work for the nurses at the end of their shift. If the SSDDS were included in the EMR documentation, there would be less perception of extra charting for the nurses.

The number of diaper changes and petroleum jelly applications was also tracked during the preintervention data collection period. There could have been undocumented diaper changes or emollient applications unaccounted for, which could affect the results when comparing pre- with postintervention data. However, the lack of consistency reinforced the need for a skin care protocol.

Another limitation was the availability of the products. Typically, the supplies used for the interventions are easily available and ordered without difficulty. However, during the COVID-19 pandemic, diapers were more challenging to purchase. Large amounts of these items were in high demand as households were stocking up on necessities. An

Summary of Recommendations for Practice and Research

What we know:	<ul style="list-style-type: none"> • Diaper dermatitis affects between 4% and 35% of infants. This rate can be up to 3 times as high in infants with loose stools. • A common withdrawal symptom in NAS infants is frequent loose stools, leading to high rates of diaper dermatitis. • Diaper dermatitis can lead to bacterial and fungal infections that can increase lengths of stay in the hospital. • Diaper dermatitis is very painful and can cause behavioral changes in the neonate, leading to changes in their treatment plans. • Skin care protocol can decrease rates of diaper dermatitis in NAS infants. These interventions include the following: <ul style="list-style-type: none"> ◦ Use of a specific diaper dermatitis assessment tool ◦ Petroleum jelly application with each diaper change ◦ Diaper changes every 3 hours or more ◦ Using superabsorbent diaper and alcohol-free wipes ◦ Using pH neutral soap with bathing ◦ Application of zinc oxide barrier cream in the presence of erythema
What needs to be studied:	<ul style="list-style-type: none"> • Further data collection on a larger sample size over longer periods of time. • The correlation between diaper dermatitis and scores on the FNAST. • Comparison of the use of antifungals/antibiotics related to diaper dermatitis preimplementation of skin care protocol versus postimplementation. • Application of skin care protocol to nursery to further prevent diaper dermatitis.
What can we do today:	<ul style="list-style-type: none"> • Aim to decrease rates of diaper dermatitis through consistent use of skin care protocol. • Educate parents so they can use the skin care protocol while providing care for their neonate.

alternate brand of superabsorbent diapers was purchased, which could have affected the data.

Implications for Research

Continued use of the protocol would allow for more data collection, which would provide further evidence to support the use of this protocol at the NICU study site. The protocol could be extended to the hospital's nursery in order to begin the skin care immediately after infants are born (rather than waiting until they are admitted to the NICU). Expanding to the nursery would require proper education for the families due to the infant spending time in the mother's postpartum room in addition to their time spent in the nursery. Finally, the SSDDS should be integrated into the hospital's EMR for more efficient documentation. Incorporating those data into the EMR would allow NICU nurses to use the tool and electronically document as part of their typical assessment every 3 hours.

CONCLUSION

Infants with NAS are at high risk for diaper dermatitis, a condition that is often preventable. Length of stay for this population is affected by exposure to infection and treatment plans, which is why preventing and managing diaper dermatitis during hospitalization are important.

Diaper dermatitis was a significant problem in the NICU of this community hospital. The implementation of the skin care protocol and specific diaper dermatitis assessment tool successfully supported a decrease in diaper dermatitis in infants with NAS at the study site, leading to the permanent adoption of

the protocol. These promising preliminary findings can help establish the basis for a future study across multiple NICUs.

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