

## Transition from catheter feeding to oral feeding and breastfeeding of neonates in NICU

Eirini Orovou <sup>1,2,\*</sup>, Panagiotis Eskitzis <sup>2</sup>, Polaktsidou Ioanna <sup>2</sup> and Evangelia Antoniou <sup>1</sup>

<sup>1</sup> Department of Midwifery, University of West Attica, Athens, Greece.

<sup>2</sup> Department of Midwifery, University of Western Macedonia, Ptolemaida, Greece.

World Journal of Advanced Research and Reviews, 2022, 14(03), 460–465

Publication history: Received on 14 May 2022; revised on 16 June 2022; accepted on 18 June 2022

Article DOI: <https://doi.org/10.30574/wjarr.2022.14.3.0578>

### Abstract

With increasing survival rates among preterm neonates, reducing morbidity and better long-term prognosis have become a priority. Thus, feeding is of utmost importance in the health care and development of the neonates in the Neonatal Intensive Care Unit. The aim of this literature review was a brief analysis of the transition steps from catheter feeding to oral feeding and breastfeeding of preterm neonates in the Neonatal Intensive Care Unit. Data were collected through the review of the literature from the databases (Medline/PubMed, Google Scholar, and Crossref). Based on the collected data on an international level, some techniques rely on the specificity of each population and require adaptation to the data of each Neonatal Intensive Care Unit. In any case, the correct application of the protocols by all NICU health professionals, aims at the proper nutritional transition and installation of oral nutrition, including breastfeeding.

**Keywords:** NICU; Catheter Feeding; Preterm Neonate; Infant Feeding; Breastfeeding

### 1. Introduction

As a result of medical technology and progress in perinatal care, the survival of preterm neonates has increased in the last decade [1]. Intestinal feeding through the gastric tube fulfills the nutritional needs in case of inability to breastfeed due to immaturity or inability to coordinate breastfeeding and respiration of the neonate [2]. When infants overcome the risk of premature life-threatening conditions related to prematurity, discharge from hospital is often delayed due to their inability to feed effectively [3]. Achieving independent oral feeding is one of the exemption criteria as oral feeding difficulties in infancy can lead to long-term feeding problems and can be detrimental to the quality of life of these infants and their families [4]. Gavage feeding is a safe feeding method for those neonates whose coordination of sucking, swallowing and breathing has not yet developed [5]. However, choosing the right time to start oral feeding is still a challenge for Neonatal Intensive Care Unit [NICU] neonatal health professionals.

Based on the results of previous research, it is believed that swallowing-breathing- sucking coordination in premature infants does not exist until the age of 33-34 weeks [6]. In the study by Simpson (2002) [7], the mammalian ability to move / swallow / breathe was shown not to be related to gestational age but to the neonate experience. Thus, neonates born at 30 weeks were introduced to oral feeding from 31 weeks. Some other studies have shown that a nurse/midwife-based oral feeding protocol has a positive effect on achieving complete oral feeding in these neonates [8], [9]. So, the development of clinical practice guidelines involving many neonatal care providers is a challenge in the NICU [9].

\*Corresponding author: Eirini Orovou  
Department of Midwifery, University of West Attica, Athens, Greece.

**1.1. Strategies for optimizing the transition to oral feeding**

By using some techniques, midwives can better assess the infant's readiness for oral feeding and facilitate the transition to it. Therefore, the transition from catheter feeding to oral feeding should occur when infants have the ability to do so regardless of weight or age criteria. If the neonate is stabilized (absence of bradycardia or drop in oxygen saturation), adequately handles milk secretions and makes mammalian movements, introducing the neonate to breastfeeding before bottle feeding can help in later success with breastfeeding. According to Sridhar (2011) [10], there are 5 feeding challenges with corresponding management strategies (Table 1).

**Table 1** Strategies for optimizing the transition to oral feeding [10]

Oral Nutrition Challenges	Management Strategies
Clinical instability during feeding	Cue-based feedings Slow flow nipples Bottle feeding
Difficulty attaching and holding the seal around the nipple	Nipple shield Providing adequate head support and proper positioning
Disorganization of suck/ swallow/ breathe/ sequence	Swaddle infant with proper positioning [light body bend with hands under the chin] Cue-based feedings Bottle feeding
Lack of adhesion, suction, or weak mammalian movements in an untypically developing neonate	Chin support Cheek support Use of systems for cleft lip and palate
Reduced resistance to feeding	Application of scheduled feeding with short duration for each cycle. Limitation of stimulation, nursing care during the rest period Bottle feeding Swaddle infant with proper positioning Pacing

The main difference between breastfeeding and bottle feeding is that the first is a more active process based mainly on suction. In breastfeeding, the infant exerts great effort to coordinate the movements of the lips, cheeks, jaw and tongue. All these parts, however, contribute to good adhesion to the breast, creating negative pressure in the oral cavity [11]. Regarding oxygen saturation, it is important to note that breastfed infants maintain higher values. This may be due to the fact that in bottle feeding they make more swallows and therefore stop breathing more often [12]. Breastfed infants incorporate their breath into the sucking bursts and therefore may have better sucking-swallowing-breathing coordination [13], (Table 2).

**Table 2** Advantages of breastfeeding and bottle feeding

Trinity Sucking/ swallowing/ breath	Coordination of mammalian movements	Caregiver handling	Nipple adjustment	Oxygenation
Breastfeeding	+		+	+
Bottle-feeding		+	+	

Notes: The symbol [+] shows the advantages of breastfeeding and bottle-feeding

### 1.2. Prediction of nutritive sucking in preterm neonates

To determine the prognostic factors of breastfeeding in infants <34 weeks of age, the appropriate premature sucking readiness score [PTSR] should be evaluated as a readiness indicator for sucking [14]. The PTSR score [Table 3] is a sensitive and specialized tool for predicting the readiness to start oral feeding in premature infants. It can be used as an objective, simple and important enhancement in the optimization and early initiation of breastfeeds in low-birth-weight infants.

**Table 3** The Preterm Sucking Readiness Scale (PTSR) [14]

	0	1	2	3	4
Behavioral condition shortly before the start of feeding	Sleeping condition	Drowsiness condition	Crying	Wake up with stress	Calming vigilance
Transition to behavioral state during care / handling	Staying asleep	Immediate awakening but fast transition to sleep modethe care	Immediate awakening but rapid transition to drowsiness during care	Awakening during care but going into drowsiness immediately after	Maintaining vigilance during and after care
Feeding readiness behaviors during care / handling	No readiness behaviors are displayed				

Notes: PTSR should be used from all professionals in NICU

According to the Kumari study [14], nutritive sucking was achieved at a median age of 14 days amongst preterm neonates, 28–34 weeks of gestation. Furthermore, it was observed that a PTSR score > 9 had the best prognostic score for achieving nutrient sucking. However, week of gestation and weight were independently associated with the age in achieving nutritive sucking.

### 1.3. Feeding based on semi-demand

A preterm neonate (<35 weeks) does not cry loudly to show that he/she is hungry. This situation makes it necessary to plan a feeding program. Semi-demand feeding has been proposed as a design for the transition from scheduled feeding to cue-based feeding for premature infants. Although semi-demand feeding has been shown to be safe and effective in reducing the time to achieve oral feeding, the application of this feeding plan in NICU is still limited [15], [16]. The peculiarity of semi-demand feeding is that nurses/midwives continue to follow a program but let the infant be the guide. For, example, it is a design that balances between planned and responsive feeding. In this method, nurses/midwives should evaluate the behavior and signs of the infant's hunger every 3 hours. Thus, in addition to meeting their nutritional needs, preterm infants can benefit from an individualized and developmentally supportive approach to their care, with uninterrupted sleep periods, mutual interaction and a balanced experience of arousal and calm [17], [18], [19]. In general, the pattern of findings over the last 50 years shows that preterm infants on demand feeding some clinical improvement compared to those infants who were offered other dietary patterns [15]. The use of a semi-demand feeding protocol for infants transitioning from catheter to oral feeding was evaluated in a randomized controlled trial of 81 infants aged 32 to 34 weeks gestation [20] and according to the results this method reduced the time for infants to achieve oral feeding by 5 days.

To start semi-demand feeding, non-nutritious sucking with a pacifier should be offered to the newborn for five to ten minutes, so as to wake up and stay quiet [open eyes, without movement and upset]. Each feeding cycle should be offered when the infant is in an active but quiet state. If while sleeping, the infant does not suck the pacifier and remains asleep, the infant should be left to sleep for another 30 minutes. Then the pacifier can be offered again. If the infant continues to sleep and does not wake up, a catheter should be used for feeding. Feeding takes place every 3 to 3 1/2 hours, so the newborn has seven or eight opportunities for oral feeding over a 24-hour period [15].

**1.4. Feeding process**

key factors for the proper feeding process are a) the correct position of the infant, b) the belching, c) the cessation of feeding, d) the nipple of the bottle [21]. More specifically, during feeding the infant is wrapped in a blanket, with the hands free and kept in a semi-sitting position (approximately 60 °), with the head supported and the neck in a neutral position. A standard single-hole nipple with softer and faster flows is recommended, as this will allow the infant to maintain better control of the speed and volume of nutrients taken orally. The nipple is touched to the lower lip and then placed on the top of the tongue in response to the opening of the mouth. Then, the infant guides the progress and duration of feeding - that is, starts, stops, and continues sucking. When pausing, the nurse/midwife should not twist or push the bottle to stimulate the breastfeeding reflex but allow the infant to continue without pressing. Finally, the infant may need to stop feeding to belch. Some newborns belch on their own by stopping sucking and swallowing and opening their mouth around the nipple. If the newborn shows no signs of cessation, one rule is to provide an opportunity for belching when consuming half the volume of milk [20],[22].

*1.4.1. Monitoring of cardiorespiratory activity*

The neonatal cardiorespiratory response to feeding is assessed through continuous monitoring of heart and respiratory rate during feeding. The midwife can predict neonatal discomfort based on the following points: a) change in relaxed muscle tone, b) color change, c) rolling behind the eyes, d) cough and e) drowning [23], [24], [25]. If these signs occur, feeding should be stopped so that the infant can regain cardiorespiratory stability.

*1.4.2. Removal of a nasogastric catheter*

Before each feeding, gastric residual volume should be checked. A neonate is considered to have achieved complete oral feeding when all volumes of milk are taken orally over a period of 24 hours, without the need to use a catheter. The nasogastric tube can be removed at the nurse's/ midwife's discretion when the neonate realizes that the bottle may be over [20], [26]. During the full oral feeding phase, the infant continues to be evaluated every three hours for behavior but is allowed to sleep up to five hours between feedings. Nutrient intake at will should be encouraged. Newborns are monitored for oral intake and weight gain until discharge from the hospital [27].

*1.4.3. Cue-based feeding*

Cue-based feeding is based on a feeding schedule of the infant guided by its signs of hunger. It is a personalized feeding model that encourages the participation of the infant. The volume-driven model relies on feeding a newborn, even if the newborn's condition is unstable or developmentally immature. Cue-based feedings, on the other hand, rely on feeding a newborn when they are able to stop, when they are unable to coordinate mammalian movements, swallowing, breathing efficiently and safely [28]. Cue-based feeding has been shown to reduce the transition time from catheter to oral feeding, achieve complete feeding and ultimately reduce hospital stay [29].

*1.4.4. The transition to breastfeeding*

**Table 4** Steps from catheter feeding to breastfeeding

<b>Gestational age in weeks</b>	<b>24-27</b>	<b>28</b>	<b>29</b>	<b>30</b>	<b>31</b>	<b>32</b>	<b>33</b>	<b>34</b>	<b>35</b>
Kangaroo care									
Non-nutritious sucking									
First attempts at placement on the breast		+/-	+/-						
Syringe feeding			+/-	+/-	+/-				
Feeding with a glass									
Feeding with bottle					+/-	+/-			
Semi-demand feeding						+/		+/	
Exclusive breastfeeding						+/		+/	

\* The colored boxes refer to the minimum gestational age that can be applied to each step: \*The symbols (+) or (-) shows the indicates the approximate age at which feeding can begin: \*The minimum age for breastfeeding with syringe or formula has not been fully elucidated by the bibliography

Determining the optimal time to start breastfeeding for premature infants remains a challenge for health professionals. Unjustified delays that are not based on evidence often occur. The main goal of the protocols is the successful transition from catheter feeding to breastfeeding. The following is a report on the protocol used in the neonatal unit of the Institute of Maternal and Child Health of Trieste, a third level care center in northeastern Italy [30], (Table 4).

---

## 2. Conclusion

The transition from catheter to oral feeding requires the presence of experienced staff, the involvement and training of parents, the required time, and the appropriate environment in the NICU. It is important to recognize infant's nutrition as a complex, interactive and developmental task. Of course, it is not necessary for all NICU professionals to know the protocols. However, it is important, that they recognize the importance of feeding and caring for their neonates. As already known, the right way to deal with newborn needs not only affects their short-term health status but also their later life, practices such as removal of the nasogastric catheter and the initiation of oral feeding should be taken seriously.

---

## Compliance with ethical standards

### *Acknowledgments*

We would like to thank the members of the research laboratory "The Laboratory of Midwifery Care during Antenatal and Postnatal period – Breastfeeding" of the University of West Attica, for their valuable help in writing this article and for the continuous support of our research.

### *Disclosure of conflict of interest*

The authors declare no conflict of interest.

---

## References

- [1] Lyu T, Zhang Y, Hu X, Gu Y, Li L, Lau C. Management of Oral Feeding Challenges in Neonatal Intensive Care Units [NICUs]: A National Survey in China. *Frontiers in Pediatrics* [Internet]. 2020 [cited 2022 Jun 7]; 8, <https://doi.org/10.3389/fped.2020.00336>
- [2] Nascimento J, Santos IMM dos, Silva LJ da. CARE GIVEN TO NEWBORNS FED BY GASTRIC TUBE: CONCEPTS AND PRACTICES. *Textcontexto - enferm* [Internet]. 12 Aug 2019 [cited 2022 Jun 10]; 28, 10.1590/1980-265x-tce-2017-0242
- [3] American Academy of Pediatrics Committee on Fetus and Newborn. Hospital discharge of the high-risk neonate. *Pediatrics*. Nov 2008; 122[5]: 1119–26.
- [4] Hardy C, Senese J, Fucile S. Rehabilitation of Infant Oral Feeding Difficulties: A Survey of Occupational Therapists Practice Approaches. *Occupational Therapy In Health Care* [Internet]. 2 Jan 2018 [cited 2022 Jun 7]; 32[1]: 14–27, DOI: 10.1080/07380577.2017.1419398
- [5] Yildiz A, Arikan D. The effects of giving pacifiers to premature infants and making them listen to lullabies on their transition period for total oral feeding and sucking success. *Journal of Clinical Nursing* [Internet]. 2012 [cited 2022 8]; 21[5–6]: 644–56. DOI: 10.1111/j.1365-2702.2010.03634.x
- [6] Liu YL, Chen YL, Cheng I, Lin MI, Jow GM, Mu SC. Early oral-motor management on feeding performance in premature neonates. *Journal of the Formosan Medical Association* [Internet]. 1 Mar 2013 [cited 2022 Jun 7]; 112[3]: 161–4. DOI: 10.1016/j.jfma.2012.08.003
- [7] Simpson C, Schanler RJ, Lau C. Early Introduction of Oral Feeding in Preterm Infants. *Pediatrics* [Internet]. 1 Sep 2002 [cited 2022 Jun 7]; 110[3]: 517–22.
- [8] Ross ES, Philbin MK. Supporting oral feeding in fragile infants: an evidence-based method for quality bottle-feedings of preterm, ill, and fragile infants. *J Perinat Neonatal Nurs*. Dec 2011; 25[4]: 349–57; quiz 358–9.
- [9] Marcellus L, Harrison A, MacKinnon K. Quality Improvement for Neonatal Nurses, Part II: Using a PDSA Quality Improvement Cycle Approach to Implement an Oral Feeding Progression Guideline for Premature Infants. *Neonatal Network* [Internet]. 1 Jan 2012 [cited 2022 Jun 7]; 31[4]: 215–22.

- [10] Transition to Oral Feeding in Preterm Infants | NeoReviews | American Academy of Pediatrics. <https://publications.aap.org/neoreviews/article-abstract/12/3/e141/87264/Transition-to-Oral-Feeding-in-Preterm-Infants?redirectedFrom=fulltext>
- [11] Moral A, Bolibar I, Seguranyes G, Ustrell JM, Sebastiá G, Martínez-Barba C, et al. Mechanics of sucking: comparison between bottle feeding and breastfeeding. *BMC Pediatr* [Internet]. 11 Feb 2010 [cited 2022 Jun 8]; 10: 6.
- [12] Goldfield EC, Richardson MJ, Lee KG, Margetts S. Coordination of Sucking, Swallowing, and Breathing and Oxygen Saturation During Early Infant Breast-feeding and Bottle-feeding. *Pediatr Res* [Internet]. Oct 2006 [cited 2022 Jun 8]; 60[4]: 450–5.
- [13] Sakalidis VS, McClellan HL, Hepworth AR, Kent JC, Lai CT, Hartmann PE, et al. Oxygen Saturation and Suck-Swallow-Breathe Coordination of Term Infants during Breastfeeding and Feeding from a Teat Releasing Milk Only with Vacuum. *Int J Pediatr* [Internet]. 2012 [cited 2022 Jun 8]; 2012: 130769.
- [14] Kumari N, Jain A, Ramji S. Prediction of nutritive sucking in preterm babies [<34 weeks] and preterm sucking readiness scale. *Maternal Health, Neonatology and Perinatology* [Internet]. 4 Nov 2019 [cited 2022 Jun 8]; 5[1]: 18.
- [15] Crosson DD, Pickler RH. An Integrated Review of the Literature on Demand Feedings for Preterm Infants. *Adv Neonatal Care* [Internet]. Aug 2004; 4[4]: 216–25.
- [16] Medoff-Cooper B, Verklan T, Carlson S. The development of sucking patterns and physiologic correlates in very-low-birth-weight infants. *Nurs Res*. Apr 1993; 42[2]: 100–5.
- [17] Blackburn S. Environmental impact of the NICU on developmental outcomes. *Journal of Pediatric Nursing* [Internet]. 1 Oct 1998 [cited 2022 Jun 9]; 13[5]: 279–89.
- [18] Als H, Duffy FH, McAnulty GB. Effectiveness of individualized neurodevelopmental care in the newborn intensive care unit [NICU]. *Acta Paediatr Suppl*. Oct 1996; 416: 21–30.
- [19] McCormick FM, Tosh K, McGuire W. Ad libitum or demand/semi-demand feeding versus scheduled interval feeding for preterm infants. *Cochrane Database Syst Rev*. 17 Feb 2010; [2]: CD005255.
- [20] McCain GC, Gartside PS, Greenberg JM, Lott JW. A feeding protocol for healthy preterm infants that shortens time to oral feeding. *J Pediatr*. Sep 2001; 139[3]: 374–9.
- [21] Infant feeding guidelines - Information for health workers. 174. <https://www.nhmrc.gov.au/about-us/publications/infant-feeding-guidelines-information-health-workers>
- [22] Saunders RB, Friedman CB, Stramoski PR. Feeding Preterm Infants. *Journal of Obstetric, Gynecologic, & Neonatal Nursing* [Internet]. 1991 [cited 2022 Jun 9]; 20[3]: 212–20.
- [23] Cohen M, Myers MM, Brown DR, Solecki L, Pilipski M, Becker J, et al. Cardiovascular Responses to Feeding in Newborn Infants are Influenced by Family History of Hypertension. *Pediatr Res*. DOI: 10.1016/s0378-3782(97)00057-1
- [24] Chatow U, Davidson S, Reichman BL, Akselrod S. Development and maturation of the autonomic nervous system in premature and full-term infants using spectral analysis of heart rate fluctuations. *Pediatric research* [Internet]. Mar 1995 [cited 2022 Jun 9]; 37[3]: 294–302.
- [25] Spectral Analysis of Heart Rate Variability in Premature Infants with Feeding Bradycardia | Pediatric Research.
- [26] Morag I, Hendel Y, Karol D, Geva R, Tzipi S. Transition From Nasogastric Tube to Oral Feeding: The Role of Parental Guided Responsive Feeding. *Front Pediatr* [Internet]. 9 May 2019 [cited 2022 Jun 10]; 7: 190.
- [27] McCain GC. An evidence-based guideline for introducing oral feeding to healthy preterm infants. *Neonatal Netw*. Oct 2003; 22[5]: 45–50.
- [28] Responsive versus scheduled feeding for preterm infants - Watson, J - 2016 | Cochrane Library <https://doi.org/10.1002/14651858.CD005255.pub5>
- [29] Whetten CH. Cue-Based Feeding in the NICU. *Nurs Womens Health*. Nov 2016; 20[5]: 507–10.
- [30] From Tube to Breast: The Bridging Role of Semi-demand Breastfeeding - Riccardo Davanzo, Tamara Strajn, Jacqueline Kennedy, Anna Crocetta, Angela De Cunto. 2014., DOI: 10.1177/0890334414548697