Human Milk Best Practices in NICU to Optimize Short and Long-Term Health Outcomes

Sarah N. Taylor, MD, MSCR
Associate Professor
I have been a consultant for Alcresta Therapeutics, Inc.
1) To determine how human milk decreases preterm infant morbidity and mortality

2) To identify evidence-based practices to initiate and sustain maternal milk production

3) To determine how to best support maternal lactation goals and why breastfeeding should be a goal.
In The Beginning...
In The Beginning…

Amniotic Fluid
Continuum of Gut Development and Maturation

Amniotic Fluid  Human Milk

Phase I  Phase II  Phase III  Phase IV  Phase V

Fetal Development  Birth

Adapted from Wagner CL et al; *Clinic Rev Allerg Immunol* 2008
Human Milk

- Maturation of Intestinal Wall
  - Decreased intestinal permeability
  - Human milk dose-dependent
- Stem cells in human milk
- Epithelial cell maturation and differentiation
  - Numerous growth factors
- Apoptosis
  - Lactoalbumin and HAMLET

Taylor SN et al 2009; Cregan M et al 2008; Koldovsky O 1995; Gustafsson L et al 2005
Human Milk and Immune Cells

- Initially, 1 billion leukocytes/ Liter
  - Polymorphonuclear cells, macrophages
  - Hypofunctional activity
- By 6 months, epithelial cells predominate

Buescher ES 2001
Multifunctional Milk Components

- Lactoferrin
  - Chelates free iron potentially for iron absorption
  - Removes unbound iron which bacteria need
  - Stimulates macrophage phagocytosis
  - Inhibits HIV, CMV, and herpes virus
  - Partial digestion
    - Lactoferricin B
    - Broad antibacterial activity

Multifunctional Milk Components

- Triglycerides
- Fatty Acids & Monoglyceride

- Monoglycerides
- Detergent on pathogen membranes

Hamosh M 1998; Thormar H et al 1987
The Immunosurveillance Balance

- Adaptive immune system
  - Maternal secretory IgA
    - 1 g/L mature milk and 12 g/L colostrum
    - Resistant to digestion
    - Accumulates in the GI tract (along mucous membranes)
    - Binds antigens on pathogens

Hanson L 1961; Uren TK et al 2005
The Immunosurveillance Balance

- Innate Immune Function
  - Role in immunomodulation
  - Anti-inflammatory cytokines
  - Antioxidants
  - Inhibition of pro-inflammatory process

Inhibition of Inflammation

- Adiponectin
  -Suppresses tumor necrosis factor (TNF)-α production

- Receptor blockers
  -Actively inhibit IL-1 and TNF-α

- Oligosaccharides/prebiotics/glycoproteins/HMOs
  -Bifidus factor
  -Promote commensal bacteria
  -Direct effect inhibiting toll-like receptor inhibition

- Human milk products
  -Modulate and mediate toll receptor interaction with bacteria

LeBouder E et al 2006; Hoffmann JA et al 1999; Labeta MO et al 2000
Balance of Inflammation

- Intestine is a constant state of inflammation
  - Immature intestinal immune cells
  - Inflammatory and toxic cytokine release
- Pro-inflammatory abilities develop faster than anti-inflammatory abilities

Physiological Inflammation

Lack of Anti-inflammatory Control

Necrotizing Enterocolitis
Human Milk for VLBW Infants

- Short-term Benefits
  - Faster attainment of full feeds
  - Decreased infections
  - Decreased necrotizing enterocolitis
    - Number needed to treat: 15
  - ELBW Infants in 1st 2 weeks: significant decrease in NEC or death with every 10% increase in human milk

Difficulties with trials: quasi-randomization, inconsistent definitions of human milk feeding (quantity and duration)

Initially Feeding the Preterm Infant

- How?
- When?
- What?
- How much?
Colostrum Oral Care

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Key Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Obtain fresh or refrigerated colostrum from mother</td>
<td>1. Give mother small breast milk collection containers and teach mothers hand expression to increase volumes of colostrum</td>
</tr>
<tr>
<td>2. Verify the colostrum identifier matches infant's identifier</td>
<td>2. Label colostrum in the order it was pumped</td>
</tr>
<tr>
<td>3. Wash hands and don gloves</td>
<td>3. Use fresh colostrum whenever possible</td>
</tr>
<tr>
<td>4. Saturate a sterile cotton swab with colostrum (approximately 0.2 mL)</td>
<td>4. HMBANA recommends to refrigerate only for 48–96 h for hospitalized infants</td>
</tr>
<tr>
<td>5. Gently paint the tongue, gums, and inner cheek with colostrum</td>
<td>5. If &lt; 0.2 mL colostrum is available, can mix with small amount of sterile water</td>
</tr>
<tr>
<td>6. Repeat every 3-4 h even when enteral feeding is begun via gavage tube£££</td>
<td>6. Document colostrum as oral immune therapy when administered</td>
</tr>
<tr>
<td></td>
<td>7. Recommend that parents do this when possible</td>
</tr>
</tbody>
</table>

Abbreviation: HMBANA, Human Milk Banking Association of North America.

From Gephart S & Weller M Advances Neo Care 2014

From Lee J et al Pediatrics 2015
COC Evidence

- Tolerated (i.e. safe?)
- Full enteral feeds sooner & decreased PN days
- Increased days of mother’s milk
- Less growth restriction at 36 weeks

Thibeau S 2013; Seigel JK 2013; Caprio M 2013; Rodriguez NA 2011

Lee J et al Pediatrics 2015
When to Start Feeding Evidence

- Is NPO safer than feeding?
  - Early feeding (≤4 days) versus delay progressive feeds (4-7 days)
    - Delayed associated with 2-4 days larger to full feeds
    - No difference NEC or mortality for all and for SGA alone

- Longer to full feeds means longer need for parenteral nutrition and central line

ELBW infants
MM and DM only

Intervention:
-education regarding safety to feed in first 24 hours

Table 2
Comparison of outcomes by epoch.

<table>
<thead>
<tr>
<th></th>
<th>Epoch 1 (n = 277)</th>
<th>Epoch 2 (n = 326)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>First EF median (hours) (interquartile range)</td>
<td>33 (17–52)</td>
<td>14 (8–24)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>PN median (days) (interquartile range)</td>
<td>14 (8–22)</td>
<td>12 (7–20)</td>
<td>NS</td>
</tr>
<tr>
<td>NEC, n (%)</td>
<td>18 (6.5)</td>
<td>23 (7.1)</td>
<td>NS</td>
</tr>
<tr>
<td>Death, n (%)</td>
<td>25 (9)</td>
<td>12 (3.7)</td>
<td>NS</td>
</tr>
<tr>
<td>NEC or death, n (%)</td>
<td>37 (13.4)</td>
<td>31 (9.5)</td>
<td>NS</td>
</tr>
<tr>
<td>Central line days, median (interquartile range)</td>
<td>12 (7–18)</td>
<td>11 (7–15)</td>
<td>NS</td>
</tr>
<tr>
<td>Central line associated blood stream infection, n (%)</td>
<td>7 (2.5)</td>
<td>0</td>
<td>0.004</td>
</tr>
<tr>
<td>Feeding intolerance, n (%)</td>
<td>43 (15.5)</td>
<td>21 (6.4)</td>
<td>0.0003</td>
</tr>
<tr>
<td>Bronchopulmonary dysplasia</td>
<td>63 (22.7)</td>
<td>80 (24.5)</td>
<td>NS</td>
</tr>
<tr>
<td>Retinopathy of prematurity</td>
<td>8 (2.9)</td>
<td>14 (4.3)</td>
<td>NS</td>
</tr>
<tr>
<td>Growth velocity, g/day median (IQ)</td>
<td>17.9 (15.2–20.4)</td>
<td>21.6 (18.8–25.5)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Length of hospital stay, median days (interquartile range)</td>
<td>42 (24–66)</td>
<td>46 (27–68)</td>
<td>NS</td>
</tr>
</tbody>
</table>
How Much and How Quickly

• Slow (15 to 24 ml/kg/day) versus Fast (30-40 ml/kg/day)

  - No differences
    - NEC
    - All-cause mortality

  - Slow
    - Delayed full feeds by 1-5 days
    - Increased invasive infection risk [1.46 (95% CI 1.03-2.06)]
      - Number needed to treat: 14

Morgan J et al  Cochrane Database 2015
Trophic Feeds First?

- Trophic versus increasing volume?
  - Early trophic versus feeding in first 96 hours
    - No benefit AND no harm
      - Growth rate, feed tolerance, NEC
  - With new evidence that progressive feeds are tolerated day 1-2, do we need trophic feeds?
    - One institution: Decreasing from 5 to 3 day for <1 kg
      - No results yet!

How To Get Mother’s Milk by the Time to Feed?

Cassatt
Evidence-based Methods to Obtain Milk

- In the first 2 weeks
  - Pumping correlates with later milk supply
  - Greater volume with pumping than hand expression alone
  - Greater volume with a “relaxation tape”
- On the first day,
  - Higher mean volume with hand expression

Early Milk Expression

- Milk expression within 6 hours
  - Current goal
- Evidence supporting milk expression within 1 hour
  - RCT of pumping within 60 minutes versus 1-6 hours
  - For VLBW infants
  - Statistically and clinically significant differences

Parker LA et al 2012
### Table 1  Milk volume (ml)

<table>
<thead>
<tr>
<th>Time</th>
<th>Volume of milk</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Early initiation (n = 10)</td>
<td>Late initiation (n = 10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>M</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Initial expression session</td>
<td>4.19</td>
<td>0.1</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>Day 1</td>
<td>19.2</td>
<td>0.7</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Day 2</td>
<td>76.7</td>
<td>2.2</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Day 3</td>
<td>142.3</td>
<td>45.4</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>Day 4</td>
<td>185.7</td>
<td>69.9</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>Day 5</td>
<td>282.0</td>
<td>85.8</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Day 6</td>
<td>322.0</td>
<td>191.9</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Day 7</td>
<td>355.0</td>
<td>188.8</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Total at 1 week&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1374.7</td>
<td>608.1</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N = 8</td>
<td>N = 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 weeks&lt;sup&gt;b&lt;/sup&gt;</td>
<td>613.0</td>
<td>267.2</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N = 6</td>
<td>N = 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 weeks&lt;sup&gt;c&lt;/sup&gt;</td>
<td>451.0</td>
<td>209.95</td>
<td>0.07</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Sum of all milk volume for days 1—7.

<sup>b</sup>24 h milk volume at 3 weeks.

<sup>c</sup>24 h milk volume at 6 weeks.

Not statistically different but clinically different

Parker LA et al 2012
Second study by Parker et al 2015

Pumping needs to occur WITHIN 6 hours after delivery
- Within first hour, higher volume in first study
- Within 2-3 hours may be even better
When You Do Not Have Mother’s Milk?
Detrimental Formula

Lipid peroxidation → Intestinal wall → Inflammation

- Increased intestinal permeability with formula compared to mother’s milk for at least 30 days
- Increased NEC with exposure to formula

Taylor SN 2008; Sisk PM 2007; Meizen-Derr 2008
Is Donor Milk Protective Against NEC (vs. Formula)?

<table>
<thead>
<tr>
<th>Meta-analysis</th>
<th>Included trials</th>
<th>NEC Reduced Relative Risk (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>McGuire and Anthony 2003</td>
<td>4 small trials</td>
<td>0.34 (0.12 to 0.99)</td>
</tr>
<tr>
<td>Boyd et al 2007</td>
<td>7 trials (5 RCTs)</td>
<td>0.21 (0.06 to 0.76)</td>
</tr>
<tr>
<td>Quigley et al 2008</td>
<td>5 trials (1 with fortifier)</td>
<td>0.4 (0.2 to 0.83)</td>
</tr>
</tbody>
</table>

Number needed to treat to avoid 1 NEC case is 33
American Academy of Pediatrics 2012

Standard of Care in the United States

**TABLE 3** Recommendations on Breastfeeding Management for Preterm Infants

1. All preterm infants should receive human milk.
   - Human milk should be fortified, with protein, minerals, and vitamins to ensure optimal nutrient intake for infants weighing <1500 g at birth.
   - Pasteurized donor human milk, appropriately fortified, should be used if mother's own milk is unavailable or its use is contraindicated.

2. Methods and training protocols for manual and mechanical milk expression must be available to mothers.

3. Neonatal intensive care units should possess evidence-based protocols for collection, storage, and labeling of human milk.\(^{150}\)


5. There are no data to support routinely culturing human milk for bacterial or other organisms.\(^{151}\)
TABLE 3 Recommendations on Breastfeeding Management for Preterm Infants

1. All preterm infants should receive human milk.
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5. There are no data to support routinely culturing human milk for bacterial or other organisms.
DHM and Neurodevelopment

- Earlier studies demonstrated better neurodevelopment with preterm formula
  - But no fortification of donor milk
- 2 recent RCTs (in abstract form)
  - VLBW infants
  - MM supplemented with PF versus DHM with bovine HMF
  - 1 showed less NEC with FDHM (1.7% versus 6.6% with PF)
  - Both showed no differences in neurodevelopment at 18-24 months

Unger S et al 2016 and Colaizy T et al 2016 PAS abstracts only
How Long to Give Donor Milk?
Or what to add?
In the first 28 days,

- For every day with >50% breast milk intake, 0.5 higher IQ
- For every 10 ml/kg/day increase, 0.7 higher IQ
## Locating the Potential Effect

**Table II.** Number of days on which enteral intake was >50% breast milk and estimated brain volumes at term equivalent age

<table>
<thead>
<tr>
<th></th>
<th>Model 0 (n = 147)</th>
<th>Model 1 (n = 133)</th>
<th>Model 2 (n = 132)</th>
<th>Model 3 (n = 131)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>β</strong></td>
<td><strong>95% CI</strong></td>
<td><strong>β</strong></td>
<td><strong>95% CI</strong></td>
<td><strong>β</strong></td>
</tr>
<tr>
<td>Intracranial volume</td>
<td>-0.05</td>
<td>-2.05, 1.05</td>
<td>-0.22</td>
<td>-1.93, 1.50</td>
</tr>
<tr>
<td>Total brain size</td>
<td>-0.07</td>
<td>-1.36, 1.22</td>
<td>0.18</td>
<td>-1.25, 1.61</td>
</tr>
<tr>
<td>Total gray matter</td>
<td>-0.29</td>
<td>-1.12, 0.55</td>
<td>-0.20</td>
<td>-1.12, 0.73</td>
</tr>
<tr>
<td>Total white matter</td>
<td>0.10</td>
<td>-0.58, 0.77</td>
<td>0.20</td>
<td>-0.54, 0.94</td>
</tr>
<tr>
<td>Myelinated white matter</td>
<td>-0.01</td>
<td>-0.10, 0.09</td>
<td>-0.03</td>
<td>-0.12, 0.07</td>
</tr>
<tr>
<td>Unmyelinated white matter</td>
<td>0.10</td>
<td>-0.56, 0.76</td>
<td>0.21</td>
<td>-0.52, 0.94</td>
</tr>
<tr>
<td>Deep nuclear gray matter</td>
<td>0.11</td>
<td><strong>0.02, 0.20</strong></td>
<td><strong>0.14</strong></td>
<td><strong>0.05, 0.23</strong></td>
</tr>
<tr>
<td>Cerebellum</td>
<td>0.03</td>
<td>-0.07, 0.12</td>
<td>0.04</td>
<td>-0.06, 0.15</td>
</tr>
<tr>
<td>Hippocampus</td>
<td>0.003</td>
<td>-0.004, 0.01</td>
<td>0.003</td>
<td>-0.01, 0.01</td>
</tr>
</tbody>
</table>

**β** indicates cc increment in estimated brain volume per 1 additional day on which breast milk was >50% of enteral intake during the first 28 days of life.

Model 0 is adjusted for exact age at assessment, sex, gestational age at birth.
Model 1 = Model 0 + social risk score.
Model 2 = Model 1 + multiple gestation, Clinical Risk Index for Babies score, antenatal or postnatal corticosteroids, neonatal illness (supplemental oxygen dependency at 36 weeks, sepsis, or necrotizing enterocolitis).
Model 3 = Model 2 + birth-to-term weight z-score change.
Results presented in bold are statistically significant (P < .05).

Belfort M et al 2016
VLBW Infant Growth

**Top Quartile of Growth**
18-21 g/kg/day weight gain in hospital

Better neurodevelopmental outcome
18-22 months

**Postnatal Growth Lag**

Neurologic and sensory handicaps
Poor school performance
Lower cognitive scores at 8 years
Lower educational at 8 years
Psychosocial delays at 8 years

Optimal Growth Velocity

- For neurodevelopment
  - 18-21 g/kg/day
- Associated with ≥ z-score on growth curve
  - 20-30 g/kg/day
- To recover days lost while regaining birth weight
  - 19 g/kg/day [15 g/kg/d (fetal) + 4.3 g/kg/d]

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>26 wks</td>
<td>818 g</td>
<td>38\textsuperscript{th} % tile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27 2/7 wks</td>
<td>818 g</td>
<td>18\textsuperscript{th} %tile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32 3/7 wks</td>
<td>1800 g</td>
<td>36\textsuperscript{th} %tile</td>
<td>20.8 g/kg/d</td>
<td></td>
</tr>
<tr>
<td>40 weeks</td>
<td>3400 g</td>
<td>37\textsuperscript{th} %tile</td>
<td>30.4 g/d</td>
<td></td>
</tr>
</tbody>
</table>

Ehrenkranz RA et al 2006; Martin CR et al 2009; Taylor unpublished
Fortifier is a Necessary Evil
<table>
<thead>
<tr>
<th>Outcome</th>
<th>Effect Size (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Versus No Minerals</td>
</tr>
<tr>
<td>Weight gain (g/kg/day)</td>
<td>3.6 (2.7, 4.6)</td>
</tr>
<tr>
<td>Weight gain (g/day)</td>
<td>4.7 (2.8, 6.7)</td>
</tr>
<tr>
<td>Length gain (cm/week)</td>
<td>0.2 (0.1, 0.3)</td>
</tr>
<tr>
<td>Head circumference gain (cm/week)</td>
<td>0.1 (0.1, 0.2)</td>
</tr>
</tbody>
</table>

Improved bone mineral content when radius measured

No difference in growth at 12 months or 18 months

No difference in neurodevelopment

Fortifier Debates Persists

- Who needs it?
- Are there risks?
- Is one product better?
- For how long?
Who Needs Some Amount of Fortification?

- Gestational age or birth weight parameters
  - 2 large trials inclusion criteria
    - <37 weeks and <1850 grams (Lucas et al 1996)
    - Birth weight 1000-1500 grams (Pettifor et al 1989)

- Other options
  - <32 weeks (Faerk et al 2000)
  - <1800 grams (Wauben et al 1998)
  - ≤33 weeks and ≤1600 grams (Reis et al 2000)
How early to fortify?

- Fortification at 40 ml/kg/day
  - Human HMF (Sullivan et al 2010)
- Fortification of first feed (Tillman et al 2012)
  - Powdered bovine fortifier
  - Early fortifying with lower likelihood of sepsis
  - No improvement in growth
  - 5 early fortifier and 1 delayed infants with bloody stools
- Trials of decreased NEC with FHM versus formula
  - Fortification at 100 ml/kg/day (Schanler RJ et al 1999; Schanler RJ et al 2005; Sisk PM et al 2007)
Randomized trial of fortified at 20 ml/kg/day (EF) versus 100 ml/kg/day (DF)

- No difference in tolerance or growth
- Increased protein delivery

**Figure 2.** Median daily A, protein and B, caloric intake in first 4 weeks of life. Data are shown as median (IQR). *P < .005.

Shah SD et al 2016
Does fortifier lead to NEC?

- RCT of fortified vs. non-fortified human milk
  - 2-fold increase in incidence of NEC
  - From 2.2% to 5.8% (p=0.12) (Lucas A et al. AJCN 1996)

- The other side of the debate
  - Both comparison groups received ~ 50% of feeds as preterm formula (Schanler et al)
  - Meta-analysis demonstrated Relative Risk (95% CI) of 1.33 (0.7-2.5) not significant (Kuschel and Harding)

- Latest trials all had fortification
  - Schanler RJ et al 1999; Schanler RJ et al 2005; Sisk PM et al 2007
  - Except Sullivan 2010 trial raises concern for bovine HMF
Bovine HMF and Necrotizing Enterocolitis

- No difference in death
- No difference in NEC, until
- The Human vs. Bovine HMF Trial
  - Population 500g-1250g birth weight
  - Powered to see a difference in parenteral nutrition (PN) duration
  - No difference in duration of PN
    - Now say difference if control for expected PN days
- Bovine-HMF also exposed to formula
- NEC rates-
  - 15.9% for bovine HMF
  - 7% for HHMF added at 40 cc/kg/day feeds
  - 4.5% for HHMF added at 100 cc/kg/day feeds

Sullivan et al 2010; Ghandehari et al 2012
Triple-blinded RCT of HHMF versus bovine HMF with base of MM and DHM

- No difference in feeding interruptions, feeding tolerance, Growth, morbidity including NEC ≥ 2, mortality

- Significantly higher severe ROP in bovine HMF group

- 127 infants <1250 grams and sponsored by CIHR

O’Connor DL PAS abstract 2016
Which Fortifier?

<table>
<thead>
<tr>
<th>Fortifier</th>
<th>High Protein</th>
<th>Hydrolyzed High Protein</th>
<th>Human-derived 26 kcal/oz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (g/kg/day)</td>
<td>4.3</td>
<td>3.9</td>
<td>3.6</td>
</tr>
<tr>
<td>Adequate Ca&amp;P</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PUFAs</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Weight gain (g/kg/d)</td>
<td>15-16</td>
<td>18.2</td>
<td>24.8</td>
</tr>
<tr>
<td>Length gain (cm/wk)</td>
<td>1.1</td>
<td>1.2</td>
<td>0.99</td>
</tr>
</tbody>
</table>

- Acidification
- Single institution observational studies
  - Increased acidosis, feeding intolerance
- RCT
  - No increase in acidosis, NEC, sepsis or 1 adverse event
- Iron supplementation
  - In vitro study shows decrease milk antimicrobial activity
  - No difference in sepsis in clinical studies

Human Milk Fortifier

- Know the components of your fortifier
- Know how your infants grow on your plan
- Develop protocol to consistently optimize growth
- Be mindful of evidence vs. expertise vs. advertising
- Feed to GROW
  - But not too big
Why sustain milk supply?
Evidence-based Benefits of Human Milk

<table>
<thead>
<tr>
<th>Decreased for infant</th>
<th>Decreased for mother</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otitis media</td>
<td>Hypertension</td>
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<tr>
<td>Gastrointestinal infections</td>
<td>Hyperlipidemia</td>
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<tr>
<td>SIDS</td>
<td>Diabetes</td>
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<tr>
<td>Lower respiratory infections</td>
<td>Cardiovascular disease</td>
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<tr>
<td>Upper respiratory infections</td>
<td>Breast cancer</td>
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<td>RSV bronchiolitis</td>
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<tr>
<td>Leukemia</td>
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<td>Diabetes type I</td>
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<tr>
<td>Diabetes type II</td>
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<td>Inflammatory bowel disease</td>
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<td>Celiac disease</td>
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<tr>
<td>Asthma</td>
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<tr>
<td>Atopic dermatitis</td>
<td></td>
</tr>
</tbody>
</table>

AHRQ report 2007; AAP report 2012; Schwarz EB et al 2009
Cost of NOT Breastfeeding

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

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

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

Rollins NC et al *Lancet* 2016
Benefits of Mother’s Milk Post-Discharge Specific to Preterm Infants

- Despite slower growth, equal or better neurodevelopment
  - Positive relationship between duration of human milk feeding and later Bayley Mental Index

- Human milk after discharge
  - Decreased upper respiratory symptom visits
  - Decreased rehospitalization

What Can Be Done to “Normalize” Preterm Infant Feeding

To be as close as possible to term infant breastfeeding?
First, Establish and Sustain Mother’s Milk Supply

- To sustain to >40 weeks gestation
  - Express by 6-hours post-delivery
  - Perform kangaroo care
  - Express milk ≥ 5 times per day
- To have adequate supply at discharge
  - Double pumping
  - 500 ml/day by day 10
  - Higher score for breast pump comfort
- NICU environment
  - Staffing, nurse level of education, nurse support of breastfeeding

Skin-to-Skin Care for Term and Preterm Infants in the Neonatal ICU

Jill Baley, MD, COMMITTEE ON FETUS AND NEWBORN

Improved

- Exclusive breastfeeding
- Milk volume
- Maternal attachment or bonding
- Participation of parents in care
- Less maternal stress
- Parents’ response to infant cues
- Potentially better sleep and neurobehavioral maturation
- Potentially improved management of procedural pain
- No increase in infections (decrease in developing countries)
- Apparent physiologic stability

Pediatrics, September 2015
Kangaroo Care as Soon as Medically-Able
Summary

- Mother’s Milk to promote health
- Consider feeding early and advancing steadily
- Donor milk for VLBW infants
- Fortify to sustain desired growth velocity
  - Fortification required for VLBW and likely <1800 g or 33 weeks
- No definitive benefit of one fortifier over another
- To obtain and sustain mother’s milk
  - Express early, pump consistently, kangaroo care
- Efforts to sustain mother’s milk supply post-hospital discharge and achieve 12-month AAP goal
  - Know mother’s personal goal