

## Overcoming NICU admission to achieve the family's feeding goals

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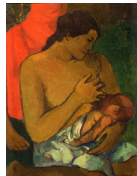
### Disclosures

Relationships	Commercial Interests
Serve as site principal investigator for industry-sponsored research at Yale University	Ferring Pharmaceuticals Pfizer Prolacta Bioscience

### Lactation in the NICU



Maternal milk for infant



Achieve family's feeding goal

To identify methods to protect lactation, provide adequate nutrition, and transition to breastfeeding for the NICU graduate.

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*I respect that not all parents feeding from the chest identify as mother or as breastfeeding. Through the talk, I will use the terms maternal, mother's milk, and breastfeeding but recognize this represents parent milk, chest feeding, and other personal choices for terminology.*



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Breastfeeding is Natural

But We are Not





### Significant risk adjustments for infants in the United States

#### Ever Breastfeeding

11% ↓ Leukemia  
12% ↓ Asthma 5-18 years  
33% ↓ Otitis media  
29% ↓ Crohn's disease  
22% ↓ Ulcerative colitis  
22% ↓ Childhood & adult obesity  
33% ↓ Type 2 diabetes mellitus  
64% ↓ Gastrointestinal infections  
72% ↓ Lower respiratory infections  
19% ↓ Infant mortality (U.S.)  
51% ↓ Neonatal mortality  
21% ↓ Postneonatal mortality  
(to 38% ↓ if >3 months)

#### >6 months exclusive breastfeeding

compared to <4 months exclusive  
19% ↓ Lower respiratory tract infection  
30% ↓ Severe or persistent diarrhea



AHRQ 2007 & AAP 2022

### Significant Risk Adjustment for Mother

#### Any or Ever

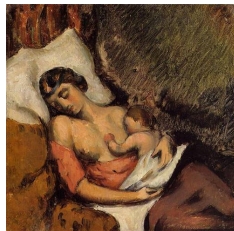
22% ↓ Breast cancer  
30% ↓ Ovarian cancer  
11% ↓ Endometrial cancer  
9% ↓ Thyroid Cancer

#### Longer vs Shorter

32% ↓ Type 2 diabetes mellitus  
78% ↓ GDM and Type 2 diabetes

#### Hypertension

< 6 months, 8% ↓  
6-12 months, 11% ↓  
>12 months, 13% ↓



AAP 2022

### Cost of NOT Breastfeeding

#### Financial

- 302 billion annually
- 0.49% of world gross national income

#### Mortality

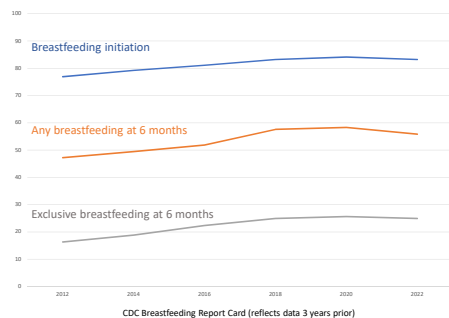
- 823,000 annual deaths in children < 5 years
- 20,000 annual deaths in women caused by breast cancer

A 10% increased rate of breastfeeding in U.S. exclusively for 6 months or continued up to 1-2 years translates to 312 million reduction in childhood disorder treatment costs

If 90% of U.S. mothers were exclusive for 6 months, \$13 billion per year savings

Rollins NC et al Lancet 2016; Bartick M & Reinhold A 2010

### United States Families



### Breastfeeding Promotion in Oklahoma

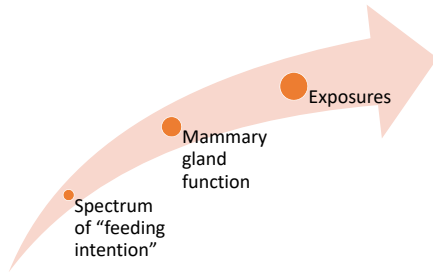
Year	Ever breastfed	At 6 months	At 12 months	Exclusively at 3 months	Exclusively at 6 months
2004	67	30	13	23	11
2019	77	48	28	43	23

CDC Breastfeeding Report 2022 & 2007

**More women have lactation goals including those in populations who historically did not breastfeed**

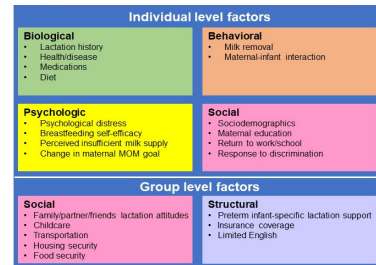


Why does the gap in sustaining breastfeeding persist?



#### Conceptual Model for Meeting Family's Infant Feeding Goal (for NICU)

Maternal race, age, and education consistently relate to breastfeeding outcomes.



#### Family Feeding Goals

Each family has the right to develop an **informed** feeding plan for their infant.

Healthcare providers have the obligation to provide the **support** needed for the family to achieve their goal.

Two separate research outcomes- 1) goal to breastfeed for at least 6 months  
2) Attaining the family's goal

#### Baby Friendly Hospital Initiative

World Health Organization

- 10 Steps
- Prenatal, Perinatal, Postnatal interventions

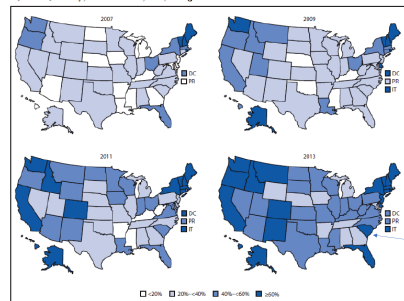


#### Baby Friendly Hospital Initiative

Health system or service	Early initiation of breastfeeding (within 1 h of birth)	Exclusive breastfeeding for 0-5 months	Continued breastfeeding for 12-23 months	Any breastfeeding up to 6 months
<b>Overall</b>	29 studies: RR 1.11 (1.06-1.16)	51 studies: RR 1.46 (1.37-1.56)	Eight studies: RR 1.18 (1.03-1.35)	47 studies: RR 1.49 (1.30-1.72)
<b>Early-friendly support</b>	Ten studies: RR 1.20 (1.13-1.28)	15 studies: RR 1.43 (1.33-1.68)	Three studies: RR 1.26 (0.96-1.64)	13 studies: RR 1.66 (1.34-2.07)
<b>Counselling or education</b>	Ten studies: RR 1.12 (1.05-1.19)	28 studies: RR 1.66 (1.43-1.92)	Five studies: RR 1.15 (0.99-1.35)	14 studies: RR 1.47 (1.29-1.68)
<b>Special training of health staff</b>	Three studies: RR 1.09 (1.01-1.18)	Five studies: RR 1.36 (1.14-1.63)	No studies	Five studies: RR 1.33 (1.07-1.67)

Rollins NC et al 2016; Sibha B et al 2015

FIGURE. Percentage of hospitals implementing more than half of the Ten Steps to Successful Breastfeeding\* by state or jurisdiction - Maternity Practices in Infant Nutrition and Care (mPINC) Survey, United States, 2007-2013



Abbreviations: DC = District of Columbia; IT = Island Territories, including American Samoa, Guam, Northern Mariana Islands, and Virgin Islands; PR = Puerto Rico.

CDC report

## Baby-Friendly USA Ten Steps for the NICU

- Have a written infant feeding policy for all health care staff
- Educate and train all staff working with NICU infants and their families in the knowledge, competence and skills necessary
- As early with possible, discuss with families whose infants are at risk for admission to the NICU the initiation and management of lactation
- Place stable infants skin-to-skin on their mothers as soon as feasible. Facilitate and support extended, ongoing skin-to-skin.
- Show parents how to initiate and maintain lactation and initiate breastfeeding.

## Baby-Friendly USA Ten Steps for the NICU

- Give infants no food or drink other than human milk, unless medically indicated.
- Allow and encourage parents and support persons to be with their infants and participate in feeding and care with unrestricted access.
- Encourage cue-based infant-driven oral feeding with breastfeeding as early as possible with no weight or gestational age restrictions
- For infants who are expected to breastfeed, use alternatives to bottle feeding whenever possible. Use nipple shields and pacifiers only for therapeutic reasons.
- Prepare parents for continued lactation and breastfeeding after NICU discharge with written follow-up plans and access to specialized clinical lactation support

## Human Milk Nutrition for Very Preterm Infants- the Mismatch

Nutrient	Very preterm infant daily need/kg	Human milk delivery (150 mL/kg/day)	Human milk delivery (200-300 mL/kg/day)
Energy, kcal	110-130	98-147	130-294
Protein, g	3.5-4.5	1-3.5	1.3-7
Calcium, mmol (mg)	3-5.5 (120-220)	1 (40)	1.3-2 (52-80)
Phosphorus, mmol (mg)	2.3-3.9 (70-120)	0.7 (22)	0.9-1.4 (29-44)

Sodium, iron, zinc, vitamins including vitamin D also **mismatched** need compared to intake

Daily volume mismatch between maternal milk removal and infant daily intake

- Daily milk volume of at least 500-800 mL associated with sustaining milk supply
- Very preterm infants often take 100-200 mL/day

If milk feed is not immediately provided from parent to infant

- Loss of nutrients in storage and feed preparation

Goldberg et al 2018; Arslanoglu S et al 2019; Taylor SN 2021. In Nutritional Care of the Preterm Infant

## Multi-component human milk fortifier

Outcomes	Anticipated absolute effects <sup>a</sup> (95% CI)	Relative effect (95% CI)	Number of participants (events)	Quality of the evidence (GRADE)
Weight gain (g/kg/d)	Comparator: Mean weight gain was 1.76 g/kg/d more (1.30 more to 2.22 more)	-	952 (34 RCTs)	moderate <sup>b</sup>
Length gain (cm/week)	Comparator: Mean length gain was 0.22 cm/week more (0.07 more to 0.37 more)	-	765 (33 RCTs)	moderate <sup>b</sup>
Head growth (cm/week)	Comparator: Mean head growth was 0.08 cm/week more (0.04 more to 0.12 more)	-	825 (33 RCTs)	moderate <sup>b</sup>
Mental development index (MDI) at 18 months	Comparator: Mean MDI was 2.2 more (1.35 fewer to 1.75 more)	-	245 (1 RCT)	moderate <sup>b</sup>
Psychomotor development index (PDI) at 18 months	Comparator: Mean PDI was 2.6 more (1.9 fewer to 6.7 more)	-	245 (1 RCT)	moderate <sup>b</sup>
Neurocognitive outcomes	Study population: 46 per 1000 (33 to 65)	RR 1.37 (0.72 to 2.43)	1138 (33 RCTs)	moderate <sup>b</sup>

<sup>a</sup>The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).  
CI: confidence interval; RCT: randomized controlled trial; RR: risk ratio.

Brown et al 2020

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## Nutrient-Enrichment vs. No Enrichment of Mother's Milk Post-Hospital Discharge

Study	Population	Intervention	Outcomes reaching statistically significance
O'Connor et al 2008	39 ≥80% mother's milk and 750-1800 g at birth infants	Protein 0.8g/kg Calories 10-15/kg Fortified with HMF 50% of feeds for 12 weeks	Intervention infants at 4-6 months: • Greater visual development Intervention infants at 12 months: • Heavier by 1.2 kg • Longer • Greater bone mineral content Infants born <1250 g at 12 months: • Greater head circumference Intervention infants at 18 months: • No difference in Bayley II scale
Zachariassen et al 2011	320 infants born 24-32 weeks PMA receiving breastmilk at discharge	Protein 1.37 g/day Calories 17/day For 4 months	At 12 months: • No difference in growth
De Cunha et al 2016	53 exclusively breastfed VLBW infants	Protein 0.5g/day Calories 20/day For 4-6 months	At 12 months: • No difference in Bayley III scale • No difference in developmental delay

Nutrient concentrations from Arslanoglu et al 2019

Preterm infant nutrition at hospital discharge: Can it be both efficacious and simple?

Disclosure: I am a part of the problem



## Balancing Efficacy and Simplicity

### Efficacious

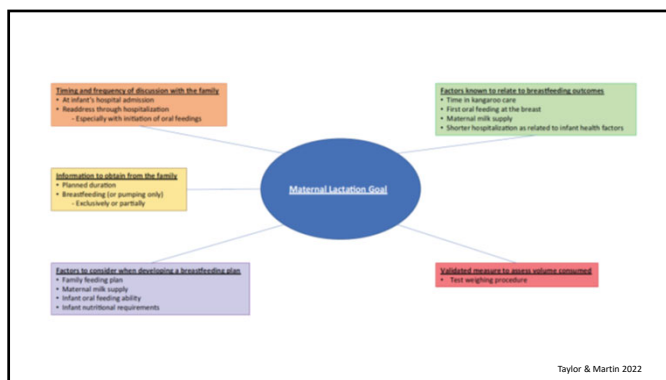
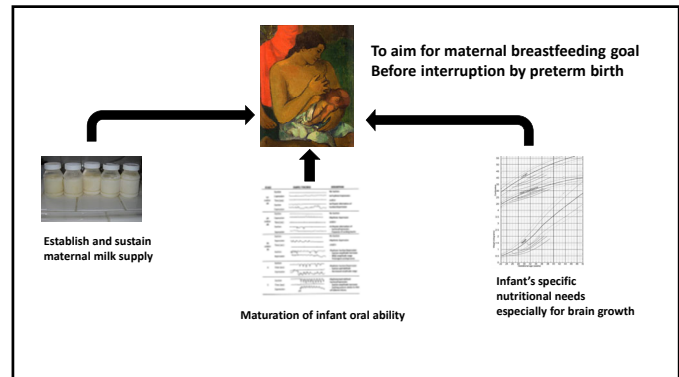
- Prioritize growth
- Prioritize maternal milk

### Simplicity

- Evidence limited as to benefit of supplementation if adequate growth
- Theory: By 40-52 weeks' gestational age, most preterm infants will "feed to grow"
  - May need nutritional density short-term and then simplify

### Also

- Iron supplementation until iron supplemented foods
- At least 400 IU/day vitamin D



## Most Common NICU patients

### Yale New Haven Hospital System

Very preterm infants (<32 weeks): 214 (16%)  
Moderately preterm (32-34 weeks): 194 (15%)  
Late preterm/term infants (≥ 35 weeks): 927 (69%)

Median length of stay: 6 days

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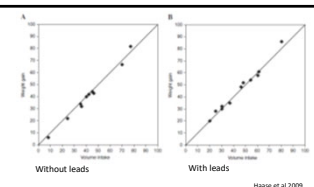
## Mother/Infant interactions related to breastfeeding

- Feeding practice
  - First oral feed at the breast
- Infant health factor
  - Shorter length of hospitalization
- Estimation of breastfeed volume intake
  - Test weighing procedure
    - Validated method to assess breastfeed volume
- Kangaroo care

Pineda 2011; Calzavara et al 2015; Smith MM 2003; Haase et al 2009; Hurst et al 2004

## Test Weighing

- Reliable procedure
  - Studies performed in U.S., Australia, Sweden
- Clinical uptake is limited
  - Concern for maternal stress
  - Medicalization of breastfeeding
- Studies show mothers value
  - No harm to confidence, competence, breastfeeding outcomes
- More reliable than any feeding assessment scoring: PBAT, EFS, NOMAS, PIBBS, LATCH in preterm infant breastfeeding



Pernell et al 2020; Haase et al 2009; Furukawa et al 2010

## Nipple Shield

- Supports shape of the nipple to aid in latch
- Support negative pressure to assist with milk transfer
- Expect infant to need until due date or a few weeks after (potentially up to 6 weeks corrected age)



Perrella et al 2021

## Nipple Shield

Table 1. Characteristics of the Sample (N=34)

Characteristic	Mean $\pm$ SD	Range
Birth weight, g	1702 $\pm$ 521	770-2820
Weight at first breastfeeding, g	1782 $\pm$ 403	1080-2820
Gestational age at birth, wk	31.9 $\pm$ 3.0	25-37

Table 2. Milk Transfer With and Without Nipple Shield Use (N=34)

Characteristic	Mean $\pm$ SD	Range
Milk transfer without shield, ml	3.9 $\pm$ 7.0	0-30
Milk transfer with shield, ml	18.4 $\pm$ 13.2	2-62
Increase in milk transfer with shield, ml	14.4* $\pm$ 9.1	2-41

\* $t=9.25$ ,  $P=0.0001$ , paired  $t$  test

Mean duration of breastfeeding was 169 days (14-365) and of nipple shield use was 33 days (2-171)

Meier P et al 2000

## Survey in Denmark

Table 3. Odds for failure of exclusive breastfeeding at discharge from NICU associated with mothers' self-reported motives for nipple shield use in preterm infants.

Adjusted analysis (N = 574)	OR (95% CI)	p-value
Infant slipped the nipple	0.73 (0.48, 1.10)	0.127
Infant could not open mouth high enough to latch on	0.71 (0.45, 1.11)	0.131
Infant became frustrated at the breast	1.20 (0.76, 1.90)	0.430
Infant fell asleep at the breast	1.90 (1.15, 3.13)	0.012
Inverted/flat nipples	0.94 (0.56, 1.56)	0.798
Breast too engorged	0.32 (0.16, 0.63)	0.001
Sore nipples	1.44 (0.77, 2.72)	0.257

Analysed with one infant per mother. Adjusted for gestational age (<32 weeks), multiples, gender, mode of delivery, maternal breastfeeding experience (<4 months exclusive), pumping at discharge, smoking, and site of discharge (NICU)

Maastrup et al 2019

## Development of Infant Oral Ability

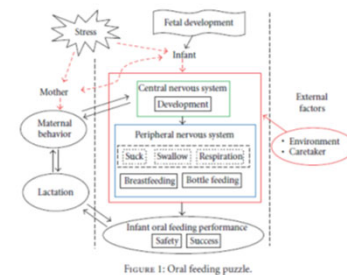


FIGURE 1: Oral feeding puzzle.

Lau et al 2012

## Stages of infant nutritive sucking

Rhythmic Expression

Well-defined suction

STAGE	SAMPLE TRACINGS	DESCRIPTION
1A	Suction	No Suction
1B	Expression	Asynchronous Expression
2A	Time (sec)	and/or
2B	Suction	Asynchronous alternation of Suction/Expression
3A	Expression	No Suction
3B	Time (sec)	Rhythmic Expression
4A	Suction	Asynchronous alternation of Suction/Expression
4B	Expression	Asynchronous alternation of Suction/Expression
5A	Suction	Rhythmic Suction/Expression
5B	Time (sec)	Suction amplitude increases
6A	Expression	Well-defined amplitude range
6B	Suction	Well-defined amplitude range
7A	Expression	Rhythmic Suction/Expression
7B	Time (sec)	Suction amplitude increases
8A	Expression	Well-defined amplitude range
8B	Suction	Well-defined amplitude range

Lau 2016

## Milk Flow Rates From Bottle Nipples Used for Feeding Infants Who Are Hospitalized

Britt F. Pados,<sup>a</sup> Jinhee Park,<sup>b</sup> Suzanne M. Thoyre,<sup>a</sup> Hayley Estrem,<sup>a</sup> and W. Brant Nix<sup>a</sup>

Figure 2. Nipple testing equipment.



Pados B et al 2016







## Scripts

**Term/Late Preterm Infants: Conversation Points to Support Breastfeeding**
**We agree that breastfeeding is best for you and your baby!**

- Things you can do to help:
- Spend lots of time skin to skin with baby! This helps stimulate breastmilk and helps regulate baby's blood glucose.
  - Breastfeed when possible and/or pumping. Each time your baby feeds, you should either breastfeed or pump to ensure regular stimulation of your breasts.
  - Hand expression is a great method to obtain early milk (colostrum). Has this option been explained / taught to you?
  - Your partner can be a big support in both helping you express milk and helping you feed your baby.

For most full-term babies, colostrum is sufficient in the first days but occasionally some babies temporarily require more.

Our goal is to support your baby with only the amount of supplementation (pumped EBM, formula) that he/she needs while supporting breastfeeding. Our priority is to work to reunite you with your baby as soon as possible to both initiate bonding and support you and your desire to breastfeed.

Your milk is best for your baby. Temporary use of small amounts of formula supplementation is not associated with significant long-term problems. Small amounts of formula may help us get you and your infant back together more quickly. We will always use any expressed breastmilk obtained first followed by supplemental formula.

You are not doing anything wrong, and this does not mean that you are failing your baby in any way. The need for NICU care is a temporary problem and a temporary situation. This does not mean that you will not be able to breastfeed your baby. We are here to support you in your lactation goals! Let us know how we can help.

## Communicate at Hospital Discharge

Preemie FEED (Facilitating Enteral Education at Discharge) Form

**Goals and Recommendations for Infants Born < 32 weeks Gestation**

At Discharge, infant is taking \_\_\_\_\_ ml every \_\_\_\_\_ hours

At Discharge, mother's 24-hour pumping volume is

☐ Adequate ( $\geq 500$  ml) ☐ Low (<500 ml) ☐ Mother is no longer pumping

Adapted from University of California San Diego

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**Feeding Plan (check applicable plan for this infant):**

(Other listed plans are options to consider)

- ☐ Mother's milk with human milk fortifier (HMF) to make 24 kcal/oz. (HMF is available through WIC for first 3 months)
- ☐ Breastfeeding \_\_\_\_\_ times per day (up to 30 minutes/session) and mother's milk with HMF to make 24 kcal/oz.
- ☐ Mother's milk with postdischarge formula (PDF) powder to make 27 kcal/oz. and 2 PDF 27 bottles per day
- ☐ Breastfeeding \_\_\_\_\_ times per day (up to 30 minutes/session) and mother's milk with PDF powder to make 27 kcal/oz. and 2 PDF 27 bottles per day
- ☐ Breastfeeding \_\_\_\_\_ times per day (up to 30 minutes/session) and mother's milk with PDF powder to make 24 kcal/oz. and 2 PDF 24 bottles per day
- ☐ PDF 27 kcal/oz.
- ☐ PDF 24 kcal/oz.
- ☐ Other: \_\_\_\_\_

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- ☐ PDF 27 kcal/oz.
- ☐ PDF 24 kcal/oz.
- ☐ Other: \_\_\_\_\_

**General Mixing Instructions:**

Mother's Milk with HMF to 24 kcal/oz=1 packet of fortifier per 25 ml of milk  
 Mother's Milk with PDF to make 27 kcal/oz= 2 teaspoons powder per 100 ml milk  
 Mother's Milk with PDF to make 24 kcal/oz= 1 teaspoon powder per 90 ml milk  
 PDF 27 kcal/oz bottle= 5 scoops powder per 240 ml water  
 PDF 24 kcal/oz bottle= 3 scoops powder per 160 ml water  
 Other: \_\_\_\_\_

### Take home points

- All families must be provided the education to make an informed infant feeding plan
- Care providers must provide the support to optimize achieving the family feeding goal
- The Baby-Friendly approach can be adjusted for the NICU
  - Critically important for late preterm/term infants
- First feed at the breast, Skin-to-Skin, test weighing are validated methods to support breastfeeding
- Important to incorporate breastfeeding into the NICU culture
- Essential to pass the baton at NICU discharge

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**The Yale Neonatal NOuRISH Team**  
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