

Supplementation Practices and Donor Milk Use in US Well-Newborn Nurseries

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ABSTRACT

BACKGROUND AND OBJECTIVES: Guidelines encourage exclusive breastfeeding for healthy newborns but lack specificity regarding criteria for medically indicated supplementation, including type, timing, and best practices. We set out to describe practice patterns and provider perspectives regarding medically indicated supplementation of breastfeeding newborns across the United States.

METHODS: From 2017 to 2018, we surveyed the Better Outcomes through Research for Newborns representative from each Better Outcomes through Research for Newborns hospital regarding practices related to medically indicated supplementation. We used descriptive statistics to compare practices between subgroups defined by breastfeeding prevalence and used qualitative methods and an inductive approach to describe provider opinions.

RESULTS: Of 96 providers representing discrete hospitals eligible for the study, 71 participated (74% response rate). Practices related to criteria for supplementation and pumping and to type and caloric density of supplements varied widely between hospitals, especially for late preterm infants, whereas practices related to lactation consultant availability and hand expression education were more consistent. The most commonly reported criterion for initiating supplementation was weight loss of $\geq 10\%$ from birth weight, and bottle-feeding was the most commonly reported method; however, practices varied widely. Donor milk use was reported at 20 (44%) hospitals with $\geq 81\%$ breastfeeding initiation and 1 (4%) hospital with $< 80\%$ breastfeeding initiation ($P = .001$).

CONCLUSIONS: Strategies related to supplementation vary among US hospitals. Donor milk availability is concentrated in hospitals with the highest prevalence of breastfeeding. Implementation of evidence-based management of supplementation among US hospitals has the potential improve the care of term and late preterm newborns.



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Breastfeeding is important for maternal and infant health.¹ The World Health Organization (WHO) and United Nations Children's Fund (UNICEF) Baby-Friendly Hospital Initiative (BFHI) recommends that hospitals provide practices supporting the establishment of breastfeeding, including avoidance of supplementation for breastfed newborns when not medically indicated, avoidance of bottles and artificial nipples, and prioritization of human milk over alternatives.² However, the BFHI does not provide guidance regarding the criteria for medical indication of supplementation, type of supplement to use, or best practices for delivery of supplemental feedings when indicated.^{1,3} Nationwide practice patterns in the United States regarding supplementation specifically for medical indication have not been previously reported. We, therefore, aimed to identify practice variations related to breastfeeding support, supplementation, and donor milk use using a survey of well-newborn care providers who serve as representatives of hospitals across the United States that participate in the Better Outcomes through Research for Newborns (BORN) network, which represents 10% of all births nationwide. We hypothesized that there may be variation in practices and donor milk availability among hospitals with a higher versus lower prevalence of breastfeeding.

METHODS

The study was approved by the institutional review board at the principal investigator's institution. This study was conducted in partnership with the BORN network, which is a core activity of the Academic Pediatric Association and consists of clinicians who provide care for newborns during the birth hospitalization. At the time of the survey, BORN had 96 newborn nursery sites across the United States, representing >400 000 annual births. Two-thirds of nurseries in the BORN network are within academic medical centers, and one-third are from community or military hospitals. A 70-question survey was constructed by the study team and modified iteratively by expert feedback (Supplemental Information). A copy of the survey is available in the supplementary methods.

The goal was to assess the primary issues clinicians consider when recommending practices related to breastfeeding and supplementation and the environment in which these occur. The survey contained questions requiring yes or no, multiple choice, prevalence estimates, or free-text responses and allowed narrative comments.

We e-mailed a link to an electronic survey in Qualtrics (Qualtrics, Provo, UT) to physicians providing newborn care who serve as their hospital's designated representative for the BORN network, allowing 1 response per institution. We sent the initial e-mail as well as 5 reminder e-mails between October 2017 and February 2018 per BORN's standard practice. No incentives were provided.

We used SPSS version 25 (IBM SPSS Statistics, IBM Corporation) for descriptive statistics and χ^2 to compare practices between hospitals with higher (defined as $\geq 81\%$ of infants ever breastfed) versus those with lower ($\leq 80\%$) breastfeeding initiation rates. This threshold was selected to correspond with the Healthy People 2020 breastfeeding initiation (Maternal, Infant, and Child Health [MICH] 21.1) target of 81.9%.⁴ We also examined the distribution of practices across regions (Midwest, west, south, and northeast) to identify any large geographic practice differences that warrant future examination with a larger sample size. For qualitative analysis of free-text responses to queries, we conducted thematic analysis using free coding in Word and ATLAS.ti. Qualitative data were analyzed by using thematic analysis with a constant comparative approach. All investigators conducted data analysis, and ≥ 2 investigators coded each narrative response.

RESULTS

Hospital and Nursery Characteristics

Of 96 BORN hospital representatives eligible for the study, 71 participated (74% response rate). Characteristics of hospital newborn units are shown in Table 1. Participating respondents represented hospitals providing newborn care across the United States in 31 different states and the District of Columbia. All units provided care for

term newborns; 67 (94%) provided care for late preterm newborns. Thresholds for admission to the hospital newborn unit rather than the NICU ranged from $\geq 33 + 6/7$ weeks' gestational age to ≥ 37 weeks' gestational age and from ≥ 1500 g birth weight to ≥ 2500 g birth weight. More than one-half (54%) of hospitals were certified BFHI with another 12 (17%) in the process of seeking designation. By comparing hospitals at which $\geq 81\%$ of infants breastfeed to those at which $\leq 80\%$ of infants breastfeed, a difference was noted in the proportion with BFHI hospital designation or in process of designation, with 64% designated and 9% in the process versus 35% designated and 31% in the process, respectively ($P = .021$).

Lactation Support

Table 2 reveals breastfeeding support practices reported for respondent hospitals. All hospitals reported providing lactation consultation, with a mean of 3.9 ± 2.5 lactation consultants reported at each hospital, and 66 (93%) reported availability of a lactation consultant on weekends. Sixty-nine (97%) of the respondent nurseries teach mothers hand expression, and the remaining 2 (3%) respondents were unsure whether this is taught at their facility. Respondent hospitals varied in indications for the recommendation to pump from 9 (13%) recommending that all obese mothers pump to more than one-half recommending that mothers pump if they deliver late preterm (82%) or are supplementing their infant with donor milk or formula (76%).

Supplementation Practices

There was substantial variation in the practices related to infant weight loss as an indicator for recommending supplementation with 57 representatives (80%) reporting absolute weight loss as a criterion, either as a sole criterion for supplementation or in combination with other factors, including the timing of onset of lactogenesis II, hyperbilirubinemia, and infant urine and stool output. The approaches used varied considerably across hospitals, and representatives also described variability within hospitals. Using qualitative, thematic analysis, we identified 3 major approaches to supplementation;

TABLE 1 Characteristics of Respondent Well-Newborn Units (*N* = 71)

Characteristic	<i>n</i> (%)
Region	
Northeast	22 (31)
Midwest	16 (23)
South	17 (24)
West	16 (23)
Annual deliveries	
<2000	18 (25)
2000–3999	32 (45)
4000–5999	16 (23)
≥6000	5 (7)
BFHI	
Certified	38 (54)
In the process	12 (17)
No	21 (30)
Newborn wt threshold for well-newborn admission	
No cutoff	17 (24)
≥1500	3 (4)
≥1750, ≥1800, or ≥1814	8 (25)
≥2000	23 (32)
≥2200, ≥2250, ≥2300, or ≥2400	5 (6)
≥2500	4 (6)
No response	1 (1)
Infant gestational age threshold for well-newborn admission	
None	4 (6)
33 + 6/7 or 34 wk gestation	3 (4)
34 + 6/7 or 35 wk gestation	49 (69)
36 wk gestation	11 (16)
37 wk gestation	4 (6)
Newborn antibiotics, yes	45 (63)
Newborn intravenous fluids, no	68 (96)
Proportion of well newborns who ever breastfeed	
51%–70%	8 (8)
71%–80%	20 (28)
81%–90%	23 (32)
91%–100%	22 (31)
Proportion of term newborns exclusively fed breast milk	
≤50%	21 (30)
51%–60%	13 (18)
61%–70%	15 (21)
71%–80%	11 (16)
≥81%	11 (16)

(3) thresholds for supplementation that were specific to gestational age and mode of delivery.

The most common weight loss thresholds described were 10%, 10% to 12%, with higher thresholds for newborns delivered by cesarean delivery and exceeding the 95th percentile for weight loss on the Newborn Weight Tool (NEWT) curves.⁵ However, other weight loss thresholds for supplementation were described, including any weight loss of 4% to 15%, weight loss of 3% in a 24-hour period (mostly for late preterm newborns), and weight loss exceeding the 75th percentile and 90th percentile on the NEWT curves. When respondents reported varying their management of supplementation in response to gestational age, they reported being most likely to supplement newborns of a younger gestational age at a lower degree of weight loss.

There was a high degree of variation between the hospitals with respect to the methods reported to be most commonly used to deliver supplemental feedings (Table 2). With providers able to select all that applied, more than one-half reported using bottles (59%), supplemental nursing systems (SNSs) (52%), and finger feeding with a syringe (58%). Forty-one percent reported recommending the use of syringe feeding without a finger. Six (35%) of the respondents in the south reported using SNSs, compared to >50% in all other regions, and only 3 (18%) of respondents in the south reported using cup feeding, compared to ≥44% in all other regions. Fifty-one (72%) reported using the same method to deliver supplemental feedings regardless of infant gestational age. Among the 20 (28%) who reported different methods based on the infant's gestational age, all representatives described deferring to lactation consultant recommendations and reported using bottles more frequently for preterm than term newborns and SNSs and cups for term newborns.

The use of human donor milk was similar for late preterm and term newborns. When hospitals at which ≥81% of infants breastfeed and those at which ≤80% of infants breastfeed were compared, differences were noted in donor milk

these approaches and example quotations are described further in Table 3 and included (1) weight loss thresholds for supplementation that were consistent

across gestational ages, (2) universal supplementation of late preterm newborns and a weight loss threshold for supplementation for term newborns, and

TABLE 2 Breastfeeding Support and Supplementation Practices (*N* = 71)

Practice	<i>n</i> (%)
Donor milk available in well-newborn unit	
Yes	21 (30)
No	43 (61)
Other (in certain circumstances or will soon)	7 (10)
Standard supplement choice for term infant if expressed mother's milk unavailable	
Donor milk	20 (28)
Standard 19–20 kcal/oz infant formula	45 (63)
Hydrolyzed formula	4 (6)
Other (nuanced approach)	2 (3)
Standard supplement choice for late preterm newborns	
Donor milk	21 (30)
Standard 19 or 20 kcal/oz infant formula	17 (24)
20 kcal/oz hydrolyzed formula	1 (1)
20 kcal/oz preterm formula	3 (4)
22 kcal/oz preterm formula	22 (31)
24 kcal/oz preterm formula	1 (1)
Other (nuanced approach)	6 (8)
No. lactation consultants	
1–2.5	25 (36)
3–4	24 (34)
5–12	21 (30)
Missing	1 (1)
Lactation consultant on weekends	
Yes	66 (93)
Method of delivering supplemental feeds ^a	
Bottle	42 (59)
SNS	37 (52)
Cup	29 (41)
Finger feeding with syringe	41 (58)
Syringe without finger	29 (41)
Spoon	34 (48)
Routinely recommended to pump ^a	
Mothers with obesity	9 (13)
Mothers who delivered by cesarean delivery	13 (18)
Mothers of late preterm infants	58 (82)
Mothers who are supplementing with donor milk or formula	54 (76)
Mothers with a high blood loss	16 (23)
None of the above	10 (14)
Hand expression taught at the hospital	
Yes, by pediatric care provider and lactation consultant	38 (54)
Yes, by lactation consultant and not by pediatric care provider	31 (44)
Unsure	2 (3)
No	0 (0)

^a Respondents could select >1 option.

availability (44% vs 4% of nurseries; $P = .001$) and use of donor milk as the standard supplement choice for term newborns in the absence of expressed mothers milk availability (42% vs 4%; $P = .001$). The large majority of well-newborn nurseries that offered donor milk reported using it as the supplement of choice for both populations (20 of 21 for term newborns and 21 of 21 for late preterm). However, there was substantial variability in the first-line formula used for supplementation in terms of standard versus hydrolyzed for both term and late preterm newborns and caloric density for late preterm newborns (Table 2).

Provider Opinions

On a 5-point Likert scale, ranging from “very negative” to “very positive,” 28 (39%) and 16 (23%) providers felt “very positive” or “somewhat positive” about using pasteurized human donor milk outside of the NICU, whereas 10 (14%) and 8 (11%) felt “very positive” and “somewhat positive” about infant formula, respectively. Although overall provider sentiment about medically-indicated donor milk supplementation was more favorable than for formula, providers highlighted the need for additional research in this area given the availability and expense. Pros and cons provided about each and example quotations are listed in Table 4.

DISCUSSION

In this survey of representatives of US nurseries participating in the BORN network, we identified wide variation in the management of supplementation for term and late preterm newborns. Specifically, criteria for supplementation, use of donor milk, pumping recommendations, and mode of delivery of supplementation varied significantly across surveyed hospitals. Identifying what practices are most effective at improving breastfeeding outcomes and how to best implement them might be done to improve overall breastfeeding rates and potentially ameliorate existing racial, ethnic, and socioeconomic disparities in national breastfeeding practices.⁶

TABLE 3 Weight Loss–Associated Supplementation Approaches and Example Quotations

Approach	Example Quotations
Universal wt loss thresholds for supplementation across gestational ages	<p>“Must have 10% weight loss and hyperbilirubinemia requiring treatment”</p> <p>“We will consider supplementation when weight loss is >10% or >95% on the NEWT curve. There is no automatic supplementation.”</p>
Universal supplementation of LPI and a wt loss threshold for term newborns	<p>“We recommend that all late preterm babies be triple fed, ie, MOC breast feeds, pumps and supplements with her own expressed milk along with donor milk or formula if she does not have sufficient supply. We begin this plan on the first day unless mother feels strongly that she wants to exclusively breast feed.”</p> <p>“We typically recommend supplementation from birth for LPIs”</p>
Different thresholds for supplementation by gestational age and mode of delivery	<p>“This is not consistent among provider(s) (some sooner than this) but all of us agree (or are supposed to agree) consider at 7% if preterm (<37 weeks), and 10% if ≥37 weeks) and must at 10% in preterm and 12% in term.”</p> <p>“>10% for vaginal and >12% for section.”</p>

LPI, late preterm infant; MOC, mother of child.

Of particular note, the pumping recommendations reported in this survey of representatives of hospitals caring for 10% of all US newborns are inconsistent with practices demonstrated to be effective. Thirteen respondents (18%) reported that their hospital routinely recommends pumping after cesarean delivery. Previously, a lack of efficacy of routine breast pumping after cesarean delivery has been reported⁷; however, in results of a more recent unblinded trial, it is suggested that targeting pump pressure to stimulate onset of lactation may improve onset of lactogenesis II and milk supply after cesarean delivery, although it may aggravate maternal nipple pain and fatigue.⁸ Nine respondent nurseries (13%) indicated that obese mothers are universally recommended to pump, despite no evidence to support this practice.⁹ Conversely, the evidence-based recommendation that women supplementing their infants should be pumping^{3,10} was only practiced by 54 respondent nurseries (76%), although it is possible that others recommend hand expression for this purpose, because that was not explicitly assessed.

Our study results are consistent with previous reports that donor milk use in the well-newborn nursery setting has increased

in the United States over the last 10 years.^{11–16} Although the American Academy of Pediatrics recommends the use of donor milk for preterm infants when mother’s milk is not available,¹ it has not yet issued a guideline or other recommendation for its use for term infants. WHO and UNICEF updated their Ten Steps to Successful Breastfeeding in 2018 while this survey was in the field and now explicitly recommend in step 6 “prioritizing donor human milk when a supplement is needed.”² Donor milk was in use at 21 respondent hospitals (30%) and was the first-line supplement for term newborns at all but one of those hospitals. This prevalence is similar to what was found in a regional survey of northeastern US hospitals.¹¹ Donor milk availability was clustered in hospitals with higher breastfeeding initiation rates. It is unclear from the cross-sectional design of the study whether donor milk availability at these hospitals led to improved breastfeeding initiation rates or already high breastfeeding rates at those hospitals led them to offer donor milk. Newborn providers in our study had overall positive opinions about donor milk use in the well-newborn population but felt more research is needed to show that this produces better outcomes than formula supplementation

because evidence supporting a positive impact on infant health or breastfeeding are lacking.

More than one-half of respondent nurseries included bottles as a first-line method for supplementation delivery, contrary to the WHO and UNICEF recommendation to avoid exposure to artificial nipples for breastfed infants.² This practice was reported to be more commonly used for late preterm infants, which may be developmentally appropriate¹⁰; however, this population also has worse breastfeeding outcomes than term infants,^{17,18} and further study on the role that bottle exposure may play in that association is warranted. Additionally, many hospitals reported providing syringe feeds without a finger, which may increase aspiration risk and is also associated with higher adjusted odds of not exclusively breastfeeding during the second month of life in comparison to other supplementation methods.¹⁹ We also found wide variation in the use of hydrolyzed formulas for both term and late preterm newborns and a variety of first-line caloric densities for late preterm newborns, indicating a need for research to identify best practices.

Although we included hospitals across the United States in this study, all were members of a clinical research network indicating potential status as academic centers or community or military hospitals affiliated with academic medical centers and may therefore not be a representative sample of all delivery hospitals in the United States. However, BORN hospitals provide care to ~10% of US births per year and, so, represent an important component of newborn health care. We do not have outcomes data for newborns cared for at respondent hospitals, and, therefore, are unable to describe the link between reported practices and outcomes. However, identifying variations in the care of breastfeeding dyads is important even in the absence of long-term outcomes because it highlights gaps in evidence, both for identification of best practices and for implementation of known best practices. The 74% response rate from newborn providers across the United States gives the results broad applicability.

TABLE 4 Well-Newborn Provider Opinions About Donor Milk and Formula

Supplement Type	Cons and Example Quotations	Pros and Example Quotations
Donor milk	<p>Infectious risk, expensive, and no evidence of benefit for term newborns</p> <p>“Don’t see much benefit for a well newborn. Risks of infectious disease is still present and benefits in this case doesn’t outweigh the risks.”</p> <p>“Would like to see more evidence for effectiveness and see cost come down so it is not differentially available to those with financial resources.”</p> <p>“It’s a scarce resource with no known benefit to term babies.”</p>	<p>Avoids risks of formula and a good option when supplementation is medically necessary</p> <p>“Given the emerging research about the effect of formula on the microbiome, it is very helpful to be able to provide donor milk instead of formula for medically indicated supplementation.”</p> <p>“I would be in support of it over using formula, especially for those mothers who desire to exclusively breastfeed but are having difficulty early on.”</p> <p>“I think every baby should have this option, if needed.”</p>
Formula	<p>Companies and marketing and used as an alternative to breastfeeding in the absence of medical indications</p> <p>“Hate dealing with formula reps”</p> <p>“I would prefer to not have it as the first feeding, am trying to get mothers who do not want to breastfeed to do skin to skin and possibly give colostrum as first vaccine.”</p>	<p>Important when medically necessary and, ultimately, a mother’s informed choice</p> <p>“It has its uses, but use should be minimized.”</p> <p>“Endorse breastfeeding over formula, but don’t dissuade people from their choice unless they feel they need formula because of inadequate supply”</p>

CONCLUSIONS

Considerable variation exists in the management of breastfed infants in US hospitals. Indications for and methods of supplementing infants are heterogeneous. Pumping recommendations inconsistent with published literature remain prevalent. Donor milk availability for well newborns is concentrated in nurseries that have the highest prevalence of breastfeeding. Areas for future research include clear indications for supplementation, mode of supplement delivery, health outcomes from donor milk versus formula supplementation, and optimal approaches for breastfeeding management and medically indicated supplementation of late preterm infants.

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