Critically Appraised Topic (CAT) Project Benefits and Methods for Promoting a Cue-Based Feeding Protocol for Premature Infants in the NICU

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Critically Appraised Topic (CAT) Project

Benefits and Methods for Promoting a Cue-Based Feeding Protocol for Premature Infants in the NICU

May 2022

This evidence project, submitted by

Katy Knackstedt, Cooper Cochran, Tiffany Frias, Sara Parish

has been approved and accepted
in partial fulfillment of the requirements for the degree of
Master of Science in Occupational Therapy {Occupational Therapy Doctorate}
from the University of Puget Sound.

Project Chairperson: Jennifer S. Pitonyak, PhD, OTR/L, SCFES

OT637/737 Instructors: Renee Watling, PhD, OTR/L, FAOTA; George Tomlin, PhD, OTR/L, FAOTA;

Director, Occupational Therapy Program: Yvonne Swinth, PhD, OTR/L, FAOTA

Dean of Graduate Studies: Sunil Kukreja, PhD

Key words: Cue-based Feeding, NICU, Premature Infants
Abstract

In collaboration with Cuyler Romeo, an occupational therapist working in the NICU at Banner-University Medical Center in Arizona, a systematic review was conducted to answer the question “What evidence exists for implementing cue-based feeding in the NICU?” Six databases were searched and eleven articles were selected for critical appraisal after meeting search criteria. The results indicate moderate evidence that supports the implementation of cue-based feeding (CBF) for preterm infants in the NICU. It is recommended that CBF be implemented in the NICU as a team approach with a protocol in order to provide positive feeding experiences for preterm infants.

A tri-fold informational pamphlet was developed to educate both bedside care staff and caregivers on CBF. It included the benefits of CBF and an overview of infant feeding cues. Feedback from the collaborating occupational therapist indicated the usefulness for the pamphlet in her setting, with modifications to be audience specific, such as two different handouts for bedside care staff and caregivers. Future research is recommended for developing consistent protocols so that bedside care staff can consistently implement this intervention while involving caregivers. Recommendations for future translation of knowledge include targeting the information to specific audiences, such as new staff or student interns in the NICU.
Executive Summary

The purpose of this project was to locate and synthesize evidence of the outcomes of a cue-based feeding approach with infants in the NICU. The second purpose of this project was to translate the findings into a universal educational pamphlet for infant caretakers and staff in the NICU at Banner-University Medical Center in Arizona.

The basis for developing our research question was formulated around early feeding experiences in the NICU. Original topics of discrete swallow protocols, early feeding interventions outside of the U.S., and the safety of starting oral feeding with infants on nasal CPAP were considered but were discarded due to the scope and timeline for this project. With further reflection on the practice context of our collaborator, the need for improved education and understanding around the use of a cue-based feeding method in the NICU was decided upon. With this as our focus, the evidence question explored in this paper was “What evidence exists for implementing cue-based feeding in the NICU”?

A systematic review was then conducted. Articles included were published in the last 6 years, in the NICU setting, and with preterm infants. Articles were excluded if the infants had comorbid health complications or were systematic reviews or single case designs. Included articles were reviewed by 2-3 researchers and then entered into a critical appraised topic table. The findings were then synthesized and assessed. CBF was found to have moderate support for providing positive health outcomes for infants in the NICU. The outcomes associated with CBF included earlier attainment of full oral feeding, decreased hospital length of stay, and increased feelings of connectedness of infant caregivers. Benefits for hospital care staff included increased satisfaction with feeding interventions and institutional benefits such as reduced hospital costs associated with a shorter length of stay. Given the evidence supporting CBF, consumers should be given the knowledge to make educated decisions for which protocol is used with their infant. Institutions should use a consistent protocol and education for staff and caregivers to increase the success of CBF. In order to provide successful and positive feeding opportunities, it is vital for all infant care providers including occupational therapists and NICU staff to proficiently recognize and respond to the physiologic and behavioral cues of the infant. Future research should examine the ease and
satisfaction of CBF implementation for care staff, and parents, outcomes related to the parent-infant relationship, long-term effects of a CBF protocol on various health outcomes and conditions, such as pediatric feeding disorders or general "picky eating" in the transition to solid foods, and differences between CBF protocols.

Findings from this research were then transformed into a knowledge translation of evidence which included an educational pamphlet for NICU staff and caregivers to learn to define CBF, the benefits of CBF, and a brief description of how to implement the general guidelines of a CBF protocol with an infant. Romero provided feedback on the usefulness of the pamphlet for staff members in the NICU at Banner-University Medical Center and suggested changes to make it more readable and accessible to different populations. Romero reported that the pamphlet was a useful tool for her setting, as it could easily be adapted to serve multiple purposes and serve as a basis to train new hires and student interns on general CBF information. She suggested changes including separate pamphlets to target different audiences like nurses, incoming student interns, and adjusting phrasing and pictures to be more understandable and inclusive for all viewers.
THE CRITICALLY APPRAISED TOPIC (CAT) PAPER

Focused Question
The research question being examined in this CAT project is “What evidence exists for implementing cue-based feeding in the NICU?”

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CAT Draft submitted: 09/30/21
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Second Revised Draft Submitted: 11/19/21
Third Revision Submitted: 1/31/22
Fourth Revision Submitted: 4/23/22
Final Revision Submitted: 5/10/22

Professional Practice Scenario
The collaborating practitioner of our project is one of two OT’s in the NICU at Banner-University Medical Center in Arizona. One of the primary goals in her setting is to ensure that the infant reaches discharge readiness by demonstrating the ability to consume all needed calories by mouth and gain weight consistently for at least 2 days. The swiftness of reaching this goal is important as the NICU setting is not optimal for development. Feeding methods used to reach this goal are a volume driven feeding (VDF) or a scheduled feeding approach. The NICU staff often uses these techniques. Another approach to infant feeding is cue-based feeding (CBF). CBF is a feeding approach that determines an infant's readiness to feed based on behavioral cues, physiological signs, and developmental readiness. It is less frequently used by NICU care staff as it takes extensive time and skill to observe feeding cues, timing of feedings can be inconsistent as they are based on infants' wakefulness and the presence of hunger cues, and more parent education is required for consistent protocol use. However, CBF is the more preferred approach to infant feeding because it provides a more positive opportunity for infants to learn proficient and effective feeding patterns, compared to the VDF method. In order to promote the use of CBF in the NICU at the Banner-University Medical Center, our collaborator is interested in finding evidence to support implementation of CBF in the NICU as best practice. This information is needed to provide infant care staff with resources for educating parents on CBF when there is limited opportunity for the OT to educate and train on the weekends or when working with other clients. This information will help address the issue our collaborator is facing in her setting in which she is not able to address the needs for CBF training with parents and nursing staff, impacting her ability to create consistency of CBF use with infants in the NICU. With this information, our collaborator hopes to fill this need and see better feeding outcomes for her clients through consistent use of CBF protocols.
Search Process: Procedures for the selection and appraisal of articles

Inclusion Criteria

Articles were included based on the study participants being preterm to 3 months old and the studies being conducted in the NICU setting. Additionally, studies were included if feeding practices or interventions used included infant driven feeding, cue-based feeding, responsive feeding, family-centered care, and parent/provider education. Studies were included if they were published within the last 6 years, 2015-2021.

Exclusion Criteria

Articles were excluded if infants were born full term or if studies were not conducted within the NICU. Studies were also excluded if the infants had confounding complications including neurological complications, cardiopulmonary conditions, craniofacial disorders, or were published before 2015. Papers were also excluded if they were systematic reviews or single case designs.

Search Strategy: Keep detailed notes on each search you conduct and its yield

<table>
<thead>
<tr>
<th>Categories</th>
<th>Key Search Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient/Client Population</td>
<td>Preterm infants, premature infants, neonates, high-risk infants</td>
</tr>
<tr>
<td>Intervention (Assessment)</td>
<td>Infant driven feeding (IDF), cue-based feeding (CBF), responsive feeding</td>
</tr>
<tr>
<td>Comparison</td>
<td>N/A</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Parent/caregiver education, provider education, family-centered care</td>
</tr>
</tbody>
</table>

Databases, Sites, and Sources Searched

- AJOT
- BJOT
- CJOT
- CINAHL
- Google Scholar
- PubMed
Search Outcomes/Quality Control/Review Process

Our research process involved multiple refinement periods where researcher understanding of the question and criteria evolved. Databases were split up among the four researchers, and literature searching was done independently. The initial search among the four researchers yielded 93 articles based on inclusion criteria of cue-based feeding (and synonyms), however after screening abstracts and full texts, 87 were rejected for multiple reasons including publication year of article, inconsistent use of cue-based feeding protocol, infants who were neither premature nor in the NICU, infants with exclusion comorbidities, or if the article was a systematic-review. Following these exclusions, only 6 articles remained causing discussion with the faculty chair on article inclusion and framework of PICO question. During this meeting, it was discovered that there was misunderstanding of the framework of the PICO question amongst researchers and inconsistencies in the use of the search term “parent education.” This discovery prompted a second round of database searches to recapture any missed articles pertaining to the parent education/education portion of the question, and recapture any excluded articles from the first round. This second search yielded 13 articles from the databases and 2 were recaptured from the master citation table, however 12 of the new articles were rejected due to being duplicates, adding a total of 3 articles. With few results being added from this second research, researchers decided to extend the search date by one year to include 2015 in the hopes of capturing more evidence. Databases were reviewed again and 4 more articles were kept, yielding a total of 13 articles for inclusion in the study. During the final summary of findings, 1 article was found to meet exclusion criteria for infants having cardiopulmonary dysfunction and was excluded. Another article was excluded due to not being published and needing major revisions, leaving a final total of 11 articles included in study.

While searching and reviewing articles, we considered and approached the terms infant driven feeding, cue-based feeding, and responsive feeding as synonyms that were interchangeable. Follow-up conversations with Romeo revealed this was not the case and a definition review began. In the articles we retained, the terms IDF and CBF were only used interchangeably in a few articles (Lane et al., 2021; Osman et al., 2021; Wellington & Perlman, 2015). The term IDF was used most commonly to refer to the feeding protocol developed by Ludwig and Waitzman (2007) that is based on a cue-based feeding approach (Gelfei· et al., 2015; Giannl et al., 2017; Lane et al., 2021; Thomas et al., 2021; Wellington & Perlman, 2015). One article, however, used the term IDF throughout their article to refer to the infant-driven oral feeding protocol that they developed (Osman et al., 2021). The term CBF was exclusively used in about half of the articles (Girgin & Gözen, 2020; Girgin et al., 2018; Ismail & Bayoumy, 2017; Kamran et al., 2020; Thoyre et al., 2016). The term responsive feeding only came up in one article and was used interchangeably with CBF (Lane et al., 2021). Based on the definitions provided in these articles, we decided to use the term CBF as an umbrella term to discuss the content of our findings.

The key player involved in this process was the project chair, Jennifer S. Pitonyak. With divided confusion amongst the group regarding the PICO question and inclusion criteria, Pitonyak helped to guide the process and improve the research strategy.
<table>
<thead>
<tr>
<th>Citation</th>
<th>Level of Evidence; Pyramid: AOTA 1-5AB</th>
<th>Y/N/M</th>
<th>Maybe (Explain)</th>
<th>If No, reason to exclude</th>
<th>Reviewers</th>
<th>Risk of Bias (RoB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Alves et al., 2016)</td>
<td>M/N</td>
<td></td>
<td>Are parent perceptions examined in study applicable?</td>
<td>Focuses on milk supply education, not feeding</td>
<td>TF, KK</td>
<td></td>
</tr>
<tr>
<td>(Canning et al., 2020)</td>
<td>Y/N</td>
<td></td>
<td></td>
<td>Participants fall under excl. criteria (e.g., use NCPAP)</td>
<td>KK, SP</td>
<td></td>
</tr>
<tr>
<td>(Cardin, 2020)</td>
<td>Y/N</td>
<td></td>
<td></td>
<td>Looks at aspects of occupation in NICU not IDF</td>
<td>CC, KK</td>
<td></td>
</tr>
<tr>
<td>(Chrupcala, 2015)</td>
<td>Y/N</td>
<td></td>
<td></td>
<td>Exclusion criteria of diagnosis to more than half of sample population</td>
<td>SP, TF</td>
<td>M</td>
</tr>
<tr>
<td>(Edwards et al., 2019)</td>
<td>M/N</td>
<td></td>
<td>Common illnesses that can delay feeding skills</td>
<td>Feeding protocol unavailable to researchers Talks about oral feeding but not about IDF Excl: BPD</td>
<td>SP, TF</td>
<td></td>
</tr>
<tr>
<td>(Gelfer et al., 2015)</td>
<td>AOTA: 2B/3B Pyramid: O2</td>
<td>Y</td>
<td></td>
<td></td>
<td>KK</td>
<td>L</td>
</tr>
<tr>
<td>(Gianni et al., 2017)</td>
<td>AOTA: 4 Pyramid: D2</td>
<td>Y</td>
<td></td>
<td></td>
<td>SP</td>
<td>L</td>
</tr>
<tr>
<td>(Girgin &amp; Gözen,</td>
<td>AOTA: 4</td>
<td>Y</td>
<td></td>
<td></td>
<td>SP</td>
<td>L</td>
</tr>
<tr>
<td>Year</td>
<td>Pyramid:</td>
<td>AOTA:</td>
<td>Y/N:</td>
<td>Emphasizes role of</td>
<td>Addresses “how” talks about nurse education and performance on transition from gavage to breastfeeding, not parent education</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2020</td>
<td>D3</td>
<td>1B</td>
<td>Y</td>
<td>nurses in NICU and oral feeding development</td>
<td>SP, TF, CC</td>
<td></td>
</tr>
<tr>
<td>(Girgin et al., 2018)</td>
<td></td>
<td>E2</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Ismail &amp; Bayoumy, 2017)</td>
<td></td>
<td>2B</td>
<td>M/N</td>
<td>Emphasizes role of nurses in NICU and oral feeding development</td>
<td>SP, TF</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>O4</td>
<td>Y</td>
<td></td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>(Kamran et al., 2020)</td>
<td>Level 1</td>
<td></td>
<td>Y</td>
<td></td>
<td>CC, TF, KK</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>E2</td>
<td></td>
<td></td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>(Lane et al., 2021)</td>
<td>AOTA:</td>
<td>3B</td>
<td>Y</td>
<td></td>
<td>KK, SP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>O3</td>
<td></td>
<td></td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>(Mohamed et al., 2021)</td>
<td></td>
<td></td>
<td>Y/N</td>
<td></td>
<td>KK, SP</td>
<td></td>
</tr>
<tr>
<td>(Osman et al., 2021)</td>
<td>AOTA:</td>
<td>3B</td>
<td>Y</td>
<td></td>
<td>KK, SP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>O3</td>
<td></td>
<td></td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>(Patra et al., 2019)</td>
<td></td>
<td></td>
<td>M/N</td>
<td>Do findings fit within PICO?</td>
<td>SP, TF</td>
<td></td>
</tr>
<tr>
<td>(Pineda et al., 2020)</td>
<td></td>
<td></td>
<td>M/N</td>
<td>Focuses on sensory interventions (SENSE), which does not include feeding</td>
<td>SP, TF</td>
<td></td>
</tr>
<tr>
<td>Study Reference</td>
<td>Design</td>
<td>Transfers Information</td>
<td>IDFS Used</td>
<td>Findings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------</td>
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<td>----------------------------------------------------------------------------------------</td>
<td>-----------</td>
<td>--------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sefatbaqa et al., 2021</td>
<td>N</td>
<td>Not published as of Nov 2021. Editorial decision for major revisions. Quasi experimental, IDF Posters used for nurses and staff</td>
<td>TF, KK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sinclair et al., 2021</td>
<td>M/N</td>
<td>Transfers might be an important educational aspect</td>
<td>SP, TF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thomas et al., 2021</td>
<td>AOTA: 3B</td>
<td>Not applicable focuses on breastfeeding and hospital transfers. The only mention of IDF is that it is not used as commonly as volume feeding</td>
<td>KK, SP</td>
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<td></td>
<td></td>
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<tr>
<td>Thoyre et al., 2016</td>
<td>Level 3B</td>
<td></td>
<td>CC, KK</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Wellington &amp; Perlman, 2015</td>
<td>AOTA: 2B/3B</td>
<td></td>
<td>SP, KK</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Articles identified from:
AJOT (n = 266)
CJOT (n = 38)
BJOT (n = 31)
CINHAL (n = 377)
Google Scholar (n = 3,878)
PubMed (n = 1,448)
Total (n = 6,038)

Records identified from:
Hand Searching (n = 7)

After title/abstract screen (n = 112)
Records excluded (n = 5,926)

Total articles to be screened (n = 119)

After Duplicates (n = 81)
Duplicates Removed (n = 38)

After assessing full-text for eligibility (n = 21)
Full-text articles excluded, with reasons (n = 60)

After screening "Maybes" (n = 11)
Records excluded (n = 10)

Total articles included (n = 11)
Risk of Bias Table

<table>
<thead>
<tr>
<th>Citation</th>
<th>Random Sequence Generation</th>
<th>Allocation Concealment from participant (until participants enrolled and assigned)</th>
<th>Baseline differences between intervention groups (suggest problem with randomization?)</th>
<th>Blinding of Participants During the Trial</th>
<th>Blinding of Study Personnel During the Trial</th>
<th>Self-reported outcomes (if all data self-reported it is higher risk of bias)</th>
<th>Blinding of Outcome Assessment: Objective Outcomes (assessors aware of intervention received?)</th>
<th>Incomplete Outcome Data (data for all or nearly all participants)</th>
<th>Selective Reporting (results being reported selected on the basis of the results?)</th>
<th>Overall Risk of Bias Assessment (low, moderate, high risk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Gelfer et al., 2015)</td>
<td>?</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>L</td>
</tr>
<tr>
<td>(Girgin et al., 2018)</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>L</td>
</tr>
<tr>
<td>(Ismail &amp; Bayoumy, 2017)</td>
<td>-</td>
<td>+</td>
<td>?</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>L</td>
</tr>
<tr>
<td>(Kamran et al., 2020)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>?</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>L</td>
</tr>
<tr>
<td>(Lane et al., 2021)</td>
<td>?</td>
<td>+</td>
<td>?</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>L</td>
</tr>
<tr>
<td>(Osman et al., 2021)</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>L</td>
</tr>
<tr>
<td>(Thomas et al., 2021)</td>
<td>?</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>?</td>
<td>+</td>
<td>+</td>
<td>L</td>
</tr>
<tr>
<td>(Wellington &amp; Perlman, 2015)</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>M</td>
</tr>
</tbody>
</table>

Note. Categories for risk of bias are as follows: Low risk of bias (+), unclear risk of bias (?), high risk of bias (-).

Scoring: 0-3 minuses=Low risk of bias (L), 4-6 minuses=Moderate risk of bias (M), 7-9 minuses= High risk (H)
### Risk of Bias: Before-After (Pre-Post) Studies with No Control Groups

<table>
<thead>
<tr>
<th>Citation</th>
<th>Study question or objective clear</th>
<th>Eligibility for selection criteria clearly described</th>
<th>Participation representative of real world patients</th>
<th>All eligible participants enrolled</th>
<th>Sample size appropriate for confidence in findings</th>
<th>Intervention clearly described and delivered consistently</th>
<th>Outcome measures clearly defined, valid/reliable and assessed consistently</th>
<th>Assessors blinded to participants exposure to intervention</th>
<th>Loss to follow up after baseline 20% or less</th>
<th>Statistical methods examine changes in outcome measures from before or after intervention</th>
<th>Outcome measures were collected multiple times before and after intervention</th>
<th>Overall Risk of Bias Assessment (low, moderate, high risk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Gianni et al., 2017)</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>NR</td>
<td>Y</td>
<td>Y</td>
<td>NR</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>L</td>
</tr>
<tr>
<td>(Girgin &amp; Gözen, 2020)</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>NR</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>(Thøyre et al., 2016)</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>NR</td>
<td>Y</td>
<td>Y</td>
<td>M</td>
</tr>
</tbody>
</table>

Y = Yes; N = No; NR = not reported. Add total of “N” and “NR” and use scale below to determine RoB:

Scoring: 0-3 N = Low risk of bias (L), 4-8 N = Moderate risk of bias (M), 9-11 N = High risk of bias (H)
## Results for Search: Summary of Study Designs of Articles Selected for CAT Table

<table>
<thead>
<tr>
<th>Pyramid Side</th>
<th>Study Design/Methodology of Selected Articles</th>
<th>Number of Articles Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>_ Meta-Analyses of Experimental Trials</td>
<td>2</td>
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<td></td>
<td>_ 2 _ Individual Blinded Randomized Control Trials</td>
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<td>_ 2 _ Individual Quasi-Experimental Studies w/ Covariate</td>
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<td>_ 3 _ Case Control or Pre-existing Groups Studies</td>
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<td>_ Group Qualitative Studies w/ more Rigor</td>
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<tr>
<td></td>
<td>a. Prolonged engagement with informants</td>
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<td>b. Triangulation of data (multiple sources)</td>
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<td>c. Confirmation (audit trail; peer/member checking)</td>
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<td>d. Comparisons among individuals</td>
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<td>Descriptive</td>
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<td>_ 1 _ Association, Correlational Studies</td>
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<td></td>
<td>_ 2 _ Multiple Case Series, Normative Studies, Descriptive Survey</td>
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<td></td>
<td>_ Individual Case Studies</td>
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<td>1A-</td>
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<td>1B- 2</td>
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<td>2B/3B- 2</td>
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<td>3A-</td>
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<td>5-</td>
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Comments:
### CAT Tables

**Tables Summarizing the Quantitative evidence**

<table>
<thead>
<tr>
<th>Author Year Journal Country</th>
<th>Study Objectives</th>
<th>Study Design/ Level of Evidence</th>
<th>Participants: Sample Size, Description, Incl/Excl Criteria</th>
<th>Interventions &amp; Outcome Measures</th>
<th>Summary of Results</th>
<th>Study Limitations</th>
</tr>
</thead>
</table>
| Gelfer et al. 2015 USA      | Assess effects of IDF model of care on infants ≥30 weeks GA in NICU. | Quality improvement project with historical controls AOTA: 2B/3B Pyramid: O2 | N = 124
Tx1 n = 64
Tx2 n = 60 | I: Tx1 = VDF
Tx2 = IDF, nurse education program on IDF principles, breastfeeding, and nipple feeding workshop. | Tx2 attained ad libitum feeding 6 weeks earlier (p = 0.008). Tx2 did not influence PCA at initiation of oral feeding or at DC. No difference in daily weight gain between treatments. No statistical difference between treatments in time to hospital DC or number of feeding therapist consults. | Nurse compliance of IDF protocol was not measured. Use of historical controls. Unexamined confounding factors. Small sample size in a single hospital. |
| Girgin et al. 2018 Turkey    | Determine the effect of ESL and ESU positions, which are used to bottle-feed preterm infants, on their physiological characteristics and feeding performance. | RCT AOTA: 1B Pyramid: E2 | N = 80
Tx1 n = 38
Tx2 n = 42 | I: Tx1 = ESL
Tx2 = ESU | Tx1 demonstrated higher SpO2 mean value during feeding (p = 0.003) and after feeding (p = 0.020); lower mean heart rate during feeding (p = 0.001) and after feeding (p = 0.037); more efficiently maintained normal values of both SpO2 and heart rate; shortened the average feeding duration (p = 0.049). No difference between interventions in feeding efficiency rate or percentage of food intake during the study. | Feeding performance was measured by percentage of food intake, feeding efficiency, and feeding duration vs. quality of feeding. Study population included infants with dx such as respiratory distress syndrome and mild BPD. Only one researcher collecting data for... |
<table>
<thead>
<tr>
<th>Authors</th>
<th>Journal</th>
<th>Study Design</th>
<th>N or Other Information</th>
<th>Intervention</th>
<th>Outcome Measures</th>
<th>Findings</th>
<th>Characteristics of Infants (no blind assessor)</th>
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<tbody>
<tr>
<td>Ismail &amp; Bayoumy (2017)</td>
<td><em>Egyptian Journal of Health Care</em></td>
<td>Quasi-experimental</td>
<td>N = 40</td>
<td>I: Tx1 = gavage feeding, Tx2 = educational program with instruction handout and step-by-step framework, lecture, group discussion, demonstration, and re-demonstration</td>
<td>Statistically significant difference (p&lt;0.001) between correctly recognizing oral feeding readiness cues pre and post implementation</td>
<td>Frequent absenteeism of nurses, overload of nurses' work, and drop out of nurses due to days off.</td>
<td>Physiological characteristics of infants (no blind assessor).</td>
</tr>
<tr>
<td>Kamran et al. (2020)</td>
<td><em>Iranian Journal of Pediatrics</em></td>
<td>Randomized two group clinical trial</td>
<td>N = 37 preterm&lt;br&gt;Tx1 n = 19&lt;br&gt;Tx2 n = 18</td>
<td>I: Tx1 = Scheduled feeding&lt;br&gt;Tx2 = CBF</td>
<td>Tx2 achieved full oral feeding sooner, shorter duration of full oral feeding, and shorter hospital LOS (p &lt; 0.001).</td>
<td>Infant behavioral patterns affect evaluation results. Inconsistent scores in the EFS. Low generalizability due to participant characteristics.</td>
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<tr>
<td>Study</td>
<td>Authors</td>
<td>Title</td>
<td>Journal</td>
<td>Year</td>
<td>Country</td>
<td>Study Design</td>
<td>Sample Size</td>
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<tr>
<td>Lane et al.</td>
<td>2021</td>
<td>Assess the impact of IDF compared to traditional schedule feeding in promoting earlier feeding outcomes.</td>
<td>Journal of Perinatology</td>
<td>USA</td>
<td>KK (TF)</td>
<td>Cross-sectional retrospective chart analysis</td>
<td>N = 489</td>
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<tr>
<td>Osman et al.</td>
<td>2021</td>
<td>Effect of IDF on achievement of oral feeding and LOS.</td>
<td>Nutrition in Clinical Practice</td>
<td>USA</td>
<td>KK (TF)</td>
<td>2 group retrospective chart analysis</td>
<td>N = 378</td>
</tr>
<tr>
<td>Thomas et al.</td>
<td>2021</td>
<td>Study effects of implementatio n of CBF for preterm infants on time to achieve full oral feedings, LOS, and parent involvement</td>
<td>JOGN Nursing</td>
<td>USA</td>
<td></td>
<td>Quality improvement project with retrospective pre-post data analysis</td>
<td>N = 249</td>
</tr>
</tbody>
</table>
| KK (TF) | Wellington & Perlman | N = 309 infants  
Tx1 n = 153  
Tx2 n = 101  
Incl: Infants ≤ 34 weeks GA.  
Incl: Discharged home on full NF.  
Excl: DC home on oxygen, requiring gastronomy tube, intraventricular hemorrhage, congenital heart disease or any condition that interfered with an infant's ability to feed (e.g., cleft palate).  
| Quality improvement Project with baseline retrospective chart review  
AOTA: 2B/3B Pyramid: O2  
| I: Tx1 = PDF  
Tx2 = IDF  
o: PMA at first feed, full nipple feeds, & at discharge. Questionnaire about provider’s acceptance to IDF plan.  
| LOS ↓ by 2.7 days (mean), and parent involvement ↑ by 49%.  
No between group differences in PMA at first feed. Tx2 led to earlier PMA’s at full NF, 17 days sooner for infants < 28 weeks (p = 0.003), 11 days sooner for infants 28-31 weeks (p < 0.001), and 3 days sooner for infants ≥ 32 weeks (p = 0.04).  
No differences in discharge for infants < 28 weeks GA. Tx2 led to earlier discharge for infants 28-31 weeks (p < 0.001) and infants ≥ 32 weeks (p = 0.048). 97% of nurses and attendings were positive about the IDF approach.  
Observational study. Different sample sizes between cohorts and across subgroups. Introduction of a standardized feeding protocol in of itself could have contributed to earlier feeds regardless of whether the feeding plan was infant driven.  

AW = primary investigator  
BCBF = behavioral cue-based feeding  
BD = bronchopulmonary dysplasia  
CBF = cue-based feeding  
CDH = congenital diaphragmatic hernia  
CPAP = continuous positive airway pressure  
DC = discharge  
EFS = Early Feeding Skill  
EHR = electronic health record  
ESL = semi-elevated side lying  
ESU = semi-elevated supine  
GA = gestational age  
GI = gastrointestinal  
HFNC = high flow nasal cannula  
IDF = infant driven feeding  
IG = intervention group  
LOS = length of stay  
NF = nipple feed  
NG = Nasogastric  
NICU = neonatal intensive care unit  
PCA = post conceptual age  
PDF = practitioner driven feeding  
PIOFRAS = Preterm Infant Oral Feeding Readiness  
PMA = postmenstrual age  
PP = practice plan  
SpO2 = oxygen saturation
<table>
<thead>
<tr>
<th>Author Year Journal Country</th>
<th>Purpose of the study; Level of Evidence</th>
<th>Sample Description</th>
<th>Assessment Instrument</th>
<th>Outcomes</th>
<th>Conclusions</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gianni et al. 2017 Early Human Development</td>
<td>To investigate the implementation of the Infant Driven Scale in NICUs and to identify a cut off value associated with delayed feeding independence.</td>
<td>$N = 47$ Incl: ≤ 32 weeks GA. Excl: Known congenital and/or chromosomal diseases; surgical intervention; brain, metabolic, cardiac, or GI diseases; ongoing sepsis; BD.</td>
<td>Infant Driven Feeding Scale Neonatal and feeding data collected from medical charts</td>
<td>The infant's feeding readiness and the PMA at achievement of feeding independence.</td>
<td>Mean PMA at feeding independence was $35.6 \pm 1.34$ weeks. Scores ≤ 8 at 32 weeks of PMA were associated with 1.8 week delay in achieving feeding independence.</td>
<td>Infant driven scale related to feeding on the breast in only 2 cases. Infant’s ability to suck was not objectively measured. Lack of assessment of caregiver’s techniques during feeding. Single center study limits generalizability.</td>
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<td>Italy SP (KK)</td>
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<tr>
<td>Girgin &amp; Gözen 2020 Journal of Pediatric Nursing</td>
<td>Determine neonatal nurses’ knowledge levels and clinical practices related to the transitioning process of preterm infants to oral feeding.</td>
<td>$N = 275$ neonatal nurses working in NICUs. Incl: At least 1 year clinical experience; holding permanent position in NICU; caring directly for preterm infants; working full time in NICU; signing informed consent form; read and speak Turkish.</td>
<td>Participant demographic form, oral feeding knowledge and practices questionnaire for neonatal nurses</td>
<td>Nurses’ mean knowledge score = 64.7/100 ($SD = \pm 8.7$; range = 40–87.5). Correct response rates particularly low for CBF items, interventions to promote oral–motor development, non-nutritive sucking, and infant positioning for oral feeding. No nurses used protocols developed for transitioning preterm infants to oral feeding.</td>
<td>Nurses need knowledge and practical training on evidence-based therapeutic interventions that promote oral feeding skills in preterm infants during transition to oral feeding. Use of protocols developed for transitioning preterm infants to oral feeding is limited in NICUs.</td>
<td>Results potentially cannot be generalized to all neonates in Turkey or other regions.</td>
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<td>Turkey SP (SP)</td>
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<tr>
<td>Thoyre et al.</td>
<td>Describe the implementation of CoReg for mothers with VP infants, guided by nursing staff trained in EFS &amp; GP.</td>
<td>$N = 16$ mothers of 17 infants. Incl: VP infants at level III neonatal care in US. Excl: Mothers unable to speak/read English, $&lt;18$; infant GA was $\geq 31$ weeks or had a congenital anomaly which interferes with feeding, grade IV intraventricular hemorrhage, ventilator $&gt;60$ days, not oral feeding by 44 weeks PMA.</td>
<td>Intervention field notes, audio recordings of sessions, video-recordings of nurse guided feedings were reviewed, organized, and analyzed to evaluate implementation.</td>
<td>Top five issues needing attention included dyad’s feeding challenges, auditory assessment of breathing and swallowing, and reflection for planning for future feedings.</td>
<td>Sessions were inconsistent due to scheduling issues. Does not say how much/intensive nurse training was.</td>
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<tr>
<td>USA</td>
<td>Case series</td>
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<tr>
<td>KK (SP)</td>
<td>AOTA: 3B Pyramid: D3</td>
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</table>

**BD** = bronchopulmonary dysplasia  
**CBF** = Cue-based Feeding  
**CoReg** = Co-Regulated Feeding Intervention  
**EFS** = Early Feeding Skill  
**GA** = gestational age  
**GI** = gastrointestinal  
**GP** = guided participation  
**NICU** = neonatal intensive care unit  
**PMA** = postmenstrual age  
**VP** = very preterm
Summary of Key Findings

Primary Outcome for Infants

*Attainment of Full Oral Feeding*

Seven out of eleven articles had similar findings related to preterm infants attaining full oral feeding earlier as a result of a CBF intervention. In a NICU setting, achieving full oral feeding is one of the primary concerns that determines if a preterm infant is eligible for discharge (Gelfer et al., 2015; Gianni et al., 2017; Kamran et al., 2020; Osman et al., 2021; Thomas et al., 2021; Wellington & Perlman, 2015). When a preterm infant achieves full oral feeding, there is a cascade effect that leads to more favorable outcomes not just for the infant, but also for the providers and parents.

Secondary Outcomes for Infants

*Decreased Hospital LOS*

Of the 7 studies that discussed attainment of full oral feeding, 4 of them examined hospital LOS as an outcome. These studies demonstrated that preterm infants fed via a CBF approach had an overall decreased hospital LOS in comparison to infants that did not receive it (Kamran et al., 2020; Lane et al., 2021; Thomas et al., 2021; Wellington & Perlman, 2015). These findings presented the strongest evidence as they contained a variety of strong study designs and a mostly low RoB. These studies suggest that a decreased hospital LOS is a critical outcome that co-occurs with the achievement of full oral feeding.

*Preterm Infant Health*

Preterm infant health outcomes were investigated within 2 studies. Girgin et al. (2018) examined the effects of elevated side-lying positioning during a CBF intervention. Preterm infants in this position, in combination with a CBF approach, displayed improved physiological stability and a better feeding experience as a result. There is moderate evidence to support these health outcomes as these studies contain a level I and II design with a low RoB. However, due to the overall lack of research
on other preterm infant health outcomes, these findings should be taken cautiously and expanded upon in future research.

One study examined the use of a CBF protocol to initiate oral feeding sooner. Lane et al., (2021) found that preterm infants who participated in a CBF intervention were able to initiate oral feeding sooner compared to preterm infants in a traditional feeding protocol. As a result, these infants were able to attain full oral feeding and be discharged earlier. Despite this study having a low RoB and sizable sample, this finding is entirely unique to this study. There is an overall lack of research that has examined earlier oral feeding initiation as a result of a CBF approach.

**Parental Outcomes**

Preterm infants are not the only individuals who experience outcomes as a result of a CBF approach. Several studies showed that the infant caretakers also benefit from the CBF protocol through decreased stress, greater feelings of bondedness, and more successful feeding opportunities (Thomas et al., 2021; Thoyre et al., 2016). One study highlighted the impact of a CBF protocol on the feeding experience for both preterm infants and their parents (Thoyre et al., 2016). Findings suggested that parents experienced decreased stress, and this reduced the challenge for the preterm infants to feed. Another study examined increasing parent involvement in CBF interventions to promote feeding outcomes (Thomas et al., 2021). The researchers found that parents felt more comfortable in providing supportive care during feeding with their infants. In addition, this approach resulted in a shorter hospital LOS for the preterm infants and their parents. The same study also found that an earlier discharge was a major contributor to decreased stress for these families (Thoyre et al, 2016).

These two studies highlight outcomes that go beyond the infant as a result of a CBF approach. Parents appear to play an influential role in helping their preterm infants achieve full oral feeding, the primary indicator for discharge from the NICU. Despite the lack of research on parental outcomes, it is an important consideration in developing and implementing CBF interventions since feeding involves the infant and the parent.
### Institutional Outcomes

Out of the 11 reviewed studies, 6 highlight important outcomes at the institutional level. These include empowering provider practice, shorter hospital LOS, and a reduction in hospital costs (Gelfer et al., 2015; Girgin & Gözen, 2020; Ismail & Bayoumy, 2017; Thomas et al., 2021; Thoyre et al., 2016; Wellerman & Perlman, 2015). Four of these studies examined the impact of a CBF approach on nursing practice and personal experiences. While there was an initial animosity towards CBF, findings suggested that as nurses became adept at administering feedings based on cues, they tended to favor it over traditional scheduled feeding (Gelfer et al., 2015; Girgin & Gözen, 2020; Ismail & Bayoumy, 2017; Thomas et al., 2021). In addition, Wellington & Perlman (2015) found that nurses were more satisfied with a CBF intervention as infants would achieve full nipple feeding sooner in comparison to a practitioner-driven feeding approach.

Two studies examined the financial benefits of a CBF approach for the hospitals that implemented it. These studies found that a CBF approach resulted in more cost savings as a result of an overall decreased hospital LOS for preterm infants and their families (Thomas et al, 2021; Wellington & Perlman, 2015). These promising findings further support the implementation of a CBF approach as it provides two meaningful outcomes for NICU settings in staff empowerment and overall cost savings.

### Implications

**Consumers**

The primary consumers of cue-based feeding are the parents/caregivers of preterm infants who are admitted into the NICU, and the infants themselves. For many parents, having an infant admitted to the NICU is a difficult process. It is even more stressful when an infant is unable to attain full oral feeding, the primary indicator for discharge, in a safe and timely manner. As a result, an increased LOS can lead to increased health care costs as well as stress for the parent and the infant (Kamran et al., 2020). One of the benefits of cue-based feeding is the earlier attainment of full oral feeding. Traditional
scheduled feeding is more focused on volume of consumption at specific times and less on infant hunger cues. CBF allows infants to maximize their food intake and minimize infant stress. Further benefits of CBF include parent involvement in the feeding process, which helps to promote a positive feeding experience for the infant and encourages parent-infant bonding through these feeding interactions (Gelfer et al., 2015; Girgin & Gözen, 2020; Kamran et al., 2020). Feeding infants using their cues is part of an evolutionary approach and it has been done long before the invention of Western medicine. These studies provide insight on the benefits of using a more developmental, family-centered approach to infant feeding in the NICU. This raises questions to the generalizability of these findings outside of hospital context with diverse families and cultures. Within a hospital setting that does not implement a CBF protocol, consumers should inquire about a CBF approach and considerations should be made to the cultural and family-centered nature of offered feeding interventions. Given the evidence supporting CBF, consumers should be given the knowledge to make educated decisions for which protocol is used with their baby. With the complexity of the medical model in the US, this research may be limited in its translatable into other settings.

Practitioners

The effects of implementing cue-based feeding in the NICU are promising, including evidence that it reduces costs for the family and NICU, decreases an infant’s LOS, and improves feeding outcomes for the infant (Kamran et al., 2020; Thomas et al., 2021). Since these interventions will be provided in NICUs, the staff serve as teachers of CBF for parents. According to Gelfer et al. (2015), success of CBF proficiency relies on the practitioners’ ability to acquire and apply evidence based knowledge on infant feeding. What makes teaching CBF a challenge is the lack of updated education/training that result in feeding strategies, practical knowledge, and goals among the NICU staff (Girgin & Gözen, 2020); and the inconsistent adherence guidelines due to “parental pressure to attempt a feeding, internal pressure to feed an infant because a previous nurse was able to complete a feeding,
and the notion that you are a ‘bad nurse’ or ‘lazy nurse’ if you do not attempt feeding the infant” (Gelfer et al., 2015).

This can lead to parents receiving conflicting information on how to use cue-based feeding for their child, and inconsistent implementation of guidelines which impedes the infant’s progression (Thomas et al., 2021). Practitioners must respond to the infants’ needs and behavioral cues, while ensuring the family plays an increasingly essential role (Gelfer, 2015).

Researchers

The primary indication for researchers to keep exploring cue-based feeding is to examine the benefits of it for infants and analyze its impact on providers and parents more deeply. As outlined earlier, there are outcome measures that have been researched and can be expanded upon through replication studies. Others can test different outcome measures and see if results are positive for preterm infants. Given that CBF involves providers and parents, measuring the practical effects of these interventions for these parties further informs NICUs on how to adopt and/or develop these types of feeding protocols. For example, future research could examine the ease and satisfaction of CBF implementation for care staff, and parents, and outcomes related to the parent-infant relationship including experience of bonding and connectedness with infants. Longitudinal research should also be performed to observe the long-term effects of a CBF protocol on various health outcomes and conditions, such as pediatric feeding disorders or general “picky eating” in the transition to solid foods.

NICUs across the U.S. have begun implementing CBF, however there is variability in CBF protocols and limited evidence to support its implementation (Thomas et al., 2021). Variability across NICUs makes it difficult to compare the outcomes of this approach, affecting the usefulness of currently available literature (Thomas et al., 2021). Larger randomized controlled studies are needed in order to examine the CBF effects more thoroughly as well as provide comparison to traditional methods (Gelfer et al., 2015; Wellington & Perlman, 2015; Thomas et al., 2021). Additionally, there is a need to better operationally define IDF and CBF, these techniques have overlap, and a clear distinction between the
terms could make it easier to compare and contrast the techniques. There is also a need for evidence from an occupational therapy lens because CBF is an emerging structured intervention within the hospital setting and occupational therapists were included in numerous studies as part of the multidisciplinary team. Future research could address OT’s role in implementing CBF through parent education in order to increase awareness and parent involvement.

Barriers to implementing CBF include the established traditional feeding practices, parent satisfaction, and the need for the hospital to develop a protocol/policy. Thomas et al. (2021) utilized a CBF Model of Practice, which includes universal education and standardized assessment tools; future research can use this model to test whether there is a difference in outcomes between a standardized approach to CBF versus an unstandardized method and whether this would improve the NICU’s implementation of supporting positive feeding experiences.

Bottom Line for Occupational Therapy Practice/Recommendations for Best Practice

There is moderately strong evidence to support the implementation of CBF interventions for preterm infants in the NICU. The studies presented in this review suggest that preterm infants achieve full oral feeding sooner as a result of an CBF intervention. Preterm infants who received CBF interventions were discharged earlier, were more physiologically stable, and initiated oral feeding sooner (Girgin et al., 2018; Kamran et al., 2020; Lane et al., 2021; Thomas et al., 2021; Wellington & Perlman, 2015). Additionally, the research demonstrated that providers and parents also benefited from CBF interventions including decreased stress, greater satisfaction, and bonding with infants (Gelfer et al., 2015; Girgin & Gözen, 2020; Thomas et al., 2021; Thoyre et al., 2016; Wellington & Perlman, 2015).

Oral feeding is an important occupation for parents and infants. Oral feeding contributes to neurodevelopment, maturation, and developing the parent-infant relationship. Parent’s roles are beginning to develop during early infant experiences and may shape how satisfied they feel in their roles. Preterm infants need to learn how to develop feeding skills in the NICU in order to be discharged home. CBF is a developmentally supportive and evolutionary based approach that provides positive
feeding experiences for both the infant and the parents. Occupational therapists, NICU staff, and caregivers need to learn skills to understand and respond to the physiologic and behavioral cues of the infant in order to provide opportunities for feeding success (Thomas et al., 2021). Support for CBF education is key in reinforcing a natural and culturally responsive approach to feeding.

In addition to preterm infants and their parents, NICU staff also stand to benefit from CBF. As the research has highlighted, many members of NICU staff are not aware of CBF as a concept, let alone as an alternative feeding protocol. While there is a scarcity of literature on NICU staff and their experience with CBF, the research that exists emphasizes the importance of the staff when it comes to CBF implementation and education. In order for CBF to be a viable feeding protocol, it begins with educating NICU staff, arguably the most important piece to make this kind of protocol proficient in a NICU setting. They act as the bridge between the concept of CBF and its practical application with infants and parents. With educated NICU staff, CBF guidelines can be streamlined to address the inconsistency concern not just in staff practice, but also in parent education. In other words, providing NICU staff with the updated evidence and training not only increases their CBF proficiency, but also integrates developmentally appropriate feeding strategies and goals into a uniform protocol that does not ignore an infant’s individual progression.

The implementation of CBF in the NICU provides many benefits for preterm infants, their parents, and the institutions that provide their care. It has research to back it up as evidence-based practice. And most importantly, it is a client-centered intervention that considers the individual needs of the preterm infant. Occupational therapists can share this approach with their team, if they are still following a traditional volume driven approach. Creation of an interdisciplinary team would be one of the next steps to moving forward with a CBF intervention. OT’s are well suited for supporting CBF in the NICU with distinct skills and training and observation, along with extensive knowledge of infant development and regulation related to feeding, as well as use of routines-based interventions which fits this approach. OT brings a unique perspective and skill set to infant feeding and when combined with
the tools of other care staff in the NICU, can offer the highest level of care to infants experiencing feeding difficulties. If implemented properly, CBF has the potential to not only provide safe and effective feeding opportunities for infants, but also allow their parents to develop a deeper connection with their infant through the co-occupation of feeding. This is in line with the OT principles of client-centered care by shifting the focus of feeding to the meaningful relationship between an infant and their parent.
Involvement Plan

From the initial discussions of our project and research objectives, our collaborator Cuyler Romeo, OTR/L, SCFES, identified the need for a knowledge translation product regarding evidence for cue-based feeding (CBF) in the NICU. Initial discussions with Romeo identified information needs regarding identifying outcomes related to cue-based feeding protocols with premature infants in the NICU, and she expressed her needs for this information to promote education and a consistent protocol to follow for all bedside care staff in the NICU. The basis for our project stems from Romeo's reports that there is a lack of formal education and protocols for cue-based feeding for care staff, which negatively impacts the consistent use of the approach and implementation of parent education.

Currently in her setting at Banner-University Medical Center in Tucson, Arizona, the traditional feeding methods, which are volume-driven or scheduled, are preferred. Romeo also reported that while some staff members may utilize the cue-based feeding approach - which is a feeding approach that determines an infant's readiness to feed based on behavioral cues, physiological signs, and developmental readiness - it is not used consistently across practitioners. In Romeo's clinical experience, CBF is a more developmentally supportive approach to feeding infants in the NICU while achieving discharge readiness requirements. For this reason, she identified the need for compiling and evaluating evidence for the use of a cue-based feeding approach in the NICU. With this information, she hopes to further her efforts in creating education for staff members on cue-based feeding and potentially implement a standard protocol for staff members to follow.

Based on our search results, we were able to establish strong evidence supporting the use of a cue-based feeding method in the NICU. Follow-up conversations regarding our findings were positively received by Romeo, and discussions for the knowledge translation began. Initial conversations with Romeo identified her ultimate goal to manualize an intervention protocol for nursing staff to consistently implement a cue-based feeding method, however the complexity of this type of project was not possible due to the rigorous and intensive process needed to perform research investigation, protocol development and testing, along with refinement. Additional ideas presented by Romeo included the creation of a
standardized feeding protocol that would be incorporated into other department protocols rolling out in the near future, including the SENSE program which uses sensory interventions tailored to the infants, with a primary focus on the development of the different senses during every day of NICU hospitalization. However, this project was not supported by the outcomes of our research due to inconsistent or inexplicit feeding protocols used from study-to-study.

For the purposes of our project, we created a universal educational pamphlet for the NICU staff members and caregivers that operationalized cue-based feeding (Appendix), as that was a need that Romeo had mentioned it would help to generate a better understanding of CBF and its protocols for staff members. Our informational pamphlet focused on the outcomes of a cue-based feeding approach for both the infant and the hospital. An educational in-service was originally planned for staff members at our collaborators site, but was not completed due to unexpected time constraints and changes in the collaborator’s needs for her setting. The creation of our universal information product outlines the evidence we gathered for a cue-based feeding approach and was intended to support Romeo’s efforts of implementing an evidence-informed CBF protocol in her setting, and reducing infant risk for hospital readmission and developmental complications. The dissemination of this information was also intended to benefit hospital stakeholders who may see additional benefits related to positive outcomes with this approach, including decreased hospital costs and length of stay, and care staff and parental satisfaction with feeding interventions. These positive outcomes could boost hospital ratings and benefit consumers, staff, and stakeholders.

**Contextual Factors**

The NICU department at Banner University Medical Center consists of many disciplines with a medical chair supervisor that oversees the entire department. The main contextual factors that were considered prior to implementation that could have impacted our plan to implement a knowledge translation project included the lack of a consistent cue-based feeding protocol for infants in the NICU which has led to inconsistent feeding practices from bedside care staff for this method. Bedside staff may favor a volume-based feeding protocol because it is often more time efficient in their busy schedules. The
nurse to baby ratio in the NICU is 1:3 babies, and they are given 30 minutes for feeding interventions. While there are 2 OTs and 3 PTs on staff, they work with the developmental clinic. Their work includes developmental screening and follow-up assessments, but they do not participate in feeding the infants. Limited availability for feeding interventions along with additional barriers including understaffing prevent consistent use of a cue-based feeding protocol. These factors play a big role in how consistent the entire department can be with implementing a new feeding protocol. Convincing the chair and possibly the board can impact the knowledge translation, as their readiness to change is unknown. However if the protocol is accepted by the chair and it becomes standard policy, this will support the implementation as nurses will be required to follow it.

An advantage is that the medical chief is quite involved with the staff. They provide quarterly educational and staff meetings as well as sending out weekly newsletters to all the staff. The developmental care teams include a RN who helps with implementation and educating the nurses. In addition, there are also people in place on staff that can assist with implementation as well. All of these factors can facilitate evidence and information dissemination to care staff and nurses in particular, as they have extensive support networks to assist them with the frequently received educational materials.

**Knowledge Translation Activities**

**Pamphlet**

Information was compiled from the 11 appraised articles to create an educational pamphlet that outlines the benefits and methods for promoting cue-based feeding protocols in the NICU (see Appendix). The pamphlet highlights what cue-based feeding would look like in practice including stress and hunger cues exhibited during feeding. This information, along with a basic CBF protocol developed by Michigan Medicine, was added for additional educational purposes. This outside information was added as it was determined to be beneficial to generating greater understanding of CBF for the reader, but was not able to be generated from the original research. Additionally, the creation of a new standardized CBF protocol was not feasible due to the level of expertise and rigor of study presented here. Many cue-based feeding protocols require users to either pay for the materials or were so complex that a general audience would
have difficulty understanding the content. Michigan Medicine provides the most simple and accessible protocol for a cue-based feeding method. This protocol also fits with the collaborator’s feedback regarding changing the language to make it compatible with a lower health literacy equivalent.

The other challenge we ran into with making the pamphlet was using consistent neutral language to keep the content applicable to two different audiences: nursing staff and parents, and finding non-copyrighted stock photos of infants in the NICU. Our group collaborated to make the pamphlet consistent with presenting its content using neutral language. This was especially challenging when it came to presenting the outcomes of cue-based feeding protocols for parents, nursing staff, and medical institutions. We had to be careful about the language we used for these sections in order to keep the content more generalizable instead of speaking to a particular audience at the expense of another. Only one non-licensed photo was found to be appropriate for the pamphlet, but did not show a premature infant or an infant of color.
<table>
<thead>
<tr>
<th>Task Product</th>
<th>Goals/objectives</th>
<th>Steps to Achieve Final Outcome</th>
<th>Date of Completion</th>
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| Universal information pamphlet on cue-based feeding | The goal is to make a universal informational pamphlet for bedside care teams on cue-based feeding. Information in the pamphlet will include evidence for the benefits to a cue-based feeding approach. | 1. Collect information to use in pamphlet - potentially protocols for CBF. Create the first draft and submit it to chair Dr. Pitonyak for review by 2/16/22.  
2. Make a final draft and submit to Dr. Pitonyak for final review by 2/23/22.  
3. Have the final draft looked at by Romeo by 2/28/22.  
2 - 3/1/22  
3 - 3/9/22  
4 - 4/5/22  
Feedback from Romeo received on 4/12/22  
Feedback from Romeo and nursing staff received on 4/14/22 |
| Staff inservice | The goal of this task will be to present the pamphlet to NICU staff members including nurses, OT’s and PT’s who work with infants and their caregivers during feeding. This session will include an introduction to cue-based feeding and the research behind it. | 1. Create a draft powerpoint for inservice by 3/4/22 and submit to the chair Dr. Pitonyak.  
3. Submit pre-test survey on staff knowledge regarding cue-based feeding by 3/10/22.  
2. Have the final powerpoint completed by 3/10/22.  
3 Present inservice via zoom by 3/18/22 and submit final survey to staff.  
4. End survey response and begin examining data by 3/25/22. | Not completed due to time constraints and needs based changes for our collaborator |
Outcome Monitoring

We planned to give a survey on cue-based feeding before and after a nursing/staff in-service to determine the level of knowledge and education the staff currently have on the benefits and implementation of a CBF protocol, and if they were currently using CBF in their practice. The second survey was to contain the same questions as the first survey to determine if and to what extent the information we provided in the in-service affected the staff's knowledge of cue-based feeding. The end survey also intended to contain questions on how useful the staff found the in-service, if they planned on starting or continuing to use cue-based feeding, and open ended questions for feedback on how to improve the education of cue-based feeding, why they do not think they will implement a cue-based approach (if they answered previously that they do not intend to), and questions they still have about cue-based feeding. Since we were unable to proceed with providing a staff inservice along with a pre-, post-survey, no outcome data was gathered for this knowledge translation product. In the absence of a staff inservice, outcome data was then collected through verbal feedback from the project collaborator and select NICU staff on the usability and readability of the pamphlet. Outcome data were collected through both a phone interview and email with Mrs. Romero.

Product Effectiveness

Based on data received over the phone and in email, effectiveness of the knowledge translation process was evaluated based on verbal feedback including the readability and usability of the pamphlet that targeted multiple audiences (i.e., caregivers, bedside care staff, and other stakeholders). Romero reported that the pamphlet was something that she would use in her setting, as it could easily be adapted to serve multiple purposes and serve as a basis for CBF to train new hires and student interns. She also expressed that the information was digestible and consolidated for nurses when compared to their prior experience with educational materials (e.g, online learning module). In her opinion, the pamphlet could accompany such educational training to help nurses carryover CBF knowledge to their practice and support families.
While Romero had initially expressed the pros of having a universal pamphlet, she then began listing pros for having a separate pamphlet for caregivers. The first reason included increasing the health literacy of the information, by changing the information to a 5th grade reading level. Another reason was the irrelevance of the two sections on institutional outcomes for caregivers. Caregivers would benefit most from a pamphlet highlighting the definition of CBF, the outcomes for infants and caregivers, and examples of how CBF is implemented.

Our collaborator also provided feedback on the picture used for the front of the pamphlet and suggested using a picture of a premature infant of color. She also needed some clarity on two bullet points under “implementing cue-based feeding practices in the NICU,” which suggests that this information would need to be either cut out or changed to be more explicit.

Via email, Mr. Romero reported feedback from staff members in her NICU included changing the language to make it shareable with families and to change pamphlet coloring to white as they do not have access to a color printer in the NICU, making it print too dark.

**Overall Process Analysis**

This project was a distinct learning experience working with an established collaborating clinician, and developing a question and product around her practice area needs. It was interesting to develop a research question that arose from real-world practice in contrast to formulating a research hypothesis based on a case study. Our first major challenge with this project came in the early stages of developing our PICO question. We had to change our research question twice as the first two questions were determined to be unfeasible for the scope of this project. Our group was initially discouraged about the overall feasibility of a PICO question on our topic of early feeding experiences and long-term outcomes as a result. But our collaborator and chair were very helpful in refining our PICO question to make it viable for this project and for practical use within our collaborator’s setting.

Once our group solidified our research question, the process of gathering and analyzing research articles felt straightforward. This is where our group came upon our next hurdle. Over the course of the research process and documentation for our CAT tables, there were moments in which questions would
come up about different aspects of our research question. These questions would have our group consistently reevaluating our gathered evidence to examine things like what definitions authors were using, what populations were being assessed, characteristics of protocols being implemented amongst other details. While it was frustrating at times to come across these challenges, our chair was incredibly helpful in talking us through the complexity of NICU practice and the varying needs of preterm infants that play into implementing feeding protocol. Applying these talking points to our gathered evidence was tedious at times, but it ultimately made the knowledge translation process easier.

The knowledge translation aspect of this project provided the opportunity to take our research to the next level, something our past projects had not explored or incorporated. Our group created two different products, but ultimately went with the pamphlet because of the communication with our collaborator. There was a period of two months where we did not hear from our collaborator regarding questions we had for her and there was difficulty gathering feedback in a timely manner during the spring semester. This placed a major time constraint on our ability to gather data from our collaborator’s practice setting and analyze it. Thus, our group was unable to document staff feedback on our pamphlet on implementing a cue-based feeding protocol in their NICU.

Despite the obstacles our group encountered, we are pleased with how our CAT project has turned out. Translating our complex findings into common language was daunting, but provided our group with a great real-world opportunity. We know that in Fieldwork II and beyond, translating occupational therapy terminology into actionable and understandable language for staff and clients is essential in creating meaningful changes in practice settings and clients’ quality of life. Having this experience will be advantageous to us as we transition into practicing occupational therapists.

**Recommendations for the Future**

Since we were unable to send out a pre- and post-survey because of the delays with gathering pamphlet feedback, this would be a viable follow-up project. Over the course of this project, our collaborator has said that her facility has been looking into the SENSE program, a multimodal sensory exposure approach to optimize infant outcomes in the NICU, including feeding. If our collaborator
incorporates the SENSE program into her practice, a pre-, post-survey could be implemented to analyze the staff’s experiences with the implementation of the SENSE program and their individual perspectives on cue-based feeding.

Another feasible follow-up project could expand upon our research to incorporate preterm infants who require continuous positive airway pressure (CPAP) or nasal continuous positive airway pressure (NCPAP). Preterm infants typically born before 32 weeks postmenstrual age require a CPAP or NCPAP. As a result, these infants need more developmentally appropriate care especially when it comes to feeding. This is one of the benefits of cue-based feeding in that it is designed to support and respond to an infant’s individual developmental needs. A follow-up project could explore cue-based feeding protocols for this population and provide an inservice to educate staff about findings.
References

*Article appraised in CAT Tables


https://doi.org/10.1111/jpc.15530.

https://doi.org/10.1016/i.jogn.2021.02.002


Appendix

Universal Cue-Based Feeding Pamphlet

Implementing cue-based feeding practices in the NICU:
- Utilize research databases and comprehensive education tools to generate understanding of standardized protocols amongst staff
- Update and implement NICU protocols for best-practice

Please scan the QR code to access the research and references used in this brochure

Cue-Based Feeding in Practice:

Feeding cues/signs of hunger:
- Rooting and/or hands to mouth and midline
- Moving hands to face or mouth
- Mouthing or sucking movements
- Increased activity/alert

Infant stress/disengagement cues:
- Gaze aversion
- Poor levels of alertness
- Irritability
- Finger splaying/arching of trunk
- Pulling away/turning head
- Tongue thrusting

Cue-based Feeding Protocol:

Start oral feeds only when showing readiness cues
Watch to see how the baby is responding
Pause when the baby seems stressed
Use calming strategies and re-attempt oral feeding
Stop if stress cues continue, if baby shows "finished" cues, or after 20-30 minutes of oral feeding

Cue-based Feeding in the NICU:

Benefits and Methods for Promoting a Cue-Based Feeding Protocol for Premature Infants in the NICU

Banner Health
WHO BENEFITS FROM CBF?:

- Premature Infants
- Parents/caregivers
- Hospitals/Care Staff

**Infant Outcomes:**

- Earlier attainment of full oral feeding
- More pleasurable and less stressful feeding experiences
- Decreased hospital length of stay
- Decreased stress

**Caregiver Benefits:**

Feeding is an intimate experience between the infant and parent/caregiver. It should be safe, comfortable, and rewarding for everyone involved.

Benefits include:

- Greater feelings of bondedness
- Decreased stress
- More successful feeding experiences for both

WHAT IS CUE-BASED FEEDING?

Cue-based feeding (CBF) is a feeding approach that determines an infant's feeding readiness based on behavioral cues, physiological signs, and developmental readiness. Cue-based feeding involves feeding a baby by mouth when they show signs or "cues" that they are ready to eat, and focuses on the quality of feeds. This allows the infant to feed safely and comfortably within a calm, positive feeding experience.

**OUTCOMES FOR CARE STAFF:**

- Increased consistency across all caregivers
- Elimination of pressure to feed for volume
- Increased nurse satisfaction with feeding intervention
- Shortened hospital length of stay leads to decreased stress
- Application of evidenced-based practices

**INSTITUTIONAL OUTCOMES:**

- Shorter hospital length of stay leads to decreased hospital expenditures
- Application of evidence-based practice in the NICU

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<tr>
<th>WHAT IT IS:</th>
<th>WHAT IT ISN'T:</th>
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<td>Infant driven</td>
<td>Practitioner driven</td>
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<tr>
<td>Quality focused</td>
<td>Quantity focused</td>
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<tr>
<td>Flexible schedule</td>
<td>Fixed schedule</td>
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<td>Oral intake based on cues</td>
<td>A prescribed volume per feed</td>
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<tr>
<td>Following an infants lead</td>
<td>Making an infant eat/finish a bottle</td>
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