Nutritional Support of the Very Low Birth Weight (VLBW) Infant

A Quality Improvement Toolkit

Revised October 2023

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Acknowledgments

The authors of the 2018 revised Nutritional Support of the Very Low Birth Weight (VLBW) Infant Quality Improvement Toolkit would like to thank the authors of the 2008 revised toolkit as well as the original authors of toolkits one (2004) and two (2005) for setting the foundations for this document.

2008 Revised Toolkit

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Original Toolkits 1 (2004) & 2 (2005)

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Executive Summary

Managing nutritional needs of preterm and ill newborns, especially the very low birthweight (VLBW) infant, has never been easy.[1] Although the incidence of postnatal growth failure has improved over the last decade, there remains an unacceptably high rate of growth failure (50%) reported for VLBW infants.[2] Since our prior 2008 edition there has been, and continues to be, much research (both basic science and clinical) on the nutritional needs of preterm infants and the optimum ways to provide that nutrition to prevent nutritional and growth deficits and provide for ideal multiorgan and system outcomes. New evidence suggests nutrition in the first 2 weeks of life may be critical.[3]

There have been several review articles and journal issues devoted to outlining the nutritional needs of preterm infants and the currently recommended best ways of providing that nutrition, with emphasis on early total parenteral nutrition, early trophic feedings, the use of human milk and fortifiers, and the importance of the microbiome for long term health and development.[4,5] More evidence evaluations and development of recommendations are in progress.[6]

The revised 2018 version of the Nutritional Support of the VLBW Infant Toolkit has been developed to promote rapid assessment of current nutritional practices, outline potentially better practices, and enable rapid multidisciplinary improvement cycles to improve nutritional outcomes for premature newborns by adding important new references, streamlining recommendations, and targeting the best resources. We hope you find it useful

References

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5. Mimouni FB, Koletzko B. Human Milk for Preterm Infants. Philadelphia, PA: Elsevier; 2017.
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DISCLAIMER: *The Potentially Better Practices (PBP) listed in this document are based on the current evidence as of the date of publication of this toolkit (September 2018).*

In This Section

Potentially Better Practices

Tools

General Principles for Supporting the Nutrition of Very Low Birth Weight (VLBW) Infants

Introduction

Intensive care of the VLBW infant continues to advance and nutrition is a cornerstone of this care. Implementing evidence-based practice as the standard of care across NICUs will further enhance the daily clinical care that is provided. Various disciplines bring specialized expertise and can contribute to identifying potentially better practices (PBPs). Working together to create a cohesive approach will promote improved outcomes. Incorporating quality measures and learning where improvements can be made will assist all babies to reach their growth and neurodevelopmental potential.

POTENTIALLY BETTER PRACTICE #1

Establish consistent, comprehensive, multidisciplinary nutrition care standards of practice based on evidence, or expert opinion if evidence is lacking.

Background, Rationale, and Goals

- Nutrition is essential for growth, metabolism, immunity, and optimizing neurodevelopmental outcomes
- While there are some well-established evidence-based practices, practitioner variation may interfere with consistent application and implementation of evidence-based practice, depending on the infant's medical course.
- Recent review articles have eloquently pulled together expert opinions and evidence as excellent resources.[1-3]
- Proper nutrition is the only way to promote growth; however, illness, infection, genetics, and gender influence growth.6[,13,14]
- Poor growth, whether it occurs during antenatal or early postnatal life, is associated with increased risk to long-term health.[15-17]
- Rapid and/or excessive weight gain that follows a period of poor growth in utero or infancy increases development of chronic non-communicable diseases, such as type 2 diabetes mellitus, hypertension, overweight/obesity, and cardiovascular disease in adulthood.[18]

Recommendations, Guidelines and Algorithms

- Create an interdisciplinary nutrition team/ committee to review and implement evidence-based practice:
  - Potential members include clinical dietitians/ nutritionists, physicians/nurse practitioners/ physician assistants, lactation professionals, bedside nursing staff, pharmacy staff, developmental specialists, occupational and/or speech language therapists (who have expertise in oral feeding practices of neonates).
- Growth Standards:
  - Growth charts should be a part of every VLBW infant chart: Readily accessible (ideally electronic[4]), appropriate growth curves, including weight, length, and head circumference

See **TOOL #1** on page 10 for the Most Current and Common Growth Curves for VLBW Infants.[5-9]

- The American Academy of Pediatrics recommends growth at intrauterine growth rates.[10]
- The ideal rate of catch-up growth is unknown, therefore catch-up growth is not prescribed.
- An emerging method of monitoring extrauterine growth using a Growth Velocity Approach suggests that to parallel an ideal intrauterine growth of 17 g/kg/day, extrauterine growth needs to be closer to 19-20 g/kg/day.[11,12]
- **Head circumference growth** is used as a surrogate marker for brain growth and is highly correlated with neurodevelopmental outcomes.[19] IQ in adolescents born preterm are best predicted by white matter volume.[17]
- Studies indicate that **linear growth** indexes organ growth and may be a more accurate and earlier predictor of growth failure.[20-22]
  - While at the present time it is not standard to monitor BMI, Weight for Length, or other measurement of body proportionality or

composition, it may become more routinely monitored in the future.[23]

- **"Ideal" Growth Goals.**[24,25]
  - **Weight:** 19-20 g/kg/day (Measured daily, or as safe and able). Clinical judgment is important in determining weight gain goals considering the neonate's medical condition, genetic growth potential, and nutrient intake.
  - **Length:** 0.8-1 cm/week (Measured weekly, ideally done with length board for accuracy).
  - **Head Circumference:** 0.8-1 cm/week (Measured weekly, unless otherwise needed more frequently).

- **Calculating Growth Changes**[25-28]:
  - Growth restriction, disproportionate fat mass vs. lean body mass in preterm infants when they reach term age vs term infants at birth suggest that current practices are not consistently promoting optimal growth and body composition in preterm infants.[25]
  - Z-Scores are valuable to understand growth in relation to standard deviations above and below the mean.
  - Calculating weight changes from the infant's nadir weight (lowest weight measured), or from the day they re-gain their birthweight, (which is typically anywhere between day of life 8-14) may be a more realistic .approach than calculating weight changes starting with birthweight.[29]
  - The amount of weight gain needed to maintain weight z score varies with age, weight z score, and sex, so weight goals should be adjusted weekly.
    - Can use PediTools Preterm calculator to individually assess growth goals

- **Nutrition Provision:** Use established, standardized monitoring protocols with defined nutritional goals
  - TPN initiation, advancement, & duration
  - Enteral feeding initiation, advancement, & duration
  - Nutrition discharge planning

- **Laboratory Monitoring**[30]
  - There are no absolute standards, only guidelines/recommendations
  - Influences on laboratory monitoring include:
    - Laboratory processing capabilities
    - Volume needed to obtain results
    - Cost to hospital and potential for reimbursement
    - Clinical status/stability, and goals of care for the patient
    - Parent preference or religious belief

Refer to **TOOL #2** on page 11 for a Monitoring Schedule for VLBW Infants Receiving Parenteral or Enteral Nutrition Support.

- Document assessments by registered dietitians who specialize in neonatal nutrition
  - Within 24 hours of admission
  - At regular intervals, every 3-5 days & no longer than 7 days apart

Quality Improvement: Outcome/ Process Measures

- Are growth charts available in the hard copy or EMR?
- Are growth charts in the EMR auto-populated?
- Are perinatally-trained dietitians available in the NICU with standard orders for consultation?
- Are protocols available for monitoring growth laboratory measures?

POTENTIALLY BETTER PRACTICE #2

Establish standards of nutrition monitoring as an integral component of improving nutrition outcomes in the neonatal population.[3]

Background, Rationale and Goals

- There is no absolute approach to guarantee each and every baby will reach their growth and cognitive potential, yet we continue to strive to optimize those outcomes to the best of our ability.[1,31,32]
- Lack of financial and personnel resources, may impact the ability to implement nutrition monitoring.
- Advances in nutrition care for VLBW infants enhance survival and can minimize or modify long-term morbidity outcomes.

Recommendations, Guidelines and Algorithms

- Review current practice.
  - Often there may be a significant disconnect between assumed practice and reality.
- Identify outdated practices and other areas for improvement.

Quality and Process Improvement

- If not already available in your unit, explore hiring a registered dietitian and lactation consultant.
- Create standardized flow-sheets or charting tools to support daily calculations, trends, and facilitate analyses.
- Identify changes in your nutrition outcomes, and measure change in clinical practice (as in Plan Do Study Act "PDSA" Cycles).

Outcome and Process Measures:

- At a minimum, annual review of nutrition outcomes and compare to internal benchmarking &/or outside benchmarks (CPQCC, VON, etc.).

POTENTIALLY BETTER PRACTICE #3

Identify, diagnose, and monitor malnutrition.[25]

Background, Rationale and Goals

- The Academy of Nutrition and Dietetics (AND) and the American Society for Parenteral and Enteral Nutrition (ASPEN) have recently established recommendations and criteria for the identification and documentation of malnutrition related to undernutrition for both adult and pediatric populations
- Malnutrition can result in poor growth and may influence neurocognitive outcomes
- VLBW infants are at very high risk for malnutrition and undernutrition due to:
  - Decreased nutrient stores at birth
  - Immature absorption and organ function
  - Delayed initiation and advancement of both parenteral and/or enteral nutrition
  - Complications due to NEC/SIP, CLD, infections, parenteral and enteral nutrition access, and/or cardiac anomalies, etc.
- Primary indicators used to diagnose malnutrition in neonates:
  - Individual data are compared to appropriate reference standards
  - To make the diagnosis of malnutrition, use the most accurate data points to determine the classification/degree of malnutrition (Mild, Moderate, Severe)

Refer to **TOOL 3** on page 12 for diagnostic criteria.

- In some situations, diagnosing malnutrition may need to be deferred due to critical illness and patient instability, or it may become not necessary (such as end of life/comfort care).

Recommendations, Guidelines and Algorithms

- Accurate anthropometric data should be obtained routinely and compared to appropriate reference standards
- Initial malnutrition assessment/diagnosis should be done within the first 2 weeks of life
- Malnutrition assessment/diagnosis should be monitored and updated appropriately at least weekly during hospitalization
- Tracking malnutrition diagnosis, and classifications (mild, moderate, severe) should be recorded and reviewed at least annually for trends

Quality Improvement: Outcome/ Process Measures

- At least annual review for the staff of proper techniques to obtain the most accurate data.
- Track influence of routine malnutrition diagnosis on short and long- term outcomes.
- Assessment of malnutrition status may affect payor reimbursement.
- Audit charts to review and assess for accuracy of malnutrition diagnosis
  - Is the criteria appropriately being applied and accurately reflected in the degree of malnutrition diagnosed?

POTENTIALLY BETTER PRACTICE #4

Track nutritional continuous quality improvement (CQI) data, for the individual patient as well as the unit aggregate data, and use it to modify current practice.

Background, Rationale and Goals

- Evidence-based quality improvement efforts continue to demonstrate the importance of measuring current practice to improve future practice.[33,34]
- An individual database should facilitate the nutrition care of an individual patient.
- Collective analysis of nutritional processes and outcomes are needed for global NICU quality improvement and interventions.[2,33,35]
- Implementation and ongoing quality improvement activities may be impeded by lack of data collection and analysis capability and resources.

Recommendations, Guidelines and Algorithms

- Individual patient data tracking of key measures
- Collective key measure information gathered from all patients admitted during a defined period (typically 1 calendar year)

Refer to **TOOL 4** on page 14 for examples of measurement tools.

- Data updated and shared with staff regularly

Quality Improvement: Outcome/ Process Measures

INDIVIDUAL DATA

- Are the patient's nutrition goals being met?
  - Daily assessment and discussion on rounds
  - Daily volume, caloric intake, including protein, dextrose, fat calories
  - When appropriate, electrolyte, vitamin and trace element intake
- If not, why are they not being met? I.e. fluid restriction, tolerance, etc.
- Number of Days NPO
- Relative contribution of gavage vs. nipple vs. breastfeeding intake
- Consistent encouragement and appraisal of mother's milk supply
  - Prenatal education and parental decision-making, especially regarding breastfeeding
  - Pumping log
  - Discussion on rounds
  - Availability of lactation professionals
  - Timing of skin-to-skin contact, non-nutritive breastfeeding
- Track the use of breastmilk as the preferred nutritional source.
  - Was breastmilk given as the first feed?
  - Did the infant receive banked breast milk (BBM)?
  - How much BBM vs. Mom's own breastmilk (MBM)?
  - Fortification used and days on fortified feeds
  - Feeding any breastmilk at discharge
  - Breastfeeding at discharge
- Biochemical monitoring
  - Frequency of lab draws
  - Chemistries to monitor & trend

AGGREGATE DATA

- Develop a nutritional database
  - Nutrition reports pulled automatically from

the electronic medical record (EMR)
    - Trends over time (Monthly vs. Quarterly vs. Annually)
- Data may include, but is not limited to:
    - Average BW, GA
    - Amount of Amino Acids received in the first DOL
    - Average and range DOL feeding pathway starts
    - Average and range of DOL BW is regained
    - % of patients who received MBM as first feed
    - Average growth velocity
    - NEC rate
    - % of patients who are feeding breastmilk upon discharge
    - % of patients discharged with a feeding tube
- Comparison of center outcomes
    - % Extrauterine growth restriction (EUGR)
    - Weight at discharge decreased ≥ 1 SD from birthweight
    - % of infants AGA at birth who are SGA (<10th percentile) at discharge
    - CPQCC
    - VON
    - Children's Hospital Association
    - Within healthcare system networks (eg. Kaiser, MedNax)
    - Published data
    - Available benchmarks
    - Internally established metrics

TOOL #1

Current and Common Growth Curves for VLBW Infants

- Use hyperlinks to view each growth chart
- Source for access to most growth charts: PediTools Preterm

FENTON GROWTH CURVE

Where do I find it	**Girls:** http://ucalgary.ca/fenton/files/fenton/fenton2013growthchartcolor-girls.pdf **Boys:** http://ucalgary.ca/fenton/files/fenton/fenton2013growthchartcolor-boys.pdf
Notes	• International Data • Combine WHO Growth Curve data points, which is to be used once former preterm infants correct to post-term
References	Fenton TR, Kim JH. A systematic review and meta-analysis to revise the Fenton growth chart for preterm infants. BMC Pediatr. 2013;13:59

GROWTH CALCULATOR

Where do I find it	http://www.growthcalculator.org/
Notes	Newer, more conceptual theory that needs further investigation, validation, and long-term understanding; however, is an approach focused on a more personalized expectation of growth
References	Rochow N, Landau-Crangle E, Thommandram A, Fusch C. Individualized postnatal growth trajectory for preterm infants – online calculator. 2016.

INTERGROWTH 21st

Where do I find it	https://intergrowth21.tghn.org/postnatal-growth-preterm-infants/#pg1
Notes	Limitations: small sample size <28 wk infants
References	Villar J, Cheikh Ismail L, Victora CG, et al. International standards for newborn weight, length, and head circumference by gestational age and sex: the Newborn Cross-Sectional Study of the INTERGROWTH-21st Project. Lancet. 2014;384:857-868. Villar J, Puglia FA, Fenton TR, et al. Body composition at birth and its relationship with neonatal anthropometric ratios: the newborn body composition study of the INTERGROWTH-21st project. Pediatr Res. 2017;82:305-316.

BMI CURVES FOR PRETERM INFANTS

Where do I find it	http://pediatrics.aappublications.org/content/135/3/e572.figures-only
Notes	• To monitor proportionality of growth • Limitation is that it cannot delineate fat-free mass accumulation vs. fat mass[36]
References	Olsen IE, Lawson ML, Ferguson AN, et al. BMI curves for preterm infants. Pediatrics. 2015;135:e572-581.

TOOL #2

Monitoring Schedule for VLBW Infants Receiving Parenteral or Enteral Nutrition Support

	Parenteral Nutrition		Enteral Nutrition	
	Initial Phase	**Stable Phase**	**Initial Phase**	**Stable Phase**
Growth				
Weight	Daily	Daily	Daily	Daily
Length	Baseline	Weekly	Weekly	Weekly
Head Circumference	Baseline	Weekly	Weekly	Weekly
Intake and Output	Daily	Daily	Daily	Daily
Glucose				
Serum	As indicated	As indicated	Baseline	As indicated
Urine	1-3 times/day	As indicated	Baseline	As indicated
Electrolytes	1-3 times/week	Every 1-2 weeks	Baseline	Every 2-3 weeks
Calcium, magnesium, phosphorus	2-3 times/week	Every 1-2 weeks	Baseline	Every 2-3 weeks
Triglycerides	Daily during dose increase	Every 1-2 weeks	As indicated	As indicated
BUN/creatinine	2-3 times/week	Every 1-2 weeks	Baseline	Every 2-3 weeks
Serum proteins	Baseline	Every 2-3 weeks	Baseline	Every 2-3 weeks
Liver enzymes	Baseline	Every 2-3 weeks	Baseline	Every 2-3 weeks
Alkaline phosphatase	Baseline	Every 2-3 weeks	Baseline	Every 2-3 weeks
Blood cell count	Baseline	Every 2-3 weeks	Baseline	Every 2-3 weeks
Vitamin and trace mineral status or other specific test	As indicated	As indicated	As indicated	As indicated

Initial Phase: Period in which PN solutions or enteral feedings are adjusted to meet the specific energy and nutrient needs of individual infants. This period general lasts for < 1 week for parenteral nutrition support and 7-10 days for enteral nutrition support.

Stable Phase: Period in when the infant is in a metabolically steady state. For clinically stable infants receiving an adequate nutrient intake with desired growth, the interval between laboratory measurements may be increase beyond the above recommendations.

Adapted from: Moyer-Mileur LJ. Anthropometric and laboratory assessment of very low birth weight infants: the most helpful measurements and why. Semin Perinatol. 2007;31:96-103.

Diagnostic Criteria for Malnutrition

Indicator	Mild malnutrition	Moderate malnutrition	Severe malnutrition	Use of indicator
Primary indicators requiring 1 indicator				
Decline in weight-for-age z score	Decline of 0.8-1.2 SD	Decline of > 1.2-2 SD	Decline of > 2 SD	Not appropriate for first 2 weeks of life
Weight gain velocity	< 75% of expected rate of weight gain to maintain growth rate	< 50% of expected rate of weight gain to maintain growth rate	< 25% of expected rate of weight gain to maintain growth rate	Not appropriate for first 2 weeks of life
Nutrient intake	≥ 3-5 consecutive days of protein/energy intake ≤ 75% of estimated needs	≥ 5-7 consecutive days of protein/energy intake ≤ 75% of estimated needs	> 7 consecutive days of protein/ energy intake ≤ 75% of estimated needs	Preferred indicator during the first 2 weeks of life
Primary indicators requiring 2 or more indicators				
Days to regain birth weight	15-18	19-21	> 21	Use in conjunction with nutrient intake
Linear growth velocity	< 75% of expected rate of linear gain to maintain expected growth rate	< 50% of expected rate of linear gain to maintain expected growth rate	< 25% of expected rate of linear gain to maintain expected growth rate	Not appropriate for first 2 weeks of life. May be deferred in critically ill, unstable infants. Use in conjunction with another indicator when accurate length measurement available.
Decline in length-for-age z score	Decline of 0.8 - 1.2 SD	Decline of > 1.2-2 SD	Decline of > 2 SD	Not appropriate for first 2 weeks of life. May be deferred in critically ill, unstable infants. Use in conjunction with another indicator when accurate length measurement available.

Adapted from: Goldberg DL, Becker PJ, Brigham K, et al. Identifying Malnutrition in Preterm and Neonatal Populations: Recommended Indicators. J Acad Nutr Diet. 2018.

TOOL #4

EXAMPLE: Data Collection Forms

INDIVIDUAL DATA COLLECTION FORM

Name:		MRN:		Birth GA:	
DOB:		Sex:		Admit PMA:	
Admit Date:		Diagnosis:			
Birth Wt:	g	%ile Wt at Birth:	%ile	% wt loss prior to regain:	%
Birth Length:	cm	%ile Length at Birth:	%ile		
Birth FOC:	cm	%ile FOC at Birth:	%ile		
Date BW regained:		DOL BW regained:			
Date of D/C:		LOS (d):		PMA at D/C:	
D/C Weight:	g	Date of D/C Weight:		%ile Weight at D/C:	%ile
D/C Length:	cm	Date of D/C Length:		%ile Length at D/C:	%ile
D/C FOC:	cm	Date of D/C FOC:		%ile FOC at D/C:	%ile
AA started DOL:		TPN start date:		Colostrum in 1st 24 hrs:	
Lipids started DOL:		TPN end date:		Tropic feeds started DOL:	
90 kcal/kg on DOL:		# d on TPN:		Type of milk for 1st feed:	
120 kcal/kg on DOL:					
130 kcal/kg on DOL:		DOL started MOM:		Peak Alk Phos:	
3.5 g/kg on DOL:		Date started MOM:		Date Peak Alk Phos:	
HMF type:		Date ended MOM:		DOL Peak Alk Phos:	
HMF started DOL:		# d total MOM:		Feeds at Peak Alk Phos:	
DOL started DHM:		DOL started Prolact+8:		DOL started Cream:	
Date started DHM:		Date started Prolact+8:		Date started Cream:	
Date ended DHM:		Date ended Prolact+8:		Date ended Cream:	
# d total DHM:		# d total Prolact+8:		# d total Cream:	
DOL started Vits:		DOL started Cow HMF:		DOL started Extra Protein:	
Date started Vits:		Date started Cow HMF:		Date started Extra Protein:	
Date ended Vitamins:		Date ended Cow HMF:		Date ended Extra Protein:	
# d total Vitamins:		# d total Cow HMF:		# d total Extra Protein:	
NEC Stage:					
Date of NEC:		Date of Perf:		D/C Feeds:	
DOL of NEC:		DOL of Perf:			
Feeds at NEC:		Feeds at Perf:			

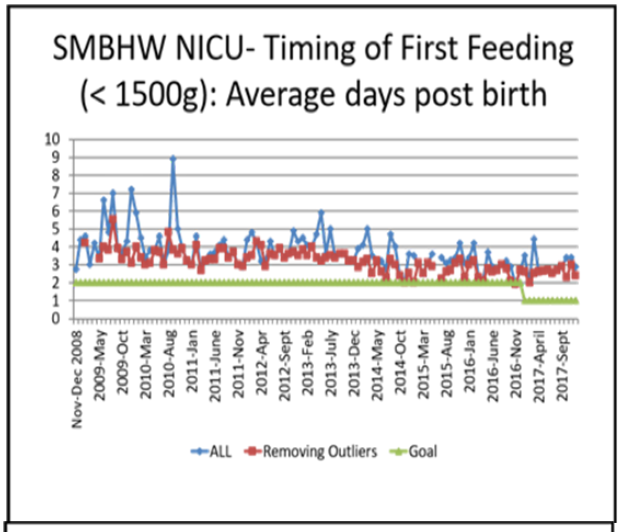
Collection examples from: Kelli Hawthorne MS, RD, LD via personal communication with the authors of this toolkit.

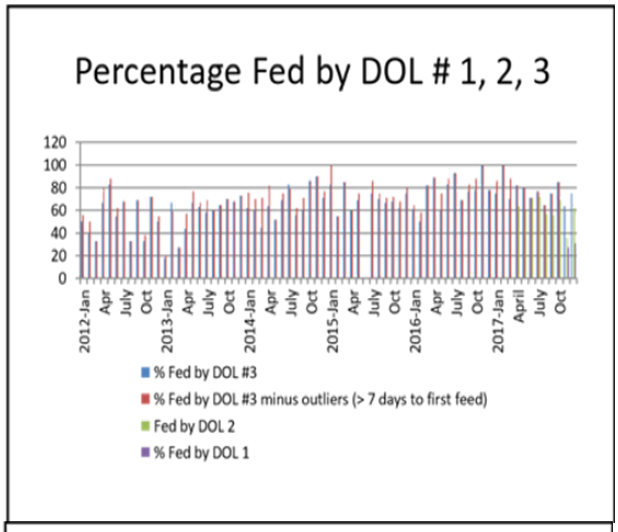
AGGREGATE DATA COLLECTION FORM

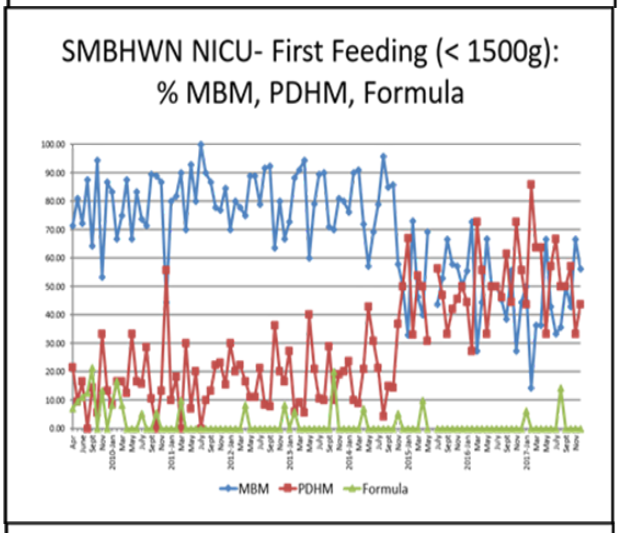
Name	MRN	DOB	Admit date	Birth GA	Admit PMA	Sex	Diagno-sis	Birth Wt	Birth Length	Birth FOC	Date BW regained	%ile Wt at Birth	%tile Length at Birth	% FOC at Birth	DOL BW regained	% wt loss prior to regain	Date of D/C	D/C Weight	D/C Length	D/C FOC

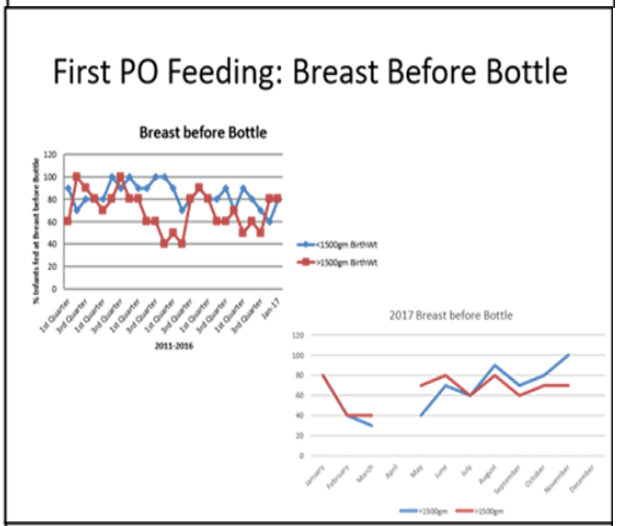
TOOL #5

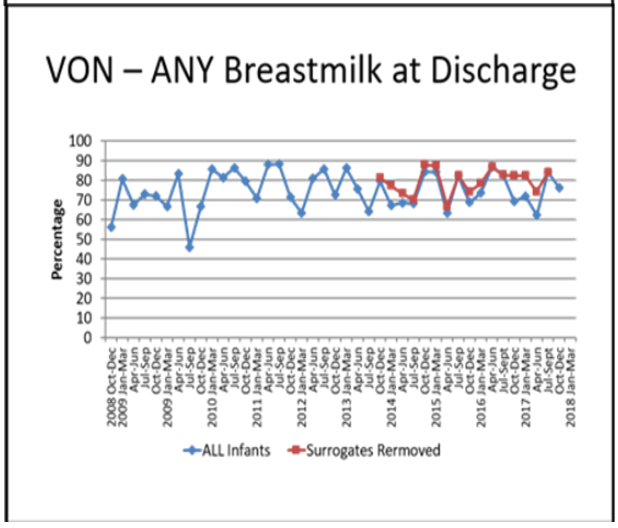
EXAMPLE CQI Data Charts

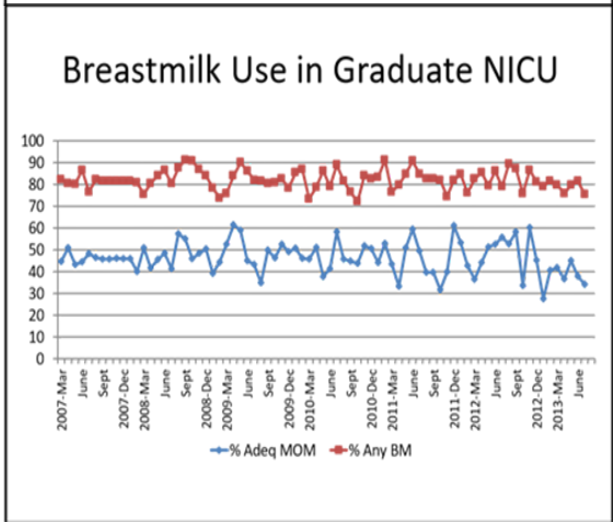












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In This Section

Potentially Better Practices

Tools

Parenteral Nutrition for VLBW Infants

Introduction

The development of sophisticated techniques for providing short- and long-term parenteral nutrition (PN) to critically ill infants has been one of the major advances in neonatology of the last several decades. While there is still a wide variation in practice in how parenteral nutrition is used to support VLBW infants, there is a growing body of literature to support evidence-based recommendations for numerous best practices.[1] There are currently a number of excellent reviews of neonatal nutrition, including information on early parenteral nutrition.[1-3]

In recent years, there have been multiple parenteral nutrition component supply issues. It is important to stay up to date with your pharmacy supply and understand the consequences if you do run out of a particular product.[4,5] The sites listed below are resources to check for national shortages, estimated time to replenish, and strategies to minimize detrimental outcomes.

- American Society of Parenteral and Enteral Nutrition
- Federal Drug Administration

POTENTIALLY BETTER PRACTICE #5

Develop and use computerized provider order entry (CPOE) for Parenteral Nutrition (PN).

Background, Rationale, and Goals

- PN is a high-risk medication with ample potential for order input, mixing, and hanging errors. CPOE facilitates clear, timely communication between provider, pharmacy, and bedside nursing.
- Most commercially available CPOE programs can be customized to guide clinical decision support and ensure safeguards to minimize order errors and, in some studies, found to decrease mortality. [6-8]

Recommendations, Guidelines and Algorithms

- Investigate the CPOE program options available to your institution
  - Is it compatible with the TPN compounder?
  - Is it compatible with the EMR?
  - Safety record at other institutions?
  - Program support – local vs. remote?
- Interdisciplinary input on the CPOE program – MD, NNP, PharmD, RD, RN, and technical support
  - Work flow assessment
  - 'Double Check'/Verification of order by clinical pharmacist
  - Who has access to the program? What level of access?
- Clinical Decision Support and Safeguards
  - Different protocols for different populations (neonate vs. pediatric vs. adult)
  - Copying previous order vs. entering new order daily
  - Ability to see past orders and laboratory trends
    - In the same program? (safer)
    - Will the provider have to alternate between different programs? (riskier)
  - Set minimum and maximum ordering limits
  - Override options/potential
    - Who has the authority?
    - Procedure

Quality and Process Improvement

- If CPOE not commonly used, identify obstacles to implementation
- Once CPOE is implemented, identify shortcomings and optimize abilities

Outcome/Process Measures

- Adverse (& 'Near Miss') Drug Events
- Prescription order error
- Product waste
- Time to attain macronutrient goals
- Time to re-gain BW
- Pharmacist verification time &/or intervention frequency

POTENTIALLY BETTER PRACTICE #6

Parenteral nutrition, including dextrose, protein, and lipids should be started as soon as possible after admission, but never greater than 24 hours of life.

Background, Rationale, and Goals

- In order to maximize growth, minimize catabolism, and support neurocognitive development, infusing nutrition with protein as soon as possible after birth has become the standard of care.[1,3,9,10]
- Amino Acids can be started as high as 3 g/kg/day to minimize catabolism.
- Macronutrients should be increased, as tolerated, so that infants receive adequate amino acids (up to 4.0 g/kg/d) and non-protein calories (80-100 kcal/kg/d) within the first five days of life
- Understand your facility's PN availability
  - In-house compounder vs. outsourced production
  - If it is outsourced, establish inventory needs
- Overcome the perception that early amino acid administration is of limited benefit, potentially toxic, or more expensive.
- Amino Acid dose may be limited by fluid restriction.

Recommendations, Guidelines and Algorithms

- Standardized policies and admission order sets
- Including monitoring standards[11]
- Availability of "pre-mixed" amino acid containing parenteral nutrition solutions in hospital pharmacy[9,12,13] OR the ability to obtain individualized parenteral nutrition solutions within the first few hours of life.
- Understand how early infusion of parenteral nutrition may effect electrolytes.[14]

Quality and Process Improvement

- Understand current state and map out ideal process.[3,13,15]
- PDSA Cycles, as necessary
- Measurements before and after process changes

Refer to **TOOL 6** on page 26 and **TOOL 7** on page 27 for guidelines on parenteral nutrition for VLBW infants.

Outcome/Process Measures

- % of VLBW infants started on amino acids at ≤ 2 hrs of age or as part of the first IV maintenance fluids
- TPN hung by ___ hours of life
- % of VLBW infants on amino acids by 24 hours of age
- % of VLBW infants receiving 3-4 g/kg/d parenteral protein by 72 hours of age
- % of VLBW infants receiving 80-100 non-protein kcal/kg/d by 5 days of age
- Total TPN days

POTENTIALLY BETTER PRACTICE #7

Start parenteral lipids within the first 24 hours of life. Lipids can be started at doses as high as 2 g/kg/d. Lipids can be increased to doses as high as 3.0-3.5 g/kg/day over the first few days of life.

Background, Rationale, and Goals

- Early lipids are well tolerated by VLBW infants & are essential components of brain structure.[10,16]
- Delayed introduction of lipids may have adverse consequences.[16]
- Prolonged IV lipids may increase risk for hyperlipidemia and Parenteral Nutrition Associated Cholestasis (PNAC).
- Can monitor triglyceride levels, with goal < 200 mg/dl
- Calls for regular monitoring of direct bilirubin and LFTs.[17,18.]
- Newer, fish oil based IV Lipids may be associated with less PNAC19; however, they may not prevent PNAC.[1-3,20]
- If used, SMOFlipid® dose should be 2.5-3 g/kg/day in order to reduce the risk of essential fatty acid deficiency (EFAD).[21] Refer to **PBP #9** on page 24 for more information.

Quality and Process Improvement

- Standardized policies and admission order sets which include IV Lipid administration starting within the first 24 hours of life

Outcome/Process Measures

- Measure provider consistency in implementation
- Time of order placement to time of lipid infusion start running
- % of VLBW infants receiving lipids by 24 hours of age
- Day of Life 3 g Lipid/kg/day is reached

POTENTIALLY BETTER PRACTICE #8

Discontinue parenteral nutrition, with removal of central catheters, as soon as adequate enteral nutrition is established.

Background, Rationale, and Goals

- Understand that leaving a central line in place caries some risk of catheter-associated infection
- Overcome the perception that the benefit of several more days of lipid administration outweighs the risk of catheter-associated infection
- As enteral feeds advance, advantages of more parenteral nutrition are outweighed by the risks of continued central vascular access and infection[22-24.]
- As feeds advance, optimize the nutrient density of the diminishing volume of PN by giving the maximum amount of Amino Acids to minimize the calorie and protein 'gap' that can occur during this transition from PN to EN [25]

Quality and Process Improvement

- Define the current state and map out ideal processes.[3,13,15]
- Plan Do Study Act (PDSA) Cycle(s), as necessary
- Develop & implement standardized policies and order sets which include discontinuation of parenteral nutrition when adequate enteral calories established. (See Section III)
  - Fortify feeds before PN is discontinued
  - May discontinue IV Lipids prior to stopping parenteral nutrition to maximize Amino Acid content of the remaining volume and as fortified enteral feeding volume and energy is increasing

Outcome/Process Measures

- Number of central line days
- Number of days on PN
- Hospital acquired infection (HAI)/Central line-associated bloodstream infections (CLABSI) Rates

POTENTIALLY BETTER PRACTICE #9

Long term management in those who become PN dependent &/or develop Parenteral Nutrition Associated Cholestasis (PNAC).

Background, Rationale, and Goals

- The development of PNAC is strongly correlated with duration of time on PN and the only evidence for prevention is initiating and advancing enteral feeds.
- Unfortunately, some VLBW infants may remain reliant on parenteral nutrition for over 30 days.
- Lack of enteral feeding, immature organ function, hypoxia, infection, PN components, and hepatotoxic medications are all risk factors that may lead to liver dysfunction.
- Risks of macro- and micronutrient deficiencies can have deleterious effects if they are not corrected.[5,26.]

Recommendations, Guidelines and Algorithms

- If/when the D. Bili becomes >2 mg/dL:
  - Although decreasing the IV Lipid dose to 1 g/kg/day has been done, it is controversial. [27,28]
    - The evidence for this strategy is inconclusive and it is not generally recommended.
    - This strategy may significantly decrease energy provided
    - Fat is essential for brain growth and neurodevelopment
  - If fish oil based IV Lipids are available[27], can transition from Intralipid®
    - Omegaven® is only available in the United States as an investigational drug, therefore access is limited
- Smoflipid® is approved by the FDA for use in adults; however, at the time of this publication, it is not explicitly approved for use in pediatrics and infants though we acknowledge there are some institutions who are using it 'off label'
  - If the Smoflipid® dose is restricted, monitor for EFAD closely[28] and elevated serum Vitamin E.
- Limiting IV Dextrose intake may be more advantageous than IV Lipid dose minimization in decreasing risk of PNAC[18]
- Cycling PN is not currently recommended for VLBW due to the high risk of hypoglycemia and the potential for other metabolic abnormalities
- Ursodiol (ursodeoxycholic acid, common brand: Actigall) promotes bile flow; however data is limited in its use and effectiveness in VLBW infants[27]
- Standardized policies and order sets which on TPN day #30, high risk micronutrients for deficiency are monitored and corrected, if needed
  - Zinc
  - Selenium
  - Copper
  - Possibly Vitamin D, or other fat soluble vitamins if the infant is demonstrating liver dysfunction

Quality and Process Improvement

- Review current policies and procedures for long term TPN management
- Update practice and order-sets, as needed

Outcome/Process Measures

- Annual number of babies on PN for >30 days
- Number of those with altered micronutrient status on PN for 30 days
- Number of diagnoses of cholestatic jaundice due to PN per year

Total Parenteral Nutrition for VLBW Infants

Nutrient	Initiate	Advance	Goal	Other Info
Amino Acids	3 g/kg/day (or maximum allowed if volume restricted)	0.5-1 g/kg/day (dependent on volume and renal function)	4 g/kg/day	
Fat	0.5-2 g/kg/day	0.5-1 g/kg/day (depending on volume and tolerance)	3 g/kg/day	Dose may need to be restricted if PNAC develops
Carbohydrate	4-6 mg CHO/kg/min	1-2 mg CHO/kg/min	<12 mg CHO/kg/min	
Pediatric IV Multivitamin	2 mL/kg/day (Goal)			
Sodium	0-1 mEq/kg/day	0-1 mEq/kg/day	2-4 mEq/kg/day	May need more, adjust dose per labs
Potassium	0-0.5 mEq/kg/day	0-1 mEq/kg/day	2-4 mEq/kg/day	May need more, adjust dose per labs
Calcium	Up to 400 mg/kg/day	50-200 mg/kg/day	400-600 mg/kg/day	Ideal Ca:Phos ratio = 1.3-1.7 mg Ca:1 mg Phos
Phosphorous	Up to 0.5 mM/kg/day	0.5-1 mM/kg/day	1-2 mM/kg/day	
Magnesium	0-0.2mEq/kg/day*		0.2-0.3 mEq/kg/day	*do NOT give if you know mom received Mg prior to delivery
Zinc	400 mcg/kg/day (Goal)			
Copper	20 mcg/kg/day (Goal)			May need to give up to 30 mcg/kg/day, if found to be deficient; OR may need to decrease dose or hold in setting of PNAC26
Selenium	If still on PN @ 30 days, check for deficiency and start at least 2 mcg/kg/day			IF found to be deficient, may need to increase dose to 3-4 mcg/kg/day
Carnitine	3-5 mg/day			Not necessary to routinely add
Heparin	0.5-1 unit/mL			

Adapted from: Moyer-Mileur LJ. Anthropometric and laboratory assessment of very low birth weight infants: the most helpful measurements and why. Semin Perinatol. 2007;31:96-103.

TOOL #7

Monitoring Guidelines for VLBW Infants on Parenteral Nutrition

Measurement	Initial Phase (usually <1 week)	Stable Phase*
Growth		
Weight	Baseline	Daily
Length		Weekly
Head Circumference		Weekly
Intake and Output	Daily	Daily
Glucose		
Serum	Baseline	1-3 x/week, as needed
Meter	Baseline, and as needed	
Urine	As indicated	
Electrolytes (Na, K+)	Baseline	
Calcium, Magnesium, & Phosphorous		
LFTs		
Direct &/or Conjugated Bilirubin		
Alkaline Phosphatase		
Triglycerides	Baseline, and daily with each increase in dose of IV Lipids	1-2 x/week, as needed
BUN and Creatinine	Baseline, 2-3x/week	1-3 x/week, as needed
Serum Proteins	Baseline	
Blood Cell Count		
Vitamin or other Microminerals		As needed

*Clinically and metabolically stable infants on PN for a prolonged period of time may be able to space out their laboratory monitoring outside of the recommended time frames.

Adapted from: Moyer-Mileur LJ. Anthropometric and laboratory assessment of very low birth weight infants: the most helpful measurements and why. Semin Perinatol. 2007;31:96-103.

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Establishing Enteral Nutrition

In This Section

Potentially Better Practices

Tools

Introduction

NICUs should standardize feeding management based on best available evidence. The introduction of enteral feeding for the VLBW infant has changed dramatically over the past few decades. The greatest trends have been driving the earliest start of feeding with oral colostrum care (OCC), standardizing feeding advancement and maximizing use of human milk. These feeding process changes have promoted trophic changes in the intestine along with immunologic protection of the host. We are only beginning to understand that such early priming may favorably alter the gut microbiome to confer positive benefits to the infant.

POTENTIALLY BETTER PRACTICE #10

Enteral feeding begins with oral colostrum care (OCC) started shortly after birth.

Background, Rationale, and Goals

- Studies have shown that OCC can reduce sepsis, improve weight gain, and reduced length of stay[1-9]
- The benefit of oral colostrum care is mostly immunologic in nature with the introduction of immune cells, immunoglobulins, other immunoprotective agents in milk, natural probiotics and prebiotics.[10]

Recommendations, Guidelines and Algorithms

- Develop a protocol for delivery of oral colostrum care including volume, timing, duration and method of collection and delivery.
- Encourage mothers to express colostrum within 1 hr after delivery in the delivery room or recovery room after cesarean section.

Quality Improvement: Outcome/ Process Measures

- OCC guidelines/protocol available?
- % of target population (e.g. VLBW infants) receiving OCC
- Age (in hours) of 1st OCC

POTENTIALLY BETTER PRACTICE #11

Enteral feeding begins with the introduction of trophic enteral feeds initiated on day of life 1 or 2, unless there are clear contraindications such as current or recent exposure of the bowel to hypoxia, severe anemia, hypotension, or congenital anomalies precluding immediate feeding (e.g. omphalocele or gastroschisis).

Background, Rationale, and Goals

- The fetal gastrointestinal tract is continually exposed to large volumes of swallowed amniotic fluid, absorbing fluid and some nutrition, performing rudimentary peristalsis, and forming meconium.
- Trophic feeding can stimulate gut maturation, hormone release, and motility. Early introduction of feeds shortens the time to full feeds and to discharge without an increase in NEC whereas withholding of feeds puts the gut at risk for infection and delayed maturation including immune protection.[11]
- Early feeding accelerates mature intestinal motility patterns.[12]
- Early introduction of feeding results in less serious infections in low birth weight infants.[13]
- There are no contraindications to initiating or feeding with an umbilical artery catheter (UAC).[14]
- The impact of feeding in the presence of a PDA or during the treatment for a PDA closure (indomethacin, ibuprofen, acetaminophen) has not been shown to add further risk for bowel complications such as NEC or spontaneous intestinal perforation (SIP). [15-17]
- The risk of SIP associated with the concomitant use of indomethacin and steroids needs to be recognized and feeding held as a precaution in this scenario. Meta-analyses of trials of non-steroidal anti-inflammatory agents alone for PDA closure have not affected NEC rates. [18,19]

Recommendations, Guidelines and Algorithms

Enteral feeding practices should be listed as policy or guideline and available in each NICU specifying the following aspects:

- Delivery of oral colostrum care including volume, timing, duration and method of collection and delivery
- Early initiation of feedings for eligible infants with type of feeding (full strength mother's milk, heat-treated donor human milk, formula only under rare conditions for VLBW infants)
- Stopping or holding rules for cardiorespiratory instability
- Details of feeding volume advancement
- Definition of feeding intolerance
- Timing of fortification steps
- Timing of introduction of vitamins and iron
- Rules for volume and concentration of feeds for infants who are not growing optimally

Quality and Process Improvement

- Creation and implementation of OCC guidelines
- Development of feeding guidelines with timing of nutritional interventions. (see example: https://health.ucsd.edu/specialties/obgyn/maternity/newborn/nicu/spin/staff/Pages/tables.aspx
- Integration of feeding guidelines into EMR

Outcome/Process Measures

- Initial feeding type (Mother's own milk, donor human milk, formula)
- Feeding protocol completed (with/without breaks) (Y/N)
- DOL full enteral feeds achieved (140 mL/kg/day or more)
- DOL when birthweight regained
- Days on parenteral nutrition
- Percentage of infants on any enteral nutrition by 24, 48, 72 hours of life (Refer to Tool #5)

POTENTIALLY BETTER PRACTICE #12

NICUs should develop standard definitions of feeding intolerance, with specific reference to actions/inactions based on gastric residual volumes, changes in abdominal signs and the presence of bloody stools.

Background, Rationale, and Goals

- Enteral feedings of VLBW infants are frequently stopped, or feeding advances held, based on concerns for feeding intolerance.
- The definition of feeding intolerance is highly variable but may include the presence and quality (normal, yellow, green, blood-tinged) of gastric residuals, emesis, abdominal distension or tenderness, the presence of heme-positive or abnormal-appearing stools, the presence, absence or quality of bowel sounds, or any combination thereof. [20,21]
- As all of these clinical phenomena may occur in a healthy premature infant tolerating feedings, it is important to put these findings into a clinical context that is understood by nursing and physician staff.[22]
- Measurement of abdominal girth may be disruptive or stressful to the infant and may not add significantly to the clinical assessment of abdominal distension or tenderness.
- In one study, when feeding intolerance was more clearly defined, nutritional outcomes were dramatically improved.[23]
- Gastric residuals reflect the immature dysmotility of the premature gut and are very common in the first few weeks of life.
- The gastric residual alone is neither a sensitive nor specific indicator of bowel injury and should not solely dictate stopping or advancing enteral feeds.[24]
- Gastric residuals may be present prior to NEC but may be more helpful in combination with other signs of early NEC (abdominal distension or tenderness, bloody stools, apnea, temperature instability) in making the diagnosis of NEC.[25]
- Not checking gastric residual volumes before each feed was associated with faster attainment of full feeding without increasing risk of NEC.[26]
- Many NICUs have now moved away from checking gastric residuals based on the lack of specificity of checking gastric residuals.
- If gastric residuals are checked, one should be cautious about using residuals as the sole reason to completely stop enteral feedings.
- There are few justifications for discarding gastric residuals as fluids, electrolytes and nutrition may be lost.

Recommendations, Guidelines and Algorithms

- Team based definition of feeding intolerance integrated into feeding algorithm

Refer to **TOOL #8** on page 42 and **TOOL #9** on page 46 for examples of feeding protocols with instructions for feeding intolerance/residuals.

- Education for staff regarding the new definition, clinical context and potential practice changes

Quality and Process Improvement

- Reasons for withholding feedings should be documented in the progress notes and discussed on rounds.

Outcome/Process Measures

- Number of feeding interruptions

POTENTIALLY BETTER PRACTICE #13

Enteral feeds can be given by bolus or continuously by gastric route and less commonly by transpyloric route.

Background, Rationale, and Goals

- VLBW infants require tube feedings before they are mature enough to safely suck and swallow.
- The two primary methods of tube feeding are bolus or continuous.
- Delivery route options are orogastric, nasogastric, or through a gastrostomy tube, and gastric versus transpyloric.
- Milk feedings given by intermittent bolus gavage method may be more physiologic because they promote the cyclical surges of gut hormones seen in normal term infants and adults.[27]
- A Cochrane analysis concluded that infants fed by the continuous tube method took longer to reach full feeds, but there was no significant difference in somatic growth, days to discharge, or the incidence of NEC.[28]
- A "slow" bolus feeding given over a longer time interval, such as 30-120 minutes, results in a return of motility and improved tolerance.[29]
- Delivery of tube feedings into the stomach elicits the associated physiologic stimulation and digestive processes.
- It is undetermined if bolus vs continuous feeding is better for GERD.[30]
- Transpyloric (e.g. nasojejunal or NJ) feeds must be continuous and are not recommended for routine use in preterm infants, as no benefit was found and are associated with a greater incidence of gastrointestinal disturbance and death.[31]
- Transpyloric feeding has the potential benefit of delivering feeds past the pylorus when concerns arise for significant GERD and/or aspiration risk and/or moderate to severe CLD.
- Fats in human milk are of lower density than other aqueous components and will therefore rise and separate.
- If a syringe is horizontal, fat may float to the top and therefore will be the last fluid emptied into the tubing, resulting in variable fat administration rates and causing some of the highest caloric feed to never reach the baby.[32-34]

Recommendations, Guidelines and Algorithms

- NICU feeding guideline should specify bolus vs continuous and if continuous is chosen greater attention to the following is required to minimize nutrient loss.
  - Orienting feeding syringes vertical and directed up using the thinnest tubing and the shortest travel distance from pump to infant will decrease fat loss.
  - Ensuring that any residual milk is purged with air or small amount of water.

Quality and Process Improvement

- Record route of feeding
- Ensure that transpyloric feeding have defined indications and guidelines to offset risk
- Define rules and timeline for need for gastrostomy tube

Outcome/Process Measures

- Route of feeding

POTENTIALLY BETTER PRACTICE #14

Enteral feeding advancement rates should be linear and specified in the feeding guidelines.

Background, Rationale, and Goals

- The lack of a feeding guideline introduces more variability in feeding rate and may increase risk of gut morbidities.
- The feeding rate of advancement has been shown to have a wide range of tolerance (20-35 mL/kg/day) and is not a major determining factor for intestinal complications such as NEC. [35]
- There is a wide range of feeding rates that are used by NICUs around the world.
- Slower feeding protocols (8-10 mL/kg/day) in ELBW have been associated with negligible NEC rates. [36,37]
- Faster rates of feeding are associated with improved weight gain, reduced PN days and line related complications.

Quality and Process Improvement

- Define rates of feeding advancement in feeding guidelines specified by birthweight

Refer to **TOOL # 10** on page 47, **TOOL #11** on page 49 and https://health.ucsd.edu/specialties/obgyn/maternity/NEWBORN/NICU/SPIN/Pages/default.aspx.

- Automate process of calculations and/or embed advancement algorithm in EMR.

Outcome/Process Measures

- Day of life started the feeding guidelines
- Day of life completion of the feeding guidelines with/without breaks

POTENTIALLY BETTER PRACTICE #15

Fortification should be established before full feeds are reached.

Background, Rationale, and Goals

- Early fortification of human milk minimizes the nutritional gap that occurs in the transition from parenteral to enteral nutrition. Fortification of breastmilk should be initiated well before a full feeding volume is reached.[38]
- There is no clear evidence when it is safe to introduce fortification of human milk during feeding advancement. However, protocols have increasingly used earlier fortification steps before full feeding volume has been reached, including some starting as early as 40 mL/kg/day without evidence of intestinal complications.[22,39-41]
- Ascertain the increase in osmolality with the addition of fortifiers does not exceed significant levels of risk that were associated with NEC.[40,42]
- There are now decided advantages to using liquid human milk fortifiers due to ease of use and better mixing. The available liquid bovine-based fortifiers contain higher protein content that is beneficial for the ELBW infant and are void of intact bovine protein.[43,44]
- National standards have long recommended that powdered infant formulas no longer be used in the NICU (CDC, FDA, ADA).
- Liquid human milk fortifiers are preferred over powder to prevent incomplete mixing difficulties, separation of milk components, while minimizing contamination risk.
- The use of donor human milk based HMF has been shown to further reduce infant morbidities such as NEC and reduce days on parenteral nutrition.[45-47] There are retrospective data suggestive of other morbidity reductions including sepsis, ROP, CLD.[48]
- Modern NICU milk preparation has advanced to the point that quality control processes are required to provide the best quality human milk derivatives.[49-52] The collection, storage and handling of human milk with fortification preparation has become more complex. The most efficient and safe way to manage all the milk preparations each day is to streamline these processes and in particular reduce the number of handlers or preparers so that quality control can occur. The other important control element is to have a clean area that can be a consistent workspace for the preparation area.

Quality and Process Improvement

- Advocate for a dedicated milk preparation room and technician to standardize mixing and optimize the quality of milk handling. This requires both a commitment for appropriate clean space and dedicated personnel for milk preparation.
- Define a standard time for starting fortifiers in the feeding advancement
- Choose a fortifier that provides the best growth outcomes with the lowest morbidities for your infants
- Identify balancing measures such as intestinal complications

Outcome/Process Measures

- Age or volume of feeds when fortifier started
- Days on PN
- DOL Full Feeds (140 mL/kg/day based on BW)
- Number of feeding intolerance events
- NEC
- SIP

POTENTIALLY BETTER PRACTICE #16

Enteral feeds should be advanced and concentrated until they are providing adequate nutrition to sustain optimal growth along an infant's growth curves

Background, Rationale, and Goals

- The goal of enteral feedings is to provide optimal nutrition and growth and replace the need for parenteral nutrition.
- The advancement of volume is the first approach to delivering nutrients.
- Delivery of volumes between 150 to 200 mL/kg/day can often be given without significant adverse effects.[53] Some growth restricted infants may demand even more volumes.
- Feeding volume should be increased until the infant shows signs that gut capacity has been reached, then kept at that volume through daily adjustment of the feeding volume for weight gain.[38,54]
- Increased milk intakes were associated with increased daily weight gains and a greater weight at 35 weeks, but no difference in any growth parameter at 1 year or difference in morbidity.[53]
- There are no standardized upper limits of volume however some preterm infants with significant lung disease may experience challenges and require further fortification instead.
- Since human milk nutrient content is so variable, infants that are not growing optimally with peak volume and 24 kcal/oz fortification will require further fortification. Restricting feeding volume until a weight plateau has been identified is the most common cause of growth delay.[55]
- Although fortification of human milk beyond 24 kcal/oz has not been well evaluated it is increasingly coming into practice.
- A proactive versus a reactive approach to growth with daily nutrition and growth assessments is favored to prevent repeated protracted poor growth performance.
- Feeding prescriptions should be adjusted according to daily weights and not weekly weights.
- Customized fortification may be required for some infants who are not growing as targeted. These infants may have differences in nutrient intake due to the variability of their mother's milk, with the use of donor milk or have energy expenditure higher than expected.
- Increases in volume or caloric density are possible to meet the greater needs of the infant. Some have advocated an adjustable approach to fortification based on growth and low BUN levels less than 9 mg/dL as a trigger for adding greater nutrient density with more fortification.[56]
- Additional fortification can be in the form of protein, formula or concentrate remembering that protein is the key to optimizing growth.
- There are also emerging technologies available that can measure macronutrient content in human milk samples down to a few milliliter volumes[57-60] These data may be helpful in growing infants since there is such variability in human milk samples between mothers whereby some milk may contain significantly less protein and fat that will not optimally support growth even with HMFs. However, these devices have not yet been approved by the FDA to support clinical decision making for selectively fortifying human milk in a targeted manner. More clinical data are required, along with more defined workflow and approval from FDA, before targeting fortification using human milk analyzers can be used clinically.

Quality and Process Improvement

- Provide education to all caregivers on nutritional planning and assessment including proactive strategies to prevent growth faltering
- Define volume practices and decision rules in feeding guidelines being used
- Define normal growth velocity targets based on growth charts
- Automate calculations of feeding volumes and calories

Outcome/Process Measures

- Anthropomorphic growth metrics
- Current Z relative to birth Z for growth metrics

EXAMPLE: Infant Feeding Nasogastric Tube Protocol

Title:	Feeding Nasogastric Tube: Infant [x] Policy [x] Procedure [ ] Guideline [ ] Other
Patient Population:	[ ] High Risk OB/Labor, Delivery and Recovery [ ] Post-partum [ ] Low Risk Infant [x] High Risk Infant
Unit(s) Affected:	[ ] L&D/BC/Antepartum [x] NICU [ ] Postpartum
Ancillary Services:	[ ] Pharmacy [ ] Nutrition [ ] Respiratory [ ] Social Work [ ] Lactation
Effective Date:	
Revision/Review Date(s):	

POLICY STATEMENT/SCOPE: N/A

RELATED POLICIES: N/A

DEFINITIONS: N/A

POLICY

1. Multidisciplinary collaboration will determine need for gavage feeding, and the type of nutrient, volume, frequency, plan for advancement and administration of gavage feedings.
2. Gavage feeding is indicated for infants requiring endotracheal intubation and infants with immature, weak, or absent suck, swallow, or gag reflex.
3. Only enteral products will be used to minimize risk of parenteral/enteral misadministration.
4. Prolonged oral gastric or nasogastric feedings may cause adverse oral stimulation and promote GERD and problems of oral aversion.
5. Feeding intolerance is frequently the first sign of illness.
6. Feedings will be held and the licensed medical provider be notified immediately if there are any negative abdominal findings, bilious or hemorrhagic residuals or evidence of feeding intolerance.
7. Non-bilious formula or breastmilk residuals can be re-fed after notifying the medical provider (see below).
8. Type of nutrient (e.g. breastmilk, formula, and fortifiers) will be documented at each feeding interval.
9. Feeding tube insertion is considered a stressful and moderately painful procedure (comparable to the pain of a heelstick). There is also evidence to suggest that the insertion of a feeding tube alters the cerebral blood flow in premature infants. Minimizing insertions will assist in minimizing exposure to pain and discomfort. (Wallace, 2014)
10. Bacterial contamination with pathogens is a documented problem with feeding tubes. While there is inconsistent evidence to suggest this may lead to an increased risk of feeding intolerance and NEC, it may be prudent to treat feedings, feeding tubes and all of the associated tubes in an aseptic manner in an attempt to minimize nosocomial contamination. (Wallace, 2014)

11. Venting of feeding tubes after feedings should be done after feeding has infused in order to prevent gaseous distention of abdomen.
12. For infants on nasal IMV or nasal CPAP the abdomen needs to be vented with an open 8 FR feeding tube.

PROCEDURES AND RESPONSIBILITIES

Procedure for insertion of NG or OG tube:

1. Assess infant to determine need for indwelling vs. intermittent gavage tube.
   a. Polyurethane indwelling feeding tubes (long term) should be used if an infant requires gavage feedings for > 24 hours. These tubes do not harden over time and can be left in place for up to 30 days.
   b. Polyvinyl chloride (PVC) tubes (short term) harden with time when exposed to the acidic environment of the stomach and should only be used for a single feeding or left in place 1-3 days. PVC feeding tubes have been implicated with tissue perforation (Wallace 2014).
2. Determine appropriate type and size of feeding tube.
   a. 16 or 20 inch feeding tubes are preferred over 36 inch feeding tubes in order to minimize the loss nutrients in tubing.
   b. If needed for decompression or venting, an 8fr will be more effective than a 5fr.
3. If an infant without a feeding tube needs to be gavaged after nippling part of a feeding, a rest period must be given before a feeding tube is passed.
4. Position infant for assessment/placement.
5. If placing a nasal feeding tube, use measuring tape to measure from the nose to the mid- earlobe to a point halfway between the xiphoid process and the umbilicus. If placing an oral feeding tube, measure from the mouth to the mid-earlobe to a point halfway between the xiphoid process and the umbilicus.
6. Put on gloves.
7. Pass the feeding tube through the mouth or nose into the stomach. If placing the tube nasally, lubricate the tip with sterile water or saline before insertion.
8. Verify correct tube placement:
   a. Inject 0.25-0.5mL of air into tube and auscultate over stomach. **NOTE:** Auscultation of air over the stomach can be unreliable and DOES NOT assure the tip of the tube is in the stomach.
   b. Aspirate residual from tube and verify gastric contents (color, consistency, and amount).
   c. While the x-ray is not a practical tool for routine assessment in the neonatal population, it does present the most accurate picture of placement. When x-rays are obtained for other purposes the tube insertion depth should be recorded and the tip location should be noted and tracked.
   d. Carefully track and record the position of the feeding tube each time it is used. Compare cm mark to measurement described in step 5 above.
9. Secure feeding tube to infant's face. Document cm mark (at nare or lip), characteristics of aspirate, and the date and time of insertion on the EMR.

Procedure for feeding/administering medication with NG or OG tube:

1. Verify correct position of the feeding tube with methods listed in step 8 above. Also note cm mark at nare or lip. Document this in the EMR.
2. Assess abdomen for bowel sounds, softness, girth, and color.
3. In the absence of a UAC/UVC, abdominal girth is to be measured at the level of umbilicus.
4. In the presence of a UAC/UVC, abdominal girth is to be measured directly above the level of the umbilicus.
5. Hold feeding and notify licensed medical provider ASAP for positive abdominal findings (such as: emesis, diarrhea/watery stools, loops of bowel, abdominal distention, increased girth, firmness, tenderness, discoloration of abdomen, decreased or absent bowel sounds, and/or heme positive (+) stools.
6. Document the amount, color, and consistency of residual or aspirate.
7. If non-bilious/non-hemorrhagic, residuals >50% notify licensed medical provider of the amount and if there are any signs of feeding intolerance. Decision will be made whether to subtract the amount from the total feeding volume from the next feed.
8. If non-bilious/non-hemorrhagic, residuals <50% should be returned and the total feeding volume given (if there are no other signs of feeding intolerance).
9. Feeding should be held for any sign of feeding intolerance and the licensed medical provider notified.
10. Residuals should not be checked if feedings are continuous.
11. Methods of administration:
    a. **Syringe pump:** Use syringe pump for ongoing or established intermittent or continuous feedings.
    b. **Hand controlled:** Slowly administer feeding with syringe over 15-30 minutes for a full feeding volume. Observe infant for intolerance of rate of administration.
    c. **Gravity controlled:** Attach syringe barrel without plunger to the feeding tube. Fill the barrel with feeding, control rate of administration by lowering or elevating the syringe. Observe infant for intolerance of rate of administration.
    d. **Continuous feedings:** Syringe and tubing will be changed every 3 hours.
12. If using intermittent feeding tube, pinch off and remove quickly after feeding complete. Use new tube with each feeding.
13. After administration of feeding or medication, flush indwelling tubes with 0.5-1 mL of sterile water.
14. Venting of feeding tubes after feedings should be done after feeding has infused in order to prevent gaseous distention of abdomen. Venting of feeding tubes should be continuous on all infants on nasal IMV, nasal CPAP, and high flow NC>2 L.
    a. A 10mL Gavifeed venting syringe (see picture below) should be attached to feeding tube between feedings. Gravifeed syringe should have end cap open to minimize resistance. Please place the syringe on a diaper or 4x4 to avoid spills.
    b. An 8 fr feeding tube will vent more effectively than a 5 fr feeding tube.
15. To facilitate gastric emptying, consider positioning infant prone or on the right side with head of bed elevated. If infant meets criteria for black to sleep positioning, need MD order for prone or HOB elevated.

16. A pacifier should be offered with gavage feedings for non-nutritive sucking if infant is awake and interested.
17. All feedings containing breast milk or any additives should have the syringe with a 90 degree angle, tip/tubing pointing up to maximize fat and nutrient delivery.
18. Document the type of nutrient and volume of feeding, residuals and emesis in the EMR record.

ATTACHMENTS

Attachment 1: Images of available catheters

FORMS/PARENT HANDOUTS

None

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EXAMPLE: Residuals & Feeding Intolerance Protocol

Use if residuals are checked routinely.

Check residuals with all NG feedings. Check residuals before restarting continuous feeds off greater than or equal to 1 hour. Residuals on continuous feeds with no break are not checked; follow P&P for continuous feeds.

Disregard:

1. Residual volume of less than 2ml regardless of infant's feeding volume.
2. Residual volume of less than 50% of feeding volumes (if there are no additional signs of feeding intolerance and the clinical evaluation is normal.)
3. Residuals less than 50% shall be refed and continue with feeding order without deducting residual from feeding volume. Do not refeed residuals that are bloody, brown and/or dark green bilious.
4. Residuals that appear light green or yellow are considered a normal gastric residual.

Physician/NNP/PA will be notified for any of the following signs/symptoms

1. Residuals that are bloody, brown and/or dark green bilious.
2. Residuals greater than 50%.
3. Residuals continue at 30-50% x 3 consecutive feedings of the current feeding volume.
4. Abnormal abdominal exam as evidenced by but not limited to: Increased distension: greater than 2 cm increase in abdominal girth; Abdominal discoloration (ie. Red and/or grayish black/blue); New onset visible bowel loops; Tenderness;
5. Repeated emesis
6. Change in characteristic of stool
7. The nurse may notify the physician at any time there is concern of feeding intolerance.

TOOL #10

EXAMPLE: Neonatal Feeding Protocol

	Weight Group 1	Weight Group 2	Weight Group 3	Weight Group 4
Birth Wt	< 750 grams	751-1000 grams	1001-1500 grams	1501-2000 grams
Daily Advance Rate	**15 mL/kg/day** BID rate increase= every 12 hours	**20 mL/kg/day** BID rate increase= every 12 hours	**25 mL/kg/day** QID rate increase= every 6 hours	**35 mL/kg/day** QID rate increase= every 6 hours
Feed Day				
1 **trophic**	10 mL/kg x 24 hrs **trophic**	10 mL/kg x 24 hrs **trophic**	10 mL/kg x 24 hrs **trophic**	10 mL/kg x 6 hr 20 mL/kg x 6 hr 30 mL/kg x 6 hr 40 mL/kg x 6 hr
2 **trophic**	10 mL/kg x 24 hrs **trophic**	10 mL/kg x 24 hrs **trophic**	20 mL/kg x 6 hrs 25 mL/kg x 6 hrs 30 mL/kg x 6 hrs 35 mL/kg x 6 hrs	45 mL/kg x 6 hr 55 mL/kg x 6 hr 75 mL/kg x 6 hr
3	20 mL/kg x 12 hrs 25 mL/kg x 12 hrs	20 mL/kg x 12 hrs 30 mL/kg x 12 hrs	45 mL/kg x 6 hrs 50 mL/kg x 6 hrs 55 mL/kg x 6 hrs 60 ml/kg x 6 hrs	65 mL/kg x 6hr HMF: 1:50 **optional** 90 mL/kg x6 hr *100 mL/kg x 6 hr ***Consider PO meds** 90 mL/kg x 6hr HMF: 1:25
4	35 mL/kg x 12 hrs 40 mL/kg x 12 hrs	40 mL/kg x 12 hrs 50 mL/kg x 12 hrs	75 mL/kg x 6 hrs 70 mL/kg x 6hrs HMF: 1:50 6 hrs	115 mL/kg x 6 hr 125 mL/kg x 6 hr 135 mL/kg x 6 hr 145 mL/kg x 6 hr D/C CVL
5	50 mL/kg x 12 hrs 55 mL/kg x 12 hrs	60 mL/kg x 12 hrs 70 mL/kg x 12hr HMF: 1:50	*100 mL/kg x 6 hrs 95 mL/kg x 6hr HMF: 1:25 105 mL/kg x 6 hrs 110 mL/kg x 6 hrs	150 mL/kg x 6 hr **160 mL/kg** Completed

	Weight Group 1	Weight Group 2	Weight Group 3	Weight Group 4
6	65 ml/kg x 12 hrs 70 mL/kg x 12hr Prolacta+8 or HMF 1:50	80 mL/kg x 12 hrs 90 mL/kg x 12hr HMF: 1:25	120 mL/kg x 6 hrs D/C CVL 125 mL/kg x 6 hrs 130 mL/kg x 6 hrs 135 mL/kg x 6 hrs	
7	80 mL/kg x 12 hrs 85 mL/kg x 12 hrs	*100 mL/kg x 12 hr *Consider PO meds 110 mL/kg x 12 hrs	145 mL/kg x 6 hrs 150 mL/kg x 6 hrs	
8	95 mL/kg x 12hr Prolacta+8 or HMF 1:25 *100 mL/kg x 12 hrs *Consider PO meds	120 mL/kg x 12 hr D/C CVL 130 mL/kg x 12 hrs	160 ml/kg Completed	
9	110 mL/kg x 12 hrs 120 mL/kg x 12 hrs D/C CVL	140 mL/kg x 12 hrs 150 mL/kg x 12 hrs		
10	130 mL/kg x 12 hrs 140 mL/kg x 12 hrs	160 ml/kg Completed		
11	150 mL/kg x 12 hrs 160 mL/kg Completed			
# Days to Full Feeding	11	9-10	7-8	5

TOOL #11

EXAMPLE: Neonatal Feeding Protocol

BW < 1kg			
Feeding Day	**Total Enteral Feeds mL/kg/day**	**Frequency**	**Comments**
1	10	q6	
2	10	q6	
3	10	q6	
4	20	q3	
5	20	q3	
6	20	q3	
7	40	q3	
8	60	q3	Prolact+6
9	80	q3	
10	100	q3	
11	120	q3	d/c PN & increase fortification with Prolact+8
12	140	q3	
13	160	q3	
BW 1-1.25 kg			
Feeding Day	**Total Enteral Feeds mL/kg/day**	**Frequency**	**Comments**
1	20	q3	
2	20	q3	
3	20	q3	
4	20	q3	
5	40	q3	
6	60	q3	Prolact+6
7	80	q3	
8	100	q3	
9	120	q3	d/c PN &increase fortification with Prolact+8
10	140	q3	
11	160	q3	
BW 1.25-1.5kg			
Feeding Day	**Total Enteral Feeds mL/kg/day**	**Frequency**	**Comments**
1	20	q3	
2	20	q3	
3	40	q3	
4	40	q3	
5	60	q3	LHMF to 24 cal/oz
6	80	q3	
7	100	q3	
8	120	q3	
9	140	q3	
10	160	q3	

EXAMPLE: Feeding Flow Chart

Please reference:

Figure 1 from: Yue-Feng Li, Hung-Chih Lin, Roberto Murgas Torrazza, Leslie Parker, Elizabeth Talaga, Josef Neu. Gastric Residual Evaluation in Preterm Neonates: A Useful Monitoring Technique or a Hindrance? Pediatrics and Neonatology 2014; 55:335-340.

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In This Section

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Human Milk/ Breastfeeding

Introduction

The benefits of human milk for term and preterm infants are well recognized[1-3] Human milk provides not only optimal nutrition, but also key digestive enzymes, direct immunologic protective factors, immunomodulators, anti-inflammatory factors, anti-oxidants, growth factors, hormones and other bioactive factors, prebiotics, probiotics and multiple cellular elements, with new components and interactions being discovered regularly.

While there are rarely medical contraindications to the use of a mother's breast milk, the most likely reason given for not providing human milk to VLBW infants is lack of availability. Mothers of VLBW infants should be educated and supported to ensure that their milk is available for their baby. A mother's successful commitment to supplying her milk is likely to have significant medical benefit for her VLBW infant in both the short and long-term. Human milk is more than nutrition. It is medicine for both the infant and the mother: the milk for the infant, and the provision of it for the mother.[4]

The World Health Organization (WHO), American Academy of Pediatrics (AAP), and the US Surgeon General's "Call to Action to Support Breastfeeding" all call for use of donor human milk (DHM) as the feeding of choice if mother's own milk (MOM) is unavailable or contraindicated.[5-7] Donor human milk has become a standard of care for VLBW infants over the last 10 years, primarily because of its proven reduction in NEC, among other morbidities.[8,9] A recent analysis of only three papers concluded that DHM did not reduce the risk of surgical NEC, and declared it was not cost-effective.[10] However several other studies have looked at any NEC and cost, and found DHM to be very effective.[11-17] In fact, a very recent meta-analysis of 18 studies concluded that DHM protected against bronchopulmonary dysplasia (BPD) in very preterm infants.[18]

Holder pasteurized donor human milk (PDHM) has been in use in some US NICUs for over 40 years. The use of PDHM, especially in Level 3 and 4 NICUs is increasing significantly, as is the number of non-profit human milk banks. In addition, there are several for-profit companies offering different forms of screened and processed DHM and DHM products (eg. fortifiers, cream) with some research showing that an exclusive human milk diet can further improve outcomes for VLBW infants.[15,16] There is current evidence that some forms of human milk processing (retort-processed; shelf stable) greatly reduce the immunologic protective factors in donor milk.[19]

As DHM is almost always used in conjunction with MOM, it is difficult to separate the protective effects of each. Concern has been raised about blurring the effects of MOM and DHM, especially within quality improvement and research efforts.[20] Another criticism of DHM is that mothers will likely abdicate their efforts to produce their own milk in favor of using DHM. Of the studies that have looked at this, all but 1 have seen some increase in the proportion of MOM used and only 1 has shown a decrease.[21-23]

POTENTIALLY BETTER PRACTICE #17

Human milk, should be used whenever possible as the enteral feeding of choice for VLBW infants.

Background, Rationale, and Goals

- Current research confirms that human milk (with appropriate fortification for the very low birth weight infant) is the standard of care for preterm, as well as term infants.[24]
- The AAP recommends:
  - All preterm infants should receive human milk;
  - Human milk should be fortified with protein, minerals, and vitamins to ensure optimal nutrient intake for infants weighting < 1500g at birth.
  - Pasteurized donor human milk, appropriately fortified, should be used if MOM is unavailable or its use contraindicated.[1,6]
- Evidence-based benefits of human milk feeding for preterm infants (beyond those already shown for term infants) include:[25]
  - Dose-related decreases in NICU length of stay
    - The use of breastmilk results in less residuals and faster realization of full enteral feedings.[26-28]
    - Reaching full feedings faster with the use of human milk means fewer days of IV's, less side effects from TPN, less infections and infiltrations from IV's, and less costly and fewer hospital days.[26,29]
  - Lower morbidity including risk of the following:
    - Sepsis[30]
    - Necrotizing enterocolitis[31]
    - Urinary tract infection[32]
    - Retinopathy of prematurity[33]
    - Chronic lung disease[34]
  - Improved gastrointestinal function and integrity via the following[35-37]
    - Decreased gastric pH
    - Increased gastrointestinal motility
    - Accelerated mucosal immunity
    - Improved gut microflora
    - Decreased mucosal permeability leading to reduced bacterial translocation
  - Enzymes in breastmilk help immature infants absorb and utilize nutrients more efficiently[38] and may also improve absorption of nutrients when breastmilk and artificial milks are combined.[39]
  - Human milk has anti-oxidant properties that assist the preterm infant in coping with increased oxidative stress.[40-42]
  - VLBW infants receiving breastmilk have improved visual development and less retinopathy of prematurity.[29,43-49]
  - Improvement in indexes of neurodevelopment that persist into at least adolescence.[50]
- Benefits of a human milk diet persist beyond NICU stay.
- Donor human milk is cost-effective.[14,16,17]
- Exclusive human milk feedings (human milk plus fortifiers made from human milk) may be an additional step to prevent NEC and other morbidities, and to optimize outcomes for VLBW infants.[13,15]

Recommendations, Guidelines and Algorithms

- Create a supportive environment to maximize milk production in the early postpartum period.
- Teach every mother hand expression and collection techniques to maximize colostrum availability. (See Jane Morton MD DVDs: "Combining Hand techniques with Electric Pumping to Increase Milk Production" and "Making Enough Milk, The Key to Successful Breastfeeding…Planning for Day One", available from www.breastmilksolutions.com).
- Establish a relationship with a milk bank and procedures for obtaining heat-treated donor milk quickly or maintain a reserve supply in the NICU. (www.hmbana.org, www.prolacta.com).
- Retort processed (shelf-stable) donor human milk products cannot be recommended at this time because of the lack of research as to safety, growth, infectious morbidity and other outcomes. Limited research to date suggests immunologic factors are significantly reduced.[19]

Quality and Process Improvement

- The first feeding for VLBW infants should always be colostrum or breastmilk (EBM or PDHM).
- Mothers should have education on manual expression, breast massage and colostrum collection in addition to pump use and safe handling of human milk.
- Establish policies and procedures for obtaining, storing, handling and using DHM products.

Outcome/Process Measures

- If colostrum or breastmilk is not available in the NICU, are there documented efforts to contact the mother before providing alternatives?
- Survey of NICU staff attitudes and knowledge regarding human milk and breastfeeding
- For VLBW infants is the first feeding EBM or PDHM or formula?

POTENTIALLY BETTER PRACTICE #18

Obstetric, perinatal and neonatal professionals should counsel mothers when breastmilk may be of concern or contraindicated.

Background, Rationale, and Goals

- As important as breastmilk is to the VLBW infant, prenatal, perinatal, and neonatal care providers should be aware there are cautions and contraindications regarding use of an individual mother's breastmilk for her infant. The physician will need to weigh the risks of using breastmilk from a mother with potentially transmittable diseases or medications against both the short-term and long-term risks of withholding breastmilk from the VLBW infant.
- Pharmaceutical manufacturers' inserts typically discourage breastmilk use, often due to lack of medication safety data and legal concerns.
- Similarly, discontinuing breastfeeding for a self-limited or treatable maternal illness deprives the infant of the maternal antibodies after having been exposed to that illness.

Current contraindications to receiving breastmilk in the USA:[51]

- Certain maternal illnesses
  - HIV/AIDS
  - Human T-Lymphotropic Virus Type I & II
  - Active tuberculosis in mother prior to treatment. Pumped milk may be used.
- Certain maternal medications[52]
  - Anti-metabolite or cytotoxic medications (e.g. anti-cancer)
  - Drugs of abuse: heroin, cocaine, amphetamine, and phencyclidine.
- Infants with classical galactosemia should not receive breastmilk. Infants with the Duarte variant may receive some of their nutrition via human milk with careful metabolic monitoring.
- The use of marijuana while breastfeeding remains controversial, especially for VLBW infants.

Most medications are safe for breastfeeding mothers and their infants.[52] Most common maternal post-partum medications are not contraindications to breastfeeding or the use of expressed breastmilk for VLBW infants (e.g. magnesium sulfate, tocoloytics, most antihypertensives, pain medications, antibiotics). Some medications may be preferred over others due to decreased excretion into milk, or experience with preterm infants. A drug that is not compatible with breastfeeding can often be changed to another drug that is compatible.

- **Methadone** in any dosage is compatible with breastfeeding.
- **Smoking** should be discouraged. Nicotine is present in human milk of women who smoke, but there is no evidence nicotine presents a health risk to the nursing infant.
- **Alcohol** in large quantities may have potential effects on the VLBW infant and maternal milk supply. More than occasional consumption should be discouraged.
- **Psychotropic Drugs** are not contraindicated for breastfeeding mothers. Because concentrations in breastmilk differ, some medications are preferred over others
- **Radioactive medications** should be approached with caution. Most, but not all, radioactive substances can be used in breastfeeding mothers after withholding the milk for an appropriate period.
- Radiocontrast agents such as gadolinium for

magnetic resonance imaging (MRI) and iodinated compounds for computed tomography (CT) are safe.

Immunizations: Lactating women may be immunized as recommended for adults to protect against measles, mumps, rubella, tetanus, diphtheria, influenza, Streptococcus pneumonia infection, Hepatitis A, Hepatitis B, and Varicella. [51]

Certain maternal infectious diseases may pose challenges to breastfeeding or the utilization of expressed milk in the NICU.[51]

- **Hepatitis A:** Immunoglobin may be given if maternal symptoms start 2 weeks before to 1 week after infant delivered. Breastfeeding is encouraged.
- **Hepatitis B:** Infants of women with Hepatitis B Virus (HBV) should receive HBIG and HB Vaccine within the recommended time. The medications do not need to be given before breastfeeding is initiated.
- **Hepatitis C:** Transmission of HCV by breastfeeding is theoretically possible but has not been documented. According to current guidelines of the US Public Health Service, maternal HCV infection is not a contraindication to breastfeeding. The decision to breastfeed should be based on informed discussion between a mother and her health care professional.
- **Varicella-Zoster Virus:** Infants of mothers with active Varicella-Zoster Virus (VZV) may breastfeed after mothers are no longer infectious. The infant may require VZIG. Expressed breastmilk may be given to the infant if no skin lesions involve the breasts and the infant has received VZIG. 51 Milk supply should be established and maintained while mother and infant are isolated.
- **Measles:** Infants of mothers with measles should be given IG and may breastfeed when the mother is no longer infectious (72 hrs after onset of the rash). The breastmilk may be pumped and given to the infant.
- **Women with Herpes Simplex Type 1** lesions on their breasts should refrain from breastfeeding or feeding expressed breastmilk from the affected breast until the lesions have healed. Active lesions elsewhere should be covered during breastfeeding, and careful hand hygiene should be used. Women should be encouraged to pump until lesions are clear, so milk supply is not interrupted.
- **Cytomegalovirus (CMV):** Refer to **PBP #32**

Recommendations, Guidelines and Algorithms

- A current, reliable reference for drugs and breastfeeding and maternal and infant illnesses should be immediately available in all antepartum, perinatal and post-partum areas, especially the NICU. The PDR is NOT a reliable reference. Recommended references are:
  - US Drugs and Lactation Database: LactMed, available at: http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?LACT
  - Thomas W. Hale R.Ph, PhD, Medications and Mother's Milk available at https://medsmilk.com/
  - Lawrence and Lawrence, Breastfeeding: A Guide for the Medical Profession 8th Ed, 2016
  - Briggs, G.G., Freeman, R.K., Yaffe, S.J.Drugs in Pregnancy and Lactation, 11th Ed, 2017, Baltimore, MD, Williams-Wilkins
  - LactMed website - https://toxnet.nlm.nih.gov/newtoxnet/lactmed.htm
  - LactMed app - https://toxnet.nlm.nih.gov/help/lactmedapp.htm
- The current edition of the Report of the AAP Committee on Infectious Diseases[51] should also be available in the NICU or on-line, and/or Lawrence & Lawrence[53]

- Nursing competencies should include information on maternal illnesses and medications and human milk.
- Infection control policies and procedures should include information and recommendations regarding breastfeeding and expressed human milk.

Quality Improvement: Outcome/ Process Measures

- Inventory available resources: Are appropriate references available in key antepartum, perinatal, post-partum and NICU areas and/or easily on line?
- Survey staff to assess their awareness of resources.
- Are infectious disease/isolation policies consistent with current breastfeeding policies, and up to date with current references?
- Is there a consistent policy as to when breastmilk should be discarded, and are those reasons documented?

POTENTIALLY BETTER PRACTICE #19

Educate health care professionals & and encourage advocacy for human milk for NICU infants.

Background, Rationale, and Goals

Obstetric, perinatal, neonatal and pediatric professionals should have the knowledge, skills and attitudes necessary to effectively support the provision of breastmilk to the VLBW infant. Inconsistent, inaccurate information and lack of support by health care professionals have been cited as reasons for breastfeeding failure among many groups of mothers.[54,55] Unfortunately, some healthcare providers may not have not had the opportunity during training to gain the knowledge and skills needed to assess, support, and assist women reach their breastfeeding goals.[54-56]

Obstetric and perinatal professionals should screen for risk factors for insufficient lactation or breastfeeding problems. As with any physiologic process, historical or physical findings may signal potential or actual barriers to breastfeeding success.[57,58]

Recommendations, Guidelines and Algorithms

- Hold regular CME, CEU and other in-service education, both multidisciplinary and physician-only, regarding lactation issues.
- Make key resources (e.g. drugs & breastfeeding information, basic text or handbook) available in all care areas (hard copy and/or digital).
- Develop/test for competencies regarding breastfeeding knowledge and skills. http://www.usbreastfeeding.org/p/cm/ld/fid=170
- Subsidize utilization of on-line breastfeeding management courses.
- Develop "scripts" for common or difficult situations.
- Designate a Medical Director of Lactation as a resource person.
- The advantage to having a physician in this position is the added medical knowledge base, prescriptive ability and credibility of physician-to-physician communication.
- Women should be screened for risk factors at the first prenatal visit by history and physical exam using a standardized format.
- Continued risk screening (history and physical exam) should occur as appropriate during prenatal visits, especially if the pregnancy becomes complicated and/or early delivery is anticipated.
- Risk factors for insufficient lactation or other breastfeeding problems should be communicated to the perinatal and postpartum staff as well as the infant's physician.
- Explore BFHI and Neo-BFHI Certification. http://www.ilca.org/main/learning/resources/neo-bfhi
- https://www.babyfriendlyusa.org

Quality Improvement: Outcome/Process Measures

- Use nursing /physicians' surveys of lactation knowledge, skills and attitudes to guide incremental program planning.
- Is there a Medical Director of Lactation?
- Are key resources immediately available to physicians and nursing staff?
- Is there a risk-screening tool in the prenatal record?
- Patient survey regarding breastfeeding support by MDs and RNs and others

POTENTIALLY BETTER PRACTICE #20

Mothers and families should be given accurate information about human milk for VLBW infants, and their decisions respected.

Background, Rationale, and Goals

The decision to breastfeed is usually made early in the pregnancy if not before.[59,60] Provider encouragement significantly increases breastfeeding initiation among women of all social and ethnic backgrounds. [61-63] Obstetric and family practice physicians, nurses and other staff are especially well placed to begin education, risk screening and anticipatory guidance regarding lactation.[64,65] Antepartum hospital stays are opportunities for dispelling myths (e.g. "I can't breastfeed because I have a premature infant.") and for providing anticipatory guidance regarding procedures to ensure a full milk supply and safe storage and use of pumped milk. A mother's perceptions of her prenatal physician's and hospital staff's attitudes on infant feeding is a strong predictor of later breastfeeding.[66]

Obstetricians, pediatricians, family practitioners and hospital staffs often unintentionally undermine breastfeeding by providing formula company access to patients via commercial literature and formula marketing strategies such as baby clubs, "gift" bags and free formula. Despite strong evidence to the contrary, breastfeeding is still perceived by some as a lifestyle choice, not a healthcare issue. Health care providers are afraid to "push" breastfeeding for fear of making mothers feel "guilty" if they do not breastfeed.[67] The AAP's policy statement encourages "physicians to work actively toward eliminating hospital practices that discourage breast feeding (e.g. infant formula discharge packs…").[6]

Recommendations, Guidelines and Algorithms

- Patient education should begin during routine pre-pregnancy obstetric/gynecologic visits and continue through the pregnancy, delivery & postpartum.
  - If a mother indicates a choice not to breastfeed, the reasons for that decision should be explored, as they may be based on misunderstanding of the value and challenges of breastfeeding.
  - Continued education should occur during prenatal visits, especially if the pregnancy is complicated and early delivery anticipated.
  - Specific anticipatory guidance should be provided if problems are discovered.
  - Mothers hospitalized with preterm labor or other complications should receive additional encouragement and education about breastfeeding.
  - Patients should be referred to appropriate, culturally competent, breastfeeding resources: breastfeeding classes; lactation consultants; mother-to-mother support groups.
  - Toward the latter part of pregnancy, patients should be instructed regarding potential barriers to breastfeeding that routine hospital care may place in their path, and suggested ways to resolve these barriers.
  - Remove formula company influence from the office and hospital.
    - Use non-formula company materials.
    - Remove formula "baby-club" materials in office and clinics.

    - No discharge formula company marketing bags should be distributed. See http://banthebags.org
  - No donation or sale of patient lists/contact information to formula or marketing companies (HIPPA).
- Provide visual cues (artwork, posters, calendars) that actively support breastfeeding,
- Support breastfeeding patients and staff by providing space and supplies for pumping and breastfeeding.
- Nurses, physicians and other staff caring for either hospitalized or outpatient high-risk antepartum mothers should communicate the importance of breastfeeding to the mother and infant.
  - Hospitals should have videotapes, DVDs or closed-circuit television programs delineating the "why" and "how" of providing breastmilk for preterm or ill NICU infants.
  - Neonatal prenatal consults should include discussion of the importance of a mother's own milk and the steps to be taken to assure a good milk supply.
  - Prenatal lactation consults should be available for both inpatient and outpatient high-risk patients.
  - The physician(s) in charge of the mother's care should reinforce the importance of breastmilk by inquiring about the mother's pumping or breastfeeding progress during routine post-partum care.
  - The first visit in the NICU with the neonatologist or pediatrician should include discussion of the value and benefits of human milk for the VLBW infant (with documentation in the medical record). Care should be taken to separate the decision to provide a few weeks of pumped breastmilk from the commitment to long-term, exclusive breastfeeding.
  - Physicians should find opportunities to praise mother's efforts to provide this "liquid gold" for their VLBW infant.
  - Standing admission orders should include "Lactation Consultation for all NICU infants."

Quality Improvement: Outcome/ Process Measures

- Inventory all current educational materials (written, audio, video, DVD, etc.) for content and bias. Establish a mechanism for periodic review.
  - Have a plan to regularly inventory your educational materials, artwork calendars in the environment and office/hospital surroundings
  - Office and hospital scavenger hunt for formula logos, materials.
- Does the prenatal record or admission record have a specific check box or blank regarding intention to breastfeed and education given?
- Survey of staff regarding attitudes towards breastfeeding as a health care issue.
- Review of policies and procedures regarding vendors and vendor materials in the environment.
  - Survey staff awareness of corporate compliance issues regarding vendor gifts.
- Chart audit of antepartum consults by neonatal service to determine if breastmilk use was discussed.
- Is a Lactation Consult routinely ordered on antepartum high-risk patients?
- Chart audit of breastfeeding education for mothers during the antepartum period.
- Documentation of such discussions in the medical record by chart review.
- Presence of LC order on standing postpartum or NICU admission orders.

POTENTIALLY BETTER PRACTICE #21

Hospital policies and practice should support breastfeeding in a coordinated, consistent manner.

Background, Rationale, and Goals

Mothers of VLBW infants are less likely to breastfeed than mothers of healthy, term infants.[68] Family members and health care professionals sometimes discourage these mothers from initiating lactation feeling that providing milk will be an added stress. Mothers may be advised, in error, that their medications preclude the use of their milk. Similarly, mothers may be inappropriately advised that their high-risk conditions may interfere with adequate volumes or composition of milk.

Mothers of VLBW infants often feel a loss of control of their lives and a loss of role as a mother. The infant is in the hands of strangers and she is the outsider. Studies indicate that providing milk for their infants helps mothers cope with the emotional stresses surrounding the NICU experience and gives them a tangible claim on their infants.[69,70]

Recommendations, Guidelines and Algorithms

- All post-partum and NICU nurses should have a basic level of knowledge re lactation physiology and breastfeeding support, as evidenced by "competencies".
- Breastfeeding supportive postpartum and nursery breastmilk policies and procedures should be in place for:
  - Collection, storage and handling of mothers' own milk for hospitalized infants

    (Refer to **TOOL #13** on page 74 for an example of a Human Milk Storage and Handling Protocol.)

  - Accidental feeding of the wrong mother's milk to an infant. https://www.cdc.gov/breastfeeding/recommendations/other_mothers_milk.htm
  - Use of fresh and pasteurized donor human milk, as appropriate.
  - Skin-to-skin (kangaroo care) https://health.ucsd.edu/specialties/obgyn/maternity/newborn/nicu/spin/staff/Pages/policies.aspx
  - Peer counselors and Mother-to-Mother Support groups
- A NICU breastfeeding support committee or task force should be multidisciplinary, including physicians, nurses, dietitians, occupational therapists, pharmacists, lactation consultants, and breastfeeding mothers.

Quality Improvement: Outcome/ Process Measures

Regular review of policies, procedures and competencies will assist in focusing attention toward areas for possible improvement.

- Do appropriate policies exist? How often are they reviewed and updated?
- Are all caregivers competent to provide needed education and support?
- Assessment and measurement of competencies

POTENTIALLY BETTER PRACTICE #22

Mothers' milk supply should be established and maintained.

Background, Rationale, and Goals

- ***The Decision to Provide Milk.*** For a mother, the decision to provide milk for a VLBW infant is quite different from the decision to breastfeed a healthy, term infant.
  - The decision is usually made based on health-related issues (i.e. The vulnerability of the infant puts him at greater risk of diseases from which breastmilk may protect him).
  - Mothers who did not intend to breastfeed, often decide to pump, while not planning to feed at the breast.[71,72]
  - Mothers are highly influenced by the advice of professionals who care for the infant, feeling thankful for (not coerced by) their guidance and even resentful if misinformed about formula being equally acceptable[73]

- ***Contact with Infant.*** Visual and tactile contact with her infant allows the mother to recognize the "reality" of the birth and the need for provision of breastmilk.
  - Early maternal-infant contact is associated with increased initiation and duration of breastfeeding.[74]
  - Skin-to-skin care is associated with increased amounts of milk.[29,75]
  - Contact with her infant stimulates the maternal entero-mammary system and helps to establish the infant's normal gut microbiome.
  - Skin to skin care has been shown to be safe and effective in promoting physiologic stability and breastfeeding in premature infants.[76,77]
  - Contact may also facilitate bonding and attachment.[76]

- ***Non-Pharmacologic Milk Stimulation***. Non-pharmacological means to stimulate milk production include expressing milk while relaxed at the bedside (or in proximity to the infant), skin-to-skin care (see above) and non-nutritive tasting at the breast. These interventions may stimulate both prolactin and oxytocin as mothers become conditioned to readily let down with psychological and tactile stimuli.
  - Psychological inhibitors of the neuroendocrine let-down reflex include fear, pain and embarrassment, while positive stimuli include the sight, sound or feel of the infant.
  - The average pumped milk yield without let-down is less than 4% of available milk.[78,79] The key to milk production is milk removal, which is largely dependent on the let-down reflex.

- ***Early Use of Expressed Milk.*** The use of human milk for trophic feeds in VLBW infants is associated with improved milk production[26] and sends the important message to staff that preterm formula is not equivalent to human milk for this vulnerable population.

- ***Expressing Milk.*** Early, frequent, and effective breastfeeding or pumping appears to be the most important factor in establishing full lactation/ "coming to volume".[80] **The object is to maximize each mother's milk supply while minimizing the number of minutes per day she needs to spend on milk expression.[81]**
  - Prolactin bursts associated with suckling or breast pumping support the continued growth of secretory tissue in the maternal breast for several weeks or months after birth.[82]

- Initiating early pumping (within the first few hours) is associated with higher levels of milk production. Even pumping 1 hr post-delivery results in a higher milk yield than at 6 hrs.[80]
- Recommendations for the ideal frequency of pumping (8-10 times every 24 hours) are based on the frequency of breastfeeding a term infant, but research has demonstrated most mothers pump 5-6 times per 24 hrs.[83,84]
- An individual mother may need to pump more or less frequently depending on her breast storage capacity and rate of milk synthesis.[85,86]
- The hospital staff is integral to the initiation of pumping and establishment of a regular pumping schedule.

- The most important determinant of the exclusivity and duration of breastfeeding for the mother-infant dyad is the volume of milk produced which typically plateaus by 2 weeks postpartum.[87] The average baseline milk production on days 6-7 postpartum is highly predictive of adequacy of milk volume (defined as ≥ 500 mL/d) at 6 weeks post-partum.[80]

- It is not clear to what extent preterm birth contributes to limitation of milk supply in mothers of VLBW infants. Lactogenesis I/Secretary Differentiation (the hormonal preparation and growth of breast tissue) starts during pregnancy.[87] Some experts suggest that the mother of an extremely preterm infant may be at a disadvantage regarding milk production as she has not had the full time for breast growth and development. Also, Lactogenesis II/Secretory Activation may be delayed in mothers of very preterm infants and affected by maternal steroid administration.[88]

- Mothers of VLBW infants typically must express milk for several weeks before the infant can be put to breast, and for several weeks after discharge, before full exclusive breastfeeding is achieved, if ever.

- The initiation and maintenance of lactation for mothers of VLBW infants is best accomplished with a hospital grade, automatic-cycling electric "double" pump. "Double" electric pumps, enabling a mother to pump both breasts simultaneously, should be consistently available to the mother during her hospital stay and at discharge. In addition, staff should be available and committed to helping the mother establish a regular pumping schedule with this equipment. In contrast to sequential pumping, the double pump results in higher milk yield, reduced time, and a higher prolactin level.80

- Because of lactation physiology, a full milk supply must be established for the tiny preterm infant, just as it is for a full term healthy infant. Just "keeping up" with the VLBW infant's needs is not sufficient, as the mother may be unable to call upon a larger milk supply when the infant's needs increase.

- ***Massage & Manual Expression.*** Breast massage has been shown to improve milk production[89,90] Effective emptying is critical to maximizing milk production and preventing engorgement and mastitis.
  - Massage of the areolar-nipple area, immediately prior to pumping, may help stimulate a let-down reflex, a prerequisite to effective emptying.
  - Manual expression, used in conjunction with electric pumping, facilitates the collection of small volumes of colostrum and helps initiate milk flow when the breasts are engorged.
  - Later, manual expression, when practiced synchronously with breastfeeding, may improve

milk transfer from the breast to the baby.
- Hand expression several times a day along with hands-on pumping can increase milk output significantly.[91]

- ***Increasing Milk Supply.*** It is very common for a mother of a VLBW infant to have her milk supply decrease after 4-6 weeks of pumping, as she resumes her normal daily routine or returns to work. Even if a full milk supply was never established, every effort should be made to help mothers of VLBW infants to maintain the supply they have.
  - Returning to an increased pumping schedule (including night-time expression) may be useful after evaluation of the mother's situation.
  - If impaired let-down is a problem, relieving pain with analgesics and topical treatment of sore nipples may help.
  - Forcing fluids has been shown to have no benefit in increasing a milk supply.[92,93]
  - Mothers also need to be educated that they do not need to drink milk to make milk.

- ***Galactogogues***. Many medications and herbal therapies have been recommended as galactogogues (a material that stimulates the production of milk), but few have been subjected to rigorous randomized controlled trials.
  - Metoclopramide (Reglan®) is no longer recommended due to the risks of depression and tardive dyskinesia with prolonged use.
  - Domperidone (Motilium™) is widely used in Australia, Canada, Mexico and Europe with a good safety record[94,95] but is not FDA approved for increasing milk supply in the US at present.
  - More than thirty herbs are considered to be galactogogues.96 Fenugreek (Trigonella Foenum-graecum) is one of the oldest medicinal plants, dating back to Hippocrates and ancient Egyptian times. As Fenugreek is a food additive, it is felt to be safe, although mothers' perspiration and milk often smells like maple syrup and may decrease blood glucose in mother and/or infant.
  - Galactogogues are generally prescribed along with recommendations regarding the frequency and thoroughness of expression.

- ***Monitoring Milk Supply.*** Ongoing monitoring of a mother's milk supply via a pumping log can provide opportunity for intervention before the milk supply is irretrievably low.
  - A NICU-designed diary-log for mothers to record their pumping history cues mothers to visit, pump and hold their infants frequently.[97] (Refer to **TOOL #14** on page 82 and https://health.ucsd.edu/specialties/obgyn/maternity/newborn/nicu/spin/parents/Pages/default.aspx)
  - Emerging technology (Apps/volume-measuring pumps) may enable easier monitoring of milk supply both in the hospital and at home.
    - Refer to **Tool #15** on page 83 for examples of pumping apps for smartphones.
  - Each mothers' milk supply should be reported and discussed on rounds.

- ***Lactation Experts.*** Although all healthcare professionals who care for mothers and infants should have a general knowledge of lactation physiology and breastfeeding management, supporting the mother of a NICU infant often requires special knowledge, skill and experience.
  - International Board-Certified Lactation Consultants (IBCLC) are one method to assist in increasing breastfeeding rates in the NICU through staff and mother education, clinical consultation and support. [98,99]
  - Lactation counseling by health care professionals for mothers of VLBW infants

has been shown to increase the incidence of lactation initiation and breastmilk feeding without increasing maternal stress and anxiety.[100]
- In some units, well-trained NICU RNs may have the knowledge and experience to counsel and manage complicated NICU breastfeeding issues.[71,97]
- NICU peer counselors have been shown to significantly increase the odds of breastfeeding at 2, 4, 8 and 12 weeks after birth.[101]
- Postnatal peer counseling was also found to increase both exclusive and any breastfeeding of term LBW infants at 6 months.[102]

Recommendations, Guidelines and Algorithms

- Peripartum caretakers should begin a discussion, as appropriate, of provision of breastmilk as something only the mother can do.
- Develop practices and policies to encourage skin-to-skin contact for ALL infants, not just breastfed ones. Such contact should be an expectation for the development of the parental-VLBW baby relationship.
  - Those infants without immediate problems (e.g. borderline preemie, Infant of a Diabetic Mother, asymptomatic congenital anomalies) should be allowed skin-to-skin care and immediate post-partum breastfeeding, before being removed to the NICU for diagnostic or therapeutic procedures.
  - All awake mothers should be given the opportunity to see, and if possible, touch, their ill infants prior to transfer to the NICU.
  - Identify knowledgeable personnel who can assist positioning and supporting mother and baby
  - Provide chairs (semi-reclining), space, and screens for privacy as requested.
  - Educate staff re the physiological and psychological benefits of skin-to-skin care.
- Provision should be made for every mother separated from her infant to have access to an appropriate breast pump both at home and in the NICU post maternal discharge.
  - Secure sufficient number of pumps to ensure access.
  - Hospital staff should be trained in acquiring pumps for women.
  - Develop a breast pump loan program for the first few weeks for those mothers with no other resources.
  - Adjust the postpartum nurse/patient ratio to support breastfeeding care and to physically assist with pumping whenever needed.
  - Nursing staff should determine who will be responsible for assisting the mother to initiate pumping (post-partum RN? NICU RN?) and who will be consistently available to assist a newly delivered mother with pumping (NICU RN, postpartum RN?)
- Teach mother the adjunctive skills of manual expression and breast massage
  - Identify skilled staff to demonstrate hand expression and breast massage to mothers.
  - Utilize available handouts or videos which demonstrate this technique J. Morton: https://med.stanford.edu/newborns/professional-education/breastfeeding/hand-expressing-milk.html
  - Identify tools and methods of assuring complete collection and transport of small volumes of colostrum.
  - Improve staff and MD awareness of the importance of the numerous gastrointestinal and immunological effects of the use of colostrum.

- Establish policies and ordering practices that limit early feeds to colostrum/human milk. (Avoid orders such as: "maternal breastmilk or preterm formula…")
- Each mother's 24 hour milk supply should be monitored frequently.
  - Use a pumping log (Refer to **TOOL #14** on page 82.)
  - Identify responsible care providers to assist mother with initiation and maintenance of pumping record.
  - Approach milk supply as a "vital sign" to be monitored by the RN.
- NICU staff members should be familiar with galactogogues which may be used or requested by NICU mothers
  - Establish communication and education with the mother's Obstetrician or primary care provider around issues of lactation.
- Provide appropriately educated and experienced experts to assist mothers and train staff.
  - Hire or contract with an appropriately experienced IBCLC, OR
  - Train an existing NICU RN or RD to be an IBCLC or lactation resource person, OR
  - Train all NICU personnel to manage complicated lactation problems and issues.
  - Utilize peer counselors to support pumping and breastfeeding
- Develop guidelines for IBCLC/lactation resource person interaction as part of the multidisciplinary care team.
  - Participation in multidisciplinary rounds and teaching rounds
  - Consultations and systematic follow-up
  - Creation and evaluation of patient literature
  - Education for other NICU staff
  - NICU breastfeeding support committee or program
  - Research as appropriate
  - Key lactation facts as part of RN "Kardex" or separate lactation "Kardex" (Plan of Care).
- If lactation consultants (LC) are used, LC's should "bill" (i.e. keep records of services performed) even if their services are not directly reimbursed at present.
- Develop and use a maternal discharge educational and skills checklist.

Quality and Process Improvement

- Is maternal-infant contact documented in nursing or medical record?
- Regular review of availability of appropriate pumps and supplies (including loaner pumps)
- Is there a facility in or near the NICU for mothers to use for pumping when they are visiting or is provision made for mothers to pump at their infant's bedside?
- Review all policies regarding human milk in the NICU – what is missing?
- One person designated to monitor discussion of milk supply on rounds.
- Hours of availability of lactation support in the NICU and for mothers of NICU infants on the post-partum unit.
- Reimbursement for LC services
- Presence and utilization of a lactation documentation tool
- Availability of a personalized breastmilk pumping diary-log for mother
- Review infant's chart for notation of milk production
- Maternal education on manual expression, breast massage and colostrum collection documented?
- Are post-partum providers competent in helping mothers collect colostrum?
- Are NICU staff encouraging and willing to use even small volumes?

- If colostrum is not available in the NICU, is there an effort to contact the mother before providing alternatives?
- Review policies for visitation, skin-to-skin care, etc.
- Assess adequacy of bedside pumping equipment and appropriate chairs

Outcome/Process Measures

- What percent of informed mothers initiated pumping?
- What is the "dosage" of mother's own milk and donor milk an infant is getting daily? Over the first 28 days? Over the hospital course?
- What percentage of mothers are providing breastmilk at any given time?
- What percentage of infants are getting any/exclusive human milk at discharge?
- What percentage of VLBW infants receive colostrum as their first feed?
- What percentage of charts have mother's milk supply documented?
- Survey of maternal satisfaction with lactation education and support.
- Incidence and extent of skin-to-skin care.
- Periodic assessment of number (%) of mothers with inadequate milk supply after day 14 (< 350 mL/24 hrs)
- All mothers who need them have appropriate pumps?
- Time of mother's first pumping.

POTENTIALLY BETTER PRACTICE #23

Human milk should be handled to ensure safety and maximal nutritional benefit to the infant.

Background, Rationale, and Goals

Although human milk has remarkable antibacterial properties, it is not sterile and should be handled and stored properly to maintain its nutritional and immunological potential, and to prevent transmission of infection.[103] Storage in a monitored, appropriately controlled hospital freezer is preferred over storage at home whenever possible.

- The California Tissue Bank Licensing Act does not apply to the storage of a mother's own milk for use for her infant in the hospital (Ca Health & Safety Code §1648) but is needed for storage and use of donor human milk.
- Appropriate steps should be taken to ensure an individual mother's milk is given only to her own child, unless the milk has been heat-treated under standardized conditions[103]. Although the risk of transmission of infectious agents with a few feedings of another mother's milk is incredibly small, many families are quite concerned and need careful explanations and to see action being taken.
- Mastitis is a complication for pump-dependent mothers and has been associated with irreversible compromise of milk production. In addition to increasing the frequency of emptying, prompt antibiotic treatment may protect milk production. Although usually not a problem for a healthy term infant or relatively healthy growing preterm infant, some extremely preterm or ill infants have been shown to acquire pathogens from human milk, usually streptococcus or staphylococcal species.[51]

Recommendations, Guidelines and Algorithms

- Every NICU should have a policy regarding safe storage, handling and administration of mothers' own milk and donor human milk. https://www.hmbana.org
    - Every NICU should have a policy regarding misadministration of human milk (i.e. a mother's milk given to the wrong infant). https://www.cdc.gov/breastfeeding/recommendations/other_mothers_milk.htm
- Mothers should be appropriately treated for mastitis should it occur.
- Although it is neither clinically necessary nor cost-effective to routinely culture all mothers' milk in the NICU,[51] appropriate evaluation of recurrent feeding intolerance, recurrent infection, or unusual infections should include a review of mothers' handling, storage and transport of milk, and possibly microbiologic assessment of the milk.
- Temperature controlled milk warmers should be used, whether water-bath or waterless variety.
- Barcoding has been shown to reduce misadministration errors and should be used for both MOM and DHM.[104]
- Dedicated space for nutrition preparation should be used [104,105] and such preparation should follow American Dietetic Association guidelines.[106]
- Dedicated, appropriately-trained milk technicians have been shown to reduce bedside RN workloads, reduce infant time to full feeds and reduce costs.[107]

Quality Improvement: Outcome/ Process Measures

- Is there a policy regarding safe storage and handling of human milk, including DHM?
- Is barcoding available for MOM and DHM?
- Is there a policy for misadministration of human milk?
- Monitor misadministration cases for number and appropriate handling of the case

EXAMPLE: Human Milk Storage and Handling Protocol

Title:	**BREASTMILK: Collection, Storage, and Preparation** [x] Policy [ ] Procedure [ ] Guideline [ ] Other
Patient Population:	[x] High Risk OB/Labor, Delivery and Recovery [x] Post-partum [ ] Low Risk Infant [ ] High Risk Infant
Unit(s) Affected:	[x] L&D/BC/Antepartum [x] NICU [x] Postpartum
Ancillary Services:	[ ] Pharmacy [ ] Nutrition [ ] Respiratory [x] Nutrition [x] Lactation
Effective Date:	10/92
Revision/Review Date(s):	8/94, 11/96, 3/98, 6/98, 7/01, 10/04, 10/05, 2/08, 3/08, 10/10, 9/11, 11/12, 8/15, 9/17, 2/18

POLICY STATEMENT

This policy provides guidelines for the safe collection, storage, and handling of breast milk outside of the Infant Feeding Prep Room to optimize nutritional and immunological protection as well as growth and development.

RESOURCES:

MOMS Milk System Tutorial Videos

RELATED POLICIES:

Women and Infant Services Policy

- Breast Pump
- Infant Feeding Prep Room Procedure
- Breastmilk: Misadministration
- Cleaning of Breast Pump Parts and Reusable Feeding Supplies (Medela Micro-Steam Bags)
- EVS policy 2.32
- Donor Human Milk

DEFINITIONS

Fresh Milk: Milk at room temperature at approximately 20° C (68 F) or refrigerated at 4°C

Frozen Milk: Milk held at approximately -20°C (14 F) or -70°C (-36 F)

Thawed Milk: Milk that has been previously frozen

Mothers' Own Milk System (MOMS): Bar-coded human milk tracking system capable of tracking individual specimens, labeling once fortified, and monitoring expiration. Provides a safe patient environment through positive identification of milk samples with the correct patient and assuring milk discharged with the patient. Creates reports for breast milk volume, available bottles for feeding, and feeding history.

Milk Warmer: Equipment that will warm or thaw breastmilk feedings without the use of water and holding the appropriate temperature for 30 minutes before feeding or the need to store in the refrigerator. These devices will be designated for individual patient use at the bedside.

DTR: Diet Technician, Registered

IFPR: Infant Feeding Prep Room

POLICY

A. Breastmilk is a bodily fluid and has been recognized as a potential source of transmission of HIV. There is a theoretical risk of transmission of other microbial pathogens, including but not limited to Cytomegalovirus (CMV), Hepatitis B virus (HBV), Hepatitis C virus (HBC), Rubella, Syphilis, and West Nile virus. The risk of transmission of microbial pathogens from a single breastmilk exposure has never been documented.

B. The Mother's Own Milk System bar-coded tracking system will be used to maximize patient safety.

C. Women and Infants Services RNs will be familiar with the MOMS system including printing labels, managing patient/mother profiles, managing orders, preparing/splitting milk, feeding, quick feed, disposal and discharge procedures.

D. Aseptic technique will be used during preparation of breastmilk.

E. Appropriate hand hygiene will be used during collection and handling breastmilk. Staff will wear non-sterile gloves when handling breastmilk or feeding infant's breastmilk.

F. The Infant Feeding Prep Room (IFPR), will operate for breast milk preparation between 0700 and 2300 at Jacobs Medical Center. At Hillcrest Medical Center all milk preparation will be completed by the Registered Nurses (RNs) in the designated milk preparation area. (see Infant Feeding Prep Room Procedure policy)

EQUIPMENT

Mothers' Own Milk System program on computer or handheld PDA with bar code scanner
Printer for printing of MOMS labels.

Collection:

- Dual electric breast pump
- Pump kit
- Sterile storage containers
- MOMS labels and pen to note date, time, and initials
- Dish soap and tub for cleaning pump parts between sessions with warm soapy water (on Postpartum)

Storage:

- Storage bin in freezer with patient's label for identification including name, MRN and date of birth as well as mother's first name.
- Storage bin in refrigerator with patient's label for identification and mother's name. Name alert stickers should be used as appropriate.
- Sterile containers
- Labels with patient identification and mothers' name
- Ink pen for labeling
- Hand held scanner or laptop with scanner and MOMS system program
- Printer to complete storage steps in MOMS with label stock

Preparation:

- Food grade disinfectant spray to clean preparation area
- Paper Towels
- Gloves, non-sterile
- Sterile containers
- Labels with complete patient identification (name, date of birth, MRN, Mothers' first name) and contents of prepared milk for sterile container.
- Handheld scanners or computer with MOMS program and scanner
- Printer to prepare labels and label stock
- Human Milk Fortifier packets

PROCEDURE

Collection

Mothers who are inpatient at UC San Diego Health are encouraged to supply breastmilk for their infant(s). If mother is separated from her infant, she should be assisted with milk expression within 1 hour of birth or at the time of separation.

A. RN should demonstrate breast pump use or hand expression to mother and give instruction on collection and storage of breast milk within 1 hour of the infant's birth; information should be reinforced on admission to Postpartum. If mother unstable, milk expression should start as soon as mother stable.
B. Initiation of milk expression in outside Women and Infants Services depends on maternal physiologic stability. Provider approval may be necessary depending on the maternal status.
C. Breastmilk will be collected and stored in enteral feeding syringes, colostrum containers or other sterile breastmilk storage containers.
D. Mother's may re-use pump bottles after appropriately cleaning but a new container or syringe should be used each time milk is stored. Mothers may collect a daily 24-hour collection in a larger 250 ml or 1 liter bottle provided once milk volume is established. The first pumping time should be noted on the bottle and used to determine expiration time of any feedings prepared.
E. In the hospital sample collections may be stored at room temperature up to 4 hours and then must be received into the MOMS system. RNs or DTRs can combine smaller quantities for batch feeding preparation simulating the 24-hr collection in the hospital. No ongoing collections may be placed in the refrigerator for 24-hrs in the hospital. Once placed in the refrigerator the sample and volume should be received into the MOMS system. No additional milk can be added to that container after received into the MOMS system.
F. Storage containers with breastmilk will be labeled with MOMS label including the date and time collected and mother's initials.
G. MOMS labels given to the family member will be verified by the family member including date of birth, infant's name, medical record number, and the mother's name prior to issuing them to the family member.
H. See Breast Pump policy for cleaning instructions for breast pumps and Cleaning of Breast Pump Parts and Re-useable Feeding Supplies policy for cleaning instructions for breast pumps parts and other feeding supplies.
    - RNs and Lactation Consultants will teach mothers proper collection and cleaning of pumps/pump parts and document education in EPIC as appropriate

Storage

Breast milk should be stored according to the following guideline:

A. MOMS system will apply the correct storage rules when the condition of the milk is selected upon logging it into the MOMS system for storage or applied automatically when the storage site is selected: freezer or refrigerator.

B. There will be a dedicated bin in both the refrigerator and the freezer for each patient as needed. The bins will be labeled with the infant's wristband label.
C. All breastmilk will be labeled when pumped with name, date, time, and initials. Maternal medications may also be listed if of concern.
    - If infant in couplet care, milk can stay in room at room temperature for up to 4 hours. If milk will not but used within 4 hours it will be appropriately labeled and received into MOMS system and placed in breastmilk refrigerator.
    - If mother is in the hospital and infant is in NICU, the milk will be brought to the NICU to be received into the MOMS system. MOMS labels will be printed on the mother's inpatient unit for correct labeling or obtained from the NICU by the mother's inpatient unit RN. Milk will not be accepted by the NICU staff without proper MOMS labeling.
D. Staff receiving breastmilk will verify that each container is labeled with mother's MOMS collection label and with date/time mother pumped and mother's initials.
E. Breastmilk should be transported from home in an insulated cooler with iced gel pack. Frozen breastmilk from home should be transported in a manner to maintain frozen state. Breastmilk may be refrozen as long as there are visible ice crystals present or otherwise will need to be received into the refrigerator as "thawed milk".
F. Breastmilk from home should be given to the RN, DTR or other designated staff with privileges to be received into the MOMS system placed in the refrigerator or freezer and relabeled as appropriate for the storage location and expiring rules. Families are not to enter refrigerators/freezers.
G. Milk collected in larger containers and fresh, not frozen, may need to be split into smaller containers based on rate of patient use to avoid waste in later preparation.
H. A yellow/gold sticker should be placed on milk collected in the first 2 weeks of life for NICU infants to help identify this milk in the freezer bin for earliest use over other samples collected. RNs in the NICU and Lactation Consultants will provide educaiotn on this and provide the yellow/gold stickers to the mothers for labeling. This will ensure that the first pumped milk will be used first when feeding is started.
I. Containers will be wiped down with food grade disinfectant prior to placement in the refrigerator or freezer. If removed from the refrigerator and replaced, also wipe down prior to replacement.
J. Breastmilk that will not be used fresh may be frozen within 4 days. DTRs will ensure milk is moved to the freezer if nearing the 4-day limit using fresh milk first whenever possible.
K. Jacobs Medical Center (JMC) HUSCs will monitor the breast milk refrigerators for variance from the required 2 degrees centigrade to 4 degrees centigrade for both Hillcrest and JMC breastmilk storage refrigerators and freezers. A pager at Jacobs Medical Center is alerted if there is a variance requiring validation in the wireless temperature monitoring system. A system of escalating pager and phone alerts to the HUSCs and Charge RN are used to identify to the HUSC staff any temperature variance outside the set range. HUSCs will document in the wireless temperature monitoring system each shift with any variances requiring correction reviewed at shift handoff HUSC to HUSC. Variances in the refrigeration equipment in the IFPR is monitored the DTRs assigned to this task.

Breastmilk Storage Guidelines:

Room Temperature	4 hours
Refrigerator set to 2-4 degrees Centigrade	
Fresh milk (never frozen)	4 days
Thawed MBM and/or fortified milk	24 hours
Pasteurized thawed, unfortified milk	48 hours
Freezer (2 door refrigerator/freezer) - home or hospital	> 6 months
Deep Freezer (-20 degrees C)	12 months

Cleaning and Maintenance of the Milk Preparation Areas:

A. The designated milk preparation areas will be wiped down with a food grade disinfectant solution every 12 hours by the designated staff and as needed when soiled. Staff will disinfect the milk prep surface between patient preparations. Two bottles will be required and labeled Breast Milk Prep and Formula Prep.
B. Food grade disinfectant will be changed out daily by the day shift EVS worker assigned to the unit. A bottle will be provided to all areas in Women and Infants Services daily that require this disinfectant. This will also be provided to specific infant environments when the infant is on contact isolation.
C. The breast milk refrigerator will be cleaned weekly and more often if visibly soiled with a food grade disinfectant by the HUSC at JMC and the NICU RN at Hillcrest.. This is documented by the JMC NICU HUSC in the wireless temperature monitoring system for all breastmilk storage refrigerators upon notification at (858) 249-5800 by designated personnel generally HUSCs or Charge RN outside the JMC NICU. At Hillcrest, the NICU RN will clean the breaskmilk refrigerator weekly and report to the HUSC at JMC to record in the temperature monitoring system. CCPs on the10th floor at JMC and scrub techs on the 9th floor at JMC will clean the breastmilk refrigerator weekly and report to the NICU HUSC for documentation of this task. Unit managers in these areas will ensure the tasks are assigned and completed. The DTR will clean and document for the Infant Feeding Preparation Room (IFPR) where this applies.
D. Refrigerator drawers installed at JMC on the F Pod are individual breast milk storage devices monitored fro temperature wirelessly in the same manner with the same alert system and documentation as the other breastmilk storage refrigerators and freezers. The HUSCs will monitor the temperature every shift. The JMC HUSC staff are responsible to clean the inside of the drawers weekly with food grade disinfectant reporting to the JMC NICU HUSC to document in the wireless online tracking system. It is important that the inside is dried completely after the required wet time to avoid rapid frost overgrowth in these smaller devices. The dehumidifier packets are changed monthly by the NICU Manager labeled with the new expiration date. The vendor provides the new dehumidifier packets monthly. Care should be taken to not get these wet with weekly cleaning. It is recommended that they be removed temporarily when using the food grade disinfectant to protect against this issue and replaced once the drawer has been disinfected and dried.

Breastmilk Preparation:

A. Use fresh breast milk when available in chronological order.
B. When fresh breast milk is not available, use oldest frozen milk available. Samples with yellow/gold dots are the earliest umped samples after birth and should be used first.
C. If mother's breast milk not available, pasteurized donor milk may be used after parental consent and provider order. (see Donor Human Milk policy) The RN will enter into the infant's profile under "Manage Babies" in the MOMS system that written consent was obtained to provide donor milk prior to using donor breast milk for a patient. A provider order should follow in the electronic medical record.

Thawing Frozen/Warming Milk:

A. Thaw breast milk in an electric milk warmer at the patient's bedside according to manufacturer's instructions. There is a thawing/warming chart available with the device to determine the approximate length of time for the procedure. Depending on the size of the frozen container thawing can take 12-25 minutes.
    - The device is for individual patient use and will be cleaned between patients if shared or used in the IFPR.
    - Disposable plastic liners will be changed daily on the day shift and dated. The plastic liners may be recycled with the exception of the rubber gasket in the middle after personal patient information is removed.
B. After milk is thawed, create a new label in MOMS System. Ensure milk has been moved from the freezer bin to the refrigerator bin to set the new expiring rules for thawed milk.
C. Thawed milk will be used within 24 hours of thawing. Thawed, pasteurized donor milk will be used within 48 hours.

D. If fresh milk will not be used within the time frame before expiring, place in the patient's freezer bin for future use moving appropriately in the MOMS system and relabeling. DTRs will monitor this daily at Jacobs Medical Center. RNs will monitor daily at Hillcrest Medical Center.

Fortifying Breast Milk:

A. A medical provider order is required to fortify breast milk. Feeding orders are populated in the MOMS system and require RN information update prior to the preparation to include total volume, time needed, and any special instructions that may be neded by the DTRs should they be performing the preparation. RNs preparing does not exclude this step in the MOMS system.
B. All fortification should be done in the designated area, IFPR by the DTR at JMC or by an RN in the designated area at Hillcrest following the Infant Feeding Prep Room policy at Jacobs Medical Center. NICU RNs at Hillcrest will prepare and fortify breast milk in the designated area of the NICU. The IFPR may be used for formula prep by the Nutrition Department DTRs as needed at both JMC and Hillcrest.
C. Orders received after 2200 daily at Jacobs will be implemented the next business day with unfortified breast milk used for feeding in the interim. Provider will be notified and ensure an order is placed in the EMR... Hillcrest NICU RNs will prepare and fortify breast milk 24/7 in the designated area of the NICU.
D. Before using Human Milk Fortifier check the expiration date and note the lot number. The lot number is a required field in the MOMS system preparation process and will need to be entered to obtain an individual feeding label for scanning at the time of feeding by the RN.
E. If the feeding order requires Enfamil Human Milk Fortifier, obtain a 4-vial foil packet of Human Milk Fortifier. It should be stored at room temperature at all times, not in the refrigerator. Date and time the packet using only for 24 hours total from the time the packet is opened. Fortifier degrades once exposing the vials to room air causing a brown color change and negative effect on the taste often compromising infant feeding. Discard open packet afer 24 hours. Unused vials should be kept in the closed foil packet and not exposed to light as much as possible.
F. For Abbott Human Milk Fortifier use the required number of packets per volume of breastmilk as directed by the dietitian in the Breastmilk Recipe Book.
G. When transferring breast milk from the storage container to the delivery/feeding containers, print a label using the MOMS system and place on the delivery container. Label will be used to "feed" infant in MOMS.
H. Prepare only one infant's feeding at a time.

Administration of Feeding to Infant:

A. If infant in couplet care and fresh breast milk has not left the patient's room, mother can use the breast milk without scanning it into MOMS system. The RN will use the "Quick Feed" method of documentation and charting in the MOMS System.
B. Verify medical provider order in EMR and order in MOMS completing required fields marked by an asterisk (*) in the Manage Orders function
C. Remove infant's milk from refrigerator and warm using milk warmer. (see Thawing Frozen/Warming Milk "A." above)
D. Gently agitate the feeding container immediately prior to feeding. Ensure syringe for tube feedings is positioned to ensure the fat in the feeding is elevated above the remaining breast milk.
E. When transferring breast milk from the storage container to the delivery container, print a label using the MOMS system and place on the delivery container. Label will be used to "feed" infant in MOMS.
F. Using the MOMS system, scan milk and infant's ID immediately prior to feeding.
G. If MOMS system not available (downtime), 2 RN's will verify ID on milk and ID of infant being fed. Double verification will be documented in EMR as RN #1 verification and RN #2 verification.
    - Documentation should be completed by the 2nd RN within an hour of the double check and not later than the end of that shift by signing into EMR separately.

H. Document feeding in EMR under Intake & Output:

Management of Breast milk at Time of Infant's Discharge/Transfer/Demise:

When infant is discharged, transferred to another hospital, or has died, breastmilk will be "disposed" of in the MOMS system immediately prior to discharge. Mothers with excess volume of stored milk may be asked to take excess home for storage. Breast milk will be scanned right before it is being taken out of the hospital; not scanned for disposal and stored in the freezer. Reason for disposal should be selected in the drop down menu including noting hospital transferred to if patient being moved to a new hospital for continued care.

A. Using the MOMS system, select "Dispose".
B. Scan bottle of breast milk.
C. Select reason breast milk is being disposed of in the system.
D. Scan infant's bar code to match breast milk with infant.
E. Repeat steps with all bottles of breast milk in the refrigerator and freezer to be disposed.
F. Pack breastmilk for disposal/discharge in a cooler on ice/frozen cooler pack for appropriate transport.
G. Breastmilk may be donated by some mothers requiring transport to the Milk Bank. The Lactation Consultants will manage this process with the mothers. Make the needed referral to the Lactation Consultants as needed.

Breastmilk Culture Collection Procedure:

A. Use sterile pumping equipment, new from the packaging. A sterile flange and graduate cylinder container with snap lid are also suitable for this purpose.
B. Use hand hygiene prior to opening the package
C. Clean breast with soap and water
D. Express a few drops wasted milk prior to collection of the sample
E. A minimum of 1 ml is preferred for the culture.
F. The sterile breast flange can be screwed onto the sterile infant bottle or a colostrum container to collect the sterile specimen
G. Label container, print lab slip, and initial lab slip indicating the patient information matches on the label on the specimen as well as the lab slip. Notify HUSC to transport sample to the Rapid Response Lab.

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Adapted from: "Breastmilk - Collection, Storage, and Preparation" Policy from UC San Diego Health, Women and Infant Services via personal communication with toolkit authors.

EXAMPLE: NICU Pumping Log

Week _____

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1 AM							
2 AM							
3 AM							
4 AM							
5 AM							
6 AM							
7 AM							
8 AM							
9 AM							
10 AM							
11 AM							
12 PM							
1 PM							
2 PM							
3 PM							
4 PM							
5 PM							
6 PM							
7 PM							
8 PM							
9 PM							
10 PM							
11 PM							
12 AM							
TOTAL							

Baby's Name: _____ **Date of Birth:** _____

Date Pumping Began: _____

Notes: _____

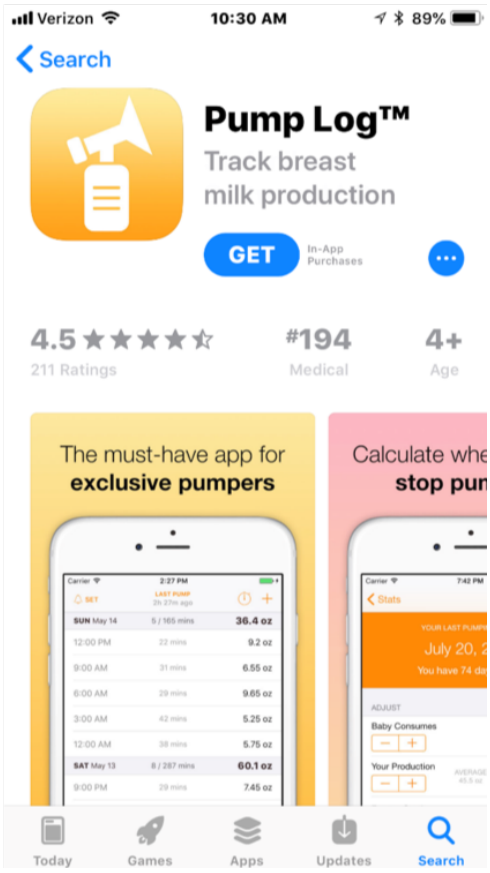
_____

Adapted from: https://health.ucsd.edu/specialties/obgyn/maternity/newborn/nicu/spin/parents/Pages/default.aspx

TOOL #15

Pumping Apps for Smartphones

iPhones



Android

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In This Section

Potentially Better Practices

Tools

Transition to Oral Feedings

Introduction

Achieving full oral feeding is an important milestone for preterm infants as it is usually a major discharge criterion and one of the most complex tasks a VLBW infant must achieve.[1] Feeding challenges put VLBW infants at significant risk for prolonged hospitalization and readmissions after discharge.[1] Older studies of oral feeding suggesting a gestational age or weight criteria for starting oral feedings were done with bottle-feeding infants. Each infant develops feeding readiness and skills on a different time path, depending on individual morbidities and growth and development patterns, and most can start oral feeding much sooner than previously thought.[2] Breastfeeding appears less stressful than bottle-feeding based on heart rate, breathing and oxygenation.[3] Infants who are to be breastfed, should start with breastfeeding first.[4] Skilled care providers should assess infants for readiness to feed and feeding performance based on objective scales. Cue-based feeding protocols appear to accelerate the development of mature feeding skills.[1]

POTENTIALLY BETTER PRACTICE #24

Infants should be transitioned from gavage to oral feedings when physiologically capable, not based on arbitrary weight or gestational age criteria.

Background, Rationale, and Goals

Infants should be transitioned from gavage to oral feedings when physiologically capable, not based on arbitrary weight or gestational age criteria.[1,5,6] Infants have been shown capable of breast or bottle-feeding much sooner than previously believed, with some breastfeeding as early as 28 weeks, and achievement of full nutritive breastfeeding at 36 weeks[2].

An infant is deemed stable for the introduction of the breast or bottle when the infant does not have a persistent physiologic decompensation such as bradycardia or desaturation when handled, the infant is handling his/her own secretions, and shows sucking behavior on a finger, pacifier or the emptied breast. Introducing the infant to breastfeeding before introducing a bottle may facilitate breastfeeding.[4] There is evidence that early attempts at oral feeding may facilitate more rapid maturation of sucking characteristics.[7]

Recommendations, Guidelines and Algorithms

- Scoring systems for feeding readiness and performance should be used by nursing and feeding specialists [Occupational therapists (OT), Speech and language pathologists (SLP), International Board-Certified Lactation Consultants or educators (IBCLC/CLEC)].
- Kangaroo care and non-nutritive breastfeeding policies and procedures should be developed, reviewed and updated at least annually, and easily accessible.
- Policies containing corrected age or weight criteria for initiation of breast- (and/or bottle) feedings should be revised to utilize feeding readiness scales.
- Pacifiers are a tool to help with oral stimulation and mature or maintain the sucking reflex[8]
- Be aware of new, emerging technologies and tools to assess and potentially aid with sucking and swallowing skills of the VLBW infant[9-11].

Quality & Process Improvement

- Review & identify current outdated feeding practices/policies
- Develop and implement a feeding transition protocol

Outcome/Process Measures

- DOL &/or GA oral feeding readiness first scored
- DOL &/or GA full oral feeds reached
- Postnatal and corrected age at first kangaroo care, first non-nutritive breastfeeding, first nutritive breastfeeding, first bottle feeding

POTENTIALLY BETTER PRACTICE #25

NICU healthcare providers should make use of safe techniques for which some evidence exists (skin-to-skin care, non-nutritive breastfeeding, test-weighing, alternate feeding methods, nipple shields) to effectively facilitate transition to full oral feeding.

Background, Rationale, and Goals

Skin-to-skin care has been shown safe and effective in promoting physiologic stability and breastfeeding in preterm infants.[12] It is the first step towards a mother being comfortable holding her preterm infant for feeding.[13] Kangaroo care (skin-to-skin care), non-nutritive breastfeeding (practicing breastfeeding on an "emptied" breast; also known as "dry" or "recreational" breastfeeding) and early introduction of the breast have been associated with increased breastmilk production and longer breastfeeding post discharge.[13-17] Test weighing, done by standard protocol is a valid measure of intake at the breast and can be used to determine need for supplementation.[18,19] Mothers can test weigh accurately[19,20] and without stress.[21]

Transitioning directly from gavage to breastfeeding is possible, and seems to prolong both exclusive and any breastfeeding,[22] but requires the mothers to be continuously present, which may not be possible because of physical limitations of many NICUs and the mothers' own outside commitments. Transported infants' mothers may not be available for frequent feeding practice. The increasing use of individual room NICU care, enabling parents to remain with their ill infants, may facilitate earlier and increased direct breastfeeding.

Although research as to efficacy is limited, cup-feeding appears safe for preterm infants[23-28] and may facilitate longer breastfeeding post-discharge[29] although may necessitate a somewhat longer hospital stay.[29] Clinical experience suggests other methods of feeding may be appropriate for specific infants: e.g. finger-feeding for neurologically impaired, or supplemental nursing systems at the breast for mothers with insufficient milk supply.[30,31] Nipple shields can be used, when appropriate, to maximize milk transfer at the breast.[32] In the absence of good research, every effort should be made to accommodate mothers' preferences as long as appropriate weight gain is maintained.

Over the last decade, the evidence, implementation, and use of "Infant Driven" or "Cue-Based" feeding practices to transition VLBW infants from tube feeds to oral feeds continues to grow[1,33,34]. Infant driven feeding methods may also decrease the number of infants sent home with any kind of feeding tube support[35].

Background, Rationale, and Goals

- Scoring systems for feeding readiness and performance/quality of feed should be used by nursing (and OT, or SLPs) & should be done when baby starts to show cues, or at least every 3 hours.
- Have at least 1 electronic scale (accurate to 1-2 g) per 20 infants and a protocol available for pre-post breastfeeding test weighing.
- Nipple shields in various sizes should be available for use in the NICU as appropriate by knowledgeable caretakers.
- Policies and procedures, education, and competency verification, should be available for all feeding methods.
- NICU nurses should be empowered to adjust transition feedings as needed.

- Family-centered care should empower mothers to suggest adjustments in feeding plans[34].

Quality & Process Improvement

- Protocol availability for test weighing, non-nutritive breastfeeding and kangaroo care.
- Feeding readiness and performance scoring system.
- Consider Neo-BFHI Evaluation & Certification

Outcome/Process Measures

- Monitor postnatal and corrected age at first kangaroo care, first non-nutritive breastfeeding, first nutritive breastfeeding, first bottle feeding
- Audits on Scoring System
- Frequency
- Compliance with use
- Appropriately scored

POTENTIALLY BETTER PRACTICE #26

Infants should have regular assessment by skilled providers of oral readiness and feeding performance.

Background, Rationale, and Goals

At birth VLBW infants do not have the neurological, cardio-respiratory stability, oral motor readiness, gastrointestinal maturity, and suck, swallow, breath coordination for oral feeding. Prolonged respiratory support, gastrointestinal anomalies, and other factors can further delay introduction of oral feeding and have long-term effects on outcomes.

Recommendations, Guidelines and Algorithms

- Skilled providers in infant feeding are vital to initiate, identify, and support the challenges of oral feeding in VLBW infants. Attention to each infant's individual oral feeding obstacles will optimize safe oral intake and work to overcome the many difficulties premature infants face during their time in the NICU. These advanced feeding evaluation and intervention skills can be acquired through education, specialty training, experience, and certifications:
  - **Occupational Therapists (OT) &/or Speech Language Pathologists (SLP)**, ideally trained in neonatal feeding practices with specific advanced training, such as:
    - Advanced Practice Certification in Swallowing Assessment, Evaluation, or Intervention (SWC) through the California Board of Occupational Therapy (CBOT).
    - Certified Neonatal Therapist (CNT)
  - **Certified Lactation Professional** (IBCLC, CLC, CLE, ALC, ANLC)
    - Dedicated clinicians with specific initial education, training, experience, and ongoing education in lactation to promote and support mom and baby in their breastfeeding challenges.
    - Integrating breastfeeding dyad strategies, approaches, and specific tools (such as nipple shields, supplemental nursing systems (SNS)) to facilitate direct breastfeeding
  - **Infant-Driven Feeding®** Training
    - Infant-Driven Feeding: Advancing Oral Feeding Practice in the NICU course
    - Online course focused on assessing, evaluating, and understanding specific challenges neonates face in the NICU.
    - Can be completed as an individual, or as part of the unit-wide education provided to staff
    - Can provide continuing education hours for RNs
  - **NOMAS® (Neonatal Oral-Motor Assessment Scale)**
    - Individual 3 day courses, or online learning for nurses, occupational therapists, and speech language pathologists. Can count for continuing education units (CEUs) for OT, SLP, and RNs
    - Institutional certifications available. A licensed NOMAS® course instructor can provide education to the staff in a particular unit.

- Ongoing education and support of these highly skilled providers will evolve and progress over time to continue to update and implement evidence-based practices.

Quality & Process Improvement

- Implement Feeding Readiness Scoring System (Refer to **TOOL #16** on page 96)
- Pre-test, and post-test bedside caregivers to see if their assessments of oral feeding readiness improves
- Implement feeding performance scoring system
- Number of referrals to OT/SLP for feeding support and evaluations

Outcome/Process Measures

Audits on Scoring Systems

- Frequency of scoring and charting the scores
- Compliance with use
  - Did the scores influence how the baby was fed?
- Appropriate/consistent scores
  - Have 2 skilled practitioners score the infant and see if they get the same result

POTENTIALLY BETTER PRACTICE #27

Infants whose mothers intend to breastfeed should be put to breast before being exposed to the bottle.

Background, Rationale, and Goals

Focusing on VLBW first oral feeding attempt at the breast will not only help with maturing oral feeding skills, but further facilitate breastfeeding, increase mom's milk supply, potentially receiving more of mom's own milk during admission, and improve chances of still taking breastmilk upon initial discharge from the NICU.[36-38] Bottle feeding has not been shown to lead to sooner discharge[39].

There is no reason to "test" a preterm infant on a bottle before offering the breast. Controlled studies confirm that breastfeeding infants have more stable oxygen saturations and body temperature as compared to bottle-feeding infants,[3,40,41] although less milk is transferred with breastfeeding.[3,42-45] The mechanism for this improved stability with breastfeeding seems to be less interruption in breathing with breastfeeding. Bottle-fed preterm infants frequently do not breathe during sucking bursts – instead they breath rapidly during pauses in sucking.[43,45] In contrast, the same preterm infants integrated breathing within sucking bursts, approximating a suck-breathe pattern of 1:1 as they reached 34-35 weeks gestation.

Research has demonstrated that breastfeeding-friendly attitudes and support may "spill over" from the normal newborn care area to the NICU in Baby-Friendly Certified hospitals, increasing the use of human milk and breastfeeding in the NICU.[46-48] The Neo-BFHI Certification currently in development will emphasize family-centered and individual care and apply modified "10 Steps" to the NICU environment.[49]

Recommendations, Guidelines and Algorithms

- Kangaroo care and non-nutritive breastfeeding policies and procedures should be developed, reviewed and updated at least annually, and easily accessible.
- Lactation professional support and/or specially lactation support trained bedside RNs should be available.
- Privacy curtains/shields should be available for mothers who request them.
- Have comfortable chairs and adequate materials (pillows, blankets, etc.) for supporting mom and baby available to achieve safe and proper positioning.

Quality & Process Improvement

- Protocol availability for test weighing, non-nutritive breastfeeding and kangaroo care
- Neo-BFHI Evaluation & Certification when available.

Outcome/Process Measures

- DOL baby first goes to breast for non-nutritive feeding
- DOL 1st nutritive breastfeed
- Number of times each day the baby is put to the breast

EXAMPLE: Feeding Readiness

Engagement and Hunger Cues	Stress and Disengagement Cues
Bringing hands to the mouth	Inconsolable crying
Alert and fussing, especially if combined with other feeding cues	Worried or frowning face
Sucking on fingers or pacifier	Yawning
Relaxed facial expression while awake	Gaze averting
"Ohhh" faces	Changing from awake to drowsy or sleepy state
Good tone (exhibits flexed moisture)	Poor tone (hypotonic)
Rooting	Splaying fingers or putting hands in a "stop" position
	Arching or pulling off nipple
	Tachypnea
	Bradycardia
	O_2 desaturations

Adapted from: Newland L, L'huillier MW, Petrey B. Implementation of cue-based feeding in a level III NICU. Neonatal Netw 2013;32:132-7.

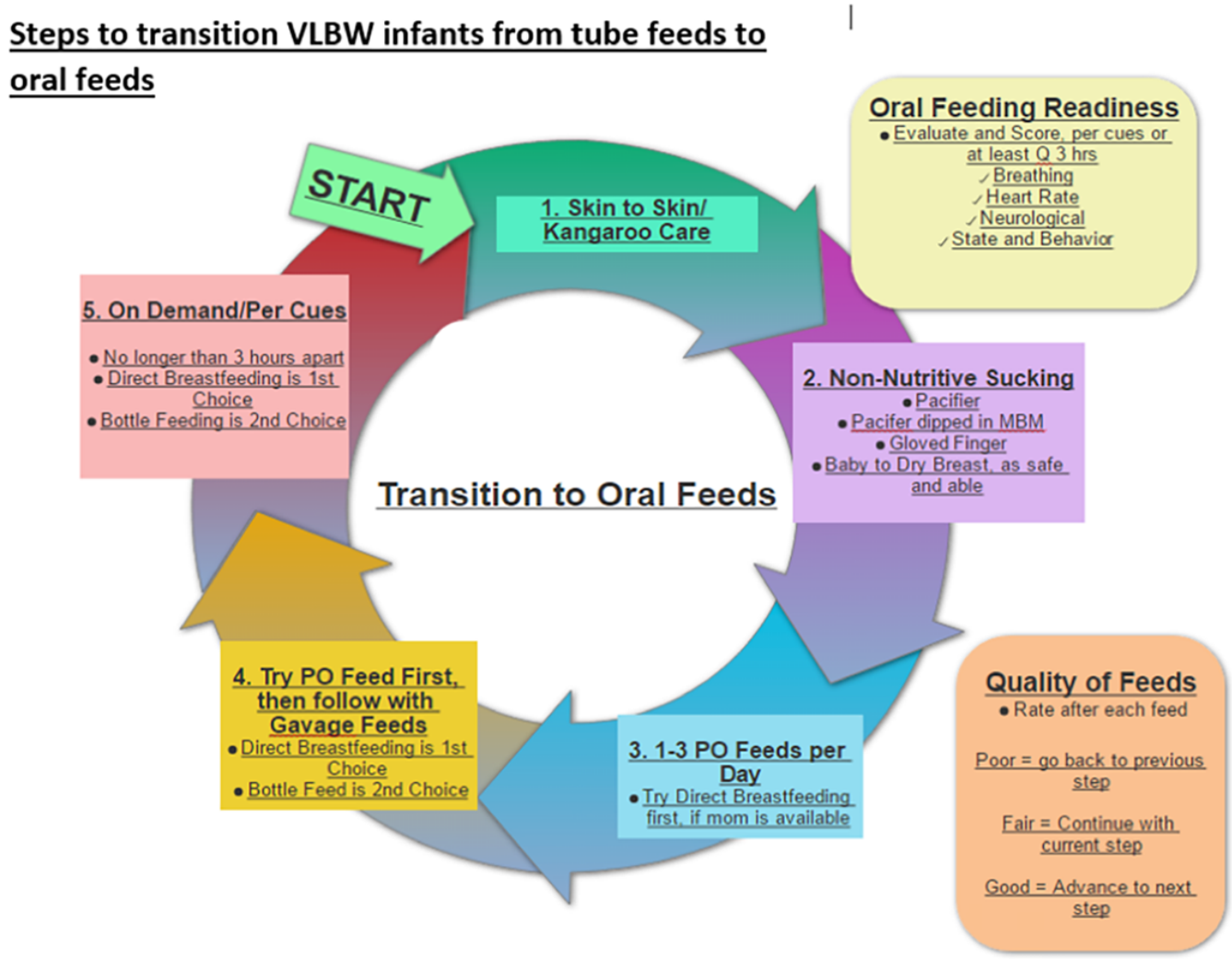
TOOL #17

EXAMPLE: Cue Based Feeding Scores and Documentation Tips

Please reference:

Figure 1 "Infant Feeding Scale" from: Newland L, L'huillier MW, Petrey B. Implementation of cue-based feeding in a level III NICU. Neonatal Netw 2013;32:132-7.

Transitioning from tube feeds to oral feeds



This chart was adapted from Figure 1, from Little Steps, found in: Lubbe W. Clinicians guide for cue-based transition to oral feeding in preterm infants: An easy-to-use clinical guide. *J Eval Clin Pract.* 2017.

Adapted from Figure 1, from Little Steps, found in: Lubbe W. Clinicans guide for cue-based transition to oral feeding in preterm infants: An easy-to-use clincial guide. *J Eval Clin Pract.* 2017.

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In This Section

Potentially Better Practices

Tools

Discharge Planning and Post-discharge Nutrition

Introduction

The VLBW infant at the time of discharge is a nutritional challenge to healthcare providers in terms of what type of milk should be given and whether human milk will need fortification or supplementation.[1,2] Post-discharge recommendations and practices vary widely by country and by region of the US. Preterm infants tend to be discharged before reaching term corrected age and before breastfeeding is well established. Volume of feeds at discharge varies greatly and has been shown to vary with caloric content, which will determine in part the intake of other nutrients, including protein.[3,4]

Despite nutritional improvements made (early TPN, trophic feeds, more rapid feeding advancement, higher protein intake) to try to match intrauterine growth rates in the NICU, many preterm infants continue to have growth restriction at discharge.[5] Postnatal growth failure and inadequate nutrition have been associated with poorer long-term neurodevelopmental outcomes.[6] However, systematic reviews have shown limited benefits in growth and neurodevelopmental outcomes with the use of post-discharge formulas or multinutrient fortification of human milk.[7]

In addition, there may be a window for catch-up growth in the early post-discharge period.[7,8] However, increasing evidence also suggests that either low birth weight or rapid post-natal weight gain, or the combination of both, may predispose to adverse long-term effects, such as increased risk for metabolic syndrome (hyperlipidemia, hypertension, cardiovascular diseases, type 2 diabetes) and osteoporosis in adulthood.[3,9,10] The goal in nourishing preterm infants after discharge is to promote human milk feeding, minimize nutrient deficits, promptly address any nutritional deficits, and avoid over-nourishing.[1]

Exclusive breastfeeding without supplementation at hospital discharge is not the primary goal for most ex-VLBW infants. A full milk supply at discharge is one of the best predictors of successful breastfeeding post-discharge.[11,12] Mothers who intend to breastfeed after discharge, should be assisted to establish and maintain a full milk supply as well as practice breastfeeding while still in the NICU.13 VLBW infants who are to be formula-fed at discharge also require careful, coordinated feeding and follow-up plans and may require substantial additional nutrients in their diets.

POTENTIALLY BETTER PRACTICE #28

Nutritional discharge planning should be individualized, comprehensive, coordinated and include appropriate nutrient fortification (if needed) and nutritional follow-up.

Background, Rationale, and Goals

- Proactive nutritional support during the NICU stay can help prevent nutritional deficits and minimize the degree of growth failure before discharge.[14]
- Infants who are small (<2,000g) or SGA at discharge will usually require some fortification.3
- Human milk (with appropriate fortification, if needed) is always the first choice for feeding at discharge.[1,7]
- Protein is almost always the limiting nutrient for growth, not calories.[15,16]
- The best determinant of long-term bone health is not how much calcium is in the diet, but how much human milk is consumed.[17]
- The development of a nutritional care discharge plan for infants on MOM should consider:[18]
  - **The mother's:**
    - current supply of stored milk
    - intention whether to continue pumping
    - current milk output (ounces/day)
    - wishes for breastfeeding after discharge
  - **The infant's:**
    - current nutritional status (including biochemical indices)
    - current health status and treatments
    - bone health
    - growth pattern during NICU stay
    - ability to take oral feeds at breast or bottle
- Overly complicated nutritional discharge plans are to be avoided.[19]
- Some infants may be discharged home on full or partial gavage feedings to reduce the length of stay in the NICU. There is limited evidence of the safety or efficacy of this policy.[20]

Recommended Guidelines and Algorithms

- In the week before discharge, a discharge feeding plan should be determined by the physician, dietitian, lactation consultant, nursing and the parents, with agreement by the follow-up primary care provider and transmitted in writing to all.[2,7,19] (Refer to TOOL #19 on page 109.)
- As human milk is preferred at discharge for **ALL** infants, especially for preterm infants, lactation support should be provided both during the hospital course and after discharge.
- To avoid creating nutritional deficits after discharge, preterm infants should at least receive the nutrient intake of their respective corrected age. (Refer to TOOL #20 on page 110 and TOOL #21 on page 111.)
- An individualized approach, based on growth, personal history and selective nutrient deficiencies as well as current needs, should be employed for the post-discharge nutrition of preterm, especially VLBW infants. (Refer to TOOL #22 on page 112.)
  - Infants born VLBW, or who are small (<2,000g), or small for gestational age (SGA) at discharge will almost always require some additional nutritional intervention (beyond term formula or human milk alone).[2,3]
  - A post-discharge nutritional intervention is more effective in promoting growth if

performed early (i.e. before term CGA).
    - The NICU team, parents and, when possible, the outpatient care provider, should be involved in discharge planning.
- Close monitoring of growth parameters (weight, length, head circumference) and feeding should be performed at discharge and every 2-4 weeks thereafter, until stable weight gain is established, using appropriate growth curves (WHO21, Fenton22, and Olsen23).[1,7,24]
    - Fenton or Olsen charts should be used for infants born < 37 wks
    - After the infant reaches 42 weeks, switch to the WHO growth charts.[25]
    - PediTools (http://www.peditools.org) provides a calculator to determine an infant's exact weight percentile and z score using Olsen, Fenton and WHO growth data.
    - Downloadable calculators on the Fenton chart are available at http://u.calgary.ca/fenton.
    - Selective biological measurements may indicate selective nutritional deficiencies (e.g. BUN, ferritin, 25(OH) vitamin D, retinol-binding protein).
- Iron supplementation should be continued after discharge until at least 6-12 months of age.[1]
- Vitamin D supplementation should be continued after discharge in breastfed infants alone or as a component of a multivitamin.
- Multivitamins, dosed to deliver at least 1500 IU/day of Vitamin A, 20-70 mg/day of Vitamin C, and 400 IU/day of Vitamin D should be added at discharge. B vitamins are also necessary for the former preemie receiving unfortified human milk. A multivitamin preparation dosed at 1 mL/day will usually supply all the above.
    - If formula constitutes >50% of an infant's daily intake, the dose should be 0.5 mL per day. Multivitamin administration should be continued for at least 3 to 6 months, although the optimum length of use has yet to be determined.[24,26]
- The composition of mature human milk and post-discharge supplementation options vary significantly. (Refer to **TOOL #23** on page 113 and **TOOL #24** on page 114.)

Quality & Process Improvement

- Provide standing admission orders for discharge planner and lactation consultant to consult with mother upon infant admission to the NICU.
- Provide facilities for rooming-in prior to discharge.
- Follow-up plan arranged and documented in discharge summary/instructions for parent and follow-up physician:
    - With infant's primary physician (1-3 days)
    - With lactation consultant (1-2 weeks or sooner if possible)
    - With dietitian (4-6 weeks if available)
- Nutritional assessments should be completed and documented prior to discharge on infants with nutritional risk factors.
- Written discharge nutritional plan should be in the chart for parent, primary physician (including nutritional laboratory follow-up). (Refer to **TOOL #25** on page 115.)
- Follow-up clinic includes a dietitian and lactation consultant if possible.
- NICU growth chart should be sent home along with the discharge summary and any other important paperwork (e.g. hearing screen results, newborn screen result, last cardiac ultrasound, nutritional laboratory follow-up recommendations, etc., as appropriate) for parents and primary physician.

Outcome/Process Measures

- Is there a discharge nutritional plan in each VLBW infant's chart? Given to parent? Sent to primary physician?
- Is the growth chart sent to the primary physician as well as the discharge nutrition plan and discharge summary?

POTENTIALLY BETTER PRACTICE #29

Mothers should be encouraged to eventually achieve exclusive breastfeeding after discharge while ensuring appropriate growth for the infant.

Background, Rationale, and Goals

- The multiple benefits of breastmilk and breastfeeding should not terminate at hospital discharge. Adequate support should be arranged to allow each mother to reach her breastfeeding goal while ensuring appropriate growth and nutrition for the infant.
- Exclusive breastfeeding without supplementation at hospital discharge is not the primary goal for most ex-VLBW infants.
- Establishing a full milk supply in the first 2 weeks after birth (coming to volume ≥ 500 mL/day) has been correlated with receiving breastmilk at discharge.[27]
- Mothers are most likely to eventually succeed in transitioning their infants when they are fed breastmilk throughout the NICU stay.12
- The duration of human milk feedings is significantly longer for those who transition to some breastfeeding in the hospital v. those who just receive expressed milk.[28]
- Mothers should be advised to continue to express milk using a hospital grade electric pump after breastfeeding to maintain milk supply for at least 1-2 months post-discharge, or until the infant is transitioned over to direct breastfeeding.
- The concept of "triple feeding" (breastfeeding, supplementing with previously expressed milk or formula, then pumping) has been useful.[29]
    - Ensure continued breast pump availability.
    - Provide families and the primary care provider with written guidelines for infant feeding at discharge.
- Initially, small infants may fall asleep at the breast due to fatigue rather than satiety, so time limits of 20-30 minutes at the breast are advised.
- As the infant becomes more efficient in emptying the breast, breastfeeding frequency can be increased as supplementation and pumping decrease.
- The most common reasons mothers cite for ceasing breastfeeding are concerns their milk is nutritionally inadequate, and the effort required for pumping is too burdensome.[30]

Recommendations, Guidelines and Algorithms

- Skin-to-skin care should be continued after discharge home.[31]
- Test-weighing (pre and post breastfeeding) in the NICU enables mothers to quantify milk intake and therefore needed supplementation without increasing their stress. This can be continued at home with rental scales if the mother wishes.[32,33]
- The method of supplementation initiated in the hospital and agreed upon by the mother, physician, primary nurse, dietitian and lactation consultant should be continued at home.
    - Infants can have fortification added to each supplemental feed of expressed breastmilk, OR, can have 1-4 feedings per 24 hrs (as calculated by the dietitian) of the prescribed supplemental formula with otherwise unlimited breastfeeding.
    - The mother should be offered options and choose the one easiest for her.
- Provide realistic time guidelines and frequent follow-up:

- Primary care follow-up in 1-3 days
- Lactation follow-up in 1-2 weeks
- Dietitian follow up in 4-6 weeks

- Encourage continued attendance at breastfeeding and other premature infant support groups after discharge as well as referral to other community resources.
- Premature infant developmental follow-up clinics should include both nutritional and lactation expertise if possible.
- If infants are to be discharged before full oral feeds are established (i.e. on some or all gavage feeds), has there been adequate assessment of the parents' understanding of the risks and benefits, social situation, identification and approval of home caregivers, the family's learning style, appropriate follow-up, etc.?[34]
- Infants formula-feeding at discharge will also need support and appropriate follow-up.

Quality and Process Improvement

- Establish a breastfeeding support group with an educational component and lactation consultant support for mothers of inpatient and discharged VLBW and other infants.
- Establish an NICU Nutrition Committee.
- Obtain or create a local community resource list for mothers, including WIC and private providers.
- Include referrals to breastfeeding resources on discharge instructions.
- Ensure affordable breast pump availability for EVERY breastfeeding mother/infant dyad for at least 2 months post discharge.
- Provide families with a written guide for transitioning to full breastfeeding for former VLBW infants at home.
- Make follow-up phone calls to discharged VLBW patients' families if possible.

Outcome/Process Measures

- Measure attendance at mother-to-mother support groups (current and discharged families).
- Quality of breastfeeding support (by nurses, physicians, lactation consultants) can be measured on post-discharge patient satisfaction surveys. Construct a related run chart and discuss findings.
- At discharge, what percentage of discharged mothers have a full milk supply? Any breastmilk for their infants? Are directly breastfeeding?
- On post-discharge phone calls: what percentage of families are reached? What questions are asked? Common themes? Have standing report to NICU Nutrition Committee.

TOOL #19

EXAMPLE: NICU Graduate Nutrition Discharge Plan

NICU Nutrition Discharge Plan

Nutrition for Preterm Breastmilk Fed Infant

Birth Weight > 1800 grams and Gestational Age 34-37 weeks → **Fortification of mother's milk not usually necessary**

- Continue current breastfeeding frequency. As baby grows and gets stronger, more breastfeeding times may be added
- If infant lagging in growth, encourage more breastmilk volume or consider adding **Post-Discharge Formula (PDF)** i.e. **Neosure™** or **Enfacare™** to provide extra calories, protein, calcium, phosphorous, and vitamins.

☐ Plain breastmilk or breastfeeding with ☐ PDF 22 cal/oz ☐ Two (2) daily PDF feedings
☐ Three (3) daily PDF feedings

☐ PDF 24 cal/oz ☐ Two (2) daily PDF feedings

Birth Weight < 1800 grams and Gestational Age <34 weeks → **Fortification of mother's milk recommended**

- Continue supplementation of mother's milk with post-discharge formula (PDF) or PDF alone based on guideline below, or longer if not growing well.
- The following fortification timeline is based on infant's birth weight. Consider history of growth restriction, growth delay, current growth trend, and feeding-related morbidities.

Birth Weight:	**Supplement duration:**
< 750 grams –	Up to 12 months postnatal
751-1000 grams	Up to 9 months postnatal
1001-1500 grams	Up to 6 months postnatal
1501-1800 grams	Up to 3 months postnatal or term weight

Supplement feeding using method A or B below. Total feedings per day = 8 (?)

☒ Continue current breastfeeding plan and pumping routine. Refer to handout: ***'Breastfeeding Plan for Going Home'***

A. ☐ Fortification of mother's milk with PDF [Neosure™ or EnfaCare™ powder] to:
☐ 22 cals/ounce ☐ 24 cals/ounce _____ **feedings per day**

B. ☐ Post-Discharge formula [PDF] only [Neosure™ or EnfaCare™ powder]*
☐ 22 cals/ounce ☐ 24 cals/ounce _____ **feedings per day**
** Mix formula powder and water per recipe provided by Sharp Mary Birch NICU*

Nutrition for Preterm Formula-Fed Infant

- Use PDF: Neosure™ or EnfaCare™ ☐ 22 cals/ounce ☐ 24 cals/ounce ☐ Other: _____
- Use term formula of mother's choice or per MD recommendation: _____
☐ 22 cal/ounce _____ ☐ 24 cal/ounce _____ Other: _____

Notes for Pediatrician

- Fortification of mother's milk or formula has been shown to improve growth in VLBW preterm infants. Sufficient protein, minerals, and calories improve long-term growth, including brain growth.
- Post-discharge preterm-adapted formula [PDF: Neosure, EnfaCare] supplies more calories, protein, vitamins, and minerals than term formula. Its use has been shown to improve somatic growth, brain growth, and bone mineralization. Preterm infants should receive PDF until term weight (3.5kg) or 12 weeks (MD discretion) and longer if not growing well.
- American Academy of Pediatrics (AAPCON) recommends oral Vitamin D supplement for all breastfed and most formula-fed infants: 400 international units per day.
- Monitor growth using Fenton, W.H.O., or CDC charts. Screen for iron deficiency. Continue iron supplement as needed. Consider periodic evaluation of biochemical indices: BUN (protein status), serum ferritin, serum 25 (OH) vitamin D, etc.

Nutritional Needs by Weeks of Gestation

Nutritional needs per kg/day GA, weeks						
	< 28	28-31	32-33	34-36	37-38	39-41
Fetal growth						
Weight gain, g	20	17.5	15	13	11	10
Lean body mass gain, g	17.8	14.4	12.1	10.5	7.2	6.6
Protein gain, g	2.1	2	1.9	1.6	1.3	1.2
Requirements						
Energy, kcal/kg	125	125	130	127	115	110
Proteins, g/kg	4	3.9	3.5	3.1	2.5	1.5
Protein/energy ration, g/100 kcal	3.2	3.1	2.7	2.4	2.2	1.4
Calcium, mg/kg	120-140	120-140	120-140	120-140	70-120	55-120
Phosphorus, mg/kg	60-90	60-90	60-90	60-90	35-75	30-75

Weight gain, lean body mass and protein gain during the last trimester of pregnancy and theoretical energy and protein requirements for enteral nutrition are indicated by gestational age (GA) group. Be- fore 39 weeks GA, requirements are based on the fetal growth, fetal accretion rate and intestinal absorption, after 40 weeks GA, requirements are based on the composition of human milk [adapted from 11, 44]. The values indicated in this table are theoretical values per GA groups. They show that both the late preterm (i.e. 34–36 weeks GA) and the early term infant (i.e. 37–38 weeks GA) have nutritional requirements that are different than the full-term infant (i.e. 39–41 weeks GA). The values indicated do not take into account the nutrient supply needed to compensate for any nutritional deficit and therefore are not applicable as such for the very preterm infant at time of, or after, hospital discharge.

Adapted from: Lapillonne A. Feeding the preterm infant after discharge. World review of nutrition and dietetics 2014;110:264-77.

TOOL #21

Recommended macro/micronutrients for infants 0-6 months

Recommended macronutrient/micronutrient requirements (units/kg/d) for the stable preterm infant				
	Term	ELBW	VLBW	VLBW Post term
Energy, kcal	90-120	130-150	110-130	90-100
Protein, g	1.52	3.8-4.4	3.4-4.2	2.0
Carbohydrate, g	16-20[a]	9-20	7-17	6.8-14.1
Fat, g	8-10.3[a]	6.2-8.4	5.3-7.2	4.0-6.6
Vitamin A, IU	1333	700-1500	700-1500	545-1273
Vitamin D, IU	200	150-400	150-400	400
Calcium, mg	70-120	100-220	100-220	253-377
Phosphorus, mg	35-75	60-140	60-140	105-273
Iron, mg	0.09[a]	2-4	2-4	1.8-2.7
Zinc, mg	666[a]	1000-3000	1000-3000	890

Adapted from: Nzegwu NI, Ehrenkranz RA. Post-discharge nutrition and the VLBW infant: To supplement or not supplement?: a review of the current evidence. Clin Perinatol 2014;41:463-74.

Composition of post-discharge formulas

Composition of post-discharge formulas (per 100 mL) and mature human milk						
	Mature Human Milk	Similac Neosure 22 kcal/oz[a]	Enfamil Enfacare 22 kcal/oz[b]	Similac Advance 20 kcal/oz[a]	Enfamil Lipil 20 kcal/oz[b]	Nestle Good Start 20 kcal/oz[c]
Energy, kcal	65-70	74.4	74	67.6	68	67
Protein, g	1.03	2.1	2.1	1.4	1.4	1.5
Carbohydrate, g	6.7-7.0	7.5	7.9	7.2	7.4	7.5
Fat, g	3.5	4.1	3.9	3.8	3.6	3.4
Calcium, mg	20-25	78.1	89	52.8	53	44.9
Phosphorus, mg	12-14	46.1	49	28.4	29	25.5
Sodium, mg	12-25	24.5	26	16.2	18.4	18.4
Iron, mg	0.3-0.9	1.34	1.3	1.2	1.2	1.0

[a] Mead Johnson Nutritionals, Evansville, IN; http://www.meadjohnson.com/Brands/Pages/Products- by Need.aspx.

[b] Abbott Nutrition, Abbott Laboratories, Columbus, OH; http://abbottnutrition.com/.

[c] Gerber (Nestle) Infant Formulas, Glendale, CA; http://medical.gerber.com/products/Default.aspx.

Adapted from: Nzegwu NI, Ehrenkranz RA. Post-discharge nutrition and the VLBW infant: To supplement or not supplement?: a review of the current evidence. Clin Perinatol 2014;41:463-74.

TOOL #23

Composition of MOM + Varying Formula Intakes (Stanford)

Assuming intake of 180 mL/kg/day	Energy (kcal/kg)	Protein (gm/kg)	Calcium (mg/kg)	Phosphorus (mg/kg)
Target (AAP)	**120-130**	**2.5-3.5**	**150-175**	**90-105**
Mature Human Milk	138	2.0	50	26
MBM+PDF 22 cal/oz (powder added to MBM)	131	≤ 2.2	54-56	25-27
MBM + 2 bottles PTF 24 cal/oz, High Protein	128	2.7-2.8	91-97	48-54
MBM + 2 bottles PDF 24 cal/oz	128	2.5	69-75	40-42
MBM + 2 bottles PDF 22 cal/oz	125	2.4	66-71	38-40
MBM + PTF 30 cal/oz mixed in a 2:1 ratio = ~23 cal/oz	138	3.5	139	76
MBM + PTF 30 cal/oz mixed in a 1:1 ratio = ~25 cal/oz	150	4	185	102
MBM + PTF 30 cal/oz mixed in a 1:2 ratio = ~27 cal/oz	162	4.5	234	130
MBM + 2 bottles PTF 30 cal/oz	130	2.6	111-122	57-66

MBM= Maternal breastmilk; **PTF** = Preterm formula; **PDF** = Post-Discharge formula

Possible Post-Discharge Feeding Regimens

Adequate Maternal Milk Supply		
Appropriate growth & benign labs	**Slow growth & benign labs**	**Slow growth and/or abnormal bone labs**
• Maternal milk ad lib • PO vitamin & iron drops	• Maternal milk ad lib • PDF-22 X 2 feedings/day • PO vitamin & iron drops	• Maternal milk ad lib • PDF-22 or PDF-24 X 2 feedings/day • PO vitamin & iron drops • PO calcium supplement

Inadequate Maternal Milk Supply		
Appropriate growth & benign labs	**Slow growth & benign labs**	**Slow growth and/or abnormal bone labs**
• Maternal milk ad lib • PDF-22 as needed • PO vitamin & iron drops	• Maternal milk ad lib • PDF-22 or PDF-24 as needed • PO vitamin & iron drops	• Maternal milk ad lib • PDF-24 as needed • PO vitamin & iron drops • PO calcium supplement

PDF-22: Postdischarge formula 22 kcal/oz
PDF-24: Post discharge formula 24 kcal/oz
Bone labs: serum alkaline phosphatase, calcium, phosphorus

Adapted from: Cohen RS, Mayer O, Fogleman AD. Managing the Human-Milk-Fed, Preterm VLBW Infant at NICU Discharge: A Simpler Algorithm? Infant, Child, & Adolescent Nutrition 2015;7:177-9.

Nutritional Assessment	
Growth	**Action Values**
Weight gain	< 20 g/day
Length growth	< 0.5 cm/week
Head circumference	< 0.5 cm/week
Biochemical Tests	
Growth	**Action Values**
Phosphorus	< 4.5 mg/dL
Alkaline phosphatase	> 450 IU/L
BUN	< 5 mg/dL
Pre-albumin/transthyretin	< 10 mg/dL

Adapted from: Hall RT. Nutritional follow-up of the breastfeeding premature infant after hospital discharge. Pediatr Clin North Am 2001;48:453-60.

TOOL #26

Procedure for Accurate Test-Weighing

DEFINITION: Weighing the infant before and after breastfeeding to determine intake at the breast.

REQUIREMENTS: A digital scale with the following features:

1. Digital read-out
2. Integration function that allows for movement of the infant
3. Accurate to 2 grams

PROCEDURE:

If leads can be disconnected for weights:

1. Place scale up against infant bed/warmer/isolette on flat, level surface.
2. Disconnect leads and place monitor on standby
3. Wrap infant tightly so he/she will not move around on scale. No leads should be hanging off the scale.
4. Turn on and zero scale.
5. Before breastfeeding, place baby on the center of the scale and weigh him/her. No need to undress, remove or hold up leads. This is the "before" weight. Record. Leave scale on during breastfeeding.
6. Reconnect leads and press "continue current" on the monitor.
7. Mother breastfeeds infant. **DO NOT CHANGE DIAPER YET.**
8. Disconnect leads and place monitor on standby.
9. Reweigh the infant, on the center of the scale with the **EXACT SAME CLOTHES, DIAPER, BLANKET, LEADS, ETC.** This is the "after" weight. Record.
10. Subtract the first (before) weight from the second (after) weight. The difference in grams is considered the "intake" in milliliters (mL).
11. Some scales automatically store the values and compute the difference for you. Refer to manufacturers' instructions.

If leads or tubing cannot be disconnected for weights:

1. Place scale up against infant bed/warmer/isolette on flat, level surface.
2. Wrap infant tightly so he/she will not move around on scale.
3. Place the baby on the scale with scale turned off.
4. Tape lead connection and other tubes to side of crib or isolette. There should be no tension on wires/tubes and they should not touch the scale.
5. Lift infant off scale.
6. Turn on and zero scale.
7. Before breastfeeding, place baby on the center of the scale and weigh him/her. You may place a hand under the leads to relieve any pulling. This is the "before" weight. Record.
8. Untape leads, tubes, etc but leave tape on crib/isolette/warmer/etc.
9. Remove infant from scale and turn off scale.
10. Mother breastfeeds infant. **DO NOT CHANGE DIAPER YET.**
11. After breastfeeding, replace infant on center of scale with the scale turned off.
12. Retape leads/tubes in same spot as before (on crib/isolette/warmer).
13. Lift infant, turn on and zero scale.
14. Replace the infant on the center of the scale and reweigh the infant, with the **EXACT SAME CLOTHES, DIAPER, BLANKET, LEADS, ETC.** You may place a hand under the leads to relieve any pulling. This is the "after" weight. Record.

15. Subtract the first (before) weight from the second (after) weight. The difference in grams is considered the "intake" in milliliters (mL).
16. Some scales automatically store the values and compute the difference for you. Refer to manufacturers' instructions.

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Controversies and Unresolved Issues

In This Section

Potentially Better Practices

Probiotics and Prebiotics

*Read FDA's 2023 Probiotics Warning

Background, Rationale, and Goals

Probiotics are live microbes that beneficially affect the health of the host. [1-3]

- The establishment of a healthy gut microbiome is essential for lifelong health and well-being but the preterm infant is predisposed to gut dysbiosis, an abnormal flora that may predispose to disease or poor health.[4]
- In the preterm infant gut, there are delays in bacterial colonization, reduction in total number of bacteria and reduced diversity of the microbial community.
- These effects may be attributed to the lack of contact with normal maternal flora, early antibiotic exposure, and limited use of human milk, especially for the initiation of feedings.
- Dysbiotic changes in the gut flora with Gammaproteobacteria before infants develop NEC have been described. [5-7]
- Numerous single center and multicenter studies (preterm infants total >10,000) have evaluated the effectiveness of multiple probiotic regimens for NEC prevention, mortality and other morbidities. [8-10]
- Systematic reviews have strongly suggested that probiotics reduce the incidence of NEC and may affect all-cause mortality but there are minimal effects seen in the smallest preterm infants with birth weight less than 1000 grams. [11]

Prebiotics are non-living substances that beneficially affect the host by selectively stimulating the growth and activity of certain bacteria in the colon that improve the health of the host. [3,12,13]

- Human milk contains over 150 different prebiotics primarily in the form of oligosaccharides that are small sugar chains, typically 3 to 7 monosaccharides in length.[14]
- These substances are naturally present in breastmilk, are not degraded by gastric acid, and support the growth of probiotics species in the GI tract. [15]
- Specific oligosaccharide structures may confer protection against NEC. [16]
- Supplementing formula milk with a mixture of galacto- and fructo-oligosaccharides not typically found in human milk stimulates intestinal growth of bifidobacteria similar to those found in preterm infants fed human milk. [17]
- Recent formulas can contain oligosaccharides found in human milk such as 2'FL and may help reduce respiratory morbidities in infants. [18]
- Prebiotic related health benefits in preterm infants have not yet been demonstrated. While term formulas contain probiotics and/or prebiotics, current preterm formulas do not contain either. Continuing research needs to be done on the effects of prebiotics on intestinal flora, feeding tolerance and the risk of NEC in preterm infants.

Recommendations, Guidelines and Algorithms

- Providing a diet based on human milk is the single most powerful method to positively influence the infant gut microbiome as human milk contains a potent mixture of natural prebiotic oligosaccharides and probiotics.
- While there is mounting evidence to support the use of exogenous probiotic treatment for the prevention of NEC, the type and quality of probiotics, dose, duration and safety measures in the NICU have not been well established yet.
- There are no FDA approved probiotics at present. The regulatory environment for probiotics is

complex and may limit the type of probiotics available for clinical use in the prevention of NEC in preterm infants.

- Although term formulas now contain some plant and human based oligosaccharides, clinical trials with prebiotics in preterm infants are required before establishing any recommendations for this promising group of compounds.

Quality & Process Improvement

- Establish guidelines for human milk use recognizing the differences in probiotic/prebiotics in mother's milk versus donor milk and other forms of processed human milk.

Outcome/Process Measures

- Human milk initiation day of life
- Human milk dose over hospital stay
- Human milk use at discharge
- All human milk at discharge

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POTENTIALLY BETTER PRACTICE #31

Pacifiers in the NICU

Background, Rationale, and Goals

- Despite earlier evidence that pacifier use was detrimental to exclusivity and duration of breastfeeding in term infants,[19,20] a recent Cochrane Review21 reported no significant effect on prevalence of breastfeeding or exclusive breastfeeding up to 4 months. The updated WHO/UNICEF 2017 Baby-Friendly Hospital Initiative guidelines has removed pacifier restriction from its key clinical practices.[22] Because of the low quality of the available evidence used by the WHO/UNICEF to adjust Step 9 (no pacifiers or artificial teats) and the desirability of newborns to stimulate a mother's milk supply by suckling at breast frequently rather than a pacifier, the United States Baby-Friendly accreditation organization (www.babyfriendlyusa.org) has not changed their recommendations.
- In preterm infants, non-nutritive sucking (NNS) has been associated with decreased hospital stay and faster transition from gavage to bottle feeding.[23] There is controversy about whether the use of pacifiers while gavage feeding is associated with more rapid gastric emptying and more rapid weight gain.[24]
- Recent studies have not demonstrated any detrimental effect on short or long term breastfeeding rates in preterm infants.[25] Indeed, a preliminary study of a motorized "pulsating" pacifier seemed to accelerate the development of NNS and facilitate improved oral intake.[26]

Recommendations, Guidelines and Algorithms

- When the mother is absent, a pacifier may be beneficial for soothing, when other techniques are not available or are ineffective.
- Pacifiers should not be used to delay feedings, even in anticipation of the mother's arrival. Crying in a term infant is a late sign of hunger.[27] A fretful infant expends calories better reserved for growth, and an exhausted infant is less capable of feeding at the breast.

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POTENTIALLY BETTER PRACTICE #32

Cytomegalovirus Transmission to Preterm Infants During Lactation

Background, Rationale, and Goals

- Maternal CMV reactivation of most seropositive mothers during lactation with shedding of viral DNA and virolactia can be detected already in colostrum by 3 days and normally ends at about 3 months after birth.
- CMV in milk is a local process without detection in plasma, throat or cervical swabs.
- Full-term infants have not been shown to have any sequalae from CMV transmission via breastmilk.
- The main risk factors for symptomatic disease are extremely low birthweight, early transmission, low gestational age, and low infant IgG titers.
- The exact milk to infant transmission rate varies from study to study.
- Despite transmission, actual illness (sepsis-like presentation) appears rare.
- There are now some data supporting the (rare) possibility of cognitive consequences of postnatally acquired CMV in preterm infants, but most studies show no differences in preterm infants with and without postnatally-acquired CMV infection.[2]
- Freezing at -20°C for various time intervals from 18 hrs to 10 days decreases the risk of CMV transmission but does not eliminate it.
- Holter pasteurization or heating to 62 °C for 5 seconds eliminates viral transmission.
- Microwave radiation or ultraviolet-C-irradiation may eliminate CMV but their efficacy and potential harmful effects on breastmilk factors are not know at present.

For a full review of the current literature refer to Hamprecht K and Goeltz R. "Postnatal Cytomegalovirus Infection Through Human Milk in Preterm Infants: Transmission, Clinical Presentation, and Prevention" in Clinics in Perinatology, March 2017; 44(1):121-130.[1]

Recommendations, Guidelines and Algorithms

General:

- The use of human milk for NICU infants should be continued.
- Established practice and guidelines for the prevention of CMV via blood products should continue.
- Breastfeeding or providing mother's breastmilk for full-term infants and preterm infants with CMV seronegative mothers should continue without further laboratory investigation.
- The low risk of symptomatic CMV infection in the extremely premature infant of a CMV-positive mother should be discussed with the mother and balanced against the known risks associated with lack of breastmilk use.
- The current frequency and nature of postnatal CMV infections in each neonatal unit should be tracked.
- CMV policies should be updated as new data become available.

Clinical:

- The mother's blood (CMV IgG) of all VLBW infants (< 1500 g or < 32 wks) admitted to the NICU may be screened for CMV serostatus. Maternal screening may be done on the high risk perinatal unit prior to delivery if possible.
- Appropriately pasteurized or HTST heat-treated donor human milk products may be used at any time without risk of CMV transmission.
- Fresh, refrigerated or frozen donor milk should not be used for VLBW infants unless the donor is CMV negative.
- Short-term heat inactivation for 5 seconds at 62° C (144° F) maintains the benefits of feeding human

milk while removing CMV transmission but this is not clinically available.

- Given the peak time of virolactia (and therefore transmission) appears to be 3-4 weeks postpartum, colostrum (the first 3-4 days of colostrum) may be used fresh or frozen.
- If the mother is CMV seropositive, freeze all maternal breastmilk for at least 24 hrs prior to feeding until the infant is > 32 weeks corrected age or feeding directly at the breast.
- Infants greater than 3 weeks of age with signs and symptoms consistent with CMV (respiratory deterioration, hepatitis, leucopenia, thrombocytopenia) or a sepsis-like syndrome should be evaluated for CMV:
  - Quantitative plasma PCR for CMV
  - Urine culture for CMV
  - Review admission maternal CMV status and initial infant status if mother was CMV positive.

References

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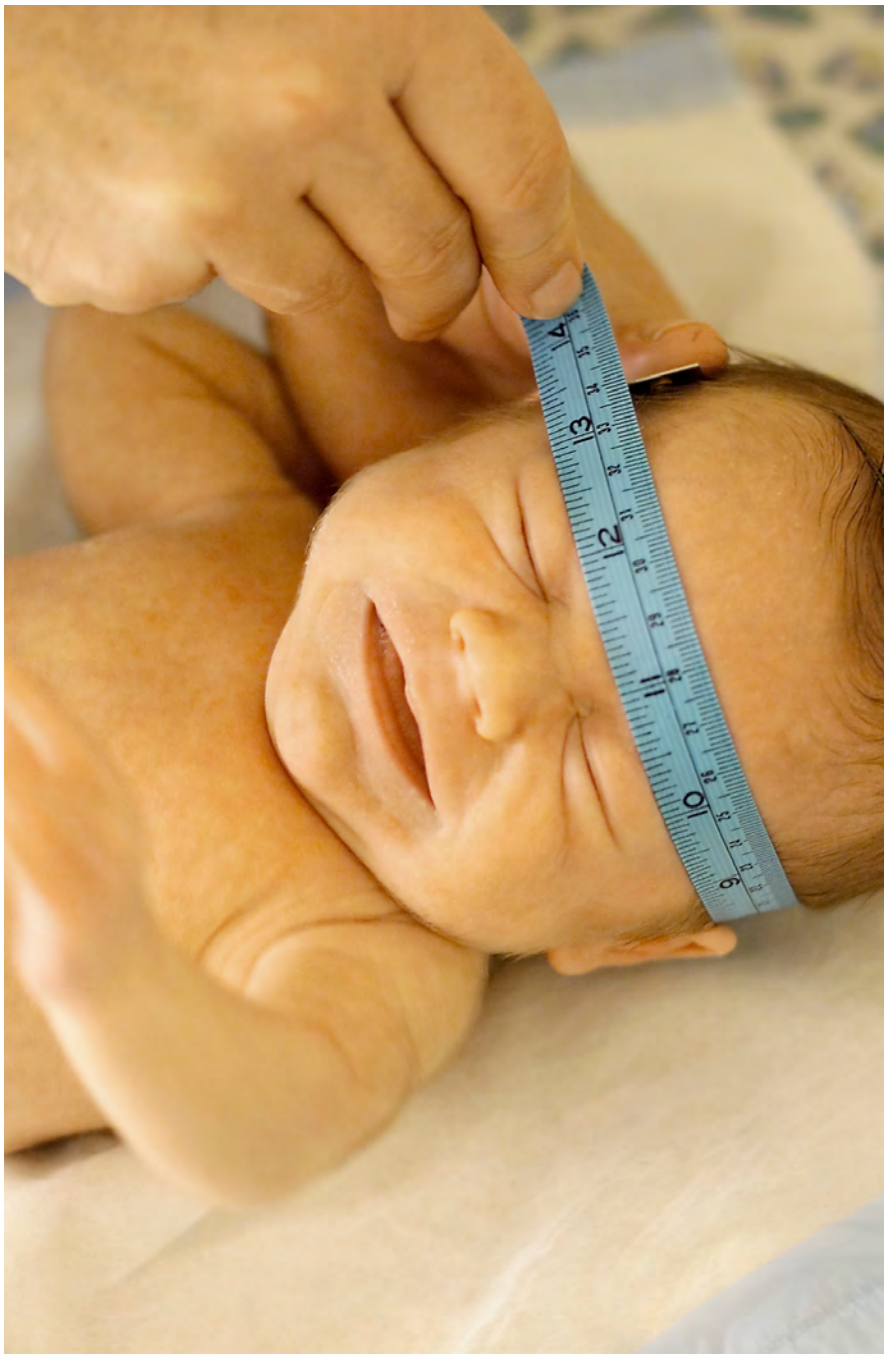
In This Section

Appendices

Appendices



APPENDIX #1

Individual Measures (patient-based)

Growth Parameters

- **Weight** (growth velocity – ideally measured from weight nadir)
- **Length** (ideally using length board)
- **Head circumferen**ce

Refer to TOOL #1 on page 10 for Growth Chart Options.

Nutritional Milestones

- **Colostrum use**: first use, use for mouth care
- **Feeding history:**
  - First feed (MOM, Donor HM, formula)
  - Discharge feeding (BM @ discharge)
- **MBM use**
- **PN use:** initiation, days of PN, discontinuation
- **Central line days** (w/or w/o PN use)
- **Feeding milestones (age of)**: birthweight regained, achieving full feeds (e.g. > 140 mL/kg/day), first non-nutritive breastfeeding, first nutritive breastfeeding
- **Skin-to-skin (kangaroo) care documentation** (1st SSC, frequency and duration)

Laboratory Testing

See TOOL #2 on page 11.

Related Clinical Diagnoses (balancing measures)

- Spontaneous intestinal perforation
- Necrotizing enterocolitis
- CLABSI

Maternal Milestones/Measures

- Documentation of breastfeeding education
- Time to first pumping
- Maternal milk supply (pump log)

Unit-Based Measures (ideally stratified by gestational age/birthweight)

Growth Parameters

- Weight (growth velocity)*
- Length velocity
- Head circumference velocity

Nutritional Milestones

- Colostrum use
- First feed (MOM, Donor HM, formula)
- MBM use (% of total feeds)
- Discharge feeding (BM @ d/c)*
- Parenteral Nutrition (PN) measurements
  - % started PN by 24 hr.
  - % protein ≥ 3 gm/kg/day by 3 days
  - % > 80 kCal/kg/d by 5 days
  - average age when lipids ≥ 3 gm/kd/day
  - % of patients getting PN > 30 days
- Central line days (w/ or w/o PN use)
- Average age when birthweight regained
- Average age of achieving full feeds
- Average age of first non-nutritive breastfeeding
- Average age of first nutritive breastfeeding
- Skin-to-skin (kangaroo) care documentation (1st, frequency)

Breastmilk Errors

Rates of Related Clinical Diagnoses (balancing measures)

- Spontaneous intestinal perforation*
- Necrotizing enterocolitis*
- CLABSI*

Maternal Measures

- % of mothers getting breastfeeding education
  - Prenatal teaching
  - First NICU teaching
- % and timing of lactation consultation
- Time to first pumping
- % of mothers documenting milk supply (pump log)

**** Data element found in CPQCC/VON or other benchmarking report***

APPENDIX #2

NICU Breastfeeding/Breastmilk Resources

- Current Concepts in Neonatal Nutrition, Poindexster B & Karpen H, eds. Clinics in Perinatology, June 2014, Multiple articles
- Human Milk for Preterm Infants, Mimouni FB & Koletzko B, eds. Clinics in Perinatology, March 2017, Multiple articles
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- Walker, D. J., Watkins, J. & Duggan, C. (Eds.) (2003) Nutrition in Pediatrics: Basic Science and Clinical Applications, 3rd Edition Hamilton Ontario, BC Decker Inc.
- Groh-Wargo, S., Thompson, M., Hovasi Cox, J. & Hartline, J. (Eds.) (2000) Nutritional Care for High-Risk Newborns, 3rd Edition, Chicago, Precept Press, Inc.

Milk Banking

- **Human Milk Banking Association of North Americ**a (www.hmbana.org)
- **Mothers' Milk Bank** (Only non-profit milk bank in California)

  751 South Bascom Ave
  San Jose, CA 95128
  Phone (408) 998-4550
  FAX (408) 297-9208
  mothersmilkbank@hhs.co.santa-clara.ca.us
  www.mothersmilk.org

- **Prolacta Bioscience** (http://www.prolacta.com)

Other Resources:

- Ban the Bags (http://banthebags.org/)
- Academy of Breastfeeding Medicine Protocols (www.bfmed.org)
- Supporting Premature Infant Nutrition (SPIN), UCSD (https://health.ucsd.edu/specialties/obgyn/maternity/newborn/nicu/spin/Pages/default.aspx)
- Center for Disease Control and Prevention (https://www.cdc.gov/breastfeeding/)
- Global Health Media – Videos (https://globalhealthmedia.org/videos)
- Open Pediatrics – Breastfeeding (https://www.openpediatrics.org/search/site/Breastfeeding)
- Risk of Invasive Disease in Preterm Infants Given Probiotics Formulated to Contain Live Bacteria or Yeast, The U.S. Food and Drug Administration (FDA) (https://www.fda.gov/media/172606/download?attachment)
- Preterm infants given probiotics at risk of fatal disease: FDA warning letter, American Academy of Pediatrics (AAP News) (https://publications.aap.org/aapnews/news/26322/Preterm-infants-given-probiotics-at-risk-of-fatal)

DISCLAIMER

The Potentially Better Practices (PBP) listed in this document are based on the current evidence as of the date of publication of this toolkit (September 2018).

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