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Benefits of Infant-Driven Feeding in the Neonatal Intensive Care Unit: A Literature Review

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Abstract

Current policy in Neonatal Intensive Care Units (NICUs) is to prescribe a volume of formula or milk to ingest a certain number of times per day to infants admitted to the NICU. The method of infant-driven feeding (IDF) is believed to be a superior alternative that allows the infants to determine the timing and volume consumed and leads to better patient outcomes. To be considered in this review, the studies were required to be primary sources that were peer-reviewed, conducted in the last five years, and had to include at least one of three outcomes: weight gain, time to full oral feedings, or hospital length of stay. The purpose of this literature review was to confirm that there are measurable benefits of the infant-driven feeding method when utilized in the NICU setting, and to validate the efficacy of this method with infants of varying levels of health and prematurity, all admitted to the NICU. The results of the review supported the hypothesis that the implementation of an IDF model would lead to decreased hospital length of stay, and earlier attainment of full oral feedings. IDF leads to shorter hospitalization, fewer adverse effects, does not compromise weight gain, and does not actually increase staff workload. It also allows parents to feel more involved with their infant's care and increases their confidence and ability to recognize and respond to readiness and disengagement cues exhibited by their infant during their hospital stay, and when they are able to return home.

Benefits of Infant-Driven Feeding in the Neonatal Intensive Care Unit: A Literature Review

The development of the suck-swallow-breathing pattern in an infant in the Neonatal Intensive Care Unit (NICU) is essential for the ability to feed orally, and eventually become discharged from the unit. This is a complex mechanism where, because the pathways for air and food cross in the pharynx, swallowing must include brief pauses of respirations to protect the airway (Mayerl et al., 2019). Within hours of birth there should be some form of coordination between sucking, swallowing, and breathing; however, it is common for premature infants and infants that require admittance to the NICU to struggle with this mechanism. The suck, swallow, and breathing ability necessary to feed is related to an infant's neurodevelopmental maturity and health status; therefore, safe and efficient feeding skills are a challenge for most premature infants because they have not yet fully developed the skills to coordinate feeding (Whetten, 2016). Physiologic maturational problems such as poor muscle tone and endurance complicate the transition of preterm infants to full oral feedings. Additionally, temperature instability, hypoglycemia, jaundice, and respiratory distress place preterm infants at greater risk for feeding difficulties (Fry et al., 2018). With a maturing central nervous system (CNS), coordination of swallowing and breathing is a skill that develops over time. Although each infant matures at a different rate, previous research suggests that the ability to coordinate the necessary reflexes (suck, swallow, and breathe) commences at 33 weeks gestational age (GA) (Settle & Francis, 2019). Oral feeding is commonly introduced in the NICU at approximately 33 to 34 weeks GA (Bache et al., 2014).

When using an infant-driven feeding (IDF) approach to the introduction of oral feeds, it is important to know hunger cues and disengagement cues that an infant will exhibit. Once an

infant has shown a capacity to maintain an alert state and has good muscle tone and stable vital signs, he or she can begin to feed orally (Whetten, 2016). After approximately 33 weeks' gestation, infants begin to show cues that they would like to be fed: waking, fussing, sucking on hands and pacifiers, and stable tone and vital signs (Whetten, 2016). IDF requires that infants are assessed before each feeding session by observing for what is known as hunger cues: bringing hands to the mouth, rooting, or sucking on fingers or a pacifier. Crying is a late feeding cue; tongue-poking, arm waving, kicking, stretching, bicycling legs, and grunting are often exhibited before crying (Watson & McGuire, 2015). For a preterm infant, crying for feeds wastes effort and energy as well as raising stress levels at such a vulnerable developmental stage (Watson & McGuire, 2015). Feeding in an infant-driven approach should always be initiated before crying occurs. IDF allows an infant to orally feed when able, and to stop a feeding when unable to coordinate the sucking, swallowing, and breathing required to do so safely and effectively (Whetten, 2016). Feeding is halted if an infant displays signs of distress: prolonged oxygen desaturation, bradycardia, or inability to coordinate suck-swallow-breathe pattern, or if the infant becomes sleepy or otherwise disengaged (Fry et al., 2018). Disengagement cues include arching, weak or absent suck, hands put in the stop position, losing tone, and going to sleep (Watson & McGuire, 2015). An infant displaying these cues is stressed and should not continue to feed orally at that time (Whetten, 2016). While feeding cues may appear to be more difficult to detect in preterm infants, they may be sufficiently evident for a parent or caregiver to recognize and respond to (Watson & McGuire, 2015). Paying attention to an infant's cues to feed is developmentally safer and more successful than provider-driven feeding (PDF) (Whetten, 2016).

PDF is the traditional approach to feeding infants in the NICU. It is a task-oriented, volume-based, provider-driven method with an emphasis on quantity consumed rather than

awareness of an infant's state of readiness (Fry et al., 2018). Advancement of feeds from gavage feeds to oral feeds has traditionally been determined by the infant's gestational age or weight and ordered by the medical team (Whetten, 2016). This model is designed to feed a required volume of milk to an infant at a scheduled time, whether the infant is willing to participate or not. The goal of this strategy is to have an infant reach full oral feeds as quickly as possible, with the hope that an early discharge home would be possible (Whetten, 2016). Criterion for PDF have shown to compromise the infant and increase levels of anxiety and frustration in the patient, the parents, and caregivers (Lubbe, 2017). Adverse or stressful feeding experiences for immature and medically fragile infants may deleteriously affect their feeding ability well beyond hospital discharge (Fry et al., 2018). The current recommendation is to implement infant-directed feeding and allow preterm infants to feed orally as early and as often as they exhibit signs of readiness (Griffith et al., 2018).

In order for an infant to be discharged from the NICU, there is certain maturational criteria that must be met. This criterion includes the infant's ability to safely feed orally at all times, and adequate growth and weight gain. Growth influences behavioral maturation and subsequent successful oral feeding (Fry et al., 2018). Oral feeding success is defined as an infant's ability to consume 100% of the prescribed volume of breast milk or formula by mouth (Griffith et al., 2018). An infant's ability to feed orally, or lack thereof is a common reason for increased NICU length of stay. Feeding difficulties place infants at risk for prolonged stays, which result in not only greater costs and financial burdens on families, but also increased likelihood of readmissions after discharge (Lubbe, 2017). The national average cost for NICU-level hospital care is estimated at $5,758 per day, and 9% of expenses are not covered by Medicaid or private insurance (Fry et al., 2018). In addition to the financial component, having

an infant hospitalized in the NICU is an emotional stressor for parents, especially if the NICU is far from their home. Mothers found it challenging to become acquainted with their newborns and to develop their roles as parents (Fry et al., 2018). It is important to decrease the length of stay for these patients in order to minimize parent/infant separation, reduce exposure to iatrogenic infection, and to save healthcare dollars (Wellington & Perlman, 2015).

Results of quality improvement (QI) initiatives indicate that weight gain, progression to full oral feedings, and hospital length of stay (LOS) may be improved with the implementation of an IDF approach (Fry et al., 2018). The literature that was reviewed varied widely when concerning the gestational age and health of the infants that the infant-driven feeding approach was established with. The purpose of this review was to confirm that there are measurable benefits of the infant-driven feeding method when utilized in the NICU setting, and to validate the efficacy of this method with infants of varying levels of health and prematurity, all admitted to the NICU.

Methods

Objectives

The following question guided this literature review: *What are the benefits of implementing an infant-driven feeding procedure for infants in the NICU?* To address this question, studies were considered whose participants were preterm infants or infants in the NICU; comparisons of the outcomes of infant-driven and provider-driven feeding; and outcomes that included weight gain, progression to oral feedings, and length of stay in the NICU.

Eligibility Criteria

In order to be included in this review, the articles that were reviewed had to meet certain inclusion criteria. Full-text, peer reviewed journal articles published in the English language

were considered, and the search was limited to those studies published in the last five years: December 2014 to December 2019. A study was excluded if it did not report any of the three outcomes that were being reviewed, if it was not focused on infant-driven feeding, or if animals were included as subjects in their research.

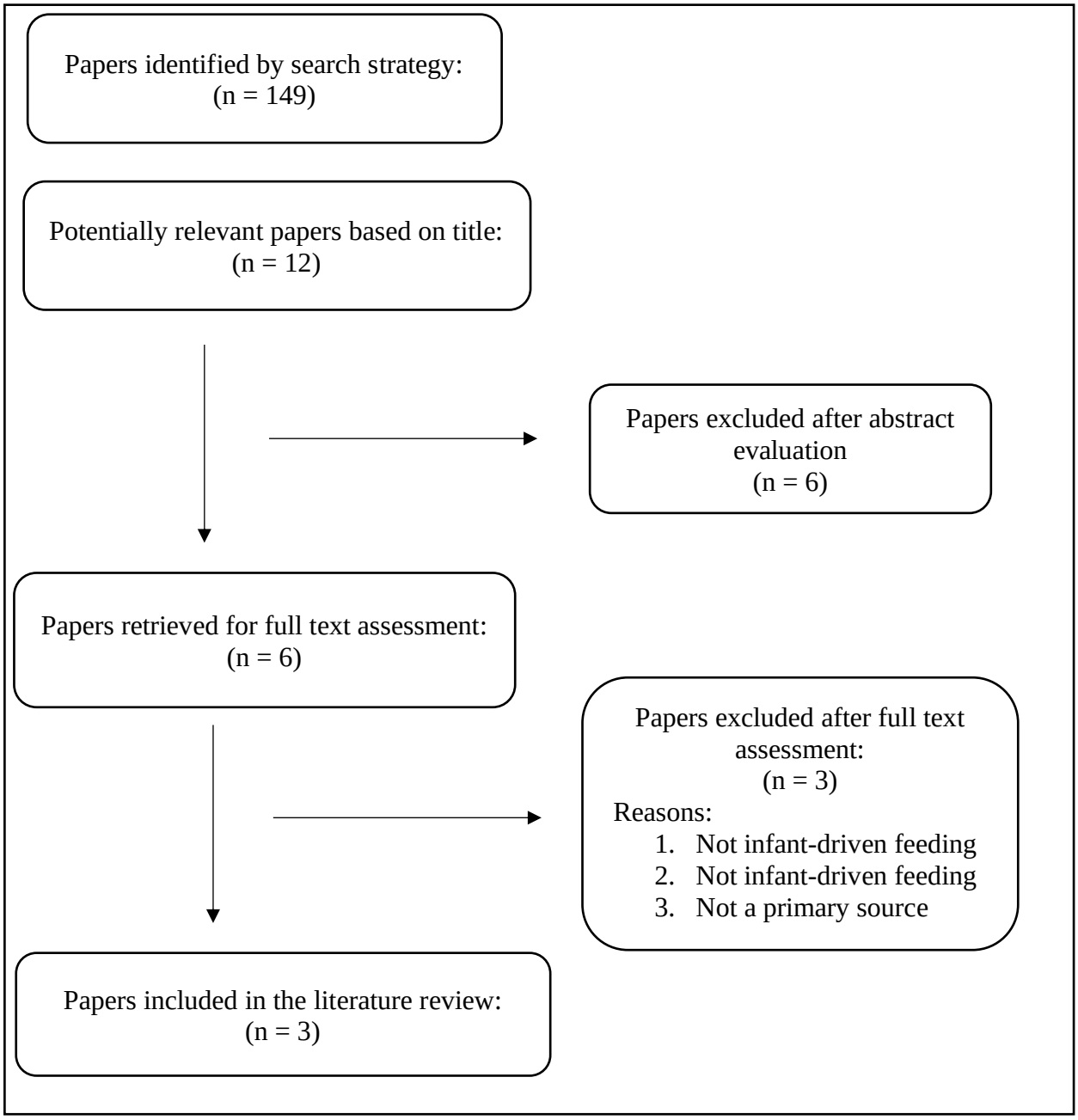
Information Sources and Search Strategy

In December 2019, the databases PubMed and CINAHL Complete were searched. The search strategy used produced results for which the title included any of the form of the word feeding combined with command, cue-based, infant-driven, or response. The terms NICU and preterm were also included in the search strategy to further limit the results.

Search Results and Data Extraction

A combined 149 research articles were identified by PubMed and CINAHL Complete using the search strategy. Of those 149 articles identified, 137 were excluded based on the irrelevance to this literature review concerning the content of their titles. A total of 12 articles remained, and after evaluation of their abstracts, 6 articles were excluded. The 6 articles that remained underwent a full text evaluation, and after excluding three articles (two articles were not focused on infant-driven feeding and one study was not a primary source), three articles were selected to be included in this literature review. Figure 1 illustrates this method of inclusion and exclusion. Data extracted from the articles included in this literature review were organized by the description and number of participants, weight gain, NICU length of stay, and accomplishment of full oral feedings. Data was extracted and organized through recurrent evaluation of the articles, and the data extracted from each study appear in Table 1.

TABLE 1: INCLUSION AND EXCLUSION CRITERIA FLOW CHART



Results

A total of 627 infants were included in the three studies that were reviewed. Chrupcala et al. (2015) implemented a quality improvement project that included 170 surgical and nonsurgical infants of all gestational ages. This study was implemented in a NICU that treated term or near-

term infants with complex surgical and nonsurgical congenital anomalies (Chrupcala et al., 2015). Baseline data was collected on infants with an average gestational age of 36 0/7th weeks, and postimplementation data was collected on infants with an average gestational age of 36 and 1/7th weeks (Chrupcala et al. 2015). Gelfer et al. (2015) implemented a quality improvement project that included 124 healthy preterm infants in a referral tertiary care unit, and the pre-intervention and post-intervention groups were similar in gestational age at birth and birth weight. All infants included in this study were born at ≥30 weeks' gestation (Gelfer et al., 2015). Wellington and Perlman (2015) implemented a quality improvement project that included 254 healthy preterm infants that they further divided into three cohorts based on gestational age: >28 weeks' gestation, 28-31 weeks' gestation, and ≥32 weeks' gestation. GA, birth weight, race, gender, post-menstrual age (PMA) at first nipple feed (NF), PMA at full NF, and PMA at discharge were all retrieved at the time of baseline collection, and after implementation (Wellington & Perlman, 2015). There were no differences between cohorts for all collected data points, except for patent ductus arteriosus ligation, which occurred a higher rate in the 28-31 weeks' gestation cohort (Wellington & Perlman, 2015). The identified outcomes to be reviewed were length of stay (LOS), weight gain, and time to full oral feedings, which can be found in Table 1.

Length of Stay

In all studies included in this review, LOS was included as an outcome that was measured. The studies that were reviewed all reported that the intervention groups had a decreased LOS when compared to the control or baseline groups (Chrupcala et al. 2015; Wellington & Perlman, 2015; Gelfer et al. 2015). Wellington & Perlman (2015) reported that the infants born at a gestational age between 28-32 weeks in the IDF cohort were discharged 9 days

earlier, and infants born at ≥32 weeks gestational age were discharged 3 days earlier than infants in the PDF group. Chrupcala et al. (2015) reported that the average LOS in the post-implementation group was 36.4 days, compared with an average of 43 days in the baseline group. Gelfer et al. (2015) discussed the propensity that the infants in the post-intervention group had for an earlier hospital discharge as well, with an average LOS of 25.6 days for the post-intervention group versus 28.2 days for the pre-intervention group.

Weight Gain

Weight gain was an outcome measured by one of the studies included in this review. Gelfer et al. (2015) reported that IDF did not compromise an infant's ability to gain weight, and that the average daily weight did not differ between the pre-intervention and post-intervention groups that were studied: 25.4 ±13.6 g in the pre-intervention group versus 23.6 +/- 12.7 g in the post-intervention group.

Time to Full Oral Feedings

In all of the studies included in this review, time to oral feeding or ability of the infants studied to exclusively feed orally by the time of discharge was included as an outcome. Chrupcala et al. (2015) reported that 80% of baseline infants were discharged feeding orally, compared with 77% of post-implementation infants. Wellington and Perlman (2015) reported that the implementation of an IDF strategy resulted in earlier attainment of full NFs and earlier discharge in infants with a gestational age of less than 34 weeks. Gelfer et al. (2015) studied the ability of infants to attain ad libitum feedings, which was reported to be attained significantly earlier in the post-intervention group (35.0 ± 1.1 weeks PCA (post conceptual age), compared to 35.6 ± 1.1 weeks PCA in the pre-intervention group.

TABLE 1 DATA EXTRACTED FROM ARTICLES INCLUDED FOR REVIEW				
Study	**Subjects**	**Weight Gain (g/day)**	**Length of Stay**	**Time to Full Oral Feedings**
Chrupcala, Edwards, & Spatz (2015)	Baseline data on 20 neonates	N/A	Mean = 43 days	80% of baseline neonates were discharged exclusively feeding by bottle/breast, compared with 77% of the postimplementation neonate group.
	Postimplementation data on 150 neonates	N/A	Mean = 36.4 days	
Gelfer, Mccarthy, & Spruill (2015)	Pre-intervention phase: 64 infants	25.4 ± 13.6 g	Average of 28.2 days	35.0 ± 1.1weeks' PCA
	Post-intervention phase: 60 infants	23.6 ± 12.7 g	Average of 26.5 days	35.6 ± 1.1 weeks' PCA
Wellington, & Perlman, (2015)	Provider-Driven Feeding group = 153 infants	N/A	Infants 28-32 weeks old in IDF group discharged 9 days earlier, and infants ≥32 weeks were discharged 3 days earlier than those in the PDF group.	Infants <28 weeks in IDF group reached full NF 17 days earlier, 28-31 6/7 weeks in IDF group reached full NF 11 days earlier, and for infants ≥32 weeks in IDF group reached full NF 3 days earlier than the PDF group.
	Infant-Driven Feeding group = 101 infants	N/A		

Discussion

All three studies that were included in this review were quality improvement (QI) projects implemented in the NICU setting and were therefore evaluated for quality using the QI-MQCS tool. This tool allowed for evaluation of specific aspects of each project to assess the strength of the project, and each project included in this review met the standards of quality that the QI-MQCS tool expects. Premature infants are an important subject for QI projects, due to the wide variety in care throughout NICUs in the United States (Fry et al., 2018).

The use of the IDF method in all studies included a decreased LOS, and one study reported that the IDF method did not compromise weight gain in the post-intervention group. In two of the studies included, time to oral feedings did not appear to be affected by the initiation of the IDF method. However, Wellington and Perlman (2015), indicated that the earlier the IDF

method is initiated, the earlier an infant will attain full NFs. Infants ≤28 weeks' gestation attained full NFs 17 days earlier than the PDF group, whereas infants ≥32 weeks' gestation attained full NFs only 3 days earlier than the PDF group. These results would suggest not only that the IDF method is effective, but also that the earlier it is initiated, the better the outcomes for the infants when concerning transitioning to full oral feeds. Gelfer et al. (2015) and Wellington and Perlman (2015) both included healthy preterm infants in their studies, and their results showed a decreased LOS than babies that were more critical. Chrupcala et al. (2015) included infants with congenital anomalies, and typically had longer LOSs than the other two articles reviewed. These results would suggest that infants with more critical health features will have an outcome of an increased LOS on the basis of their medical conditions; however, with the initiation of the IDF model, even the more critical infants will have the opportunity for a decreased LOS.

While implementing these QI projects, many health care professionals felt that an IDF approach would not work in practice due to a variety of factors. Many nurses considered having to assess infant feeding behaviors as unnecessary to assess an infant's readiness and felt that it would be time consuming, while physicians questioned whether premature infants could reliably provide feeding cues. Ultimately, nurses reported that they spent less time feeding when using the IDF approach, because they were able to accurately assess whether an infant wanted to feed or not, instead of forcing feeding at a time that the infant was not hungry (Wellington & Perlman, 2015). The consistency of the assessing and charting infant feeding behaviors indicates that premature infants are able to exhibit signs of feeding readiness. The assessment of infant feeding behaviors was essential to standardizing objective criteria for readiness (Wellington & Perlman, 2015). The implementation of an IDF program not only provides nurses with an

objective method to evaluate a patient's readiness to feed, but also an additional strategy to assist parents with successful feeding of their preterm infants. Helping parents interpret unique feeding cues, as the nurse does, can facilitate an increase in oral feedings with a resulting weight gain and the potential to decrease hospital LOS (Fry et al., 2018).

Recommendations for Practice

In order for an IDF method to be introduced as policy in the NICU setting, staff education regarding hunger and disengagement cues and appropriate documentation is required for accurate implementation. A skilled and observant caregiver is essential to assist the infant in a pleasurable feeding experience that maximizes intake and minimizes stress (Lubbe, 2017). Welling & Perlman (2015) introduced the "Premature Infant Feeding Assessment" flowsheet, which allows the bedside nurse to evaluate an infant prior to each feeding in order to determine nipple feeding assessment scales. The flow sheet is divided into a "Readiness Score" and a "Quality Score", both of which range in scores 1-5. "Readiness Scores" are utilized when a nurse evaluates an infant for signs of nipple readiness every three hours as part of care. The nurse begins charting readiness scores at 32 weeks-gestation but continues to gavage feed until infant is at least 33 weeks PMA and is scoring 1-2s on the Readiness Scale for at least half the day for 1-2 days. Enteral feeding can begin when the caregiver recognizes infant cues that indicate readiness to feed and should be discontinued when the infant demonstrates satiation (Watson and McGuire, 2015). When using the IDF approach, emphasis should be placed on the quality of the feeding, instead of the quantity of formula or breast milk ingested. Following a NF at 33 weeks-gestation, the nurse documents a "Quality Score": range 1-5, where infants feeding safely and effectively (1-3) are fed for a maximum of 20-25 minutes, and the remaining volume, if necessary, is delivered via gavage feed (Wellington & Perlman, 2015). Allowing preterm infants

to dictate the timing and duration of enteral feeding may result in longer rest periods between feeds and promote sleep and wake patterns that reduce unnecessary energy expenditure, and increase growth rates (Watson & McGuire, 2015). Using readiness scores and documenting disengagement cues empowers nurses to use sound, evidence-based judgement and allows nurses to feel confident in feeding decisions (Whetten, 2016).

Limitations

Infants of different gestational ages and health status were included in this review, and the efficacy of the IDF method was independent of those factors. However, there have been reviews of the IDF method that called into question the reliability of the approach. The question of the IDF method possibly compromising an infant's ability to gain weight was raised by Watson and McGuire (2015). A recent Cochrane Review noted potential adverse effects of this method, which related to whether metabolic stability could be guaranteed. Watson and McGuire (2015) stated that preterm infants are known to be susceptible to hypoglycemia if a scheduled enteral feed is omitted or delayed, which in turn would raise concern that repeated or prolonged hypoglycemic episodes may impair longer term growth and development. The results of this review did not find any of those concerns listed to be a reasonable basis for not implementing the infant-driven feeding method in NICUs. Gelfer et al. (2015) reported that IDF did not compromise an infant's ability to gain weight, and that the average daily weight did not differ between the pre-intervention and post-intervention groups. Lubbe (2017) stated that IDF improved infants' nutrient intake and there was a reported increase in weight, or at least at the same rate as infants fed with quantitative approaches (PDF). To complete this review, the results of the literature searches using PubMed and CINAHL Complete were reviewed meticulously. It

remains a possible limitation, however, that not all current studies conducted regarding infant-driven feeding between December 2014 and December 2019 were included in this review.

Implications for future research

Non-nutritive sucking (NNS) is also a fairly new and under-utilized approach to progressing preterm infants to full oral feedings. Some evidence exists that NNS shortens the transition from tube to oral feeds for preterm infants (Watson & McGuire, 2015). This would be an important method to implement based on future evidence, because an extended duration of tube feeding during initial hospitalization created a less likely outcome of achieving oral feeding skills during the transition from the first to full oral feeding (Griffith et al., 2018). The sucking reflex matures at a much faster rate, and earlier readiness for bottle feeding are reported when preterm neonates are presented with (NNS) opportunities during gavage feeding (Bache et al., 2014).

There is also a need for a higher number of quantitative and qualitative research studies conducted related to the implementation of the IDF method in the NICU. There were very few studies that were eligible for inclusion in this study, all of which were quality improvement projects, and it would be beneficial for future study to conduct more research on this subject for review and implementation purposes.

Conclusion

Infant driven feeding is considered “developmental care” for preterm infants (Watson and McGuire, 2015). The duration of hospitalization from the start of oral feedings until discharge was predicted by maturity at the first oral feeding and positive feeding experiences contributed to a more rapid transition to oral feeding, regardless of the severity of illness (Lubbe, 2017). Research has found that initiating feedings at a later gestational age and increasing oral feeding

opportunities resulted in a more rapid transition to full oral feedings and a decrease in LOS (Settle & Francis, 2019). Data from two trials that recruited infants at the start of the transition to the oral feeding phase indicated that IDF allows infants to establish oral feeding about five days earlier than PDF (Watson & McGuire, 2015).

There are measurable benefits of the IDF method in the NICU, which include the ability to gain weight, the time that it takes an infant to progress to full oral feedings, and hospital LOS. IDF, when compared to PDF, leads to increased weight gain, shorter hospitalization, fewer adverse effects, and does not actually increase staff workload (Lubbe, 2017). It also allows parents to feel more involved with their infant's care and increases their confidence and ability to recognize and respond to readiness and disengagement cues exhibited by their infant during their hospital stay, and when they are able to return home (Watson & McGuire, 2015).

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