An Algorithm for Diaper Dermatitis Management in the Neonatal Intensive Care Unit

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Abstract

Problem: Diaper dermatitis (DD) is inflammation of the skin in the perianal area that ranges from mild erythema to broken skin and bleeding. At baseline, 20% of infants ≥ 30 weeks gestation had DD in the target Level IV Neonatal Intensive Care Unit (NICU). Historically, DD was managed based on individual nursing judgment due to a lack of current standardization of care for infants with DD and resulted in inconsistent care of infants with DD.

Purpose: The purpose of this quality improvement project was to implement and evaluate the effectiveness of an algorithm for the prevention and treatment of DD in infants ≥ 30 weeks gestation in a Level IV NICU in an urban, academic medical center.

Methods: Bedside nurses were given education on DD and the new algorithm for the management of DD. They also completed pre-and post-knowledge surveys. The algorithm was placed at the bedside of each infant for reference and the educational PowerPoint was emailed to all bedside nurses. Once a week, bedside nurses documented incidence of DD, if prophylactic or therapeutic treatment was performed, and if the algorithm was followed. Continued education was provided throughout implementation, reminder cards were placed on each nurse computer, and reminder texts to document DD data were sent out via unit phones each Monday.

Results: The use of the algorithm and the use of prophylactic petroleum jelly increased from 0% at baseline to 100% over the 15-week data collection period. The prevalence of diaper dermatitis decreased from 20% (9/46) prior to implementation to 18% (2/11) on the last week of data collection. Following the education on DD and the implementation of the algorithm, the majority of nurses stated that they were more aware of DD and monitored for it more closely during diaper changes.

Conclusions: The use of an algorithm for the management of diaper dermatitis helped to increase the use of prophylaxis and education on the algorithm increases bedside nurses' awareness of DD in their patients on this unit.

Introduction

Diaper dermatitis (DD) can be described as an acute inflammatory condition in the perianal area that can range from mild erythema to broken skin and bleeding and is a common problem in healthy and ill infants (Hemiall et al., 2014). The incidence is 25% by the first month of life, with most starting in the first few weeks after birth (Blume-Peytavi et al., 2014). Neonates in the Neonatal Intensive Care Unit (NICU) are at a higher risk of DD due to risk factors such as prematurity, increased use of antibiotics, malnutrition and high calorie enteral nutrition (Heimall et al., 2014). Skin breakdown due to DD increases the risk of infection, pain, and hospital costs due to the need for treatment of infections (Heimall et al., 2014). The pain and infection risks of DD can cause significant distress to the infant, families, and bedside caregivers (Esser, 2016).

DD is prevalent in this urban level IV NICU. This level IV NICU cares for critically ill infants, and infants at high risk for DD. Common diagnoses encountered by neonates in this NICU contributing to the incidence of DD include prematurity, severe neonatal abstinence syndrome causing diarrhea, and infants requiring gastrointestinal surgery causing increased stool acidity. An informal bedside survey in this level IV NICU showed that 20% (9/46) of infants ≥ 30 weeks gestation have some type of DD. This survey also showed that 0% (0 out of 35) of infants ≥ 30 weeks were receiving petroleum jelly prophylaxis. This high level of DD and low level of prevention demonstrates that a change in practice was needed.

The purpose of this quality improvement project was to implement and evaluate the effectiveness of an algorithm for the prevention and treatment of DD in infants ≥ 30 weeks

gestation in a Level IV NICU in an urban area. The primary goals were to have a 0% DD rate and for 100% of infants ≥ 30 weeks to receive prophylactic petroleum jelly.

Evidence Review

This evidence review provides a synthesis of the evidence to support the implementation of an algorithm for the management of DD. The review includes studies supporting the use of algorithms within the pediatric population, the use of algorithms specific to DD, and the benefits of using petroleum jelly for prevention of DD. Melnyk and Fineout-Overholt's (2014) level of evidence rating system (Table 1) and Newhouse (2006) quality of evidence rating system (Table 2) were used to determine the levels and quality of the research studies.

Algorithms in general have been shown to be beneficial in standardizing care in healthcare settings (Chang et al., 2016; Hamilton, 2014). Chang et al. (2016) conducted a systematic review with meta-analysis that showed improved quality of life in children with chronic coughs when a care algorithm was implemented. Hamilton et al. (2014) conducted a quasi-experimental study that showed that pediatric patients reached their feeding goals faster when an algorithm was used. Across studies of pediatric populations, there was strong quality evidence (I-II B) demonstrating success when algorithms are used in the healthcare setting.

Algorithms specific to the management of DD are beneficial in the neonatal population (Esser, 2016; Heimall et al.). A cohort study by Heimall et al. (2012) showed a decrease in the incidence of DD in pediatric units when an algorithm for DD was implemented. Evidence from systematic reviews of descriptive and qualitative studies done by Esser (2016) showed an effective reduction in cases of DD after the implementation of a DD algorithm. Across studies of pediatric populations, there is low to moderate quality evidence (IV-V C) demonstrating the use of algorithms specific to DD.

The use of petroleum jelly as a preventative mechanism aids in the prevention of DD in the neonatal population (Esser, 2016 & Heimall et al). A cohort study by Heimall et al., (2012) showed that literature supported the use of petroleum jelly as an effective barrier against infant's skin breakdown. Evidence from systematic reviews of descriptive and qualitative studies done by Esser (2016) showed that petroleum jelly products help protect skin integrity. Across pediatric studies, the type and quality of evidence is low to moderate (IV-V C) demonstrating that the use of petroleum jelly can aid in the prevention of DD.

In conclusion, strong quality (I-IV B) studies have shown that algorithms in general in the pediatric population are beneficial in healthcare (Chang et al., 2016 & Hamilton et al., 2014). Low to moderate quality evidence has shown that the use of algorithms specific to DD can decrease the incidence of DD and that the use of petroleum jelly prophylaxis is helpful in preventing DD in the pediatric population (Esser, 2016 & Heimall et al). Although there is only low to moderate quality evidence, the implementation of an algorithm for the prevention of DD is low risk to the patient population and has the potential to be highly beneficial.

Theoretical Framework

Kurt Lewin's Theory of Change stems from his "Frontiers in Group Dynamics" paper from 1947 where he first discussed the concepts of unfreezing, change (moving to a new level), and refreezing. The unfreezing phase states that it may be necessary "to break open the shell of complacency and self-righteousness" (Lewin, 1947) before true change can occur. The next phase is change. The third and final phase is the refreezing of the new practice. The refreezing phase is important in order to ensure sustainability of the quality improvement project.

These steps were used to aid in the implementation of an algorithm for the management of DD. The unfreezing phase focused on the current practice on the target unit. The historical

practice for the management of DD in the targeted NICU was based on individual nursing judgment. Products used for prevention and treatment of DD were changed as often as every 3-4 hours due to nurse preference. This practice needed to be broken and education on proper prevention and treatment needed to occur. The change phase occurred with the implementation of the algorithm along with staff education. This changed the way in which nurses respond to DD, as it was no longer based on nurse preference but instead was based on an evidence-based algorithm. Finally, the refreezing phase involved the use of unit champions, continued bedside audits, and verbal reminders every three months in the nursing pre-shift huddle to continue daily use of the algorithm. Lewin's Theory of Change aided in the understanding of and guided decision making for this quality improvement project.

Methods

The population/setting affected by this QI change included the staff and patients on a > 50 bed Level IV NICU in an urban academic medical center. The neonates affected by this change were infants ≥ 30 weeks gestational age (post-menstrual or at birth) due to the increased maturity of their skin when compared to more premature infants. On average, about 94% of the infants on the unit were ≥ 30 weeks gestational age. This practice change affected the nursing staff which consisted of roughly 145 nurses with years of experience ranging from <1 year to >30 years. This practice change also minimally affected the Providers (Nurse Practitioners, Residents, Fellows, and Attending Physicians) as they continued to order necessary medications such as Nystatin for treatment of DD according to the algorithm.

The implementation team included the project leader, the unit champions, the clinical site representative, the administrative sponsor, the project faculty advisor, the nursing director, and the medical director of the target NICU. The unit champions included two bedside nurses who

were passionate about increasing the consistency of care for infants with DD. They worked closely with the project leader to lead educational in-services and model the use of the algorithm on the unit. The evidence-based implementation was an algorithm for the management of DD (see Appendix A). The algorithm was adapted from the Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN) 2018 Skincare Guidelines (AWHONN, 2018). This algorithm provided nursing staff with clear steps and escalation of care for worsening DD.

A structural measure assessed during this quality improvement project was the number of staff that received the education on the new algorithm. The process measures of the number of infant's ≥ 30 weeks gestational age treated prophylactically with petroleum jelly and the documented use of the algorithm in infants ≥ 30 weeks gestational age were assessed. Finally, an outcome measure that was tracked during implementation was the number of infants ≥ 30 weeks with any type of DD (ranging from mild erythema to skin breakdown).

Implementation strategies and tactics were used to aid in the success of this quality improvement project. Feedback from bedside nurses was obtained and was used to increase compliance with petroleum jelly prophylaxis half-way through implementation. Formal commitments were obtained from key stakeholders. The project leader and unit champions modeled the use of the algorithm prior to and during implementation, and meetings were held bimonthly with the CSR and unit champions. A laminated algorithm with a table of the target NICU's corresponding products was placed in each bedside patient chart, pictorial reminder cards were placed on each computer (see Appendix B), and weekly staff texts were sent to remind bedside nurses to document. Finally, the unit was updated on key data from the project such as DD prevalence, prophylaxis, and algorithm usage via a mass unit email.

During implementation, data including gestational age ≥ 30 weeks, incidence of DD, if a skincare product (not petroleum jelly) was used, if petroleum jelly was applied, and if the algorithm was followed was collected via paper documentation outside the infant's room (see Appendix C). The data was then analyzed by the project leader, and percentages were calculated and entered into run charts to better visualize progress.

Staff education was performed via in-person educational sessions that were held biweekly for the first 5 weeks of implementation and the educational PowerPoint was emailed to all nursing staff (see Appendix D). These educational sessions were performed by the project leader and unit champions. Prior to receiving the education, staff filled out pre-knowledge surveys and after they received the education, they filled out a post-knowledge survey. Staff pre- and post-knowledge surveys were anonymous and thus posed no risk to confidentiality (see Appendix E). Staff education data was collected on a paper document where nurses signed their name when they received DD education (see Appendix F). This document was kept in a secure locked cabinet and did not leave the unit. The data on staff education was collected as a percentage and without staff names or identifiers (see Appendix G). No identifiable data was collected from infants on the unit and thus no confidentiality risk was present. This quality improvement project also received Not Human Subjects Research determination from the Institutional Review Board from the target medical center.

Results

The purpose of this quality improvement project was to decrease the incidence of DD in the target NICU and increase the use of prophylactic petroleum jelly for all infants ≥ 30 weeks gestation through the implementation of an evidence-based algorithm. Secondary goals were to have a 100% compliance rate for use of the new DD algorithm and provide education to all

bedside nurses in order to increase their confidence in recognition of DD and understanding of the new algorithm.

After implementation and education on the algorithm for the management of DD in the NICU, the incidence of DD decreased from 20% (9/46) prior to implementation to 18% (2/11) on the last week of data collection with fluctuations in incidence throughout the data collection period (see Figure 1). Nursing use of the algorithm steadily increased throughout the data collection period from 0% at baseline, to 59% (19/32) halfway through, and finally reached 100% (11/11) on the final week of data collection (see Figure 2). The use of petroleum jelly as prophylaxis increased from 0% prior to implementation to 100% (9/9) on the last week of data collection (see Figure 3). After education on the new algorithm, the percentage of employees who agreed that petroleum jelly should be used prophylactically for all infants ≥30 weeks gestation increased from 84% to 100%. At the end of the data collection period, 100% of bedside nurses reported following the algorithm for their patients in the NICU.

Approximately 74% (108/145) of the bedside nurses received in-person education on this project, but 100% received the educational PowerPoint via email. After implementation was completed, an informal bedside survey was demonstrated 100% of staff reported feeling confident in their ability to identify DD in their patients and 95% of staff stated they knew how to use the algorithm for DD management. Finally, after education, the percentage of employees who strongly disagreed that DD is a trivial issue that does not affect families increased from 40-66%.

Discussion

Overall, the incidence of DD was similar prior to implementation when compared to after implementation of the algorithm with only a small decrease (20% to 18%). The data collected

only looked at incidence of DD and not at the severity of the DD. The lack of a severity scale prevented this QI project from collecting data that could show a change in not only incidence but also in severity of DD after the algorithm was implemented. The small change in DD incidence could also be secondary to improved recognition of mild DD.

The use of the algorithm increased from 0% pre-implementation to 100% the last week of data collection. The use of the algorithm allowed all nurses to follow the same guidelines for management of DD. This is consistent with the study by Esser (2016) that showed that an algorithm increased the consistency of care for the patients in the target NICU.

The use of prophylaxis increased to 100% by the last week of data collection as well. This use of prophylaxis is supported by AWHONN's 2018 skincare guidelines that stated the use of prophylaxis with each diaper change can decrease the incidence of DD. The use of unit champions to provide continued education on the importance of prophylaxis was crucial. Approximately halfway through the data collection period, an informal survey was completed that showed nurses were not using prophylaxis because it was not stocked in their bedside patient carts. This issue was addressed with the senior clinical nurse staff and the unit technicians began to stock petroleum jelly packets in the diaper drawers of each infant's bedside cart. Petroleum jelly packets were already stocked in all unit supply rooms prior to the implementation of this project, so there was no concern for cost. After this change, prophylaxis rates continued to increase, and bedside nurses stated satisfaction with this change.

Data was collected via paper documentation filled out by nurses outside of each patient's room. This was a limitation as DD is not included in the nursing skincare documentation within the electronic health record. The number of patients for which data was collected ranged from 11 to 35 per week throughout the 13-week implementation period. This fluctuation in data

collection could be due to the large number of quality improvement projects on the unit causing staff fatigue, as well as high patient acuity and difficult staff assignments during some weeks of data collection. The addition of this documentation to the electronic charting system could increase nursing documentation compliance and improved data availability.

Conclusion

The use of an algorithm for the management of DD is beneficial in increasing staff awareness and management of DD in this NICU. Although the incidence only decreased by 2%, the prophylaxis and use of the algorithm both increased to meet the goal of 100%. The use of in-person educational sessions were successful and although time-consuming, staff expressed satisfaction in being able to ask questions and receive demonstrations and explanations about the new algorithm.

The implementation of a severity scale could allow more detailed nursing documentation and allow for more thorough analysis on the ability of the algorithm to decrease the incidence of DD. It would also be beneficial to incorporate a perianal skin assessment and management to the electronic charting system. The use of electronic charting could increase sustainability as it would become a common part of the nursing documentation.

The use of unit champions to aid in modeling the algorithm, educational sessions, and data collection was instrumental to this QI project. As the project continued, more bedside nurses became involved and expressed interest in becoming unit champions. These unit champions will continue to collect data (via current paper documentation or future electronic data) and analyze this to assess DD incidence, use of prophylaxis, and use of the algorithm.

They will also be available for questions from staff and to hold continuing education sessions twice yearly.

Overall, the use of an algorithm for the management of DD has been beneficial to the targeted NICU by increasing prophylaxis and consistency of care. Most staff have expressed satisfaction with the new algorithm and its clarity. Although further steps can be taken to increase data collection and further analysis, this QI project encouraged the target NICU to be more aware of the issue of DD in the neonatal population.

References

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Tables

Table 1: *Evidence-Review Table*

Chang, A. B., Oppenheimer, J. J., Weinberger, M., Weir, K., Rubin, B. K., & Irwin, R. S. (2016). Use of management pathways or algorithms in children with chronic cough. *Chest, 149*(1), 106–119. doi: 10.1016/j.chest.2016.12.025					Level: I
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
"… our overall aim was to evaluate the use of management pathways or algorithms in children with chronic cough. We undertook three Systematic reviews to examine three related key questions (KQ): In children aged ≤ 14 years with chronic cough (>4 weeks' duration), KQ1, do cough management protocols (or algorithms) improve clinical outcomes? KQ2, should the cough management or testing algorithm differ depending on the duration and/or severity? KQ3, should the cough management or testing algorithm differ depending on the associated characteristics of the cough and clinical history?"	Systematic Review with meta-analysis	**Search Strategy:** The search was conducted by librarians at the University of Massachusetts Medical School. Two reviewers independently read all abstracts and then agreed on which full text articles would be considered. Disagreements were resolved with a third reviewer. The RCTs were assessed using criteria in Cochrane Reviews. For cohort studies, data was extracted by one reviewer and then checked by the second. KQ1: 351 abstracts were identified by searchers. 20 full text were retrieved and 13/20 were excluded due to age > 14 years, old Cochrane review, study protocol only, guidelines without patient data, and an algorithm not being	**Control:** Controls varied between studies in the Systematic Review but mainly included management of chronic cough in children (≤14 years of age) without the use of an algorithm and without changing the treatment based on associated characteristics of the cough and clinical history. **Intervention:** Interventions in the studies in the Systematic Review included the use of an algorithm for the management of chronic cough in children ≤ 14 years of age. **Protocol:** Not applicable to Systematic Review	**Dependent Variable:** The dependent variable is improved clinical outcomes which include identification of cause of chronic cough, early diagnosis, and decreased cough. **Measure:** Measures differed and included parent-reporting, and cough diary.	**KQ1:** All studies found that the use of cough algorithms was beneficial. The RCT found the group that used the algorithm (intervention group) had better quality of life, shorter cough duration, and higher proportion of children were cough-free. The cohort studies reported high levels of achieving diagnosis when algorithms were used. **KQ2:** There were no eligible studies. **KQ3:** All studies showed that algorithms should differ depending on cough characteristics and clinical history. The CHEST algorithm was reviewed includes chest pointers. Chest pointers include wet cough, exertional dyspnea, and recurrent

		used. 7 studies met the inclusion criteria and 2 were added from author's database. There were 9 total studies included in the current systematic review. KQ2: 253 abstracts identified, 11 full text retrieved, and 11/11 studies were excluded for reasons of: studies did not study effect of duration or severity on algorithm, guidelines without patient data, and an algorithm for cough not used. No study was included for KQ2 KQ3: 251 abstracts identified, 20 full text retrieved, 12/20 were excluded for reasons of: association study, case series, and just reviews. 8 studies met inclusion criteria for KQ3.			pneumonia (as well as many others). Using presence of specific cough pointers for the cause of chronic cough (when compared to resolution without specific treatment) had a sensitivity of 1.0 (95% CI, 0.98-1.0), specificity of 0.95 (95% CI, 0.82-0.99), positive predictive value of 0.99 (95% CI, 0.97-1.0), negative predictive value of 1.0 (95% CI, 0.89-1.0), positive likelihood ratio of 20 (95% CI, 5.18-77.21), and negative likelihood ratio of 0 (95% CI, 0-0.3).
Citation: Hamilton, S., Mcaleer, D. M., Ariagno, K., Barrett, M., Stenquist, N., Duggan, C. P., & Mehta, N. M. (2014). A stepwise enteral nutrition algorithm for critically ill children helps achieve nutrient delivery goals. *Pediatric Critical Care Medicine*, *15*(7), 583–589. doi: 10.1097/PCC.0000000000000179					Level II
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results

Purpose: "To evaluate the impact of implementing an enteral nutrition (EN) algorithm on achieving optimal EN delivery in the Pediatric Intensive Care Unit (PICU)" (Hamilton et al., 2014). **Hypothesis:** "We hypothesized that implementation of a uniform nutrition guideline would decrease avoidable EN interruptions, increase likelihood of reaching energy delivery goals early via the enteral route and decrease unnecessary reliance on PN in the PICU" (Hamilton et al., 2014).	Quasi-experimental QI design	**Sampling Technique:** Convenience: Patients admitted to the PICU over two 4-week periods with a stay of > 24 hours who received EN **# Eligible**: 160 **# Accepted**: 160 **# Control**: 80 **# Intervention**: 80 **Group Homogeneity:** "There were no significant differences in median age, gender, need for mechanical ventilation, and length of PICU stay between the 2 cohorts" (Hamilton et al., 2014). There was a significantly higher number of children with respiratory illness ($p < 0.005$) in the pre-intervention cohort.	**Control:** Initiating, advancing, and maintaining EN in critically ill children without the use of a standard algorithm. **Intervention**: Implementing "a stepwise, evidence-based algorithm for initiating, advancing, and maintaining EN in critically ill children" (Hamilton et al., 2014). **Intervention fidelity**: Before implementation, physicians and nurses were given a pre-test to learn of knowledge deficits. Then, learning modules, one-on-one education, and weekly rounds with nutrition were done. Then, paper and electronic copies of the algorithm were sent to all personnel and reminders were given during daily bedside rounds to review the algorithm.	**Dependent Variables**: Total and avoidable interruptions to EN, time to initiate EN after admission, time to reach prescribed energy goal, and PN use in patients with EN interruption **Measurement tool:** Audits of bedside nutrition practices were examined to determine the impact of this intervention. The audits were completed twice daily by nurses (at the end of each 12-hour shift). These documents were then reviewed by nurse investigators to ensure all data was documented.	**Statistical Results:** Delivery of EN was improved and there was less reliance on PN in very sick children after the algorithm was implemented. Children also met their enteral goals faster after algorithm implementation. There was a significant decrease in number of avoidable episodes of EN interruption (3 vs. 51, $p = 0.0001$) The median time to reach the energy goal went down from 4 to 1 ($p< 0.0001$). There was also a higher proportion of patients that reached the energy goal (99% vs. 61%, $p = 0.01$).
Citation: Heimall, L. M., Storey, B., Stellar, J. J., & Davis , K. F. (2012). Beginning at the bottom: Evidence-based care of diaper dermatitis. The American Journal of Maternal/Child Nursing, 37(1), 16–18. doi: 10.1097/NMC.0b013e31823850ea					Level IV
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results

Purpose: "The diaper dermatitis frequency cited in literature, the suspicion that the hospital's rate was high, and observed practice variations encouraged us to look at our own prevalence rates and prevention and treatment tactics" (Heimall, Storey, Stellar, & Davis, 2012). Hypothesis: The consistent use of a diaper dermatitis standard of treatment plan will decrease the rates of diaper dermatitis in pediatric units.	Cohort Study	**Sampling technique** Convenience sampling of infants in 5 different inpatient pediatric units **Eligibility**: Infants had high risk for diaper dermatitis **N total** = 195 pediatric patients from 6 inpatient units **Power analysis**: not conducted **Homogeneity**: inpatient pediatric patients considered at high-risk of diaper dermatitis	**Control**: No use of algorithm (nurse based) for prevention and treatment of diaper dermatitis **Intervention**: Use of algorithm for prevention and treatment of diaper dermatitis **Intervention Fidelity:** This controlled trial compares the percentage of infants with diaper dermatitis before and after implementation of an algorithm Nursing units received information on the algorithm via tip sheets and posters of the new algorithm. Skin care champions were used for routine collection of data and are resources for nursing staff.	**DV**: Cases of diaper dermatitis **Measurement**: Prevalence of diaper dermatitis was reassessed after implementation at 3 months, 6 months, and 9 months.	**Statistical Results:** *Pre-implementation* diaper dermatitis prevalence data 24% *Post implementation* diaper dermatitis prevalence data recorded at: 3 months: 15% 6 months: 18% 9 months: 11% 2 years after implementation of an algorithm for the prevention and treatment of diaper dermatitis → the rates went down from 24% to 11%

Citation: Esser, M. (2016). Diaper dermatitis: What do we do next? *Advances in Neonatal Care*, *16*. doi: 10.1097/ANC.0000000000000316					Level: V
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
"Initiation of an evidence-based algorithm to assist in the prevention and treatment of diaper dermatitis can be supported by data of the number of cases of diaper dermatitis collected before and after implementing the algorithm"	Evidence from systematic reviews of descriptive and qualitative study	**Sampling Technique:** Convenience of infants in the Neonatal Intensive Care Unit (NICU) in the study **Eligibility**:	**Control** No algorithm for prevention and treatment of diaper dermatitis **Intervention** Use of algorithm for the prevention and	**DV**: Cases of diaper dermatitis **Measurement**: Survey of patient cases of diaper dermatitis before and after implementation of algorithm. Use of chart audits	**Results**: The use of the algorithm helped to standardized management of diaper dermatitis and aided in more consistent use of skincare products.

		Infants in the NICU with diaper dermatitis **N total**: 2 infants with diaper dermatitis in NICU **Power analysis**: not conducted **Homogeneity:** NICU patients greater than 30 weeks gestation	treatment of diaper dermatitis **Intervention fidelity** This review of descriptive studies gives examples of 2 infants' diaper dermatitis treatment based on an algorithm The nursing staff received education on the steps of the algorithm with descriptive images. The current NICU skin care policy was revised to include the algorithm and adherence from staff was expected. Weekly skin rounds and chart audits were performed to determine adherence and efficacy.		This study stated they had increased consistency of care and decreased severity of diaper dermatitis with use of the algorithm.

Table 2: *Literature Synthesis*

Evidence Based Practice Question (PICO): Does the use of an algorithm for the prevention and treatment of diaper dermatitis in a level IV Neonatal Intensive Care Unit (NICU) decrease the incidence and severity of diaper dermatitis in infants' ≥ 30 weeks gestation?			
Level of Evidence	**# of Studies**	**Summary of Findings**	**Overall Quality**
I	**1**	Change et al., (2016) performed three systematic literature reviews for three key questions (KQ) about algorithms for chronic cough in children. The systematic reviews only included randomized controlled trials (RCT) and case/cohort studies. KQ1 asked if the use of an algorithm for chronic cough would improve clinical outcomes. Nine studies (1 RCT and 7 cohort studies) were examined for KQ1 and all found the use of an algorithm for chronic cough in children to be beneficial. One RCT found it improved quality of life and the cohort studies found high success in achieving a diagnosis when the algorithm was used. No studies were found for KQ2. Eight studies (2 RCT and 6 cohort) were included for KQ3 which asked if the algorithm should differ depending on associated cough characteristics. All studies found that the algorithm should differ depending on characteristics and cough pointers (dyspnea, wet cough, pneumonia, etc). KQ1 was the only question that is applicable to the evidence based PICO question and shows that the use of an algorithm in the pediatric population can be beneficial in healthcare.	B – This systematic review was reasonably thorough however, the search strategies were not given so it is not easily reproducible (why it was not given an 'A'). The results were consistent with definitive conclusions. The recommendations were based on a comprehensive literature review that included references to scientific evidence.
II	**1**	Hamilton et al., (2014) used a quasi-experimental design to perform an audit of enteral nutrition practices to determine the impact of an enteral nutrition algorithm. The study took place over 4 weeks and determined a significant decrease in the number of avoidable episodes of EN interruption (3 vs. 51, p= 0.0001) after implementation of the algorithm. The algorithm implementation also showed a decreased time to reach energy	B – The results were consistent with a large sample size of 160 pediatric ICU patients (80 pre and 80 post-implementation). There was a control group and there were reasonably consistent recommendations. It was stated that a group of critical care medical professionals conducted a search of literature that included grading and reporting the evidence, however this was not described in this article.

		goal (4 days to 1 day, $p < 0.0001$) and a high proportion of patients reaching their energy goal (99% vs. 61%, $p = 0.01$). This study shows that algorithms in the pediatric population can improve healthcare outcomes.	
IV	**1**	Heimall et al., (2012) used a literature synthesis, along with expert opinion, to create an algorithm for the prevention and treatment of diaper dermatitis in pediatric/neonatal Intensive Care Units. Pre and post-implementation data were gathered (n= 195 pediatric ICU patients) for the total diaper dermatitis rate and severity of diaper dermatitis. They found that after the implementation of the algorithm, the rates of diaper dermatitis decreased from a 24% to 11% (9 months post-implementation). The severity of diaper dermatitis also decreased. After 9 months of implementation, the prevalence of the most severe (Type IV) diaper dermatitis decreased to 0% (pre-implementation was 11%).	C – This cohort study had reasonably consistent results with a large sample size (also no power analysis was performed). There was a comprehensive literature review completed prior to the implementation of the algorithm. References to scientific evidence are given throughout the article. However, there are conflicting pre-implementation data and the dates given do not align with the number of years of implementation.
V	**1**	Esser (2016) reviewed literature and research on the prevalence and management of diaper dermatitis. An evidence-based algorithm for diaper dermatitis management was created and implemented in a level IV NICU. Two case reports were examined, one severe and one mild, to show the steps of the algorithm and the resulting success when used consistently. Pre and post-implementation data was collected on the incidence of diaper dermatitis and supported the use of the algorithm. The NICU from this case saw increased consistency of care and decreased severity of diaper dermatitis after the implementation of the algorithm.	C – Although the results were stated as being consistent, the sample size (of 2 case reports) was not sufficient (no power analysis was done). The pre/post-implementation data was stated to show support of the algorithm; however no data was presented. There was a comprehensive literature review that included some references to scientific studies.

Newhouse, R. (2006). Examining the source for evidence based nursing practice. JONA.Volume 36, Number 7/8, pp 337-340

Figure 1: *Diaper Dermatitis Incidence*

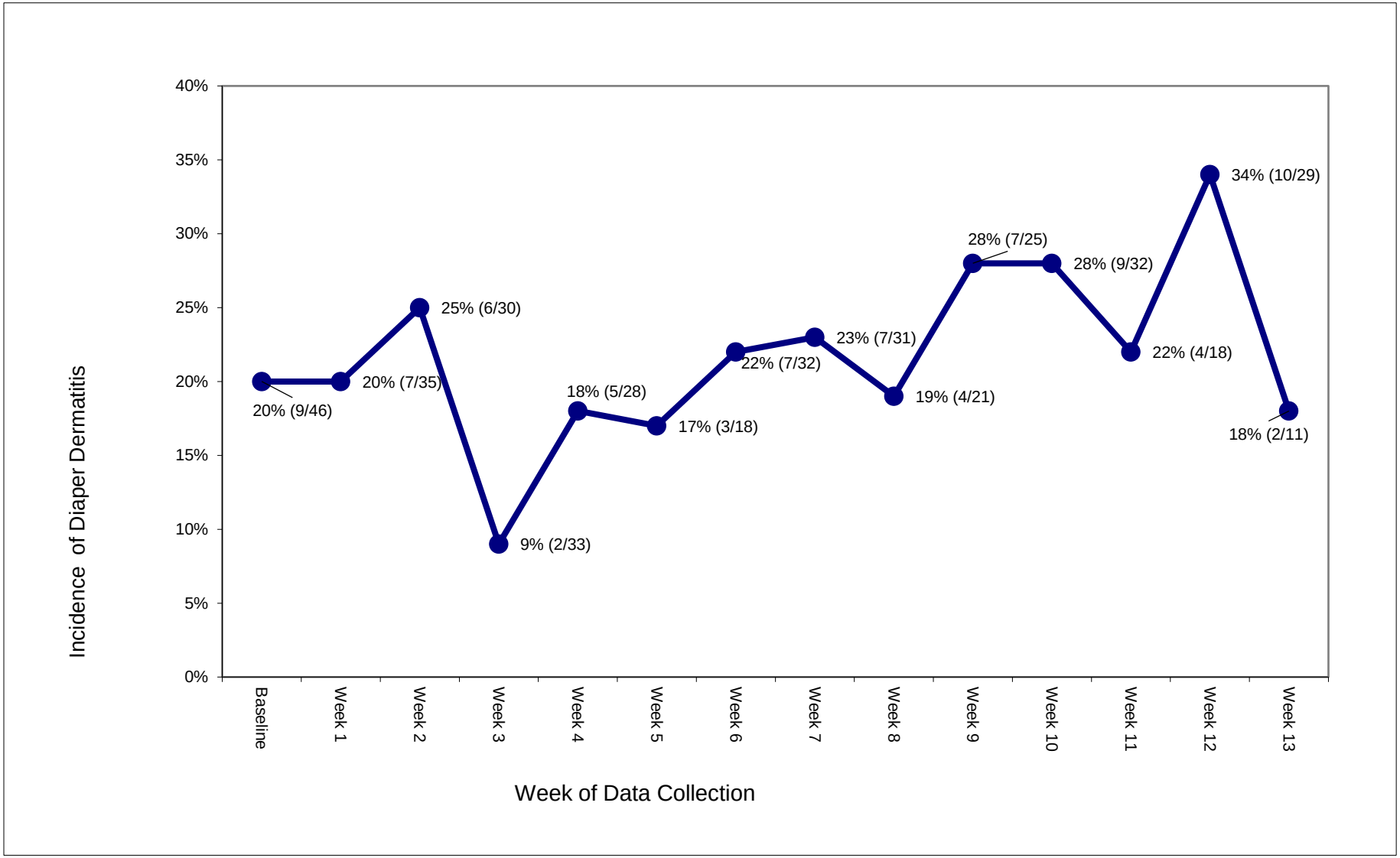


Figure 2: *Algorithm Usage Run Chart*

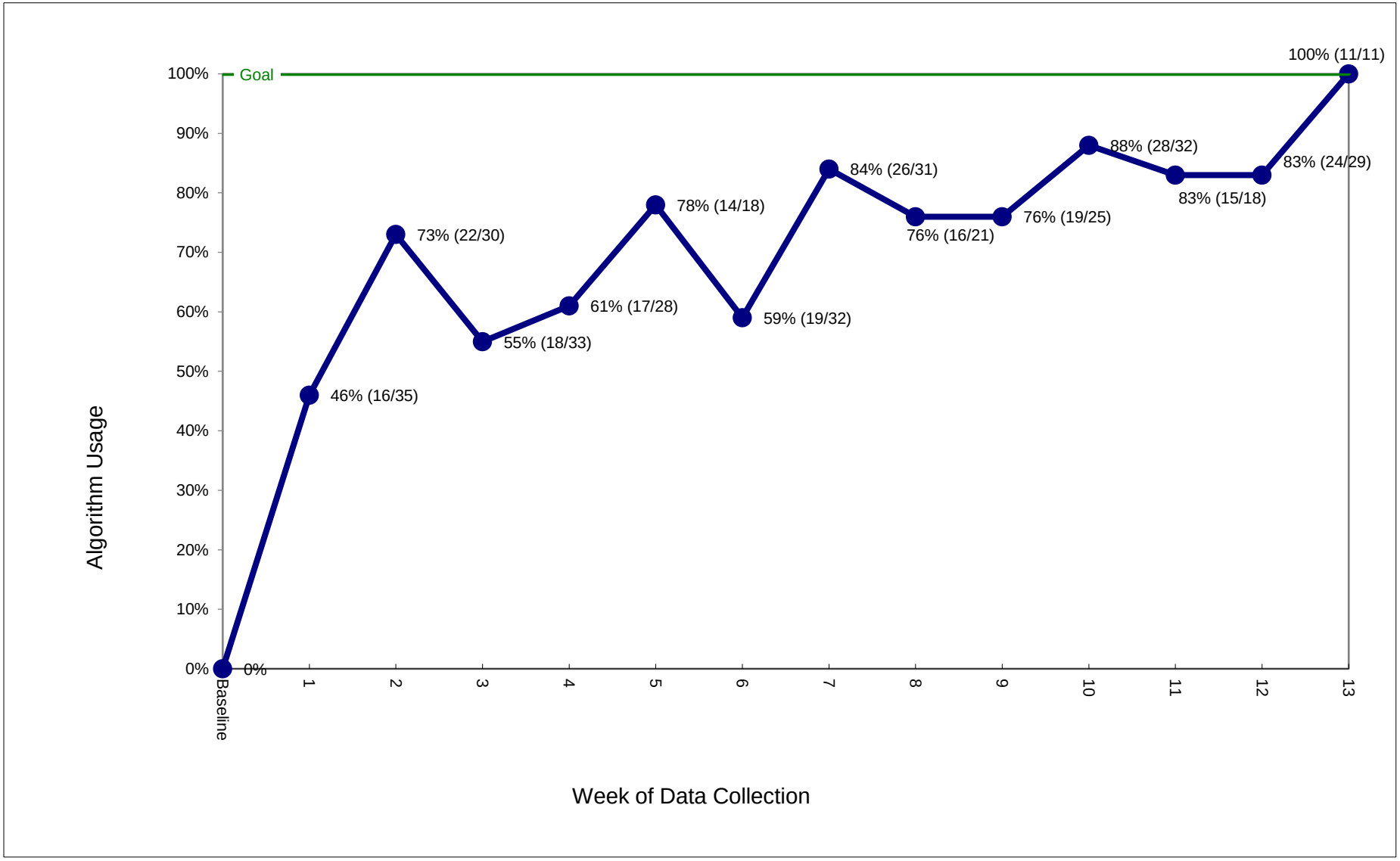
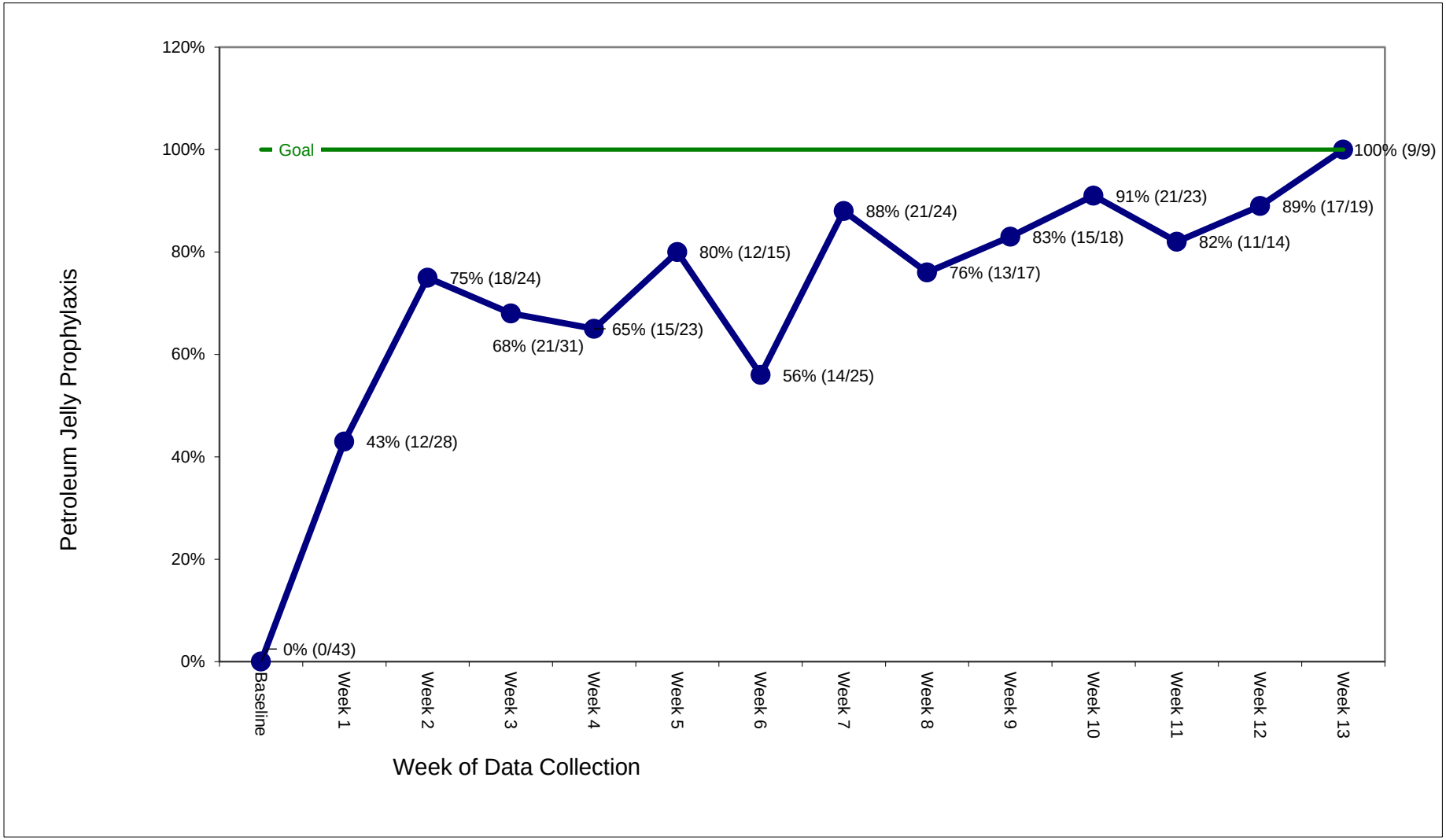


Figure 3: *Petroleum Jelly Prophylaxis Run Chart*



Appendix A

Algorithm for the Management of DD

SUGGESTED PERINEAL SKIN CARE GUIDELINES FOR DIAPERED/INCONTINENT PATIENTS

Skin Assessment	• Intact skin • No erythema	• Intact skin • High risk for skin breakdown due to causticity of stool (short gut, post pull through or ostomy closure) • With or without erythema	• Intact skin • Erythema • No *Candida*** 	• Intact skin • Erythema, satellite lesions typically on thighs, perineum • Evidence of *Candida*** 	• Denuded skin* • No *Candida*** 	• Denuded skin* • Evidence of *Candida*** 
Goal of Treatment	Prevent skin breakdown	Prevent skin breakdown; Provide barrier	Prevent skin breakdown; Provide barrier	Treat *Candida*	Prevent further skin breakdown; Provide barrier	Prevent further skin breakdown; Treat *Candida*; Provide barrier
Barrier film may be applied prior to application of any of the below products (in patients > 28 days old)						
Treatment	Petrolatum	Zinc oxide barrier cream **OR** Alcohol-free, pectin-based paste, covered with petrolatum	Zinc oxide barrier cream	Antifungal topical treatment	Pectin powder then zinc oxide barrier cream **OR** Pectin powder then alcohol-free, pectin-based paste then petrolatum **OR** Crusting technique (see next column)	Antifungal ointment or cream then zinc oxide barrier cream **OR** Antifungal powder and alcohol-free skin protectant crusting technique then alcohol-free, pectin-based paste then petrolatum
Application Instructions	Apply a thick layer of petrolatum over the entire area to be protected (think "icing on a cake").	Apply a thick layer of zinc oxide-based cream (think icing on a cake"). **OR** **For alcohol-free, pectin-based paste:** -"Press" into place vs. "spreading." -Apply a thick layer of petrolatum on top of pectin product, to prevent pectin product from sticking to diaper. **With each diaper change:** -Only remove stool, try to leave pectin product in place. -If skin showing, replace pectin product as needed, re-apply petrolatum.	Apply a thick layer of zinc oxide-based cream (think "icing on a cake").	Apply antifungal ointment; if no improvement in 24-48 hours, consider using a different antifungal preparation.	Apply a thin layer of pectin powder to denuded areas. Brush off excess. Powder will stick to the open skin. Then apply thick layer of zinc oxide barrier cream or alcohol-free, pectin-based paste on top of pectin powder. **For alcohol-free, pectin-based paste:** -Press into place vs. spreading. -Apply thick layer of petrolatum over pectin product to prevent pectin from sticking to diaper. **With each diaper change:** -Only remove stool, try to leave pectin product in place. -Skin showing: replace pectin product prn, re-apply petrolatum.	Apply antifungal ointment or cream, followed by zinc oxide barrier cream. **OR** **Crusting Technique:** 1. Apply a thin layer of antifungal powder to denuded areas. Brush off excess. 2. Seal the powder with a skin-protectant covering. 3. Then apply thick layer alcohol-free, pectin-based paste, zinc oxide barrier cream, or petrolatum on top of skin-protectant.

*Denuded Skin: Skin with moist, open, oozing ulcerations.
**Candida infection: Beefy red skin with oval/ dotty lesions scattered at edges (satellite lesions), usually involves skin folds, skin may or may not be denuded.
NOTE: These products promote moist wound healing, therefore do not leave diaper open to air or have air/oxygen blowing on diaper area
† Source: ©Douglas Hoffman, MD, Dermatlas. http://www.dermatlas.org

Appendix B

Pictural Reminder Cards

Appendix C

Paper Documentation

DIAPER DERMATITIS: BEDSIDE DATA COLLECTION

Date _____

Shift (AM/PM) _____

Please Circle YES or NO

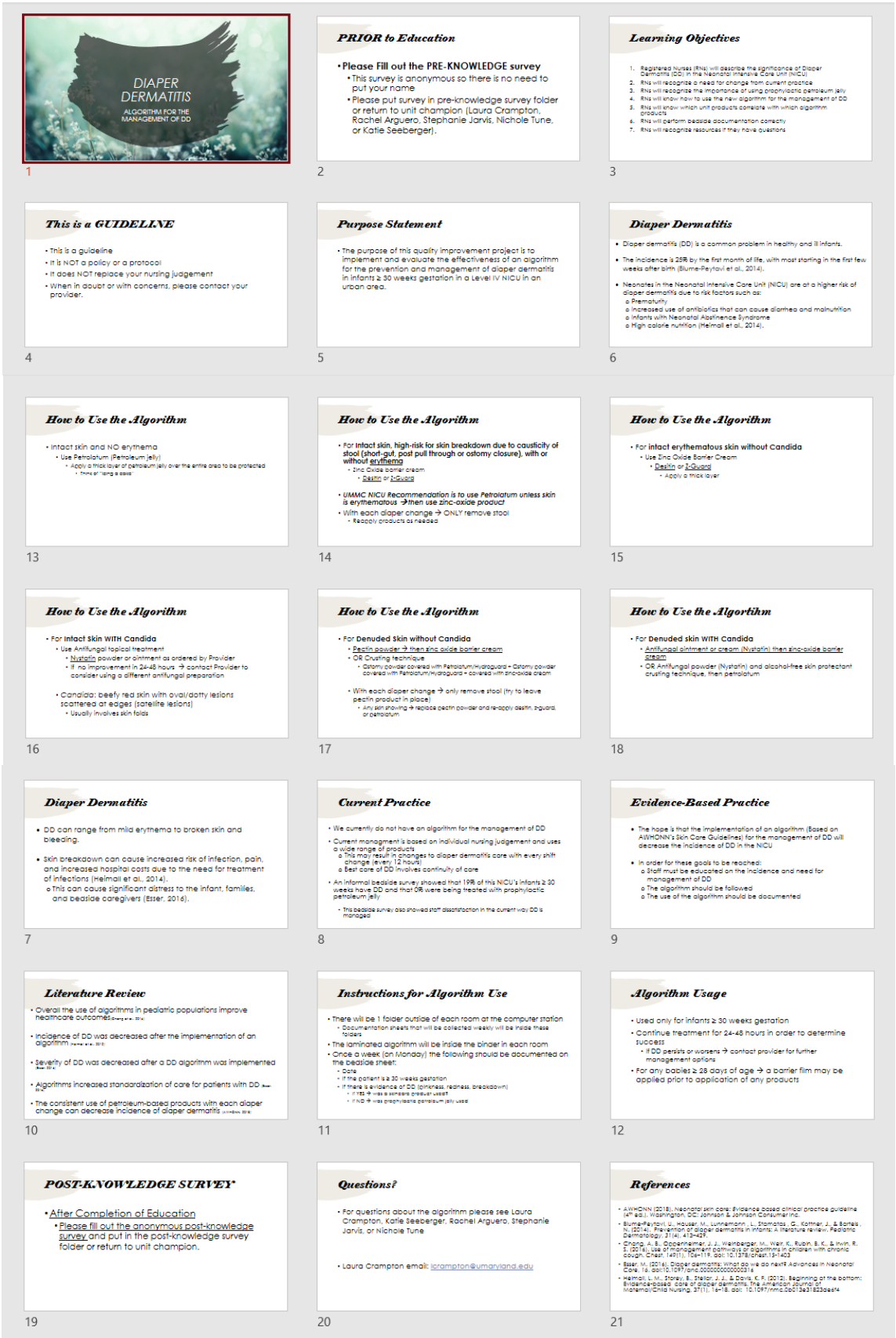
- Is your baby ≥ 30 weeks corrected gestational age? YES NO
    - If NO, please do not fill out the form
    - If YES, please answer questions below

- Do they have any Diaper Dermatitis (pinkness, redness, or breakdown)? YES NO
    - If YES: Did you use a skincare product? YES NO
    - If NO: Did you apply Vaseline? YES NO

- Did you follow the Algorithm? YES NO UNSURE

Appendix D

Educational PowerPoint



Appendix E

Pre/Post Knowledge Survey

1. Approximately what percentage of infants develop diaper dermatitis in the first month of life?
    a. 10%
    b. 15%
    c. 20%
    d. 25%

2. Infants in the NICU are at an increased risk of developing diaper dermatitis due to which of the following?
    a. Prematurity
    b. Antibiotic Use
    c. Mature Skin
    d. A and B only

3. Diaper dermatitis is a trivial issue that does not cause stress to families.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

4. Preventative treatment with petroleum jelly (Vaseline) should be used on every infant ≥ 30 weeks gestation who does not have diaper dermatitis.
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagree

5. If diaper dermatitis does not improve after 4 hours, it is best to change the product.
    a. Strongly Agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly Disagre

Appendix F

Nursing Education Sign-Off

Employee Name	Employee Signature once education is received

Appendix G

Data on Staff Education

Date/Week	Total Number of Staff on Unit	Number of Staff Educated