Nutrition & Growth in the NICU: the 2018CPQCC Toolkit

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Breastfeeding Coordinator, Chapter 3, District IX, AAP
Past President, Academy of Breastfeeding Medicine
Founding Member, Education Chair, San Diego County Breastfeeding Coalition
Board of Directors, HMBANA

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Declaration of Industry Support

• I have no relevant financial relationships with the manufacturers of any commercial products and/or providers of commercial services discussed in this CME activity.
• I will indicate if a therapeutic agent is not approved for the clinical condition under discussion during this presentation.
OBJECTIVES:

At the conclusion of this presentation the participant will be able to:

• Identify the major goals of nutrition for preterm and ill NICU infants.

• Discuss the research-based advantages of human milk for NICU infants.

• List at least 4 major nutritional potential best practices in the CPQCC Toolkit.

• Recognize the need for, and components of nutritional monitoring.
OUTLINE:

• The CPQCC, Toolkits & Collaboratives
• Preterm Nutrition & Growth
• Human Milk in the NICU
• Nutritional Potential Best Practices
• Nutritional Monitoring and CQI
The “Quality Chasm”


• “Between the health care we have and the care we could have lies not just a gap, but a chasm.”

• Rapid new knowledge, technologies

• Inability to translate into clinical practice
  - Average of 17 years needed for results of RCT to be incorporated into general practice (Balas & Boren, 2000)
  - Underuse, overuse and misuse of therapies is commonplace

• Quality Chasm in Neonatology and Obstetrics
  - Unexplained variations in care practices
  - Large variations in outcomes
  - #1 on the list of examples: (lack of) use of breastmilk in the NICU
  - Must change the SYSTEM

Quality Improvement in Perinatal Care

• Central truths of improvement
  • Every change has both a technical and a social aspect
  • Technically rational changes can fail if the social aspects of change are not handled well

• Making Change Attractive
  • Clear advantage of new versus current
  • Compatibility with current system & values
  • Simplicity of change and transition
  • Trialability – how easy is it to try out?
  • Observability of change and its impact
Change Ladder

• Every system is perfectly designed to get the results it gets.
• If you don’t like the results, change the system.
• To change the system, must change the culture.
• Culture can be defined as “what we do around here”.
• Culture is composed of patterns of behavior.
Sustaining New Behaviors

• To change individuals’ behavior, organizations must know, and then **make it easy to do the right thing.**
  • This requires continuous organizational learning: the processing of new information into knowledge and widely sharing it.
  • For changes in behavior to last, an individual must learn the right thing to do and want to and be motivated to do it. (Incentives, disincentives, WIIFM)

• Support new behavior patterns:
  • What committed actions are needed to support the new behavior patterns? More than new policies and procedures.
  • What new structures are needed to support and sustain the new behaviors?
  • What new training, education, meetings, communications are needed for staff to perform and interact appropriately?
Sustaining the Gains

• The #1 enemy of sustaining the gains is the next new initiative
• Must embed the work into routine, everyday practice (the way we do things around here)
• Evolve from ‘a project’ to on-going, continuous discovery and improvement
Major Stakeholders and Executive Committee Members

- Perinatal Practitioner Organizations
  - California Association of Neonatologists
  - California Chapter American Academy of Pediatrics
  - American College of Obstetricians & Gynecologists
- State of California
  - Maternal, Child and Adolescent Health Branch
  - California Children’s Services (CCS)
  - Office of Vital Records
  - Office of Statewide Health Planning and Development
- Private Organizations
  - March of Dimes
  - Pacific Business group on Health
  - California Hospital Council
  - David and Lucile Packard Foundation
  - Vermont Oxford Network, Inc. (VON)
CPQCC
California Perinatal Quality Care Collaborative

- PQIP (Perinatal Quality Improvement Process)
  - Regional leaders identify NICU care practices with potential for improvement
    - Available indicator data
    - Demonstrated current variability in practice
    - Research evidence of valid recommended practices
  - Practice recommendations presented in a stand-alone quality improvement “Toolkit” (12 Current Toolkits)
- Multidisciplinary QI Workshop designed to jump-start unit teams
  - Data collection before workshop to create “cognitive dissonance” as a force for change
- Institute for Healthcare Improvement (IHI) style Collaboratives
Nutrition Toolkit History


- Nancy Wight MD, IBCLC, FABM, FAAP, Sharp Mary Birch Hospital for Women & Newborns
- Jane Morton MD, FABM, FAAP, Stanford University Medical Center
- William Rhine MD, FAAP, Stanford University Medical Center
- David Durand MD, FAAP, Children’s Hospital Oakland
- David Wirtschafter MD, FAAP, Kaiser Permanente
- Barbara Murphy, RN, MSN, CPQCC
- Courtney C. Nisbet, RN, MS, CPQCC

Authors: 2008 Revised Toolkit:

- Nancy Wight MD, IBCLC, FABM, FAAP, Sharp Mary Birch Hospital for Women & Newborns
- William Rhine MD, FAAP, Stanford University Medical Center
- David Durand MD, FAAP, Children’s Hospital Oakland
- David Wirtschafter MD, FAAP, Kaiser Permanente
- Jae Kim MD, PhD, FRCPC, FAAP, University of California San Diego
- Barbara Murphy, RN, MSN, CPQCC
- Courtney C. Nisbet, RN, MS, CPQCC
Collaborative Measurement Strategy:
Increasing Breastmilk Use in the NICU

• Primary Outcome Measure:
  • Percent discharged on ANY breastmilk

• Process Measures
  • % staff receiving recommended breastmilk feeding education
  • % infants with appropriate maternal skin2skin contact
  • % shifts where IBCLC or trained equivalent available
  • % VLBW infants with EBM as the FIRST feeding
  • Maternal breastmilk volume discussed/recorded in RN notes
  • Time of first pumping
  • Neonatologist discussed EBM at prenatal, or first postnatal contact

• Balancing Measures
  • Average LOS in NICU (length of stay)
  • Incidence of NEC
  • % VLBW AGA infants at birth that are SGA at discharge
Collaborative #2
Breastmilk Nutrition QI Collaborative

Call for Participation
-3 mo

Participant Enrollment
-0-3 mo

Participant Pre-Work

Select Topic
Aug 08

Expert Meeting
05.15.09

Develop Framework & Changes
Charter (aim, goals)-done
Change package
Measurement strategy

Supports
- Conference calls
- Listserv
- Monthly Team Reports

Learning Session #4 Sustain & Spread
05.11.11

Learning Session #1
09.30.09

Learning Session #2
02.03.10

Learning Session #3
10.08.10

-- underway
-- complete
QI Project to Increase Breastmilk Use in VLBW Infants


IHI Collaborative model
Change package/Best Practices
Rapid cycle PDCA

Figure 1: Annotated run chart of breast milk feeding at discharge for collaborative participants.

Figure 2: Percent of eligible infants with NEC by collaborative participation.
Download Metrics:
(Change in computer system 2015)

- 2016: 1,580
- 2017: 1,720
- Jan-Feb 2018: 201

Most downloaded toolkit
CPQCC Toolkits Available: 12
- Nutritional Support of the VLBW Infant
- Severe Hyperbilirubinemia Prevention
- Neonatal Disaster Preparedness
- Neonatal Therapeutic Hypothermia
- Perinatal HIV
- Care & Management of the LPI
- Improving Initial Lung Function
- Delivery Room Management of the VLBW Infant
- Antenatal Corticosteroid Therapy
- Postnatal Steroid Administration
- Improving Discharge Management
- Neonatal Hospital Acquired Infection Prevention

GROW BABY GROW Collaborative: 23 sites
2018 Revision Authors:

- Nancy Wight MD, IBCLC, FABM, FAAP, Sharp Mary Birch Hospital for Women & Newborns (SMBHWN)
- Jae Kim MD, PhD, FRCPC, FAAP, University of California San Diego
- William Rhine MD, FAAP, Stanford University Medical Center
- Olivia Mayer RD, CSP, IBCLC, Lucile Packard Children's Hospital, Stanford University
- Mindy Morris DNP, NNP-PC, CNS
- Rachelle Sey MSN APRN, CNS, RNC-NIC, Sharp Mary Birch Hospital for Women & Newborns (SMBHWN)
- Courtney Nisbet RN, MS, CPQCC
Improving long term health outcomes for VLBW infants by optimizing growth and nutrition in the NICU

Grow, Babies, Grow!

• Despite current intensive care, 38% of very low birth weight babies across California are leaving the NICU having fallen one full standard deviation or more from their initial birth weight parameters, compromising their future growth and neurodevelopmental potential later in childhood. This rate only increases for the most vulnerable infants, with more than half of babies born at less than 1,000 grams experiencing this same sub-optimal growth.

• In September 2018, CPQCC launched Grow, Babies, Grow! our 6th IHI-style QI Collaborative aimed at helping you optimize growth and nutrition of the VLBW infants in your NICU, with the goal of reducing growth failure at discharge. Don’t miss out on this exciting opportunity to tackle one of the most critical and modifiable factors for the long-term health and neurodevelopment of your smallest babies!

Registration March 6 to April 6, 2018
12 month QI Collaborative September 2018 to August 2019
Sustainability Phase September 2019 to March 2020
Fee subsidized at $8,500 per hospital
OUTLINE:

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• Nutritional Monitoring and CQI
NUTRITIONAL MORBIDITY

Are we providing ideal nutrition?

“Best possible conditions for the full development of all physical and intellectual potentials granted the child by its genetic heritage.”

Martinez & Desai. World Rev Nutr Diet.
Basel, Karger, 1995;78:55-73
**Improved Survival:**

Weight at 50% Survival (in USA)

<table>
<thead>
<tr>
<th>Year</th>
<th>Weight (g)</th>
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<tbody>
<tr>
<td>1970</td>
<td>1500</td>
</tr>
<tr>
<td>1980</td>
<td>1000</td>
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<tr>
<td>1990</td>
<td>750</td>
</tr>
<tr>
<td>1995</td>
<td>600</td>
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<td>2000</td>
<td>500</td>
</tr>
<tr>
<td>2005</td>
<td>500</td>
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<tr>
<td>2010</td>
<td>500</td>
</tr>
<tr>
<td>2015</td>
<td>500</td>
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</table>
Factors Affecting Growth Outcome at 18 Months in ELBW Infants
Dusick A et al. (NICHD Network), Pediatric Res 1998; 43:213A, Abstr # 1243

<table>
<thead>
<tr>
<th>BW (g)</th>
<th>n</th>
<th>Birth Wt ≤ 10%</th>
<th>36 wks Wt ≤ 10%</th>
<th>18 mo Wt ≤ 10%</th>
<th>18 mo L ≤ 10%</th>
<th>18 mo HC ≤ 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>401-500</td>
<td>15</td>
<td>71%</td>
<td>100%</td>
<td>77%</td>
<td>69%</td>
<td>92%</td>
</tr>
<tr>
<td>501-600</td>
<td>94</td>
<td>35%</td>
<td>100%</td>
<td>73%</td>
<td>63%</td>
<td>92%</td>
</tr>
<tr>
<td>601-700</td>
<td>208</td>
<td>15%</td>
<td>99%</td>
<td>52%</td>
<td>52%</td>
<td>57%</td>
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<tr>
<td>701-800</td>
<td>237</td>
<td>16%</td>
<td>100%</td>
<td>47%</td>
<td>42%</td>
<td>46%</td>
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<tr>
<td>801-900</td>
<td>290</td>
<td>15%</td>
<td>99%</td>
<td>43%</td>
<td>41%</td>
<td>37%</td>
</tr>
<tr>
<td>901-1000</td>
<td>307</td>
<td>17%</td>
<td>98%</td>
<td>35%</td>
<td>33%</td>
<td>31%</td>
</tr>
</tbody>
</table>
Growth Failure

- **IUGR (intrauterine growth restriction)**
  - Maternal nutrient stores & intake
  - Maternal illness
  - Placental insufficiency

- **EUGR (extrauterine growth restriction)**
  - Neonatal status at birth
  - Neonatal illnesses
  - Energy/Protein expenditure vs. intake
Growth and Neurologic/Developmental Outcome

Postnatal growth failure
Ekhard E. Ziegler MD, Univ of Iowa, VON, iNICQ

- Poor growth = inadequate nutrition
- Inadequate nutrition = impaired neurocognitive development
- Poor growth is likely a marker of suboptimal neurocognitive outcome
- Improved growth means improved neurocognitive outcome
Leaving the Placental Pipeline: A Nutritional Emergency

Fetal Nutrient Needs – Third Trimester

Energy ~ 90 kcal/kg/d
Protein ~ 3.5-4.0 gm/kg/d
Glucose ~ 10-14 gm/kg/d
    (~ 8-10 mg/kg/min)
Lipid ~ 4 gm/kg/d
Lactate ~ 2 gm/kg/d
Fe ~ 1.6-2.0 mg/kg/d

Adapted from Jae Kim MD, 2014
GOAL
GOALS OF NUTRITION

• Defining and achieving a standard of short-term growth
• Meeting the unique nutritional needs of prematurity
• Preventing feeding-related morbidities
• Optimizing long term outcome
Changes in Brain Weight Over 8 Weeks

Volpe, Neurology of the Newborn, 3rd Ed, 1995

- At 28wks: 100% Increase
- At term: 40% Increase
- At 3 mo: 25% Increase
Current Standard of Growth

To provide nutrients to approximate the rate of growth and composition of weight gain for a normal fetus of the same postmenstrual age and to maintain normal concentrations of nutrients in blood and tissue. AAP Committee on Nutrition: Pediatric Nutrition Handbook, 7\textsuperscript{th} ed, Elk Grove Village, IL, AAP, 2014

New weight-for-age gender-specific curves (solid line) for girls (A) and boys (B) compared with Lubchenco unisex curves (dashed line; start at 24 weeks).

Constantly refining growth curves

Should Extraterine Growth = Intrauterine Growth?

The “Privileged” Intrauterine Environment:

• The FETUS bears no responsibility for:
  • Temperature maintenance
  • Working against gravity
  • Digesting and absorbing food
  • Doing the work of breathing on a regular basis

** to match this in utero growth rate a 70 kg adult would have to gain ~ 3.2 lbs per day!

In Utero Growth of VLBW Infant

<table>
<thead>
<tr>
<th>Wt (g)</th>
<th>500-700</th>
<th>700-900</th>
<th>900-1200</th>
<th>1200-1500</th>
<th>1500-1800</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth (g/kg/d)</td>
<td>21**</td>
<td>20</td>
<td>19</td>
<td>18</td>
<td>16</td>
</tr>
</tbody>
</table>

Ziegler, Clin Perinatol 2002; 29:225

Theoretically infants ex-utero need MORE nutrients than in utero
Unique Aspects of Nutrition for the VLBW Infant

- Higher organ: muscle mass ratio
- Higher rate of protein synthesis and turnover
- Greater oxygen consumption during growth
- Higher energy cost due to trans-epidermal water loss
- Higher rate of fat deposition
- Prone to hyperglycemia
- Higher total body water content

Groh-Wargo et al. Nutritional Care for High-Risk Newborns, 2000

Figure 2.1. Age-related changes in body composition.
Preventing Feeding-Related Morbidities

- NEC
- Osteoporosis
- Vitamin and mineral deficiencies
- Feeding intolerance
- Prolonged TPN
- Prolonged hospitalization
- Lack of full physical and intellectual potential
Optimizing Long Term Outcome

**Nutritional Programming:**
(The Barker Hypothesis)

Nutrition during critical periods in early life may permanently affect the structure and/or function of organs or tissues.

Alan Lucas, 1990  
David Barker 1992

**Epigenetics:** promote normal intestinal ecosystem for normal gene expression and immune system development.
Early Diet Influences Long-term Health and Disease

Breastfeeding leads to **reduction in diastolic blood pressure** in later years of 3.2 mmHg, a greater impact that seen by other public health measures including:

- Weight loss (-2.8 mmHg)
- Alcohol reduction (-2.1 mmHg)
- Salt restriction (-1.3)
- Exercise (-0.2 mmHg)


Compilation of Research: Atul Singhal MRCP, Dec 2003
Early Diet Influences Long-term Health and Disease

Adverse effects of growth acceleration in humans include:

- Obesity
- Elevated blood pressure
- Insulin resistance and diabetes
- IGF-1 concentrations
- Cardiovascular mortality

Fewtrell M et al. Diabetologia 200; 43:714-717
Compilation of Research: Atul Singhal MRCP, Dec 2003
Opportunities for Improving Nutritional Care & Outcomes

• “Early” TPN
  • Prevent protein deficit
  • Prevent EFA deficiency

• GI priming/MEN/Trophic feeds
  • Prevent GI atrophy effects
  • Faster realization of full enteral feeds

• Fortification/Supplementation
  • Starting earlier
  • Continuing longer

• HUMAN MILK: a complex fluid that simultaneously provides nutrients and bioactive components that facilitate the adaptive, functional changes required for the optimal transition from intrauterine to extrauterine life.

Donovan, J Ped 2006; 149(5):S49-S61)
OUTLINE:

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• Human Milk in the NICU
• Nutritional Potential Best Practices
• Nutritional Monitoring and CQI
Evidence for Human Milk in the NICU

• Human Milk is:
  • Food for nutritional management
  • A therapeutic agent that protects from, and reduces incidence and severity of various morbidities
  • A programming agent for genetic and biologic pathways
  • A mechanism to involve mothers and families in NICU care

Adapted from P. Meier RN, DNSc, FAAN
Human Milk in the NICU

- Reduces the risk of short- and long-term morbidities in preterm infants
  - Enteral feeding intolerance
  - Nosocomial infection
  - Necrotizing enterocolitis
  - Chronic lung disease
  - Retinopathy of prematurity
  - Developmental and neurocognitive delay
  - Rehospitalization after discharge

- Protective mechanisms
  - Varied
  - Synergistic
  - Change over the course of NICU stay and course of lactation
Benefits of Human Milk for Preterm Infants

• Host Defense
• Gastrointestinal Development
• Special Nutrition
• Neurodevelopmental Outcome
• Physically & Psychologically Healthier Mother
• Economic & Environmental
Host Defense:
(Each element has multiple functions)

- **Cellular elements**
  - Lymphocytes, PMN & Macrophages

- **Immunoglobulins & other direct anti-infective factors**
  - IgA, Secretory IgA
  - Lactoferrin
  - Lysozyme
  - Casein
  - Mucin

- **Anti-inflammatory factors**
  - Vitamin A, C, E
  - Catalase
  - Glutathione peroxidase
  - PAF acetylhydrolase
  - Prostaglandins

- **Immunomodulators**
  - Prolactin
  - Cytokines
  - Cortisol, thyroxine, insulin & growth factors
  - Interleukins
  - Interferon
  - TNF & TGF

- **Other bioactive factors**
  - Oligosaccharides
  - FFA
  - Nucleotides
  - Glutamine, Taurine
  - EGF
“A pair of mammary glands has the advantage over the two hemispheres of the most learned professor’s mind in the art of compounding nutritious fluid for infants.”

Slide Courtesy of B. Behr

Chief Justice Oliver Wendell Holmes (1809-1894)
The effect of maternal milk on neonatal morbidity of very low-birth-weight infants


• Prospective observational study
  • 119 singleton VLBW infants
    • Mean B Wt 1056 g
    • Mean gest age 28 wks
  • Effect on neonatal outcomes of graded doses of MOM

• Results:
  • Threshold amount of at least 50 ml/kg/d (~ 1/3 of normal intake) of maternal milk through week 4 of life needed to decrease rate of sepsis in VLBW infants
  • Rate of sepsis lower by factor of 0.27
Gut Colonization: Less Pathogenic Flora
The Original “Probiotic”

**Human Milk**
BIFIDOBACTERIA

**Artificial Milks**
Clostridia
Enterococcus
Enterobacter
Bacteroides

**The Original “Prebiotic”:**
> 150 different oligosaccharides not found in artificial milks
The Gut & Inflammatory Processes

• **Gut microbiota**
  - Commensal bacteria – anti-inflammatory
  - Pathogenic bacteria – pro-inflammatory

• **Bacteria and their toxins stimulate inflammatory processes**
  - Local: NEC, feeding intolerance
  - Systemic (SIRS): lung, brain

• **Systemic Inflammatory Response Syndrome (SIRS)**
  - GI tract is the earliest interface between infant and environment
  - Early bacterial colonization of GI tract may “program” long-term responses and development

• **Compensatory anti-inflammatory response syndrome (CARS)**
  - Primarily mediated by interleukin-10 (IL-10) & transforming growth factor-β (TGF-β)
  - Immature in preterm and all newborns

Gastrointestinal Development

**Human Milk:**

- Reduces intestinal permeability faster (1, 6)
- Induces lactase activity (2)
- Multiple factors to stimulate growth, motility and maturation of the intestine (3)
- Human milk empties from the stomach faster than artificial milks (4)
- Less residuals and faster realization of full enteral feedings (5)

2. Shulman et al, J Pediatr 1998; 133:645
5. Wight et al. Best Medicine... , 2008, pg 46 with refs X4
Time needed to establish full enteral feeds in 95% of infants

<table>
<thead>
<tr>
<th>Type of feed</th>
<th>Number of days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expressed breastmilk (EBM)</td>
<td>20</td>
</tr>
<tr>
<td>Standard formula (SF)</td>
<td>45</td>
</tr>
<tr>
<td>Preterm formula (PTF)</td>
<td>48</td>
</tr>
</tbody>
</table>

Effect of human milk intake on length of stay (LOS) for VLBW infants (N=202)
Sisk PM et al. Abstr #46, ISRHML, Cambridge, 2004

• Amount of human milk received during the first 28 days
  LOS
  • Lower 50%: <55mL/kg/day 54±2.3 days
  • Higher 50%: >55mL/kg/day 45±2.3 days

• Amount of human milk received entire hospitalization
  • Lower 50%: <67 mL/kg/day LOS no diff
  • Higher 50%: >67 mL/kg/day

• Conclusion: HM in the first 28 days of life is critical to the health of VLBW infants and a thresh-hold amount of 55 mL/kg/day is needed to result in shorter LOS.
Benefits of Human Milk for the Preterm Infant

• Special Nutrition
  • Different quantity and quality of proteins
  • Lipid profile: Cholesterol, DHA, ARA
  • Carbohydrates designed for human infants
  • Antioxidants
  • Lower Osmolality/Renal solute load
  • Other factors: eg. Erythropoietin, EGF
## Composition of Milk on Day 7 Postpartum


<table>
<thead>
<tr>
<th>Component</th>
<th>Preterm Milk</th>
<th>Term Milk</th>
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<tbody>
<tr>
<td>Calories (kcal/100 ml)</td>
<td>67.4</td>
<td>60.6</td>
</tr>
<tr>
<td>Protein (gm/100 ml)</td>
<td>2.44</td>
<td>1.87</td>
</tr>
<tr>
<td>Fat (gm/100 ml)</td>
<td>3.81</td>
<td>3.06</td>
</tr>
<tr>
<td>Sodium (mEq/l)</td>
<td>21.8</td>
<td>16.9</td>
</tr>
<tr>
<td>Chloride (mEq/l)</td>
<td>25.3</td>
<td>21.3</td>
</tr>
<tr>
<td>Lactose (gm/100 ml)</td>
<td>6.05</td>
<td>6.52</td>
</tr>
<tr>
<td>Phosphorus (mg/100 ml)</td>
<td>14.2</td>
<td>15.1</td>
</tr>
<tr>
<td>Calcium (mg/100 ml)</td>
<td>24.7</td>
<td>25.4</td>
</tr>
</tbody>
</table>
Benefits of Human Milk for the Preterm Infant

• Neurodevelopmental Outcome
  • Higher IQ scores (especially for males)
  • Improved visual development
  • Less, and less severe ROP
  • Development of taste and smell
Breastmilk and Subsequent Intellectual Performance in Premature Infants at 8 yr

<table>
<thead>
<tr>
<th>Factor Affecting IQ</th>
<th>IQ Points</th>
</tr>
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<tbody>
<tr>
<td>Breastmilk</td>
<td>+ 8.3</td>
</tr>
<tr>
<td>Social Class</td>
<td>- 3.5/class</td>
</tr>
<tr>
<td>Mother’s Education</td>
<td>+ 2.0/group</td>
</tr>
<tr>
<td>Female Gender</td>
<td>+ 4.2</td>
</tr>
<tr>
<td>Mechanical Ventilation</td>
<td>- 2.6/week</td>
</tr>
</tbody>
</table>

Persistent beneficial effects of breast milk ingested in the neonatal intensive care unit on outcomes of extremely low birth weight infants at 30 months of age.


- 771 infants enrolled in Glutamine Study
  - 76% received some human milk
  - Divided into pentiles of human milk intake (total volume human milk/kg/day)
  - Bayley MDI (Mental Dev Index) & PDI (Physical DI) at 30 months

Results:
- Increased scores with increased human milk
- Every 10 cc increase in vol/kg/day of human milk increased the MDI by 0.8 point (p<.0008)

<table>
<thead>
<tr>
<th>Score</th>
<th>N</th>
<th>≤ 20%</th>
<th>20-40%</th>
<th>40-60%</th>
<th>60-80%</th>
<th>&gt;90%</th>
<th>p</th>
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<tbody>
<tr>
<td>MDI</td>
<td>535</td>
<td>78.8</td>
<td>76.8</td>
<td>82.8</td>
<td>86.3</td>
<td>89.6</td>
<td>.0001</td>
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<tr>
<td>PDI</td>
<td>511</td>
<td>83.2</td>
<td>79.7</td>
<td>85.5</td>
<td>87.2</td>
<td>90.2</td>
<td>.0076</td>
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</table>
Mother’s milk: Food for smarter kids

By Mike Snider
USA TODAY

Children who got mother’s milk as premature infants score higher on IQ tests than children who didn’t, a new study finds.

Other studies have suggested breast feeding boosts development and IQ, but some researchers have attributed that to having a nurturing mother.

This new study of 300 preemies — fed by tube — offers “strong evidence … that receiving breast milk was associated with the IQ advantage, rather than the process of breast feeding,” says Alan Lucas of the Medical Research Council, Cambridge, England.

He and others studied the preemies in two groups: those who got milk from their natural mothers and those who didn’t. Infants in both groups may also have been fed infant formula and milk from a woman other than their mother.

Preemies who got milk from their mothers during the first four to five weeks of life averaged 8.3 points higher on IQ tests at age 7½-8, show findings in the British medical journal Lancet, out Saturday.

“We’ve produced strong evidence that breast milk may be beneficial for long-term development,” Lucas says.

Researchers did not identify a specific amount of mother’s milk needed for the IQ advantage, but the more mother’s milk they got, the better the children seemed to do.

He says new formulas — with a better supplement of hormones, growth factors and certain fats found in mother’s milk, coupled with at least some milk from the natural mother — could give preemies “a double advantage.”
"I forgot to say I was breast-fed."
Benefits of Human Milk for the Preterm Infant

• Physically Healthier Mother
  • (Weight loss ↑)
  • Breast cancer/ovarian cancer ↓
  • Osteoporosis ↓
  • Child spacing via LAM

• Psychologically Healthier Mother
  • Alternate focus
  • Sense of control & Claim on infant
  • Guilt issue (D. Miracle/Rush study)
 Benefits of Human Milk for the Preterm Infant & Society

• Decreased Healthcare Costs
  • Less acute illness
  • Less chronic illness

• Decreased Societal Costs
  • Loss of time and income from work
  • Less waste
  • Less use of resources
The Breast Supplies What the Baby Lacks

- Lactose
- Lipase
- sIgA
- EGF
- Lactobacillus
- Oligosaccharides
- Nutrients
- Digestive Enzymes
- Protective Factors
- Trophic Factors
- Probiotics
- Prebiotics
- Energy requirements
- Immature pancreatic function
- Immature barrier function
- Mucosal differentiation
- Immunomodulation
- Support normal anti-inflammatory bacteria

The Breast Supplies What the Baby Lacks.
Possible Concerns re Human Milk for Preterm Infants

• **Nutritional**
  • Insufficient Pro, Ca, Phos, Na, vitamins
  • Variability of composition
  • Loss of nutrients during storage/feeding

• **Infectious**
  • Bacterial contamination during expression, storage and feeding
  • Viral transmission: CMV, HIV
Clinical Indications (Ideal, My Bias)

• For human milk:
  • Being born

• For donor human milk
  • Being born
  • No mother’s own milk (MOM) available
Supporting Donor Human Milk

• “If mother’s own milk is unavailable despite significant lactation support, pasteurized donor human milk should be used.”

  American Academy of Pediatrics, Section on Breastfeeding. Breastfeeding and the Use of Human Milk. Pediatrics 2012; 129(3); e827-e841

• Actions for Health Care: 12. Identify and address obstacles to greater availability of safe banked donor milk for fragile infants.

1. Monitor nutritional intake & outcomes
2. Begin TPN within first 2 hours of life
3. Promote human milk as the preferred nutritional substrate
4. Begin trophic feeds within the first 3 days of life
5. Manage residuals appropriately
6. Fortify human milk adequately
7. Facilitate post-discharge feeding of breastmilk, including fortification

General Considerations (2006 iNICQ):

• Breastmilk is the feeding of choice, including donor milk when mom’s own is not available.
• ELBW infants (<1000g) deserve our special attention as they have lesser reserves and tend to receive less nutrition than larger infants.
• Protein is almost always the limiting nutrient.
Concerns re **Donor** Human Milk for Preterm Infants

**Nutritional**
- Insufficient Pro, Ca, Phos, Na, Vitamins
- Variability of composition - donors usually term+ (lower protein)
- Alteration of nutrients with processing (eg. no lipase activity)
- Loss of nutrients during storage/feeding

**Infectious**
- No cellular components
- Bacterial contamination during storage and feeding
- Bacterial contamination with processing
- (Viral transmission: CMV, HIV)

**Overall**
- Species-specific, BUT
- Lower quality milk when compared to fresh MOM
Prevalence of Ever Use of Banked Donor Human Milk in US NICUs  
Perrine CG & Scanlon KS. Pediatrics 2013; 131(6):1066-1071  
Data from mPINC (Maternity Practices in Infant Nutrition and Care) Surveys

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The prevalence of maternity hospitals with an advanced care unit ever using banked donor milk in 2011, by state, and the location of active milk banks.
Uses of Donor Human Milk in NICU (USA, 2019)

- **Categories:**
  - Trophic feeds before MOM available
  - Supplement to QNS MOM
  - When MOB not pumping (medical or social reasons)
  - Adoption or surrogacy (when surrogate refuses to pump)

- **Specific indications**
  - VLBW (<1500 gm) and no MOM
  - (until reach full fortified feeds or > 1500 gm)
  - Feeding intolerance
  - Post GI surgery
  - Short Gut
  - Post-NEC
  - Other

- **Other hospital uses**
  - Supplementation for medical indications
  - Any infant at parents request
The Cost of Using Donor Human Milk in the NICU to achieve Exclusively Human Milk Feeding through 32 Weeks Postmenstrual Age

### Table 2. Volume of Donor Human Milk Fed to Infants

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**Discharge feeding category**

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<td>Breastmilk and formula</td>
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<td>953–9,271</td>
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Data are expressed in milliliters. MOM, mother’s own milk. DBM, donor breastmilk

### Table 3. Intervals (Days) Infants Were Fed Donor Breastmilk and Cost

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**Discharge feeding**

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<td>Formula (no MOM during admission)</td>
<td>29 (12–60)</td>
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72% of the study mothers were unable to provide all MOM needed.
OUTLINE:

• The CPQCC, Toolkits & Collaboratives
• Preterm Nutrition & Growth
• Human Milk in the NICU
• Nutritional Potential Best Practices
• https://www.cpqcc.org/resources/nutritional-support-vlbw-infant
• Nutritional Monitoring and CQI
Nutritional Support of the VLBW Infant

Managing the nutritional needs of preterm and ill newborns, especially the very low birthweight (VLBW) infant, has never been easy. Although the incidence of postnatal growth failure has improved over the last decade, there remains an unacceptably high rate of growth failure (50%) for VLBW infants. In the past several years there has been considerable basic science and clinical research on the nutritional needs of preterm infants and the optimum ways to provide that nutrition to prevent nutritional and growth deficits and ensure ideal multiorgan and system outcomes. New evidence suggests nutrition in the first two weeks of life may be critical.

The 2018 update of the Nutritional Support of the VLBW Infant Toolkit was developed to provide rapid assessment of current nutritional practices, outline evidence-based best practices, and enable rapid multidisciplinary improvement cycles to improve nutritional outcomes for premature newborns. We have added important new references, streamlined recommendations, and targeted the best resources.

DOWNLOAD TOOLKIT »
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EXECUTIVE SUMMARY 2

GENERAL PRINCIPLES 3

• Potentially Better Practice #1: Establish consistent, comprehensive, multidisciplinary nutrition care standards of practice based on evidence or expert opinion
• Potentially Better Practice #2: Establish standards of maternal monitoring as an integral component of improving nutrition outcomes in the neonatal population
• Potentially Better Practice #3: Identify, diagnose, and monitor malnutrition
• Potentially Better Practice #4: Track nutritional continuous quality improvement (COI) data for the individual patient as well as the unit aggregate data, and use to modify current practice

PARENTERAL NUTRITION 19

• Potentially Better Practice #5: Establish computerized order entry (CPOE) for Parenteral Nutrition (PN)
• Potentially Better Practice #6: Parenteral nutrition, including dextrose and protein should be started within the first 24 hours of life
• Potentially Better Practice #7: Start parenteral nutrition within 24 hours of life
• Potentially Better Practice #8: Discontinue parenteral nutrition, with removal of central catheters, as soon as adequate enteral nutrition is established
• Potentially Better Practice #9: Establish protocols for long-term management in those who become parenteral nutrition dependent and/or develop PN-associated cholestasis

ESTABLISHING ENTERAL NUTRITION 31

• Potentially Better Practice #10: Enteral feeding begins with oral caloric mix care started shortly after birth
• Potentially Better Practice #11: Start with minimal enteral nutrition (trophic feeds; gut priming) initiated on day of life 1 or 2, unless there are clear contraindications
• Potentially Better Practice #12: Follow a standard definition of feeding intolerance
• Potentially Better Practice #13: Give enteral feeds by intermittent bolus or continuously by gastric route, and less commonly by transpyloric route
• Potentially Better Practice #14: Enteral feeding advancement rates should be linear and specified in the feeding guidelines
• Potentially Better Practice #15: Fortification should be established before full enteral feedings are reached
• 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 curve

HUMAN MILK/BREASTFEEDING 55

• Potentially Better Practice #17: Human milk should be used whenever possible as the enteral feeding of choice for VLBW infants
• Potentially Better Practice #18: Obstetric, perinatal and neonatal professionals should counsel mothers when breast milk may be of concern or contraindicated
• Potentially Better Practice #19: Educate healthcare professionals and encourage advocacy for human milk for NICU infants
• Potentially Better Practice #20: Mothers and families should be given accurate information about human milk for VLBW infants, and their decisions respected
• Potentially Better Practice #21: Hospital policies and practice should support breastfeeding in a coordinated, consistent manner
• Potentially Better Practice #22: Mothers' milk supply should be established and maintained
• Potentially Better Practice #23: Human milk should be handled to ensure safety and maximal nutritional benefit to the infant

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• 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
• Potentially Better Practice #25: NICU healthcare providers should make use of safe techniques for which some evidence to effectively facilitate transition to full oral feeding
• Potentially Better Practice #26: Infants should have regular assessment by skilled providers of oral readiness and feeding performance
• Potentially Better Practice #27: Infants whose mothers intend to breastfeed should be put to breast before being exposed to the bottle

DISCHARGE PLANNING & POST-DISCHARGE NUTRITION 103

• Potentially Better Practice #28: Nutritional discharge planning should be comprehensive, coordinated and include appropriate nutrient fortification (if needed) and nutritional follow-up
• Potentially Better Practice #29: Mothers should be encouraged to eventually achieve exclusive breastfeeding after discharge while ensuring appropriate growth for the infant

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• Potentially Better Practice #30: Probiotics and Prebiotics
• Potentially Better Practice #31: Pacifiers
• Potentially Better Practice #32: CMV and Human Milk Feeding

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• Appendix #1: Key Individual and Unit-Based Measures
• Appendix #2: NICU Breastfeeding/Breastmilk Resources
Section I. General Principles

- Create a nutrition team/committee to review and implement evidence based practice
- Establish standards of nutrition monitoring as an integral component of improving nutrition outcomes
- Growth Standards, with links to:
  - Fenton (2013) Growth Charts
  - Olsen (2015) BMI curves for preterm infants
  - PediTools Preterm – online tool
- Identify, diagnose, and monitor malnutrition
- Examples of data collection forms for both individual and aggregate data
Section II. Parenteral Nutrition

• Computerized Provider Order Entry (CPOE) for PN
• PN, including IV Lipids, should be started within the first 24 hours of life
• Links to American Society of Parenteral and Enteral Nutrition & the FDA websites for information on PN component drug shortages
  • Guidelines for conservation and prioritizing short supply
• Discontinue PN with removal of central catheters, as soon as adequate enteral nutrition is established
• Long term management for those who become PN dependent &/or develop Parenteral Nutrition Associated Cholestasis (PNAC)
  • Newer IV lipids & other strategies
Section III: Establishing Enteral Nutrition

- Oral colostrum care
- MEN/Trophic feeds/gut priming starting day 1-2
- Standard definition of feeding intolerance
- Gastric feeding rather than transpyloric
- Standard feeding advancement protocol
- Fortification per standard protocol – before full feeding reached
- Advance and concentrate to sustain optimal growth along growth curve
Section IV: Human Milk / Breastfeeding

- Human milk (MOM & PDHM) is the feeding of choice for VLBW infants
- Healthcare professionals and hospital policies should advocate for and support human milk and know when a mother’s milk is inappropriate to use
- Mothers and families should receive accurate information about human milk and artificial milks and fortifiers
- Help mothers establish and maintain their milk supply
- Handle human milk to ensure safety and maximal nutritional benefit
- Consider EXCLUSIVE human milk diet for selected infants
Expansion of the Baby-Friendly Hospital Initiative Ten Steps to Successful Breastfeeding into Neonatal Intensive Care: Expert Group Recommendations

Kerstin H. Nyqvist, RN, PhD¹, Anna-Pia Häggkvist, RN, MSc, IBCLC², Mette N. Hansen, RN, RM, IBCLC³, Elisabeth Kylberg, PhD, IBCLC³, Annemii L. Frandsen, RN, IBCLC⁴, Ragnhild Maasrup, RN, IBCLC⁵, Aino Ezeondo, RN, CEN, CPN, CNICN, MHC⁶,⁷, Leena Hannula, RN, RM, MNSc, PhD⁷, and Laura N. Haiek, MD, MSc⁸

Abstract
In the World Health Organization/United Nations Children’s Fund document Baby-Friendly Hospital Initiative: Revised, Updated and Expanded for Integrated Care, neonatal care is mentioned as an area that would benefit from expansion of the original Ten Steps to Successful Breastfeeding. The different situations faced by preterm and sick infants and their mothers, compared to healthy infants and their mothers, necessitate a specific breastfeeding policy for neonatal intensive care and require that health care professionals have knowledge and skills in lactation and breastfeeding support, including provision of antenatal information, that are specific to neonatal care. Facilitation of early, continuous, and prolonged skin-to-skin contact (kangaroo mother care), early initiation of breastfeeding, and mothers’ access to breastfeeding support during the infants’ whole hospital stay are important. Mother’s own milk or donor milk (when available) is the optimal nutrition. Efforts should be made to minimize parent-infant separation and facilitate parents’ unrestricted presence with their infants. The initiation and continuation of breastfeeding should be guided only by infant competence and stability, using a semi-demand feeding regimen during the transition to exclusive breastfeeding. Pacifiers are appropriate during tube-feeding, for pain relief, and for calming infants. Nipple shields can be used for facilitating establishment of breastfeeding, but only after qualified support and attempts at the breast. Alternatives to bottles should be used until breastfeeding is well established. The discharge program should include adequate preparation of parents, information about access to lactation and breastfeeding support, both professional and peer support, and a plan for continued follow-up.
Staff perceptions and experiences of implementing the Baby-Friendly initiative in NICUs in Australia.

Focus Groups and individual interviews with 47 NICU staff nurses, midwives and hospital-based BFHI coordinators

• **Key facilitators:**
  - Clear baby-friendly policies
  - Staff education
  - Positive organizational culture & leadership
  - Availability of time
  - Adequate training & resources

• **Factors limiting the application of many BFHI steps:**
  - Fragile infant health
  - NICU Physical environment
  - Entrenched staff attitudes & practices surrounding infant feeding
  - Ubiquitous use of bottles & pacifiers
  - Resistance to practice change
  - Lack of staff confidence & time
Section V: Transitioning to Oral Feedings

• Transition from gavage to oral feedings based on physiologic readiness, not arbitrary weight or gestational age
• Utilize safe and effective methods and technologies to assist in transition to oral feedings
• Utilize skilled providers to assess feeding readiness and performance
• If a mother intends to breastfeed, put the infant to breast before using an alternative feeding method for supplementation
Direct breast-feeding in the NICU: is it important?

- All mothers who pumped but did not put baby to breast were not pumping at discharge.
- All mothers who provided breastmilk at discharge had put their babies to breast.
- “Through participating in breastfeeding, mothers are given an active and meaningful role in the NICU, which can build confidence and enable parents to handle and care for their infant.”
Section VI: Discharge Planning & Post-Discharge Nutrition

• Nutritional Discharge planning should be comprehensive, coordinated and include appropriate nutrient fortification (if needed) and nutritional follow-up
  • Infants who are SGA at discharge or who have special nutritional needs based on pathology, will usually require some fortification. Offer options for such fortification.
  • Balance some “catch-up” growth with risk of obesity, hypertension and heart disease
  • Laboratory studies and growth parameters should be followed
  • Send a nutritional plan and the in-hospital growth chart to the primary physician

• Mothers should be encouraged to eventually achieve exclusive breastfeeding after discharge while ensuring appropriate infant growth
  • Establish a good milk supply (≥ 500 mL/24 hrs) within the first 2 weeks
  • Help mothers to maintain their milk supply
  • Encourage mother-to-mother support groups
  • Continue skin-to-skin care after discharge
  • Provide written plan for gradual transition over to direct breastfeeding
**TOOL #24**

Possible Post-Discharge Feeding Regimens

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<th>Adequate Maternal Milk Supply</th>
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**PDF-22:** Post-discharge formula 22 kcal/oz

**PDF-24:** Post-discharge formula 24 kcal/oz

**Bone labs:** serum alkaline phosphatase, calcium, phosphorus


---

**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
- If infant lagging in growth, encourage more breastmilk volume or consider adding Post-Discharge Formula (PDF) i.e. Neosure™ or Enfamil™ to provide extra calories, protein, calcium, phosphorus, and vitamins.
- Plain breastmilk or breastfeeding with PDF 22 cal/oz
- Two (2) daily PDF feedings
- Three (3) daily PDF feedings
- Four (4) 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 morbidity.

**Birth Weight:**

- 750 grams
- 751-1200 grams
- 1201-1500 grams
- 1501-1800 grams

**Supplement duration:**

- Up to 12 months postnatal
- Up to 9 months postnatal
- Up to 6 months postnatal
- Up to 3 months postnatal or term weight

**Supplement feeding using method A or B below. Total feedings per day = B [7]**

A. Continue current breastfeeding plan and pumping routine. Refer to handout: "Breastfeeding Plan for Going Home"

B. Fortification of mother’s milk with PDF (Neosure™ or Enfamil™ powder) to:

- 22 cal/ounce
- 24 cal/ounce

**B. Post-Discharge formula (PDF) only (Neosure™ or Enfamil™ powder)***

- 22 cal/ounce
- 24 cal/ounce

* Mix formula powder and water per recipe provided by Sharp Mary Birch NICU

**Nutrition for Preterm Formula-Fed Infant**

- Use PDF: Neosure™ or Enfamil™: 22 kcal/ounce
- Use other formula: 22 kcal/ounce

**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.
- 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 (AAP) and/or SCOG recommends oral vitamin D supplement for all breastfed and most formula-fed infants: 400 international units per day.
- Monitor growth using Feinman, W.H.O., or CDC charts. Screen for iron deficiency. Continue iron supplement as needed.

Section VII: Special / Controversial Issues

• **Prebiotics:** A human milk diet is the principal way to encourage a high prebiotic diet. No recommendations yet for any novel commercial prebiotics.

• **Probiotics:** Increasing evidence that several different probiotics may reduce NEC and mortality but may not be helpful for the smallest preemies. We still do not have an FDA approved product.

• **Pacifier use in the NICU** is appropriate to soothe an infant when the mother is not available, and does not violate the WHO/UNICEF BFHI best practices

• **CMV:** The use of human milk for NICU infants should be continued
  • 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
    • Freezing the milk reduces, but does not eliminate viral infectivity
    • Heat treatment eliminates viral infectivity
OUTLINE:

• The CPQCC, Toolkits & Collaboratives
• Preterm Nutrition & Growth
• Human Milk in the NICU
• Nutritional Potential Best Practices
• Nutritional Monitoring and CQI

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Best Practice: Established NNTF (Neonatal Nutrition Task Force) Now SNNAC (Sharp Neonatal Action Committee)

• Goals
  • To facilitate optimal nutritional practice for all NICU infants.
  • To provide consistent, evidence-based information and advice to all mothers/families to enable them to meet their own breastfeeding goals.
  • To assure sufficient expressed breastmilk is available to meet an infant’s needs throughout the hospital course.
  • To assist mothers to transition to full breastfeeding at home, by maintaining a full milk supply and providing opportunities to breastfeed to infant discharge and beyond.
SNNAC (Sharp Neonatal Action Committee)

- Areas of Work
  - Policy and Procedure/GOC
  - Education: Parents/Families
  - Education: Physician/Staff
  - Support: Mother
  - Support: Staff
  - **Measurement/Evaluation**
  - Miscellaneous
Measurement/Evaluation

“If you can’t/don’t measure it, it’s not important”

- Time from Birth to TPN Hung (< 1500 g)
  - By hand by neonatal pharmacist – working on monthly Cerner report
- Breastmilk Use in the NICU & Graduate NICU
  - Collected once a week on rounds on data sheet by LC
  - Numbers entered into spreadsheet
  - Graph updated and printed by for NICU dashboard
- Timing of First Feeding (< 1500 g birthweight)
  - By chart review by NICU RD – now monthly Cerner report
- Type of First Feeding (< 1500 g birthweight)
  - By chart review by NICU RD – now monthly Cerner report
- First PO Feeding: Breast Before Bottle
  - Chart review
- VON Data
- Failure Mode Analysis
SMBHW NICU- Timing of First Feeding (< 1500g):
Average days post birth
SMBHWN NICU - First Feeding (< 1500g): % MBM, PDHM, Formula
VON – ANY Breastmilk at Discharge

Percentage

- ALL Infants
- Surrogates Removed

Yearly Data:
- 2008 Oct-Dec
- 2009 Jan-Mar
- 2009 Apr-Jun
- 2009 Jul-Sep
- 2009 Oct-Dec
- 2010 Jan-Mar
- 2010 Apr-Jun
- 2010 Jul-Sep
- 2010 Oct-Dec
- 2011 Jan-Mar
- 2011 Apr-Jun
- 2011 Jul-Sep
- 2011 Oct-Dec
- 2012 Jan-Mar
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- 2015 Apr-Jun
- 2015 Jul-Sep
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- 2016 Jan-Mar
- 2016 Apr-Jun
- 2016 Jul-Sep
- 2016 Oct-Dec
- 2017 Jan-Mar
- 2017 Apr-Jun
- 2017 Jul-Sep
- 2017 Oct-Dec
- 2018 Jan-Mar
Basic Measures

• Growth parameters
  • Weight, length, FOC velocity
  • % AGA to SGA at discharge
• Nutritional Milestones
  • Colostrum for mouth care
  • Time (hrs) of first feeding
  • Type of first feeding (MOM, PDHM, formula)
  • TPN days; central lines days
  • First non-nutritive/nutritive breastfeeding
  • First skin-to-skin
  • Day birthweight regained/full feeds
  • Breastfeeding BEFORE bottle-feeding
  • % of total intake (1st 28 days, at discharge) was human milk
• Breastmilk Misadministrations (Errors)
• Balancing Measures
  • SIP
  • NEC
  • CLABSI
• Maternal Measures
  • Time to first pumping/hand expression
  • Mothers with full milk supply (>500 mL/d)
  • Any breastmilk at discharge
  • Breastfeeding/pumping/storage/handling education
Baby-Monitor: A Composite Indicator of NICU Quality

Table 1. Comparison of Median and Mean Expert Weights Assigned to Each Measure

<table>
<thead>
<tr>
<th>Measure</th>
<th>Median (IQR)</th>
<th>Mean (SD, Range)</th>
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<tbody>
<tr>
<td>Antenatal steroids</td>
<td>20 (10)</td>
<td>16.5 (5.8, 5–25)</td>
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<tr>
<td>Health care-associated infection</td>
<td>15 (5)</td>
<td>16.5 (5.5, 5–25)</td>
</tr>
<tr>
<td>Survival</td>
<td>8 (15)</td>
<td>12.8 (11.7, 4–40)</td>
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<tr>
<td>Growth velocity</td>
<td>10 (10)</td>
<td>10.1 (5.5, 3–20)</td>
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<tr>
<td>Hypothermia on admission</td>
<td>9 (10)</td>
<td>10.1 (6.5, 3–25)</td>
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<tr>
<td>Discharge on any human milk</td>
<td>10 (6)</td>
<td>9.7 (5.4, 3–20)</td>
</tr>
<tr>
<td>Timely eye examination</td>
<td>9 (5)</td>
<td>9.1 (5.4, 3–20)</td>
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<tr>
<td>Chronic lung disease</td>
<td>5 (10)</td>
<td>8.9 (6.3, 0–25)</td>
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<tr>
<td>Pneumothorax</td>
<td>5 (3)</td>
<td>6.3 (2.4, 3–11)</td>
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Thank You

Questions?
Suggestions?