DISCLAIMER: This presentation is intended to provide a guideline for healthcare providers in the use of an Exclusive Human Milk Diet in infants ≤1250 g birth weight. The information within is the collective opinion of the Nutrition Advisory Committee, a committee sponsored by Prolacta Bioscience. As with all feeding guidelines, appropriate medical judgement should be exercised. Be sure to review your clinical experience and outcomes around the management of nutrition in very low-birth-weight infants.
Andi Markell, RD, LD

EDUCATION
Bachelor of Science in Nutrition and Food Management, Focus: Dietetics

NATIONAL CERTIFICATIONS
Commission on Dietetic Registration, 2000 - present
Oregon Board of Examiners of Licensed Dietitians, 2001 – present

PUBLICATIONS


Agenda

• Introduce the Nutrition Advisory Committee (NAC)

• Discuss the clinical significance of an Exclusive Human Milk Diet (EHMD)

• Review the 2016 NAC NICU Enteral Guidelines for the use of an EHMD for ≤ 1250 g babies
The Nutrition Advisory Committee is comprised of leading registered dietitians from around the country. Their mission is to provide neonatal intensive care units (NICUs) with clinical expertise, research, insights, and guidance on premature infant nutrition. They also serve as a resource to fellow clinicians for education and support around the growing use of an exclusive human milk diet for extremely premature infants.

The NAC is committed to sharing ideas and evidence-based practices with others who are also dedicated to providing the best care for their patients.

The NAC is sponsored by Prolacta Bioscience.
Exclusive Human Milk Diet (EHMD)

2016 NICU Enteral Guideline
Exclusive Human Milk Diet (EHMD) for ≤ 1250 g babies

Caloric Protein Goals
- 110-130 kcal/kg, 3.5-4.5 g/kg of protein
- Calories and protein should be based on refeeding assessment

Intake of Fluids
- Begin feeds on day of birth or as soon as possible
- Use breast milk (MBM) or Human Milk Fortifier (BBM)

Achievement of Fluids
- Feeding Protocol recommended
- 30-50 ml/kg advancement

Initiation of Fortification
- Initiation Fortification before 150 ml/kg
- Fortify at 50 ml/kg for lower volume fortification
- Fortify at 125 ml/kg for higher volume fortification
- Fortify at 150 ml/kg for extra volume fortification
- Avoid vitamin fortification on the same day
- Tolerating changes in fortification can tolerate changes above

Fortification Goals
- Fortification goal to meet protein and calorie goals
- Fortify at 125 ml/kg with Predominantly HM
- Fortify at 150 ml/kg with Human Milk Modular
- Fortify at 175 ml/kg with Predominantly HM
- Fortify at 225 ml/kg with Predominantly HM
- Fortify at 250 ml/kg with Human Milk Modular
- Fortify at 275 ml/kg with Predominantly HM
- Further advancement is recommended by achievement of goal growth
- Do not add HM milk-based modular to EHMD

Predominantly HM
- Predominantly HM can be used as a 1:1 product of 95 ml of HM from birth

Vitamins & Ions
- 1 ml/kg with Fe
- 10-15 ml/kg
- Concomitantly give twice a day for tolerance

Growth Goals
- Weight: 15-20 g/kg
- Length: 2-3 cm/kg
- Head CTR: 20-50 mm

Transition to HM
- Consider using EHMD until 34 weeks postmenstrual age
- Consider transition to Predominantly HM over three days
- Consider weaning Modulars, 1 week before transition
- Transition to Predominantly HM
- Over two days, on Predominantly HM
- Day one: 25% on Predominantly HM
- Day two: 50% on Predominantly HM
- Day three: Transition complete
**Calorie/Protein Goals**

- 110-130 kcal/kg, 3.5-4.5 g/kg of protein\(^1\)
- Calories and protein should be based on nutritional assessment

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<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Koletzko 2014</th>
<th>AAP 2014</th>
<th>ESPGHAN 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calories Kcal/kg</strong></td>
<td>110-130</td>
<td>105-130</td>
<td>110-135</td>
</tr>
<tr>
<td><strong>Protein g/kg</strong></td>
<td>3.5-4.5</td>
<td>3.5-4.0</td>
<td>4-4.5*</td>
</tr>
</tbody>
</table>

\(^*\) < 1 kg  
\(^**\) 1-1.5 kg  
\(^***\) 1-1.8 kg


Initiation of Feeds

- Initiate feeds on day of birth or as soon as possible\(^{(1,2)}\)
- Use Mom’s own Milk (MOM) or Banked Breast Milk (BBM)\(^{(3)}\)

### Advantage

- Start as soon as possible after birth\(^{(1,2)}\)
  - Benefits:
    - Decreased incidence of indirect hyperbilirubinemia, cholestatic jaundice, metabolic bone disease, nosocomial sepsis, and oxygen needs
    - Increased levels of gastrin and other enteric hormones
    - Decreased days to full feeds
    - Increased weight gain and head growth
    - Decreased length of stay

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Initiation of Feeds

Disadvantage

- Disadvantage (none):\(^{(1,2)}\)
  - Studies show no increased incidence of NEC among preterm infants receiving trophic feeds
  - Absence of enteral feeds leads to GI mucosal atrophy and dysfunction
  - Delaying introduction of enteral feedings significantly increases the time to establish full enteral feedings and therefore PN needs and associated morbidities

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Initiation of Feeds

Benefits of HM

“Human milk from the preterm infant’s mother is the enteral feeding of choice”\(^{(2)}\)

<table>
<thead>
<tr>
<th>HM Components(^{(2)})</th>
<th>HM Benefits(^{(1)})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunologic and antimicrobial</td>
<td>Decrease LOS</td>
</tr>
<tr>
<td>Hormones</td>
<td>Decreased hospital readmission</td>
</tr>
<tr>
<td>Enzymes</td>
<td>Improved feeding tolerance</td>
</tr>
<tr>
<td></td>
<td>Decrease need for PN</td>
</tr>
<tr>
<td></td>
<td>Improved mother infant bonding</td>
</tr>
<tr>
<td></td>
<td>Reduction of severity of ROP</td>
</tr>
<tr>
<td></td>
<td>Higher long term neurodevelopmental scores</td>
</tr>
<tr>
<td></td>
<td>Lower risk for later metabolic syndrome</td>
</tr>
</tbody>
</table>

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"If MOM is unavailable...pasteurized donor milk should be used"

**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.


5. There are no data to support routinely culturing human milk for bacterial or other organisms.

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**Clinical Benefits**

- Protection against NEC
- Enhanced feeding tolerance
- Long-term health benefits

**Potential Clinical Benefits**

- Enhanced immunity
  - HMO
  - LCPUFA

**Concerns**

- Slow growth
- Optimize fortification
- Alterations in nutritional/biological quality

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Initiation of Feeds
Pasteurized Donor Milk

<table>
<thead>
<tr>
<th>Lost Biological active milk components</th>
<th>Preserved Biological active milk components</th>
</tr>
</thead>
<tbody>
<tr>
<td>• slgA</td>
<td>• Oligosaccharides</td>
</tr>
<tr>
<td>• Total IgA</td>
<td>• Vitamin A</td>
</tr>
<tr>
<td>• Lactoferrin</td>
<td>• Vitamin D</td>
</tr>
<tr>
<td>• Lysozyme</td>
<td>• Vitamin E</td>
</tr>
<tr>
<td>• Lymphocytes</td>
<td>• Lactose</td>
</tr>
<tr>
<td>• Lipase</td>
<td>• LCPUFA</td>
</tr>
<tr>
<td>• Alkaline phosphatase</td>
<td>• Epidermal growth factor</td>
</tr>
<tr>
<td>• Cytokines</td>
<td></td>
</tr>
<tr>
<td>• Some growth factors</td>
<td></td>
</tr>
</tbody>
</table>


Advancement of Feeds

- Feeding Protocol recommended (1,2)
- 10-35 mL/kg advancement (1)

## Advancement of Feeds
### Standardized Feeding Protocol

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Possible Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Earlier full enteral feeding</td>
<td>1. Establish criteria</td>
</tr>
<tr>
<td>• Reduction in neonatal morbidities</td>
<td>2. Desired milk (MOM/BBM)</td>
</tr>
<tr>
<td></td>
<td>3. Trophic volume of feeds (1-25 mL/kg/day) for 3-5 days (2)</td>
</tr>
<tr>
<td></td>
<td>4. Daily advances (10-35 mL/kg)</td>
</tr>
<tr>
<td></td>
<td>5. Include fortification as part of the feeding protocol</td>
</tr>
<tr>
<td></td>
<td>6. Establish stopping criteria</td>
</tr>
</tbody>
</table>


### Initiation of Fortification

<table>
<thead>
<tr>
<th>Initiation of Fortification</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Initiate fortification before 100 mL/kg(1)</td>
</tr>
<tr>
<td>• Prolact+ 4 H2MF for lower volume fortification</td>
</tr>
<tr>
<td>• Ex 40-60 mL/kg</td>
</tr>
<tr>
<td>• Prolact+ 6 H2MF for higher volume fortification</td>
</tr>
<tr>
<td>• Ex 80-100 mL/kg</td>
</tr>
<tr>
<td>• Avoid fortification and advancement on the same day</td>
</tr>
<tr>
<td>• Wait to make changes in fortification until tolerance shown</td>
</tr>
</tbody>
</table>

### Initiation of Fortification

#### Feeding Progression

<table>
<thead>
<tr>
<th>Day</th>
<th>Feed</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>Initiate feeds</td>
<td>10 ml/kg</td>
</tr>
<tr>
<td>Day 2-3</td>
<td>Trophic feeds</td>
<td>10 ml/kg</td>
</tr>
<tr>
<td>Day 4-6</td>
<td>Advancement</td>
<td>20 ml/kg</td>
</tr>
<tr>
<td>Day 7</td>
<td>Prolact+4</td>
<td>40 ml/kg (no advance)</td>
</tr>
<tr>
<td>Day 8-13</td>
<td>Advance</td>
<td>20 ml/kg</td>
</tr>
<tr>
<td>Day 14</td>
<td>Prolact+6</td>
<td>130 ml/kg (no advance)</td>
</tr>
<tr>
<td>Day 15</td>
<td>Advance</td>
<td>20 ml/kg</td>
</tr>
<tr>
<td>Day 16</td>
<td>Protocol end</td>
<td>160 ml/kg</td>
</tr>
</tbody>
</table>

### Fortification Goals

- Fortification goals to meet protein and caloric goals
  - ≥ 170 ml/kg: MOM/BBM with Prolact+ 4 H²MF
  - ≥ 145 ml/kg: MOM/BBM with Prolact+ 6 H²MF
  - ≥ 125 ml/kg: MOM/BBM with Prolact+ 8 H²MF
  - < 125 ml/kg: MOM/BBM with Prolact+ 10 H²MF

- Further increase in concentration may be needed to meet growth goals
- Do not add non-human milk-based modulars to EHMD
- Prolact CR
  - 4 mL Prolact CR with 100 mL MOM/BBM if growth goals not met in 3-7 days
  - Prolact CR can also be mixed as 4 mL of Prolact CR with 96 mL of MOM/BBM
### Fortification Goals

#### Volume Goals

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Koletzko 2014</th>
<th>MOM/BBM + Prolact+ 4 170 ml/kg</th>
<th>MOM/BBM + Prolact+ 6 145 ml/kg</th>
<th>MOM/BBM + Prolact+ 8 125 ml/kg</th>
<th>MOM/BBM + Prolact+ 10 115 ml/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories Kcal/kg</td>
<td>110-130</td>
<td>139</td>
<td>129</td>
<td>121</td>
<td>115</td>
</tr>
<tr>
<td>Protein g/kg</td>
<td>3.5-4.5</td>
<td>3.9</td>
<td>4.1</td>
<td>4.0</td>
<td>4.1</td>
</tr>
</tbody>
</table>

### Fortification Goals

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Koletzko 2014</th>
<th>MOM/BBM + Prolact+ 6 150 ml/kg</th>
<th>MOM/BBM + Prolact+ 6 + Prolact CR 150 ml/kg</th>
<th>MOM/BBM + Prolact+ 8 150 ml/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories Kcal/kg</td>
<td>110-130</td>
<td>134</td>
<td>143</td>
<td>146</td>
</tr>
<tr>
<td>Protein g/kg</td>
<td>3.5-4.5</td>
<td>4.2</td>
<td>4.1</td>
<td>4.8</td>
</tr>
</tbody>
</table>
Vitamins & Iron

- 1 mL MVI without Fe
- Fe 2-3 mg/kg
- Consider splitting dose twice a day for tolerance

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Vitamins & Fe

<table>
<thead>
<tr>
<th>Koletzko 2014 (kg/d)</th>
<th>1 mL Poly-Vi-Sol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A, IU</td>
<td>400-1,100</td>
</tr>
<tr>
<td>Vitamin D, IU</td>
<td>400-1,000</td>
</tr>
<tr>
<td>Vitamin E, IU</td>
<td>2.2-11</td>
</tr>
<tr>
<td>Vitamin C, mg</td>
<td>11-46</td>
</tr>
<tr>
<td>Thiamin, mg</td>
<td>0.14-0.30</td>
</tr>
<tr>
<td>Riboflavin, mg</td>
<td>0.2-0.4</td>
</tr>
<tr>
<td>Niacin, mg</td>
<td>0.38-5.50</td>
</tr>
<tr>
<td>Vitamin B6, mg</td>
<td>0.045-0.300</td>
</tr>
<tr>
<td>Vitamin B12, mcg</td>
<td>0.10-0.77</td>
</tr>
<tr>
<td>Iron, mg</td>
<td>2-3</td>
</tr>
</tbody>
</table>

- 1 mL Poly-Vi-Sol adds +160 mOsm/kg water, recommended to add 0.5 mL BID
- 1 mL Fer-In-Sol adds +55 mOsmol/kg water

Growth Goals

- Weight: 15-20 g/kg
- Length: > 0.9 cm/wk
- OFC: > 0.9 cm/wk


- Weight gain, measured daily, assessed as an average over one week
  - Often linked with neurodevelopmental outcome
  - May be effected by clinical picture

- Length, measured weekly
  - Preferred method is with two people using a length board

- OFC, measured weekly
  - Measured with a tape measure
  - Can be effected by micro/macrocephaly

Transition off EHMD

| Transition off EHMD | Consider using an EHMD until 34 weeks post menstrual age  
| | Consider transition off Prolact+ H\textsuperscript{2}MF over three days  
| | Example of feeding transition  
| | Day one: 6 of 8 feeds as Prolact+ H\textsuperscript{2}MF  
| | Day two: 4 of 8 feeds as Prolact+ H\textsuperscript{2}MF  
| | Day three: 2 of 8 feeds as Prolact+ H\textsuperscript{2}MF  
| | Day four: Transition complete |

EHMD until 34 weeks post menstrual age

- Early studies using an EHMD diet reported the last case of NEC at 34 weeks

- AAP recommends using MOM/BBM for premature infants

- Transitioning at 34 weeks gives time to test tolerance of new fortification
Example transition off EHMD
8 feeds per day

<table>
<thead>
<tr>
<th>Day</th>
<th>Feed (q 3 hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Day 1</td>
<td>CMB</td>
</tr>
<tr>
<td>Day 2</td>
<td>CMB</td>
</tr>
<tr>
<td>Day 3</td>
<td>CMB</td>
</tr>
<tr>
<td>Day 4</td>
<td>CMB</td>
</tr>
</tbody>
</table>

- Introduce the Nutrition Advisory Committee (NAC)
- Discuss an Exclusive Human Milk Diet (EHMD)
- Review the 2016 NAC NICU Enteral Guidelines for the use of an EHMD for ≤ 1250 g babies
Prolacta develops clinically proven high value products derived from human milk that are designed to meet the needs of extremely premature infants in the Neonatal Intensive Care Unit.

OUR MISSION

NAC March 2016

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Q&A
• Calorie/Protein goals

• Initiation of Feeds
# References

## Initiation of Feeds

## Initiation of fortification

## Vitamins & Iron

## Growth Goals

## Transition off EHMD