

Transitioning to Cue-Based Feeding by Implementing an Evidence-Based Protocol

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Author Note

Conflict of Interest: project lead is employed at the implementation site.

Abstract

Problem: In an urban 70-bed level IV Neonatal Intensive Care Unit, cue-based feeding scores were previously implemented into the electronic medical record without sufficient education, leading to a lack of documentation by nursing staff. In a random chart audit, only 4% (n=1) of eligible patients had feeding scores documented. As a result, premature infants were not provided developmentally appropriate care that could improve their feeding outcomes. **Purpose:** The purpose of this quality improvement initiative was to improve the documentation of feeding scores by implementing and evaluating an electronic medical record alert and cue-based feeding rounds to notify providers of cue-based feeding eligibility. **Methods:** An EMR alert was developed to identify patient eligibility, and cue-based feeding rounds were utilized to notify providers of patients who qualified for cue-based feeding. Eligibility criteria included patients who were 34 weeks corrected gestational age or older, on 4 liters Vapotherm or less, and with a diet order to oral feed. The intent of the alert was to trigger the provider to order feeding score documentation as well as to remind nurses of cue-based feeding assessment and documentation. **Results:** Forty six percent of staff completed cue-based feeding education (n=105), 100% of eligible patients were identified (N=137), and 27% (n=37) of orders were documented in the EMR. Sixty one percent of eligible patients (n=83) had feeding scores documented. **Conclusions:** Two hundred forty-two interdisciplinary providers participated in the project. One hundred thirty-seven patients were included in the project. Findings suggest that cue-based feeding rounds can be useful in identifying patients who are eligible for cue-based feeding and reminding staff to document feeding scores. Weekly staff reminders are helpful in identification of eligible infants and in documentation.

Keywords: Cue-based feeding, NICU, quality improvement, preterm infants, premature

Transitioning to Cue-Based Feeding by Implementing an Evidence-Based Protocol

Approximately 12% of infants in the United States are born before 37 weeks. Preterm infants have poor muscle tone, immature oromotor control, and limited coordination of sucking, swallowing, and breathing which contributes to delayed independent oral feedings (feedings delivered by breast or bottle). Assessment of infants' individual needs and reading/understanding oral cues builds on infant strengths for feeding self-regulation. Cue-based feeding (CBF) compared to volume-based feeding has been shown to improve time to full independent oral feedings (IOF), improve weight gain, and decrease length of hospital stay among premature infants (Fry et al., 2018; Kamran et al., 2020; McFadden et al., 2021; Samane et al., 2022; Thomas et al., 2021).

In a 70 bed level IV Neonatal Intensive Care Unit (NICU), despite the previous implementation of CBF protocol in 2021, the use and documentation of cue-based feeding scores (FS) remained inconsistent, and feeding practices continued to be mainly volume-driven. In a chart audit conducted over a one week period in December 2022, only 4% (n=1) of patients had FS documented. A root cause analysis was conducted to help identify potential reasons for the variable response to CBF. A major cause included differences in understanding the elements of CBF across NICU providers (Figure 1). In addition, due to the COVID-19 pandemic, CBF education was delivered primarily by email and face-to-face discussion and follow up was limited. The site expressed a strong desire to improve the consistent use of CBF in NICU patients.

The purpose of this quality improvement (QI) initiative was to accurately identify all NICU patients eligible for CBF through the use of an electronic medical record (EMR) alert and

patient rounding as well as the implementation of a CBF feeding score order (FSO) to facilitate feeding score documentation (FSD).

Available Knowledge

PubMed and CINAHL databases were searched using the keywords “cue-based feeding” and “NICU” to identify relevant CBF articles. Articles were chosen based on strength of evidence and most recent publication. A literature review identified seven articles that supported the use of CBF and one article that supported the use of an EMR alert within the NICU population. The articles included in the evidence review table (Table 1) and evidence synthesis table (Table 2) are composed of one Level I, one Level II, one Level III, and five Level IV articles with a B quality rating using the John’s Hopkins Nursing Evidence-Based Practice Model (Dang et al., 2022). CBF has been shown to decrease length of hospital stay (Kamran et al., 2020), improve weight gain (Fry et al., 2018; McFadden et al., 2021; Samane et al., 2022), improve feeding cues and quality nipple (Aziz et al., 2017), and improve time for premature infants to achieve full IOFs (Thomas et al., 2021; Wellington & Perlman, 2015). EMR alerts have been used across patient populations and serve as valuable provider practice reminders. Ernst (2017) successfully implemented immunization reminders and improved two month immunization rates in NICU patients. In summary, CBF may reduce hospital length of stay, improve weight gain, improve feeding cues, and decrease time to full independent oral feedings, and EMR alerts may facilitate consistent adherence to CBF practices across providers.

Rationale

The Promoting Action on Research Implementation in Health Services (PARIHS) framework (Kitson et al., 1998) was used to guide and execute the project. The PARIHS framework model is provided in Figure 2 (Hack et al., 2011). The framework focuses on three

components: evidence, facilitation, and context. The low rate of feeding score documentation at the site (4%, n=1) served as evidence that a practice change was needed. The implementation itself was driven by the review and synthesis of best current evidence in order to provide the rationale for the use of CBF and FSD (Table 1 and Table 2). The project lead (PL) was the primary facilitator for this project. In conjunction with project champions (PC), “buy in” was obtained and project education was based on the role and skills of the staff. In terms of context, the PL identified that openness to change in this unit was inconsistent, but staff were more open to change when desired practice changes were supported best by evidence. The PARIHS framework model adapted to fit this initiative is provided in Figure 3.

Methods

Context

In this institution, the level IV NICU population is comprised of high-acuity medical and surgical neonates. When able to feed, these patients often require slower feeding volume advancements but may be able to tolerate nipple feedings. The staff is comprised of 200 staff nurses, 12 advanced practice providers, 9 fellows, and 19 attendings.

The Context Assessment Index (CAI) is a 37-question survey that was used to determine the unit’s readiness for change and identifies barriers and facilitators to change (McCormack et al., 2009). Barriers to change within the unit included an inconsistent feedback process between management and staff and inconsistent communication between staff and providers. Staff were open to evidence-based practice as demonstrated by the acceptance of previous QI initiatives within the unit and by the support of nursing management and clinical specialists. Additionally, the Quality and Research Council, as leaders of change within the hospital, supported and encouraged staff to review and identify needed practice changes based on best evidence.

Prior to implementation, a diet order to provide IOF was placed in the EMR when an infant reached 34-weeks gestation. Nipple feeding readiness and safety was then determined by a member of the Occupational Therapy (OT) team by offering eligible infants their first nipple feeding. After that initial nipple feeding, the OT staff then recommended nipple feedings once per shift as well as a nipple feeding progression schedule (Figure 4). Nipple feedings are defined as feedings delivered by bottle. The EMR included a feeding score scale, but FS were rarely documented. The desired implementation process change was to allow nurses to nipple feed infants based on the documented FS, and only patients with complex histories would require their first nipple feeding with OT (Figure 5). A detailed plan of the site-specific CBF program is provided in Appendix B.

Intervention

The QI initiative was implemented between August and December 2023 (Table 4). The CBF team was comprised of the PL, PCs, a nursing informatics representative, a medical provider representative, a nursing representative, an OT representative, a clinical site representative, the site sponsor, and the faculty advisor. They helped to facilitate the project and provide feedback to the PL if changes to the implementation plan were required. Team members and their duties are listed in Table 3.

In collaboration with the Nursing Informatics staff and the Alerts Committee, a passive EMR alert was created to notify staff when an infant became eligible for CBF. Eligibility included patients who were 34 weeks postmenstrual age and older, on respiratory support of 4 liters or less, and had a diet order to orally feed (an existing order set for breast and bottle feeding). Eligibility criteria can be found in Appendix A. In addition, a specific electronic feeding score order was also created to prompt feeding score assessment and documentation.

Due to technical challenges, the alert was unable to be deployed, and the electronic feeding score order was deployed during week 8 of implementation. In place of the alert, CBF rounds were conducted weekly in order to identify CBF eligibility. When eligibility was determined and until the electronic FSO was set up and running, providers were prompted to place a separate order to assess and document feeding scores. A site specific feeding score tool, the “Bear Cues Feeding Scale” was used to assess feeding scores (Table 7). This tool was created as part of the previous CBF initiative in 2021. Pre-feeding scores of 1-2 demonstrated nipple feeding readiness (nipple feeding allowed), and scores of 3-5 demonstrated lack of nipple feeding readiness (gavage feeding required). Patients with oral malformation, patients diagnosed with micro-aspiration syndrome, and patients with tracheostomies were not included. Patients who required experienced OT support for oral feedings were also excluded.

Several strategies and tactics were used to aid the implementation of this CBF project (Table 5). Prior to implementation, the PL met with the interdisciplinary team, prepared project champions (PC), and provided emails to alert staff regarding the implementation of the anticipated CBF practice change (Bingham & Main, 2010; Perry et al., 2019). During implementation, weekly CBF rounds were used to identify patient eligibility and remind nursing staff to document FS. A continuous education plan that included where, how, and why to document FS was implemented and facilitated by the PCs and the PL via face-to-face in services that were provided during the workday for all shifts (Perry et al., 2019). Education was provided to staff weekly when able during the workday. Email notifications were also sent monthly to promote communication of the project’s progress to staff and providers (Bingham & Main, 2010). Lastly, posters were placed around the unit to remind nurses to document FS, and staff were incentivized with a donut party for the shift with the most FS documented.

Measures

Project structure changes included the creation of an EMR eligibility alert, a feeding score documentation order, and weekly CBF rounding. Process measures included the identification of patient eligibility via CBF rounds and the placement of a feeding score documentation order. The goals were to identify 100% of patients eligible for CBF and to have a feeding score documentation order placed for 100% of eligible patients. The overall project outcome measure was to have feeding scores documented for 100% of eligible patients. The PL completed weekly chart audits using the REDCap chart audit tool (Appendix C). The project data dictionary can be reviewed in Appendix D.

The placement of the feeding score order (Figure 6) and feeding score documentation (Figure 7) were analyzed using run charts. Run chart data points were examined to identify trends, shifts, and special cause variation throughout the 15-week implementation. A detailed measurement plan is provided in Table 6.

Ethics

To ensure ethical standards were met for this DNP project, non-human subject determination approval was provided by the University of Maryland, Baltimore (UMB) from the office of human research protections office (HRPO), as well as the site Quality and Research Council and institutional IRB. The PL is employed at the site where the project was taking place. No funding or monetary incentives were implicated in the development of this project.

To protect patient privacy, data collection took place in the patient's room to access the patient's information in a controlled and private setting. No other personnel were present in the patient's room when data collection occurred. To protect patient confidentiality, data collection was conducted via REDCap, a HIPAA compliant data base, in a side by side fashion. A unique

patient ID code was created within REDCap that was only known to the project lead and was removed prior to downloading data (Appendix D). Initial education was tracked using attendance sheets kept by the PL and shredded once the implementation phase was completed.

Results and Analytics

Across the 15-week implementation period, forty-six percent (n=105) of staff completed CBF education. 100% (N=137) of eligible patients were identified using CBF rounds.

At the close of the implementation period, 27% (n=37) of eligible patients had a feeding score order placed into the EMR (Figure 6). Before the electronic FSO went live, 15% (n=46) of patients had an order to document feeding scores (week 1 through 7). After the electronic FSO go-live date (week 8), a total of 91 patients were eligible for CBF, and 31% (n=30) had the order placed.

Feeding score documentation increased to 61% (n=83) for all eligible patients during the implementation phase (Figure 7). The day shift had overall less feeding score documentation (n=72) compared to the night shift (n=74). No trends or shifts were identified in the run chart data.

Discussion

Despite the fact that the EMR CBF alert was not deployed during the project implementation, CBF rounding was successful in identifying all eligible patients and may have been useful in reminding providers to place the feeding score order.

The FSO placement was inconsistent throughout the implementation phase. Data collection during weeks one through seven only identified feeding score orders placed in the EMR and did not include verbal orders. Inability to use an active order set resulted in different methods of orders for feeding score documentation to take place, resulting in less consistency.

Adherence to FSO placement improved after the electronic FSO was deployed. Having an active order set for FSD allowed providers to become more consistent with placing an order. Overall reasons why providers did not place a FSO included they forgot to place the order and verbal feeding scores were common but not documented.

Although there was inconsistent documentation throughout the 15-week period, FSD improved from the baseline of 4% (n=1) to 61% (n=83) of all eligible patients during the implementation phase. Feeding score orders and feeding score documentation may have been negatively impacted secondary to the low education rate as well as high census and patient acuity during the implementation phase.

The outcomes of this project align with the support of literature that identification of patient eligibility and FSD is important for CBF success (Aziz et al., 2017; Kamran et al., 2020; McFadden et al., 2021; Thomas et al., 2021; Wellington & Perlman, 2015). CBF practices, such as FSD and identification of eligibility, may show overall improvements in outcomes with continued data collection relating to weight gain, length of hospital stay, and time to achieve full independent oral feeds as shown in the literature.

Sustainability

The EMR alert was approved for use after the implementation phase to identify patient eligibility and will be used in conjunction with the electronic FSO to improve FSD. Data collection will continue to identify the effectiveness of the EMR alert and electronic FSO together. Post implementation of the alert and electronic FSO will determine if CBF rounds will continue to be needed.

Limitations

During project implementation, the unit experienced an increase in high acuity patients, leading to less downtime for completing education and resulting in only 46% of staff completing the education. When identifying barriers to education completion, dayshift nurses reported that there was limited downtime due to time transporting patients off the unit for testing and treatments. The lack of ability to deploy the EMR alert and the late deployment of the FSO may have negatively impacted overall outcomes.

Conclusion

This QI initiative demonstrates that CBF rounding can be useful in identification of CBF eligibility and in the improvement of FSD. The EMR alert will be used for project sustainability and continue to promote CBF practices and FSD. Data analysis of post-implementation use of the EMR alert and electronic FSO together may help to improve the overall approach and success of CBF. Results of this project have been disseminated to national neonatal conferences, to the quality improvement council within this facility, as well as to the NICU staff. This QI implementation project is specific to this site. It is not generalizable to other NICUs; however, it may serve as a framework for other CBF initiatives.

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Wellington, A., & Perlman, J. (2015). Infant-driven feeding in premature infants: a quality improvement project. *BMJ Journals*. doi:10.1136/archdischild-2015-308296

Table 1*Evidence Review Table for Cue-Based Feeding*

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| Citation: Aziz, R., Abd El Asis, S., & Elewa, A. (2017). Effects of implementation of cue based feeding technique on premature infant feeding outcomes and parent satisfaction. <i>IOSR Journal of Nursing and Health Science</i> . Retrieved February 10, 2023 from https://www.iosrjournals.org/iosr-jnhs/papers/vol6-issue6/Version-6/I0606065567.pdf | Level and Quality: II-B |
| Purpose or Hypothesis | To evaluate the effect of implementation of cue based feeding technique on premature infant feeding outcomes and parent satisfaction |
| Type of Evidence Research Design | Quasi-experimental pre and post intervention study with random assignment |
| Sample Population, Size, Setting | <p>Sampling Technique: Convenience. Eligible Participants: Premature infants less than 37 weeks gestational age and weighing less than 2500 grams</p> <p>Setting: A NICU at Mansoura University Children's Hospital in Egypt</p> <p>Excluded: infants who have gastrointestinal tract malformations, neurological defects, and required longer ventilator support</p> <p>Accepted: 68 premature infants</p> <p>Control: 34 premature infants</p> <p>Intervention: 34 premature infants</p> <p>Power analysis/Achieved: To achieve a level of significance of 5%, a sample size of 34 was needed in each group</p> <p>Group Homogeneity: There was no significant difference in baseline characteristics for each participant</p> |
| Intervention Procedures | <p>Control Protocol: Scheduled feeding pattern</p> <p>Intervention Protocol: Cue based feeding pattern dependent on feeding scores</p> <p>Treatment Fidelity: An educational period was implemented to improve mother's participation in the infant's feeding. The feeding scales were tested for validity and reliability using Cronbach's alpha.</p> |
| Primary Outcome and Measure | <p>Dependent Variable: Feeding readiness cues and bottle feeding</p> <p>DV Measure: A t test was used to analyze variables with continuous data, and a chi-square test was used for variables with categorical data.</p> |
| Results/Conclusions | <p>Statistical Results: There was a significant difference between both groups. After the intervention phase, 88.2% of infants in the intervention group had more readiness cues compared to 61.8% in the control group ($p < 0.05$).</p> <p>Conclusions: The researchers concluded that infants who were fed using cue based feeding techniques had less feeding problems, improved feeding cues, and had quality nipping. Parents also had high satisfaction scores in the cue based feeding group.</p> |

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| <p>Citation: Ernst, K. (2017). Electronic alerts improve immunization rates in two-month-old premature infants hospitalized in the neonatal intensive care unit. <i>Applied Clinical Informatics</i>, 8, 206-213. https://doi.org/10.4338/ACI-2016-09-RA-0156</p> | <p>Level and Quality: V-B</p> |
| <p>Purpose or Hypothesis</p> | <p>To determine if an electronic alert improves 2-month immunization rates in infants hospitalized in the neonatal intensive care unit</p> |
| <p>Type of Evidence Research Design</p> | <p>Quality Improvement with retrospective chart review</p> |
| <p>Sample Population, Size, Setting</p> | <p>Sampling Technique: Convenience. Eligible Participants: All infants with a birth weight of less than 2 kg and admitted to the NICU Setting: Level IV NICU at University of Oklahoma Children’s Hospital Excluded: Infants transferred into the NICU after 50 days of age or if immunizations were due between 30 days before the alert and 30 days after the alert Accepted: 261 premature infants. Control: 95/121 in pre-alert group were included; 26 patients lost due to not needing vaccine order and did not have vaccines administered on calculation day Intervention: 134/140 in post alert group were included; 6 patients lost due to not needing vaccine order and did not have vaccines administered on calculation day Power analysis/Achieved: Power analysis is not discussed within this study. Group Homogeneity: All infants were within similar age ranges (2 months old).</p> |
| <p>Intervention Procedures</p> | <p>Control Protocol: Retrospective chart review of patient immunizations prior to the implementation of the EMR alert. Immunizations were ordered when healthcare providers remembered to order the vaccine. Intervention Protocol: An electronic alert triggered for patients between the ages of 56 and 67 days old to prompt clinicians during rounds for immunization orders. The alert appeared for nurses between 0600 and 1200 to prompt clinicians during rounds for an immunization order. Treatment Fidelity: The alert triggered for all patients within the qualifying age range for both nurses and providers.</p> |
| <p>Primary Outcome and Measure</p> | <p>Dependent Variable: Vaccine order placement and vaccine administration. DV Measure: Two tailed t test was performed to identify the alpha of 0.05. Demographics and vaccine order and administration were reported and compared using Mann-Whitney U tests due to unequal standard deviations. The Fisher’s Exact test was used to identify categorical outcomes of immunization status and missing vaccine orders and administrations.</p> |
| <p>Results/Conclusions</p> | <p>Statistical Results: Vaccines were ordered 6 days sooner and administered 7 days earlier in the post-alert phase versus the pre-alert phase (p<0.0001). There was a 23% increase in the number of infants who were fully immunized by 90 days old (p<0.0001). The number of infants who had missing vaccine orders decreased by 11% (p=0.001) and those missing vaccine administrations decreased by 17% (p<0.0001). Conclusions: There was a significant improvement in vaccine administration rates and appropriate timing of administration after the implementation of an immunization alert in the EMR.</p> |

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| <p>Citation: Fry, T., Marfurt, S., & Wengier, S. (2018). Systematic review of quality improvement initiatives related to cue-based feeding in preterm infants. <i>Nursing for Women's Health</i>. doi: 10.1016/j.nwh.2018.07.006</p> | | <p>Level and Quality: V-B</p> |
| <p>Purpose or Hypothesis</p> | <p>To synthesize the outcomes of quality improvement initiatives related to cue-based feeding in premature infants and to facilitate the implementation of findings to improve nursing practice.</p> | |
| <p>Type of Evidence Research Design</p> | <p>Integrated Review of Quality Improvement Initiatives and Outcomes</p> | |
| <p>Sample Population, Size, Setting</p> | <p>Excluded: Articles that were not cue-based, did not use the preterm population, or had no outcomes reported. Accepted: 11 studies Power analysis/Achieved: A power analysis was not discussed in this study. Group Homogeneity: All articles pertained to the efficacy of cue-based feeding in premature infants.</p> | |
| <p>Intervention Procedures</p> | <p>Control Protocol: The control was the standard care practiced, such as provider-driven or volume-driven feedings, within each unit included in the review. Intervention Protocol: All studies discussed the implementation of a cue-based interventional or algorithm.</p> | |
| <p>Primary Outcome and Measure</p> | <p>Dependent Variable: Hospital length of stay, weight gain, and attainment of full oral feedings. DV Measure: The measure of each study was not discussed in this systematic review.</p> | |
| <p>Results/Conclusions</p> | <p>Conclusions: Cue-based feeding practices improve weight gain, time to full oral feedings, and decreases length of stay based on the evidence from the quality improvement initiatives included in this systematic review.</p> | |

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| Citation: Kamran, F., Khatoonabadi, A., Aghajanzadeh, M., Ebadi, A., Faryadras, Y., & Saghem, S. (2020). Effectiveness of cue-based feeding versus scheduled feeding in preterm infants using comprehensive feeding assessment scales: a randomized clinical trial. <i>Iran Journal of Pediatrics</i> , 30(6). doi: 10.5812/ijp.107475 | Level and Quality: I-B |
| Purpose or Hypothesis | The aim of this research is to investigate the effectiveness of cue-based feeding compared to scheduled feeding in preterm infants using feeding assessment scales in the NICU. |
| Type of Evidence Research Design | Randomized clinical trial |
| Sample Population, Size, Setting | <p> Sampling Technique: Convenience. Eligible Participants: Preterm infants in less than 34 weeks gestational age Setting: Neonatal Intensive Care Unit in Tehran University of Medical Sciences Excluded: conditions relating to infant death or transfer to another hospital, discharge before the end of the intervention, sudden change affecting neonates' nutritional status, cerebral hemorrhage, or intestinal problems Accepted: 37 preterm infants; 3 infants were discharged or transferred to a different hospital during the study Control: 19/20 infants- 1 infant lost due to transfer to another hospital Intervention: 17/20 infants- 2 infants were discharged before the end of the intervention Power analysis/Achieved: Power analysis determined a sample size of 40 infants, 20 in each group, to achieve power of 80% - Power Analysis met Group Homogeneity: All infants were similar in gestational age </p> |
| Intervention Procedures | <p> Control Protocol: Infants bottle fed every 3 hours without use of feeding scores Intervention Protocol: Use of cue-based feeding scores to determine if the infant was ready to take a bottle (score of 1 demonstrated readiness to bottle feed, score 5 demonstrated infant was not in a stable state to attempt bottle feed) Treatment Fidelity: All nurses were taught to use the feeding readiness score to assess readiness to feed. The feeding readiness score used had an intra-rater reliability of 0.81 prior to its use in this study. </p> |
| Primary Outcome and Measure | <p> Dependent Variable: Time to full oral feedings and time to discharge. DV Measure: Data was analyzed using an independent t-test for all variables to analyze differences in the two groups. </p> |
| Results/Conclusions | <p> Statistical Results: The duration to full oral feedings was shorter in the cue-based feeding group ($p < 0.001$) and infants were discharged earlier in the cue-based feeding group ($p < 0.001$). Conclusions: Researchers concluded that although there was no difference in the stages of achievement in oral feedings, the process of attainment of oral feeding and discharge from hospital were more rapid in the cue-based feeding group. </p> |

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| <p>Citation: McFadden, A., Fitzpatrick, B., Shinwell, S., Tosh, K., Donnan, P., Wallace, L., Johnson, E., MacGillivray, S., Gavine, A., Farre, A., & Mactier, H. (2021). Cue-based versus scheduled feeding for preterm infants transitioning from tube to oral feeding: the cubs mixed-methods feasibility study. <i>National Institute for Health Research</i>, 25(4). DOI: 10.3310/hta25740</p> | <p>Level and Quality: III-B</p> |
| <p>Purpose or Hypothesis</p> | <p>To describe the characteristics, components, theoretical basis and outcomes of approaches to feeding preterm infants transitioning from tube to oral feeding, identify operational policies, barriers and facilitators, and staff and parents’ educational needs in neonatal units implementing cue-based feeding, to produce an intervention for feeding preterm infants in response to feedings cues, the appraise the willingness of parents and staff to implement and sustain the intervention, and to assess associated costs of implementing cue-based feeding, to determine the feasibility and acceptability of a future trial, to scope existing data-recording systems and potential outcome measures, and to determine stakeholders’ views of whether or not a randomized controlled trial of this approach is feasible.</p> |
| <p>Type of Evidence Research Design</p> | <p>A mixed-methods intervention development and feasibility study with a systematic review, case studies, qualitative research, and stakeholder consensus; the co-production of the intervention, a mixed-methods feasibility study, and an assessment of stakeholder preferences for future evaluations.</p> |
| <p>Sample Population, Size, Setting</p> | <p>Sampling Technique: Convenience. Eligible Participants: Developmentally normal, clinically stable preterm infants receiving enteral feeds, parents, and healthcare practitioners Setting: Three neonatal units (one Level II and two Level III) in the United Kingdom Excluded: Infants born after 37 weeks gestation, were not at least partially enterally fed, preterm infants who had transitioned to full oral feeding, major congenital anomalies, gastrointestinal disorders, congenital infections or major neurological conditions, and infants on high-flow oxygen Accepted: 49/50 infants born before 37 weeks gestation, were clinically and developmentally stable, had partially enterally fed, had an intragastric tube in place, and whose parents consented to the study. 1 infant was withdrawn from the study, parents of infants included in the study, and health-care practitioners. Control: No control group was used in this study. Intervention: 49 patients were followed from start of implementation to 2-week follow-up after discharge. Power analysis/Achieved: Power analysis was not discussed in this study. Group Homogeneity: All infants were of similar gestational age and medically stable.</p> |
| <p>Intervention Procedures</p> | <p>Control Protocol: No control group was used in this study. Intervention Protocol: Utilization of training, a feeding protocol, feeding assessment tools, supplemental training materials, and a feeding journal for parents to write in throughout the study. All levels of the interventions culminated in the implementation of cue-based feeding. Treatment Fidelity: There were several different objectives to this study with the overall purpose of identifying if cue-based feeding is feasible and effective in the NICU. An extensive evidence-based systematic review was performed prior to implementation and data from the systematic review were supportive of this change in practice.</p> |
| <p>Primary Outcome and Measure</p> | <p>Dependent Variable: Weight gain, time to full oral feeds, parent satisfaction, and stakeholder views. DV Measure: Recruitment and screening rates, infant weight gain, duration of the intervention, feeding outcomes, implementation outcomes, and stakeholder preferences were measured in this study. Statistics were used to identify effects of implementation on patient outcomes and parent satisfaction. Qualitative and quantitative statistics were used. The IBM SPSS Statistics version 26 was used to run quantitative data. Qualitative data was obtained through interviews with parents and staff.</p> |
| <p>Results/Conclusions</p> | <p>Statistical Results: The mean number of days to transition to full oral feedings was 10.8 with a mean daily weight gain of 25 grams. Conclusions: The researchers concluded that it is feasible to implement a cue-based feeding intervention.</p> |

| | |
|--|---|
| <p>Citation: Samane, S., Yadollah, Z., Marzieh, H., Karimollah, H., Rezza, Z., Afsaneh, A., & Als, H. (2022). Cue-based feeding and short-term health outcomes of premature infants in newborn intensive care units: a non-randomized trial. <i>BMC Pediatrics</i>, https://doi.org/10.1186/s12887-021-03077-1</p> | <p>Level and Quality: II-B</p> |
| <p>Purpose or Hypothesis</p> | <p>To determine the effect of cue-based feeding on the short-term health outcomes of premature infants.</p> |
| <p>Type of Evidence Research Design</p> | <p>Non-randomized, quasi-experimental study with a phase lag design. Phase 1 is the control phase followed by a 2-week washout. The washout period is followed by phase 2, which is the intervention phase.</p> |
| <p>Sample Population, Size, Setting</p> | <p>Sampling Technique: Convenience. Eligible Participants: Premature infants with gestational age between 28 and 36 weeks Setting: Level III Neonatal Intensive Care Unit in a large referral hospital in Tehran, Iran Excluded: Premature infants with the following conditions: intraventricular hemorrhage grade III or IV, necrotizing enterocolitis, stage II or III bronchopulmonary dysplasia, sepsis, major medical illness in mother, lack of weight gain for three consecutive days, currently on mechanical ventilation, currently on sedative medications, and/or phototherapy. Accepted: 60 premature infants Control: 30 premature infants in control phase (phase one) following current feeding practices Intervention: 30 premature infants in intervention phase (phase two- after 2-week washout) following behavioral cue-based feeding practices Power analysis/Achieved: Sample size in each group was estimated to be 30 infants to achieve an effect size of 0.5 with a 95% confidence interval with 80% power – Power analysis met Group Homogeneity: Intervention/control homogenous based on</p> |
| <p>Intervention Procedures</p> | <p>Control Protocol: Standard care practice of volume-driven feeding infants every 3 hours with a specified ordered amount. Intervention Protocol: 3 phases were implemented. Phase 1 consisted of 1 cue-based feeding based on feeding cues every 12 hours for 3 days. Phase 2 consisted of 2 cue-based feeding based on feeding cues every 12 hours for 3 days. Phase 3 started all oral feedings were based on feeding cues. Treatment Fidelity: Cue-based feeding was implemented after two mandatory workshops for training were provided. Training workshops covered cue-based feeding goals and benefits, as well as behavioral cues associated with readiness to feed.</p> |
| <p>Primary Outcome and Measure</p> | <p>Dependent Variable: Time to full oral feedings. DV Measure: The dependent variable was measured using two-tailed t-tests and ANOVA to check weight gain for both groups.</p> |
| <p>Results/Conclusions</p> | <p>Statistical Results: The study found that the mean duration of days to achieve full oral feedings was 17 ± 6 and 20 ± 11 days, respectively ($p = 0.19$). No apnea events were reported in the CBF group while the frequency of apnea in the VDF group was 1 ± 2.11 ($p = 0.16$). The repeated ANOVA showed that mean weight gain significantly ($p = .003$). There was an average of about 97g gained more in the intervention group than the control group. Conclusions: The researchers concluded that cue-based feeding in premature infants results in greater weight gain, earlier attainment of full oral feeding, and fewer oxygen desaturations compared to the control group.</p> |

| | | |
|--|--|--|
| <p>Citation: Thomas, T., Goodman, R., Jacob, A., & Grabher, D. (2021). Implementation of cue-based feeding to improve preterm infant feeding outcomes and promote parents’ involvement. <i>Healthcare Improvement and Evaluation</i>, 50(3), 329-339. https://doi.org/10.1016/j.jogn.2021.02.002</p> | | <p>Level and Quality: V-B</p> |
| <p>Purpose or Hypothesis</p> | <p>To implement cue-based feeding practices for preterm infants and to assess its effects on time to achieve full oral feedings, length of stay, and parents’ involvement in the feeding process.</p> | |
| <p>Type of Evidence Research Design</p> | <p>Quality Improvement with pre-post design in 2 phases: one pre-implementation phase and two post implementation phases</p> | |
| <p>Sample Population, Size, Setting</p> | <p>Sampling Technique: Convenience. Eligible Participants: Preterm infants 23 to 31 6/7 weeks gestation age Setting: Level III NICU in a quaternary hospital in Northeast U.S. Excluded: 34 infants who were discharged on tube feedings or oxygen, transferred to long term care, oral feedings that were terminated due to respiratory distress, necrotizing enterocolitis, or any condition that interfered with the infant’s ability to orally feed Accepted: 249 infants admitted to the NICU from September 2014 to September 2017 from 23 0/7 to 31 6/7 Control: 82 infants were recorded prior to implementation Intervention: 167 infants were recorded in the first and second year of implementation Power analysis/Achieved: Descriptive statistics were used to identify the mean number of days to attain full oral feeds, the mean length of stay, and the percentage of parents’ involvement. The means for each category of pre- and post- implementation data. Group Homogeneity: All infants were within the same gestational age of 23 to 31 6/7 weeks. Infants who were excluded from the data were born outside of this range or had medical conditions that excluded them from the study.</p> | |
| <p>Intervention Procedures</p> | <p>Control Protocol: Traditional feeding practice of oral feeding every 3 hours of ordered volume Intervention Protocol: Use of infant driven feeding scale to determine feeding readiness Treatment Fidelity: 4-hour cue-based feeding educational modules were provided to the RNs within the NICU. 10 RNs attended the cue-based feeding conference to provide education and core team members for cue-based feeding practices. Documentation was changed to include the infant driven feeding scale.</p> | |
| <p>Primary Outcome and Measure</p> | <p>Dependent Variable: Time to full oral feedings, time of length of stay, and parents’ involvement. DV Measure: The dependent variable was measured through patient chart information to identify the mean data of 3 points (number of days to achieve full oral feedings, number of days from admission to discharge, and parent involvement).</p> | |
| <p>Results/Conclusions</p> | <p>Statistical Results: The study found that infants born between 23 – 27 6/7 weeks gestational age achieved full oral feedings 7 days earlier, were discharged 4.4 days earlier, and improved parent involvement by 80%. For infants 28 – 31 6/7 weeks gestational age, full oral feedings were achieved 6.6 days earlier, were discharged 2.7 days earlier, and parent involvement increased by 49%. There was also an estimated \$103,950 saving in healthcare costs due to the decreased length of stay. Conclusions: Cue-based feeding allowed for earlier attainment of full oral feeding, decreased length of stay, and increased parent involvement.</p> | |

| | |
|--|---|
| <p>Citation: Wellington, A., & Perlman, J. (2015). Infant-driven feeding in premature infants: a quality improvement project. <i>BMJ Journals</i>. doi:10.1136/archdischild-2015-308296</p> | <p>Level and Quality: V-B</p> |
| <p>Purpose or Hypothesis</p> | <p>To determine if an infant driven feeding (IDF) protocol will reduce time to full oral feeds.</p> |
| <p>Type of Evidence Research Design</p> | <p>Quality Improvement with a baseline phase, a development phase, and an implementation phase</p> |
| <p>Sample Population, Size, Setting</p> | <p>Sampling Technique: Convenience. Eligible Participants: Premature infants born less than 34 weeks gestational age Setting: NICU at New York Presbyterian Hospital Excluded: Infants discharged home on oxygen, required a gastrostomy tube, was diagnosed with an intraventricular hemorrhage grade two or more, necrotizing enterocolitis, congenital heart disease, or any condition that effected the infant’s ability to feed Accepted: 254 premature infants Control: 153 premature infants Intervention: 101 premature infants Power analysis/Achieved: Power analysis is not discussed within this study. Group Homogeneity: All infants were within similar age ranges and without significant differences in diagnoses.</p> |
| <p>Intervention Procedures</p> | <p>Control Protocol: Continue the practice of provider-driven feeding where the providers orders will determine the frequency and amount of oral feedings Intervention Protocol: Utilization of feeding scores to determine frequency and volume of bottle feeding Treatment Fidelity: Interdisciplinary team meetings were held to facilitate the introduction of the feeding assessment flowsheet, and refresher in-service events were held for reinforcement of the implementation.</p> |
| <p>Primary Outcome and Measure</p> | <p>Dependent Variable: Time to full nipple feedings. DV Measure: Two tailed t tests were used for continuous data, and a multivariable linear regression analysis was used to correct for potential confounders.</p> |
| <p>Results/Conclusions</p> | <p>Statistical Results: There was a significant difference in postmenstrual age full nipple feedings for all groups. Infants less than 28 weeks reached full nipple feedings 17 days sooner (p=0.03), infants aged 28-31 weeks reached full nipple feedings 11 days sooner (p<0.001), and infants greater than 32 weeks reach full nipple feedings 3 days sooner (p=0.04) than the provider driven groups. Conclusions: An infant driven feeding approach is associated with a reduction in time to full feeds and discharge, especially in infants aged greater than 28 weeks gestational age.</p> |

Table 2*Evidence Synthesis for Cue- Based Feeding*

| Project Title: Improving the Transition to Cue-Based Feeding | | | |
|--|---|---|---|
| JHNEBP Model Level | Total Number of Sources | Author and Quality Rating of each study | Synthesis of Findings |
| Level I Experimental study · Randomized Controlled Trial (RCT) · Systematic review of RCTs with or without meta-analysis | 1 (Randomized clinical trial) | Kamran et al.- B | Kamran et al. (2020) found that infants using cue-based feeding were discharged home earlier than the control group. |
| Level II Quasi-experimental studies · Systematic review of a combination of RCTs and quasi-experimental studies, or quasi-experimental studies only, with or without meta-analysis | 1 (Quasi-experimental study; non-randomized quasi-experimental controlled trial) | Aziz et al.- B Samane et al.- B | Both studies found that infants in the CBF group had fewer feeding problems and less desaturations during feeds. Both studies utilized the quasi-experimental study to identify cause and effect relationship of CBF in improving nipple feedings. Aziz et al. (2017) found that quality of nipple feeding had improved and there was higher parent satisfaction for infants in the CBF group, and Samane et al. (2022) found that infants in the CBF group had greater weight gain. Though the studies had different measures, the results of both studies were in support of using CBF to improve patient's feeding outcomes. |
| Level III Non-experimental study · Systematic review of a combination of RCTs, quasi-experimental, and non-experimental studies, or non-experimental studies only, with or | 1 (Mixed method with a systematic review) | McFadden et al.- B | McFadden et al. (2021) found that the cue-based feeding intervention was feasible to implement and improved infant weight gain. |

| | | | |
|--|--|--|--|
| without meta-analysis · Qualitative study or systematic review of qualitative studies with or without meta-synthesis | | | |
| Level IV Opinion of respected authorities and/or reports of nationally recognized expert committees/consensus panels based on scientific evidence | | | |
| Level V Evidence obtained from literature reviews, quality improvement, program evaluation, financial evaluation, or case reports · Opinion of nationally recognized expert(s) based on experiential evidence | 5 (Quality improvement; integrative review) | Ernst- B Fry et al.- B Thomas et al.- B Wellington & Perlman- B | All studies used quality improvement initiatives as the basis for the implementation of CBF. Thomas et al. (2021) and Wellington & Perlman (2015) both found that cue-based feeding helped to decrease the time it took premature infants to achieve full OF. Fry et al. (2018) and Thomas et al. (2021) found that there was decreased length of stay for infants after CBF was implemented. Ernst identified that electronic medical records reminded healthcare providers to order and administer hepatitis B vaccines. |
| Overall Quality Rating w/rational and Recommendation: There was consistent results across the articles included in this evidence review. All study outcomes support the idea that CBF improves infant feeding outcomes by improving the quality of OF or decreasing the time to achieve full OF. Other findings consistent across most of the studies included in this evidence review are greater parent satisfaction (Aziz et al., 2017; Thomas et al., 2021), and shorter length of hospital stay among infants in the CBF group (Thomas et al., 2021; Wellington & Perlman, 2015; Kamran et al., 2020). Therefore, a rating of B for good and consistent evidence is given to support a practice change. | | | |
| Recommendations Based on Evidence Synthesis <ul style="list-style-type: none"> • Strong, compelling evidence, consistent results: solid indication for a practice change. • Good and consistent evidence – practice change • Good but conflicting evidence: questionable indication for practice change; consider risk/benefit analysis • Little or no evidence: no indication for practice change | | | |

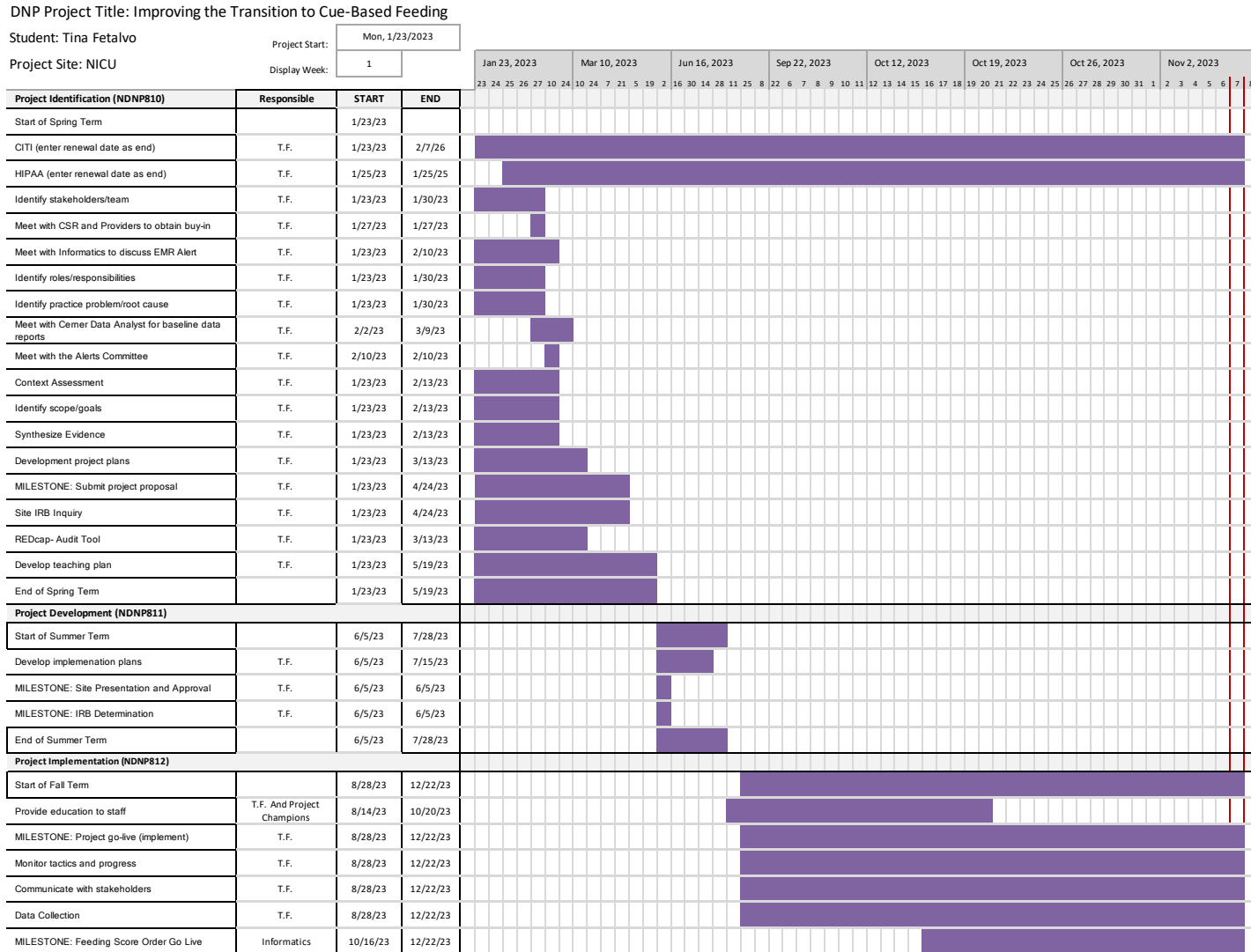
Table 3

Site Team

| Team Member Name/Credentials/Title | Responsibilities |
|--|--|
| 1. Project Leader | <ul style="list-style-type: none"> • Project expert tasked with creating a clear plan of project goals and how they will be achieved. • Hold team meetings to discuss progress of project and champions chart audits. • Analyze the progress of the project plan and create adjustments to plan as needed. • Maintain a timeline to monitor progress. • Maintain direct communication with project champions. |
| 2. Nursing Informatics Representative | <ul style="list-style-type: none"> • Consult on information technology aspects. • Act as primary point of contact for Cerner and informatics. |
| 3. Nursing Representative | <ul style="list-style-type: none"> • Serve as liaison for project and nursing staff. • Present and discuss concerns of the project in relation to nursing. • Serve as a project champion. |
| 4. Occupational Therapy Representative | <ul style="list-style-type: none"> • Serve as liaison for project and occupational therapy staff. • Present and discuss occupational therapy concerns of the project. • Assist with guidance of OT recommendations for cue-based feeding guidelines. |
| 5. Medical Provider Representative | <ul style="list-style-type: none"> • Serve as liaison for project and medical team/advanced practice providers. • Present and discuss concerns of the project in relation to the medical providers. |
| 6. Clinical Site Representative | <ul style="list-style-type: none"> • Serve as advisor for project team lead. • Assist with questions or concerns regarding project implementation and planning. |
| 7. Site Sponsor | <ul style="list-style-type: none"> • Serve as administrative lead and liaison for site leadership • Approve the project proposal |
| 8. Faculty Advisor | <ul style="list-style-type: none"> • Advise project leader during the planning, implementation, and evaluation periods • Maintain accountability for the PL regarding ethical standards and considerations |
| Project Champions | <ul style="list-style-type: none"> • Assist the PL to provide education to staff • Serve as facilitators to improve adherence by reminding staff to complete feeding score documentation • Attend CBF team meetings to discuss project progress and areas for improvement |

Table 4

Cue-Based Feeding Project GANTT Chart



| Project Site: NICU | | | | Display Week: 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|------|----------|----------|-----------------|----|----|----|--------------|----|----|----|--------------|---|----|---|--------------|---|----|----|--------------|----|----|----|--------------|----|---|---|--------------|---|----|----|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|---|---|---|---|---|---|
| | | | | Jan 23, 2023 | | | | Mar 10, 2023 | | | | Jun 16, 2023 | | | | Sep 22, 2023 | | | | Oct 12, 2023 | | | | Oct 19, 2023 | | | | Oct 26, 2023 | | | | Nov 2, 2023 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | 23 | 24 | 25 | 26 | 27 | 10 | 24 | 10 | 24 | 7 | 21 | 5 | 19 | 2 | 16 | 30 | 14 | 28 | 11 | 25 | 8 | 22 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Dissemination Plan | T.F. | 11/30/23 | 1/10/23 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MILESTONE: Manuscript | T.F. | 11/10/23 | 11/10/23 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| End of Fall Term | | 8/28/23 | 12/22/23 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Evaluation and Dissemination (NDNP813) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Start of Spring Term | | 1/22/24 | 5/17/24 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Analyze, synthesize & evaluate results | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sustainability Plan | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MILESTONE: Develop Poster | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MILESTONE: Site Presentation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MILESTONE: Extremal Dissemination | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MILESTONE: Final Manuscript | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MILESTONE: UMSON Poster Day | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Project Closure w/site | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| End of Spring Term | | 1/22/24 | 5/17/24 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Table 5

Actions to Achieve Goals

| Implementation | |
|--|---|
| Action to Achieve Goals (Bingham ABCDE strategies and tactics) | Goal the Action will Achieve |
| <p>Accountability</p> <ul style="list-style-type: none"> • Obtain and use nurse feedback • Provide clinical supervision • Remind clinicians • Prepare staff to be active participants | <p>The PL and PCs will obtain feedback and provide reminders to clinicians or how to document FS, and where FS can be found. The PL will meet with providers to obtain feedback for the EMR alert.</p> |
| <p>Buy-In</p> <ul style="list-style-type: none"> • Intervene with provider, nursing, and OT to enhance uptake and adherence • Involve the interdisciplinary team | <p>The PL met with physicians, APPs, OT, and nursing staff to discuss the potential of the project and create support amongst staff.</p> |
| <p>Collaboration/Communication</p> <ul style="list-style-type: none"> • Identify and prepare champions • Hold meetings with champions and representatives to discuss progress of project and if problems need to be addressed • Share progress information with nursing staff, providers, and occupational therapy • Change record systems to include an EMR alert | <p>The PL will train PCs to provide education to staff and hold team meetings to discuss progress. This information will be shared via email to staff.</p> |
| <p>Data</p> <ul style="list-style-type: none"> • Assess for readiness • Identify barriers and facilitators • Complete audits and provide feedback • Use data experts • Provide data reports • Tailor implementation strategies if needed/ Assess and redesign workflow | <p>The PL conducted a context assessment to identify barriers and facilitators. Chart audits will be performed by the PL and data will be shared among staff. Data will be reported to the Alerts Committee.</p> |
| <p>Education</p> <ul style="list-style-type: none"> • Conduct ongoing training • Conduct educational meetings • Develop and distribute education materials | <p>The actions will improve education strategies to teach RNs, OT, and providers about:</p> <ul style="list-style-type: none"> • Feeding score documentation • Eligibility requirements for cue-based feeding |

Note. Adapted from Bingham & Main (2010).

Table 6

Measurement Plan

| Project Goals | Data Collection Procedures (who, how, when) | Name of Data Collection Tool |
|---|--|--|
| Nurses and providers will sign off that they received the feeding score documentation education | A list of providers, nurses, and OT will be provided to each champion. The champions will provide education to the listed team members and have them sign to document that they received the information. Education materials will be provided to the champions after IRB approval. Education will be provided starting in mid-August 2023 after IRB approval. | Educational sign off by project champions and the team lead. |
| <p>CBF rounds will identify eligible patients.</p> <p>Eligibility criteria for CBF include:</p> <ul style="list-style-type: none"> • patient is at least 34 weeks CGA age • patient has no respiratory support requirement or, if on respiratory support, on no more than 4Lpm • Diet order to oral feed | The project lead will perform weekly rounds and identify patient eligibility by investigating patient charts for gestational age, respiratory support and oxygen requirement, and a diet order to oral feed. | Chart audits. |
| CBF rounds will lead to the placement of an order to document feeding scores for 100% of eligible patients. | A chart audit will be conducted by the project lead to identify if eligible patients have an order for feeding score documentation. If a feeding score order was not placed, then the champion will identify that reason with the nurse and/or provider. | Chart audits. |
| 100% of eligible patients will have feeding scores documented. | A chart audit will be conducted by the project lead once a week to identify if patients who are eligible for cue-based feeding have feeding scores documented. | Chart audits. |

Table 7*Bear Cues Feeding Scale*

| Pre-feeding score | Description |
|-------------------|--|
| 1 | Alert during/following cares. Rooting/sucking on pacifier/fingers (<u>Bottle feed</u>) |
| 2 | Drowsy during/following cares. Inconsistent rooting or interest in NNS (<u>Bottle feed</u>) |
| 3 | Limited arousal during cares, no rooting or interest in NNS (<u>Gavage</u>) |
| 4 | No arousal during cares. No feeding or hunger cues present (<u>Gavage</u>) |
| 5 | Needs increased respiratory support; has events during or stress cues during and following cares-(<u>Gavage</u>) |

| Feeding score | Description |
|---------------|--|
| 1 | Strong and coordinated suck throughout PO bottle feed |
| 2 | Strong and coordinated suck at beginning but fatigues quickly |
| 3 | Strong suck but has some difficulty with coordination, has anterior spillage or needs pacing |
| 4 | Weak and intermittent sucking |
| 5 | Poor coordination despite pacing, frequent/multiple events |

Figure 1

Root Cause Analysis of Ineffective Cue-Based Feeding Implementation

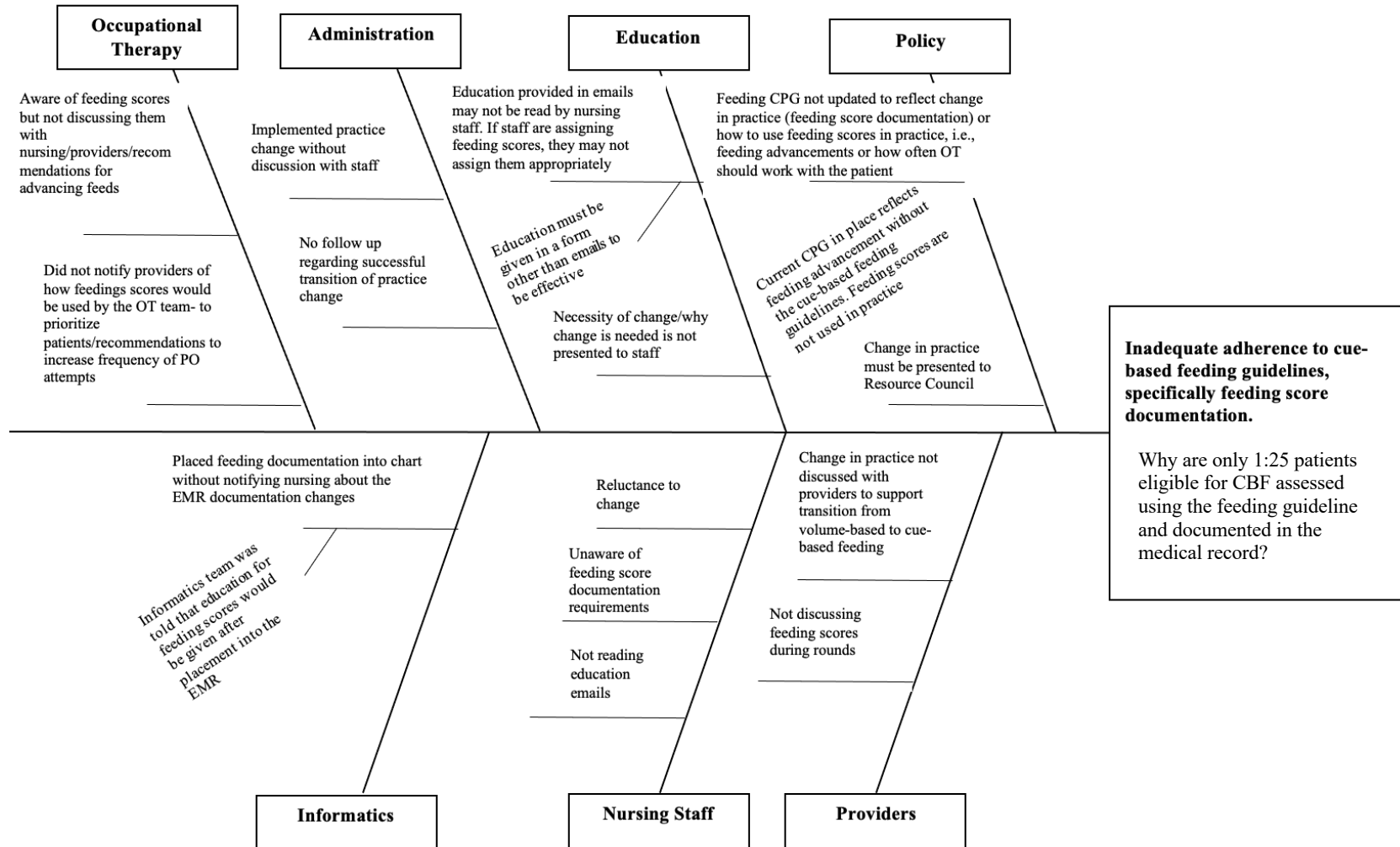


Figure 2

Promoting Action on Research Implementation in Health Services Model



Source: Hack et al. (2011)

Figure 3

Promoting Action on Research Implementation in Health Services Model for Implementation

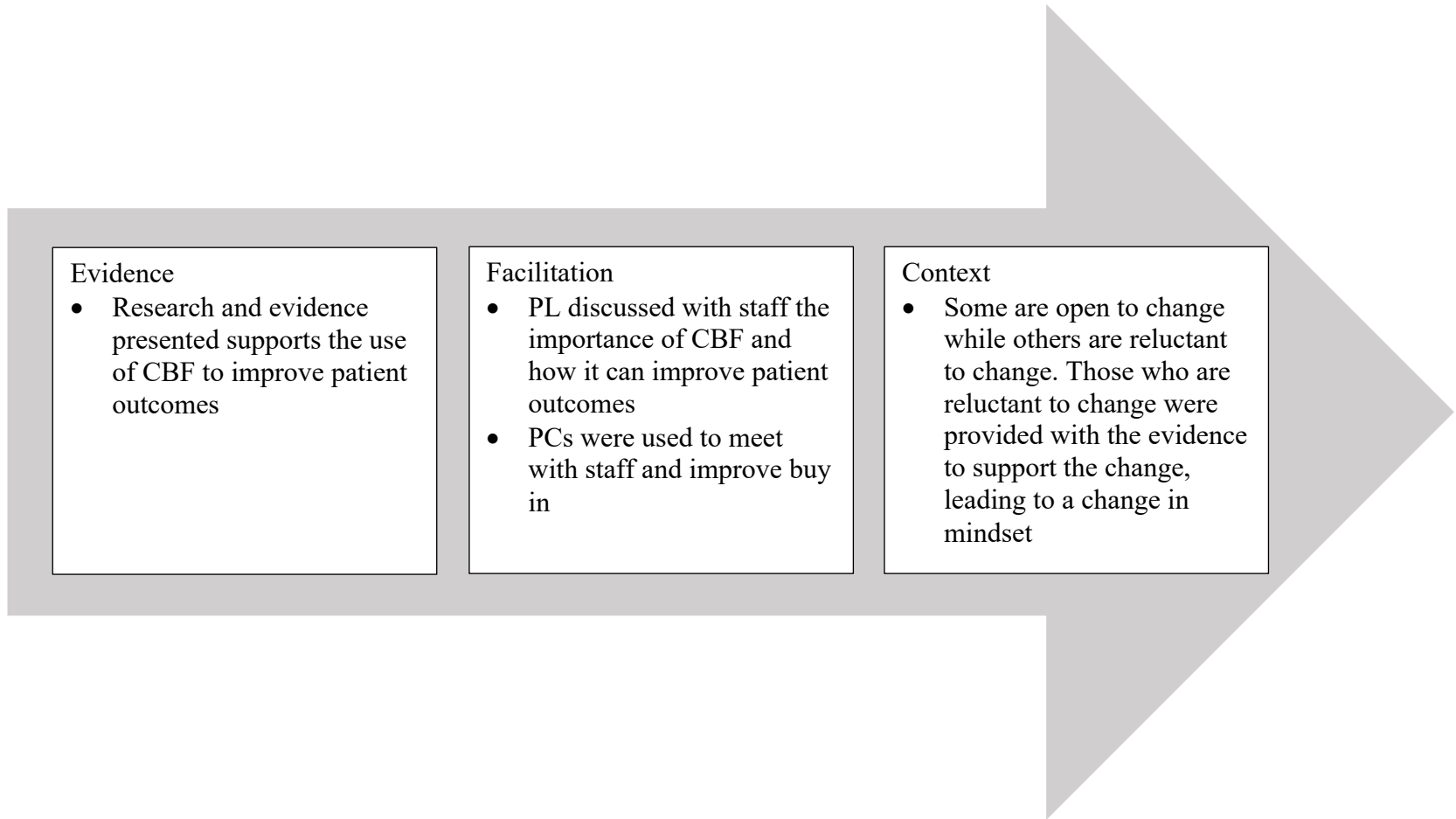


Figure 4

Current Site Structure and Processes

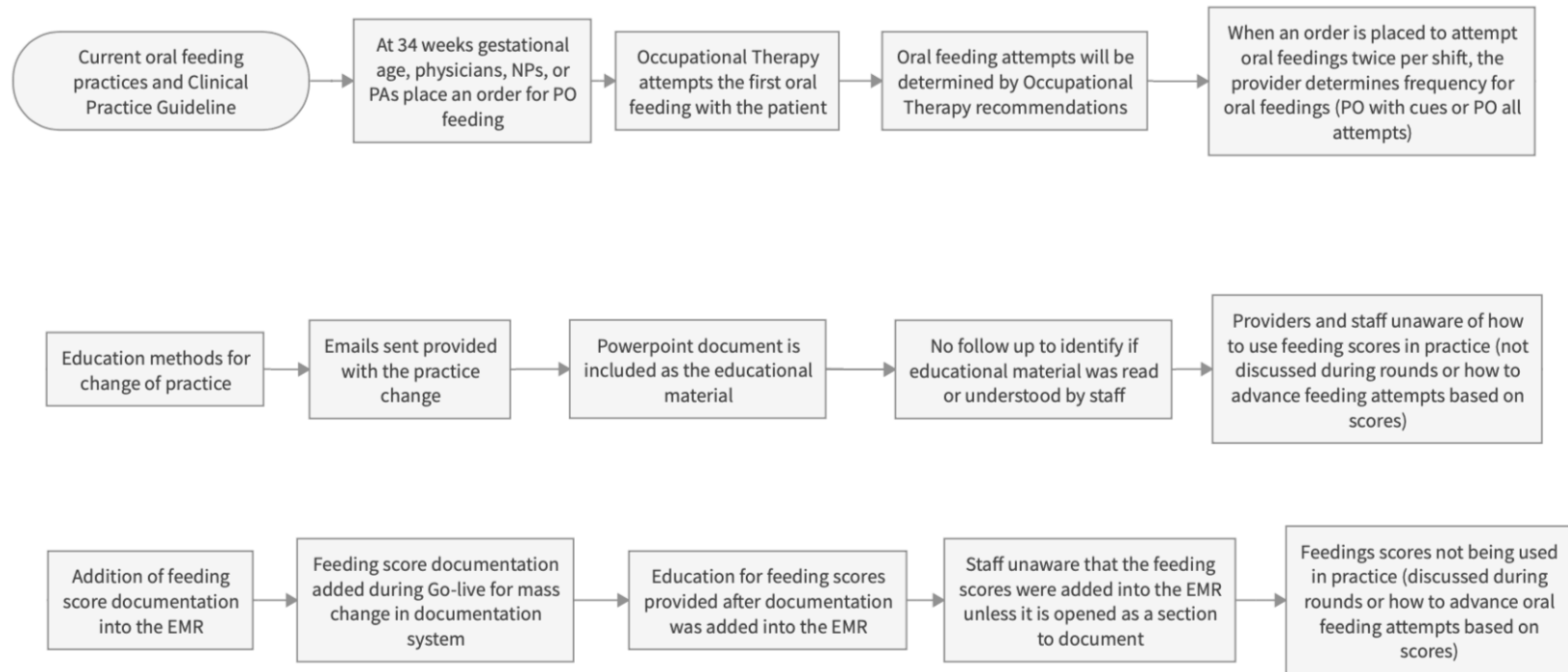


Figure 5

Desired Site Structure and Process for Cue-Based Feeding

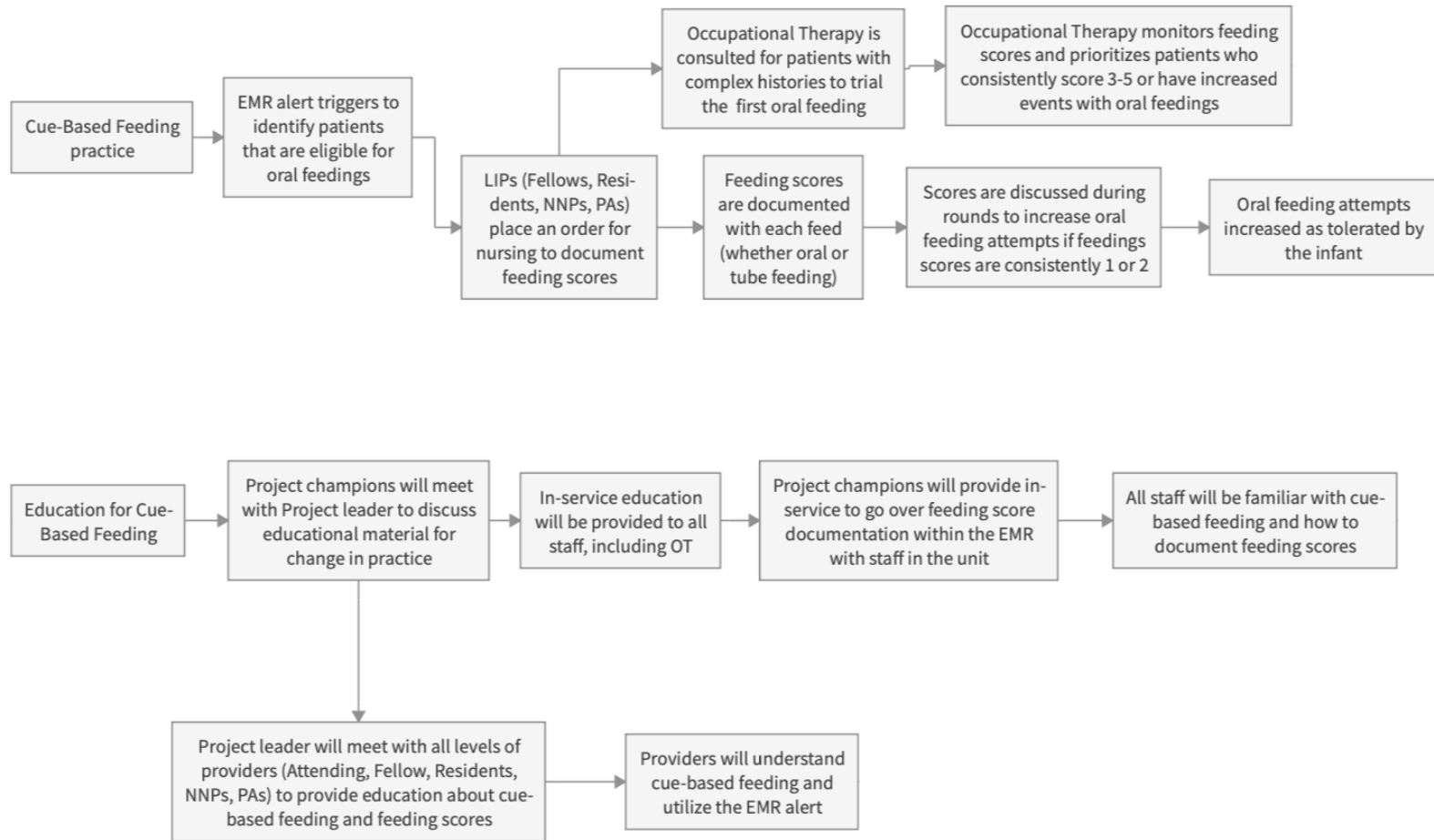
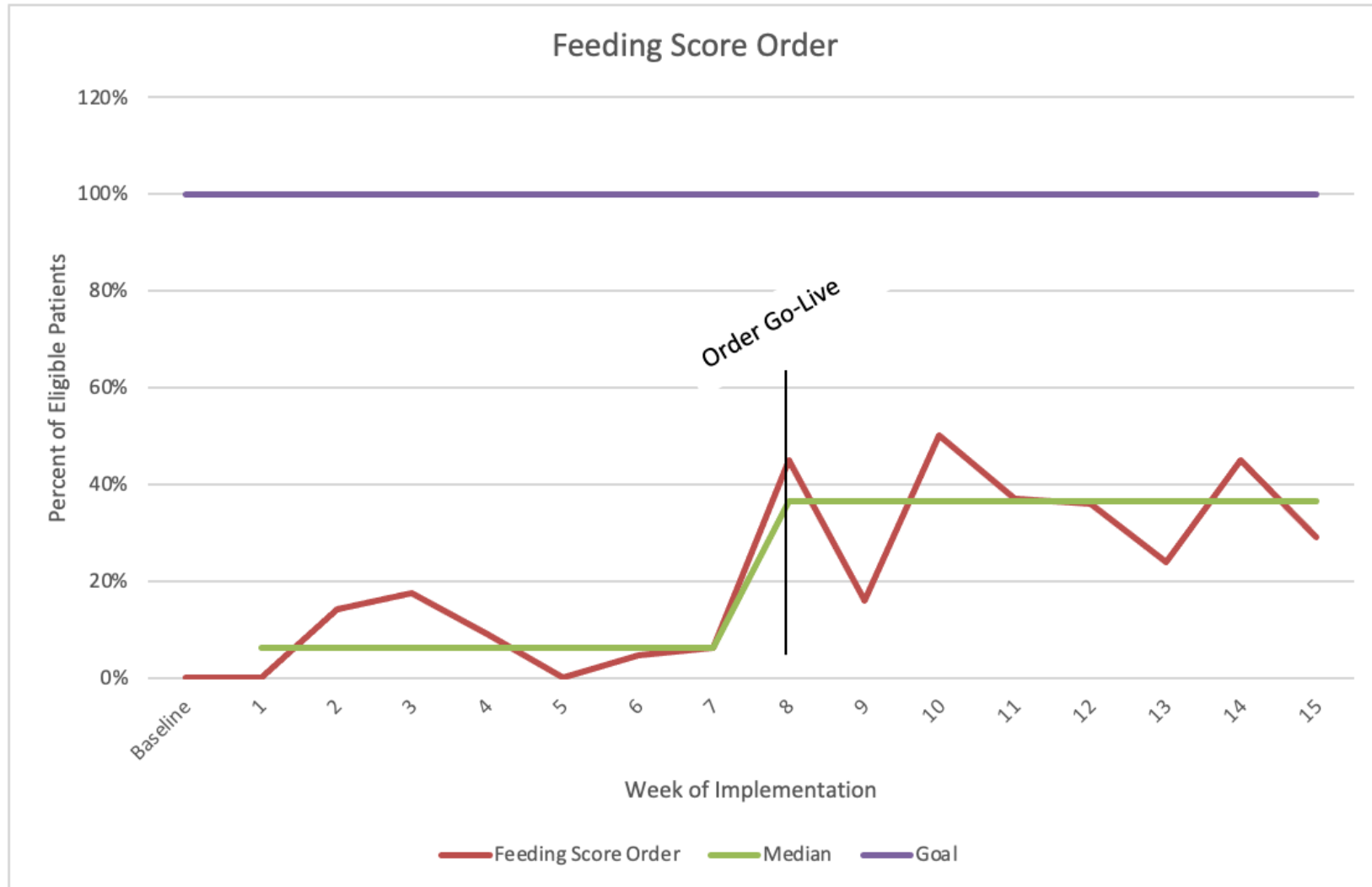


Figure 6

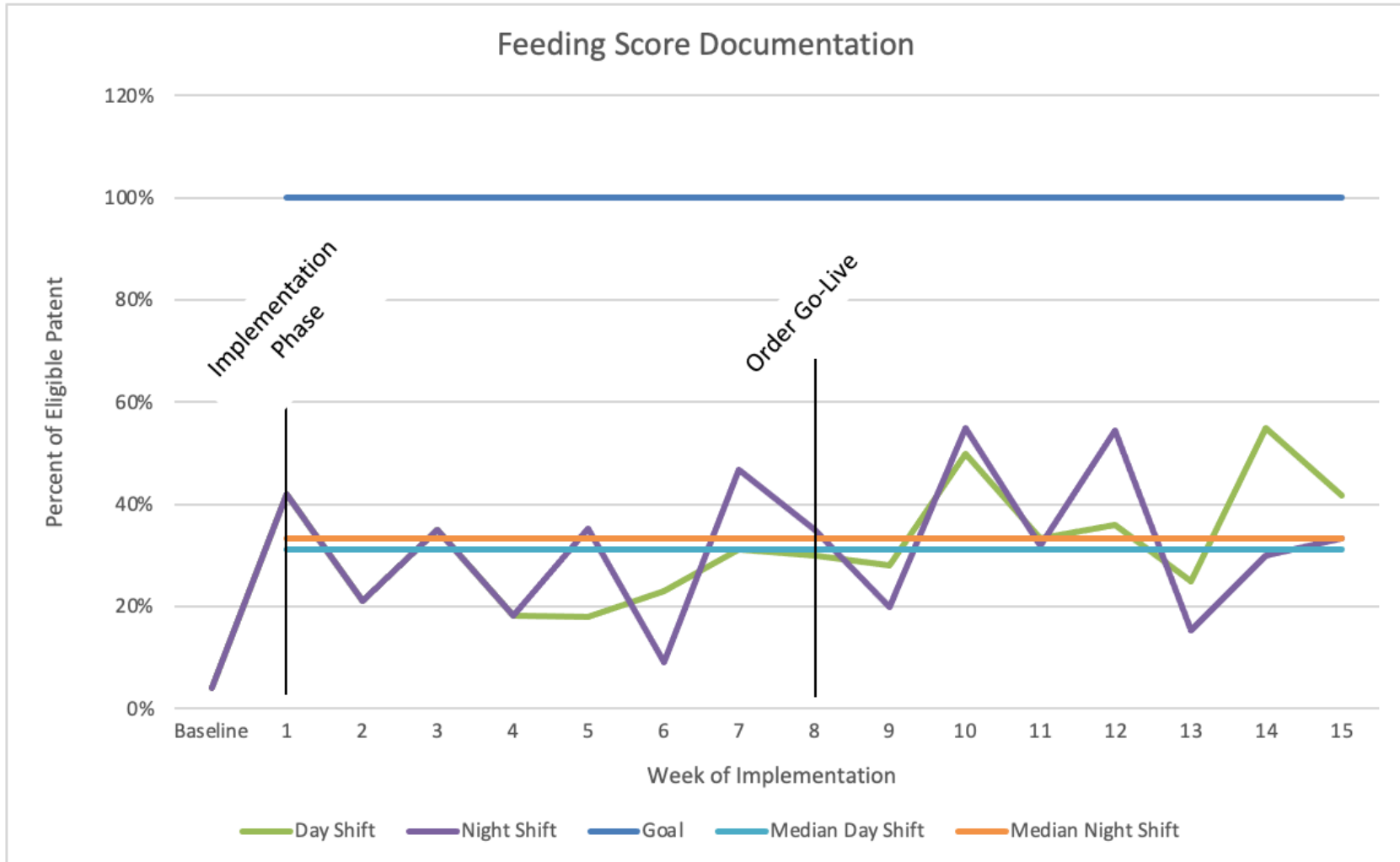
Feeding Score Order Run Chart



Note. n=37. Feeding score order went live during week 8 of the implementation phase.

Figure 7

Feeding Score Documentation Run Chart



Note. N=137. Feeding score go-live occurred during week 8 of implementation phase.

Appendix A

Criteria for EMR Alert/CBF Eligibility

The EMR alert will trigger for patients who fit the following criteria:

- Patients who are 34 weeks postmenstrual age and older
- Are in the NICU
- Have no oxygen requirement or have no more than 4L of respiratory support delivered by Vapotherm
- Have an order for OFs
- Does not have a FSO

Appendix B

Site-Specific Cue-Based Feeding Program

High Acuity/Complex History and Post-Surgical Patients

- CBF with an ordered volume component and at prescribed intervals.
 - A feeding volume will be ordered by the provider.
 - Feeding volumes are increased slowly and as tolerated by the infant based on patient presentation.
 - Feedings are prescribed at every 3-hour intervals for all premature NICU patients
 - Ex. A 36-week postmenstrual age infant who recently had ileostomy surgery.
Small feeding volumes are ordered by the provider and increased as tolerated by the infant due to decreased peristalsis and increased risk for dumping syndrome.

Low Acuity/Noncomplex History Patients

- CBF with feedings ordered at prescribed intervals with or without a volume component
 - For patients who are born term or are corrected to term and have an order for ad lib oral feedings
 - No volume component necessary. Patient may eat as much as they would like.
 - Feeding scores will be documented at every 3-hour intervals prior to every feeding.
 - For patients who are born term or are corrected to term and have ordered volumes
 - Feeding volumes are increased by the provider and as tolerated by the infant.
- CBF with feedings ordered without prescribed intervals and without a volume component

- For patients who are born term or are corrected to term who can eat ad lib on demand
 - Feeding scores will be documented prior to every feeding.

Infants who can only OF with OT

- Those with oral aversion
- Those with possible silent or micro-aspiration
- Those with oral malformations who are deemed unsafe to oral feed without OT
- Those who have a tracheostomy receiving oral feeding trials

Appendix C

Feeding Score Order and Documentation Chart Audit Tool
Confidential

Improving the Transition to Cue-Based Feeding
Page 1

Feeding Score Order and Documentation Chart Audit

Record ID _____

Date of Chart Audit _____

Is patient at minimum 34 weeks corrected gestational age at time of audit? Yes No

Is the patient on 4L VT or less? Yes No

Is an order placed to document feeding scores? Yes No

Date the order is placed _____

If the patient is eligible for feeding scores, why is the order not placed? NEC rule/out Indomethacin use Post-surgery Other

Please explain _____

Were feeding scores documented at time of audit? Yes No

Why not? Did not have time Forgot to document Did not know or how to document Did not know where to document, Other

Please explain _____

Appendix D

Data Dictionary Codebook

Data Dictionary Codebook

04/19/2023 4:40pm

Collapse all instruments

Collapse all instruments

| # | Variable / Field Name | Field Label <i>Field Note</i> | Field Attributes (Field Type, Validation, Choices, Calculations, etc.) |
|--|---|---|--|
| Instrument: Feeding Score Order and Documentation Chart Audit (feeding_score_order_and_documentation_chart_audit) <input type="checkbox"/> Collapse <input type="checkbox"/> Collapse | | | |
| 1 | record_id | Record ID | text |
| 2 | date_audit | Date of Chart Audit | text (date_dmy) |
| 3 | eligibility | Is patient at minimum 34 weeks corrected gestational age at time of audit? | yesno, Required 1 Yes 0 No |
| 4 | resp | Is the patient on 4L VT or less? | yesno 1 Yes 0 No |
| 5 | order_placed <i>Show the field ONLY if: [eligibility] = '1' and [resp] = '1'</i> | Is an order placed to document feeding scores? | yesno, Required 1 Yes 0 No |
| 6 | date_of_order <i>Show the field ONLY if: [order_placed] = '1'</i> | Date the order is placed | text (date_mdy), Required |
| 7 | no_order_why <i>Show the field ONLY if: [order_placed] = '0'</i> | If the patient is eligible for feeding scores, why is the order not placed? | dropdown, Required 1 NEC rule/out 2 Indomethacin use 3 Post-surgery 99 Other |
| 8 | other_order_why_not <i>Show the field ONLY if: [no_order_why] = '99'</i> | Please explain | text, Required |
| 9 | feed_score_document <i>Show the field ONLY if: [order_placed] = '1'</i> | Were feeding scores documented at time of audit? | yesno, Required 1 Yes 0 No |
| 10 | feed_score_not_why <i>Show the field ONLY if: [feed_score_document] = '0'</i> | Why not? | checkbox, Required 1 feed_score_not_why__1 Did not have time 2 feed_score_not_why__2 Forgot to document 3 feed_score_not_why__3 Did not know or how to document 4 feed_score_not_why__4 Did not know where to document, 99 feed_score_not_why__99 Other |

| | | | |
|----|--|---|--|
| 11 | other_why <i>Show the field ONLY if: [feed_score_not_why(99)] = '1'</i> | Please explain | text, Required |
| 12 | feeding_score_order_and_documentation_chart_audit_complete | Section Header: <i>Form Status</i> Complete? | dropdown 0 Incomplete 1 Unverified 2 Complete |