Optimizing Nutrition for the Preterm Infant after Discharge

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MUSC, College of Pharmacy
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Disclosures

• I have no relevant disclosures.

• Reference to specific infant formulas is necessary to confer the desired content only and is not an endorsement of one product over another.

“There is no finer investment for any community than putting milk into babies.”

- Winston Churchill, 1943
Objectives
At the conclusion of this presentation, the attendee will be able to:

• assess a preterm infant’s nutrition regimen for appropriateness;
• design a plan to optimize the nutrition regimen for a preterm infant, including human milk or formula and other nutrition supplements; and,
• evaluate evidence related to short- and long-term nutrition-related outcomes in preterm infants after hospital discharge.

Goals of Nutrition Support after Discharge
• Promote human milk feeding
• Achieve postnatal growth similar to infant at same PCA
• Minimize nutritional deficiencies
• Promptly address deficits when identified
• Avoid promoting postnatal growth acceleration beyond normal for PCA
• Recognize that individualized plans are needed
Facts

• All preterm infants’ needs are not alike.
• Early nutrition is critical for growth and brain development.
• In-hospital nutrition has improved significantly.
• Nutrition can become problematic after discharge.
• Premature infants discharged at younger ages and lower weights than ever before.
• Late preterm infants are at nutrition-related risk.

Facts

• Premature infant nutrition may be limited by oral abilities and immature feedings cues (may sleep through hunger).
• Infants discharged well before expected due date and fed primarily human milk are at greatest risk.
• At discharge, growth indices below the 3rd – 5th percentile expected for PCA increase risk of long-term growth failure.
• Additional morbidities may increase nutrition needs and limit feeding tolerance.

Impact of Nutrition Deficits

- Energy and protein deficits → Lean tissue growth
- Energy and protein excess → Metabolic syndrome
- Mineral deficiency → Low bone mineral content, poor linear growth
- Zinc deficiency → Lean mass accretion
- Iron deficiency → Anemia, poor growth
- Vitamin D deficiency → Poor linear growth

Phases of Nutrition Support in the Preterm Neonate/Infant

- Phase 1: Parenteral nutrition / gut priming
- Phase 2: Transition feeding: enteral phased in, parenteral phased out
- Phase 3: Enteral alone (oral, tube) – inpatient
- Phase 4: Enteral alone (oral) – home
Stages of Nutrition Support

- 50th
- 10th
- Post-discharge nutrition
- HMF or Preterm formula
- Early aggressive nutrition

**Nutritional Needs of Preterm Infants**

<table>
<thead>
<tr>
<th>Birthweight</th>
<th>1000 – 1800 g</th>
<th>&lt; 1000 g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcal/kg/d)</td>
<td>110 – 135</td>
<td>110 – 135</td>
</tr>
<tr>
<td>Protein (g/kg/d)*</td>
<td>3.5 – 4</td>
<td>4 – 4.5</td>
</tr>
<tr>
<td>Pro-to-energy ratio (g/100 kcal)</td>
<td>3.2 – 3.5 (12.8% – 14.4%)</td>
<td>3.6 – 4.12 (14.4% – 16.4%)</td>
</tr>
</tbody>
</table>

*No benefit seen with protein > 4.5 g/kg/d

# Nutritional Needs by GA (weeks)

<table>
<thead>
<tr>
<th>Variables (per kg/d)</th>
<th>&lt;28</th>
<th>28 – 31</th>
<th>32 – 33</th>
<th>34 – 36</th>
<th>37 – 38</th>
<th>39 – 41</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fetal growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight gain, g</td>
<td>20</td>
<td>17.5</td>
<td>15</td>
<td>13</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>LBM gain, g</td>
<td>17.8</td>
<td>14.4</td>
<td>12.1</td>
<td>10.5</td>
<td>7.2</td>
<td>6.6</td>
</tr>
<tr>
<td>Protein gain, g</td>
<td>2.1</td>
<td>2</td>
<td>1.9</td>
<td>1.6</td>
<td>1.3</td>
<td>1.2</td>
</tr>
<tr>
<td>Requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy, kcal</td>
<td>125</td>
<td>125</td>
<td>130</td>
<td>127</td>
<td>115</td>
<td>110</td>
</tr>
<tr>
<td>Protein, g</td>
<td>4</td>
<td>3.9</td>
<td>3.5</td>
<td>3.1</td>
<td>2.5</td>
<td>2</td>
</tr>
<tr>
<td>Calcium, mg</td>
<td>120 – 140</td>
<td>120 – 140</td>
<td>120 – 140</td>
<td>120 – 140</td>
<td>70 – 120</td>
<td>70 – 120</td>
</tr>
<tr>
<td>Phosphorus, mg</td>
<td>60 - 90</td>
<td>60 - 90</td>
<td>60 - 90</td>
<td>60 - 90</td>
<td>35 – 75</td>
<td>35 – 75</td>
</tr>
</tbody>
</table>


# Nutritional Needs by Birthweight

<table>
<thead>
<tr>
<th>Units/kg/day</th>
<th>Term</th>
<th>ELBW</th>
<th>VLBW</th>
<th>VLBW Postterm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy, kcal</td>
<td>90-120</td>
<td>130-150</td>
<td>110-130</td>
<td>90-100</td>
</tr>
<tr>
<td>Protein, g</td>
<td>1.52</td>
<td>3.8-4.4</td>
<td>3.4-4.2</td>
<td>2.0</td>
</tr>
<tr>
<td>CHO, g</td>
<td>16-20</td>
<td>9-20</td>
<td>7-17</td>
<td>6.8-14.1</td>
</tr>
<tr>
<td>Fat, g</td>
<td>8-10.3</td>
<td>6.2-8.4</td>
<td>5.3-7.2</td>
<td>4.0-6.6</td>
</tr>
<tr>
<td>Vitamin A, IU</td>
<td>1333</td>
<td>700-1500</td>
<td>700-1500</td>
<td>545-1273</td>
</tr>
<tr>
<td>Vitamin D, IU</td>
<td>200</td>
<td>150-400</td>
<td>150-400</td>
<td>400</td>
</tr>
<tr>
<td>Calcium, mg</td>
<td>70-120</td>
<td>100-220</td>
<td>100-220</td>
<td>253-377</td>
</tr>
<tr>
<td>Phosphorus, mg</td>
<td>35-75</td>
<td>60-140</td>
<td>60-140</td>
<td>105-273</td>
</tr>
<tr>
<td>Iron, mg</td>
<td>0.09</td>
<td>2-4</td>
<td>2-4</td>
<td>1.8-2.7</td>
</tr>
<tr>
<td>Zinc, mcg</td>
<td>666</td>
<td>1000-3000</td>
<td>1000-3000</td>
<td>890</td>
</tr>
</tbody>
</table>

Growth

• Goal: match IUGR
  • Too rapid growth is not recommended.
  • Growth through gestation and early infancy is not constant
  • Careful to avoid continued high calorie feedings once period of poor growth or poor PO feedings resolves.

• Intrauterine growth rate
  • Weight gain: 15 – 20 g/kg/day\(^1\)
  • Length: 1 cm/week
  • Head circumference: 0.7 cm/week

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight gain, g/kg/day</td>
<td>20</td>
<td>17.5</td>
<td>15</td>
<td>13</td>
<td>11</td>
<td>10</td>
</tr>
</tbody>
</table>

Average Growth Rates – Term

<table>
<thead>
<tr>
<th>Age</th>
<th>Weight (g/day)</th>
<th>Height (cm/month)</th>
<th>Head circumference (cm/week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 3 months</td>
<td>24 – 35</td>
<td>2.8 – 3.4</td>
<td>0.5</td>
</tr>
<tr>
<td>4 – 6 months</td>
<td>15 – 21</td>
<td>1.7 – 2.4</td>
<td>0.5</td>
</tr>
<tr>
<td>7 – 12 months</td>
<td>10 – 13</td>
<td>1.3 – 1.6</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Growth Charts

Preterm Charts
- Fenton
  - 22 weeks GA to 10 weeks post-term (50 weeks PCA)
  - Not sex-specific
- Olsen
  - Only to 41 weeks
  - Sex-specific

Term Charts
- WHO charts
  - Use after 50 weeks PCA
  - Sex-specific
  - Must correct for gestational age
    - Weight: until 2 years of age
    - Length and head circumference: until 3 years of age

Example:
Growth Parameters
BW: 820 grams
OFC: 24 cm
Length: 35 cm
Olsen Growth Chart

Measurement Accuracy is Important
Poor Weight Gain and Outcomes

ELBW infants, in-hospital growth: 12.0 vs. 21.2 g/kg/day

Poor HC Growth and Outcomes

ELBW infants, in-hospital HC growth: 0.67 vs. 1.17 cm/week
Nutritional Programming

- Epidemiologic evidence that early nutrition and growth impact development of disease later in life
- Rapid weight gain in infancy has been associated with obesity.\(^1\)
- Hack et al\(^2\)
  - At 20 years of age, 21% overweight and 15% obese
- Over-interpretation and over-reaction should be avoided.


Feeding Options at Discharge

- Human milk, unfortified, expressed or breast-fed
- Human milk, fortified partially or fully
- Preterm formula
- Nutrient-enriched, post-discharge formula
- Term formulas
  - Soy – contraindicated (osteopenia)
  - Enfamil A.R.\(^\circledR\) – not recommended (bezoars)
Human Milk

• 2012 AAP Policy Statement
  • Exclusive breastfeeding for the first 6 months
  • Use of human milk for all preterm infants, whether mother’s own milk or pasteurized donor human milk
  • Human milk should be fortified with protein, minerals, and vitamins to ensure optimal nutrient intake for infants weighing < 1500 g at birth.


Human Milk and Neurodevelopment

Assessment Battery for Children (K-ABC) Mental Processing Composite score (mean, SD) at 5 years as a function of breastfeeding status at time of discharge and corrected age (*) at which infants were weaned off breastfeeding, in EPIPAGE cohort.

Weight, head circumference and height expressed as Z-score at discharge, 6 or 9 months and 2 years of corrected age (EPIPAGE and Loire Infant Follow-up Team (LIFT) cohorts) and at 5 years (EPIPAGE cohort) according to breast feeding at discharge.

Weight measurements was known for 1460, 1430, 973, 873 and 1447 infants at birth, discharge, 6 months, 2 and 5 years, respectively, in EPIPAGE and for 1463, 1463, 1341 and 1297 infants at birth, discharge, 9 months and 2 years, respectively, in LIFT cohort.

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**Human Milk vs. Needs**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Mature Human Milk</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy, kcal/kg</td>
<td>120–130</td>
<td>130</td>
</tr>
<tr>
<td>Protein, g/kg</td>
<td>2.5–3.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Fat, g/kg</td>
<td>6.0–8.0</td>
<td>7.8</td>
</tr>
<tr>
<td>CHO g/kg</td>
<td>10–14</td>
<td>13.2</td>
</tr>
<tr>
<td>Vitamin A IU/kg</td>
<td>1000</td>
<td>780</td>
</tr>
<tr>
<td>Vitamin D, IU</td>
<td>200–400</td>
<td>4</td>
</tr>
<tr>
<td>Vitamin E, IU/kg</td>
<td>6–12</td>
<td>2.0</td>
</tr>
<tr>
<td>Ca, mg/kg</td>
<td>150–175</td>
<td>50</td>
</tr>
<tr>
<td>Phos, mg/kg</td>
<td>90–105</td>
<td>26</td>
</tr>
<tr>
<td>Fe, mg/kg</td>
<td>2–4</td>
<td>0.2</td>
</tr>
</tbody>
</table>


Human Milk Feeding

- If birth weight > 1500 g: at least 150 – 180 mL/kg/day before fortification
  - If not fortified, may need MVI with iron, folic acid, phosphorus, sodium
- If birth weight < 1500 g: unfortified HM will not meet needs even at 150 – 180 mL/kg/day.
- Less calorically dense formula results in 22-23% increased intake.\(^1\)


Human Milk Fortifiers

www.similac.com; www.enfamil.com
Comparison of Human Milk Fortifiers

<table>
<thead>
<tr>
<th>Nutrient (per packet)</th>
<th>Similac HMF powder</th>
<th>Enfamil HMF powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories, kcal</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Protein, g</td>
<td>0.25</td>
<td>0.275</td>
</tr>
<tr>
<td>Fat, g</td>
<td>0.09</td>
<td>0.25</td>
</tr>
<tr>
<td>Sodium, mg</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Calcium, mg</td>
<td>29</td>
<td>22.5</td>
</tr>
<tr>
<td>Phosphorus, mg</td>
<td>16</td>
<td>12.5</td>
</tr>
<tr>
<td>Iron, mg</td>
<td>0.08</td>
<td>0.36</td>
</tr>
<tr>
<td>Vitamin D, IU</td>
<td>30</td>
<td>37.5</td>
</tr>
<tr>
<td>Vitamin A, IU</td>
<td>155</td>
<td>237.5</td>
</tr>
<tr>
<td>Zinc, mg</td>
<td>0.25</td>
<td>0.18</td>
</tr>
</tbody>
</table>

* Not a complete list of all nutrients; examples only.

www.similac.com; www.enfamil.com

Human Milk Fortification

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved nutrition</td>
<td>Interruption of BF</td>
</tr>
<tr>
<td>Better growth</td>
<td>Inadequate supply</td>
</tr>
<tr>
<td>Better neurodevelopment</td>
<td>Early HM discontinuation</td>
</tr>
<tr>
<td></td>
<td>Potential contamination</td>
</tr>
</tbody>
</table>
HM Fortification - Mixing Instructions

<table>
<thead>
<tr>
<th>Concentration (kcal per oz)</th>
<th>Mixing Directions</th>
</tr>
</thead>
<tbody>
<tr>
<td>HM with HMF (powder)</td>
<td>22</td>
</tr>
<tr>
<td>HM with HMF (powder)</td>
<td>1 packet per 50 mL milk</td>
</tr>
<tr>
<td>HM with HMF (powder)</td>
<td>24</td>
</tr>
<tr>
<td>HM with HMF (powder)</td>
<td>1 packet per 25 mL milk</td>
</tr>
<tr>
<td>HM with PDF</td>
<td>24</td>
</tr>
<tr>
<td>HM with PDF</td>
<td>1 tsp per 90 mL milk</td>
</tr>
<tr>
<td>HM with PDF</td>
<td>27</td>
</tr>
<tr>
<td>HM with PDF</td>
<td>2 tsp per 90 mL milk</td>
</tr>
</tbody>
</table>

HM = human milk; HMF = human milk fortifier; PDF = post-discharge formula

Human Milk Fortification Options

<table>
<thead>
<tr>
<th></th>
<th>Protein (g/kg/day)</th>
<th>Calcium (mg/kg/day)</th>
<th>Phosphorus (mg/kg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended intake</td>
<td>2.5 – 3.1</td>
<td>70 – 140</td>
<td>35 – 90</td>
</tr>
<tr>
<td>Nutrient intake at 120 kcal/kg/day</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HM alternating with PDF</td>
<td>2.5</td>
<td>85</td>
<td>50</td>
</tr>
<tr>
<td>HM alternating with HM + SHMF powder</td>
<td>2.3</td>
<td>129</td>
<td>74</td>
</tr>
<tr>
<td>HM alternating with preterm 24 kcal/oz formula</td>
<td>2.7</td>
<td>136</td>
<td>76</td>
</tr>
<tr>
<td>HM + SHMF powder</td>
<td>2.8</td>
<td>205</td>
<td>118</td>
</tr>
</tbody>
</table>

HM = human milk; HMF = Human Milk Fortifier; PDF = post-discharge formula

Abottnutrition.com/tools-for-patient-care/nutrition-in-nicu
Human Milk Fortification

• Systematic review, 2 RCT, n=246
• Fortified human milk vs. unfortified human milk
• No difference in growth at 3-4 months
• No difference in neurodevelopment at 18 months
• Infants tended to increase intake when given unfortified human milk; increased protein intake in fortified group.


Human Milk Fortification

• VLBW, 750 – 1800 g, fed primarily HM
  • Group 1: unfortified HM
  • Group 2: 50% of HM feeds were fortified

• Results
  • More rapid growth in Group 2, sustained for first year
  • Duration of HM feeding longer than previously reported

Human Milk Fortification

• RCT, 535 – 2255 g, n=207 fed HM
  • Group 1: unfortified HM
  • Group 2: 20-50 mL fortified daily from discharge to 4 months corrected age

• Results
  • No differences


Breastfeeding Tips

• Empty breasts 6-8 times/day by pumping or pumping after breastfeeding
• Pumping 2-5 minutes to cause let down before putting infant to breast may be helpful.
• At least until term age, pump breasts after breastfeeding to make sure they are empty.
• For feedings of fortified breast milk, pump to empty breasts and fortify milk as directed.
• May put infant to empty breast for suckling to stimulate milk supply.
• Consult lactation specialist early.
Premature Infant Formulas

- Similac® brand (Similac Special Care®) and Enfamil® brand (Enfamil® Premature) each offer the following in ready-to-feed bottles primarily for in-hospital use:
  - 20 kcal/oz
  - 24 kcal/oz
  - 24 kcal/oz High Protein
  - 30 kcal/oz
- Not intended for use once infant weight > 3600 g (8 lb)

www.similac.com; www.enfamil.com

Nutrient-Enriched Post-Discharge Formulas

www.similac.com; www.enfamil.com
Discharge Formulas

- Higher amounts of protein, minerals, trace elements, energy, and long-chain polyunsaturated fatty acids (DHA, ARA) than term formulas, less than preterm formulas

- When to start?
  - Weight near 1800 – 2000 g or 34 weeks GA

- How long to continue?
  - 6-9 months
  - Up to 12 months in high-risk patients

Discharge Formulas – Standard Concentration

<table>
<thead>
<tr>
<th>Formula</th>
<th>Energy kcal/dL (kcal/oz)</th>
<th>Protein (g/dL)</th>
<th>Fat (g/dL)</th>
<th>Vitamin D (IU/mL)</th>
<th>Calcium (mg/dL)</th>
<th>Phosphorus (mg/dL)</th>
<th>Iron (mg/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mature Human Milk</td>
<td>65-70 (19.5-21)</td>
<td>1.03</td>
<td>3.5</td>
<td>variable</td>
<td>20-25</td>
<td>12-14</td>
<td>0.3-0.9</td>
</tr>
<tr>
<td>Similac® Neosure® (A)</td>
<td>74 (22)</td>
<td>2.1</td>
<td>4.1</td>
<td>52</td>
<td>78</td>
<td>46</td>
<td>1.3</td>
</tr>
<tr>
<td>Enfamil® EnfaCare® (MJ)</td>
<td>74 (22)</td>
<td>2.1</td>
<td>4</td>
<td>MCT 25%</td>
<td>53</td>
<td>90</td>
<td>50</td>
</tr>
</tbody>
</table>

A = Abbott Nutrition, Chicago, IL; MJ = Mead Johnson Nutrition, Evansville, IN
Discharge Formulas
Meta-analysis, n=631 infants
• Nutrient-enriched vs. standard term formula
• Results:
  • Little evidence of difference in growth or development up to 18 months
• Critique:
  • Patients at most risk either excluded or underrepresented
  • Growth could not be evaluated until 6 months post-term


Discharge Formulas
Meta-analysis, n=1128 infants
• N = 15 trials, RCT or quasi-RCT
• Post-discharge or preterm formula vs. standard term formula
• Bias: lack of allocation concealment, incomplete follow-up
• N = 10, 22 kcal/oz vs 20 kcal/oz
  - no differences in growth at 12 – 18 months
• N = 5, 24 kcal/oz vs 20 kcal/oz
  - improved growth at 12 - 18 months

Discharge Formulas

- Use associated with lower fat mass, corrected for body size, at 6 months corrected age vs. term formula or HM.¹
- Use associated with increased fat-free mass and peripheral fat mass but not with central adiposity vs. term formula.²


Discharge Formulas – Mixing Instructions

<table>
<thead>
<tr>
<th>Caloric concentration per fl oz</th>
<th>Water, fl oz (mL)</th>
<th>Scoops of powder (unpacked, level)</th>
<th>Approximate yield (fl oz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 - standard</td>
<td>2 (60)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>24</td>
<td>5.5 (165)</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>26</td>
<td>5 (150)</td>
<td>3</td>
<td>5.5</td>
</tr>
<tr>
<td>27</td>
<td>8 (240)</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>28</td>
<td>3 (90)</td>
<td>2</td>
<td>3.8</td>
</tr>
<tr>
<td>30</td>
<td>7 (210)</td>
<td>5</td>
<td>7.8</td>
</tr>
</tbody>
</table>

Abbottnutrition.com/tools-for-patient-care/nutrition-in-nicu
Cost: 2-kg infant receiving 120 kcal/kg/day

- **Human milk fortifier powder:** ~$1.10 / packet
  - ~$1.10 per packet; 1 packet per 25 mL to make 30 mL at 24 kcal/oz
  - 10 oz/day x $1.10 = $11.00/day x 30 = $330.00/month

- **Preterm formulas**
  - Case of 48 (2 oz bottles): ~$75-80
  - 10 oz/day = 5 bottles/day = ~$225-240/month

- **Post-discharge formulas**
  - 1 can powder makes 87 oz (Neosure) or 82 oz (Enfacare): $15-20
  - 10 oz/day x 30 = 300 oz / 82-87 = ~4 can/month = $60-80

Costs obtained from various web sites, including Target, Walmart, Amazon.

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South Carolina WIC Formulary

- **Similac® Human Milk Fortifier (powder)**
  - Available if < 52 weeks gestational age

- **Similac® Special Care® 24 w/iron**

- **Similac® Special Care® 30 w/iron**

- **Similac® Neosure®**

https://scdhec.gov/health/wic-nutrition-program/what-does-wic-offer/wic-approved-baby-formulas
Micronutrient Requirements

• Iron
  • Stores at discharge – highly variable
  • Screen for IDA at discharge and 4, 9, and 12 months
  • Early IDA associated with negative cognitive effects
  • AAP / ESPGHAN: iron supplement for up to 1 year
    • 2 mg/kg/day, started at 2 weeks to 2 months PNA
    • Provided by iron-fortified formula
      • If < 150 mL/kg/day, may need 1 mg/kg/day
      • About 1 mg Fe++ per mL blood

Iron Supplementation

• n = 285
  • 0, 1, and 2 mg/kg/day iron at 6 weeks – 6 months
  • No difference in growth or morbidities

<table>
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<tr>
<th>Iron dose, mg/kg/day</th>
<th>Prevalence of IDA at 6 months</th>
<th>Rate of IDA</th>
</tr>
</thead>
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<td>0</td>
<td>36</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Micronutrient Requirements

• Vitamin D
  • No evidence that preterm infants need more vitamin D than term infants
  • Human milk inadequate unless maternal intake is very high* and sun exposure should be avoided
  • All infants 400 units/day until taking > 1000 mL formula daily

*Generally insufficient unless mother consistently takes 4000-6400 IU/day every day.


Micronutrient Requirements

• Zinc
  • Role: growth, immune function, development
  • Preterm HM is low in zinc
  • Preterm and discharge formulas and HMF increase zinc delivery
  • 2 mg/kg/day x 6 weeks improved growth (both weight and length)

Islam MN, et al. Indian Pediatr 2010
Suggested Monitoring after Discharge

- Weigh and measure within 48 hr after discharge to reassure and establish new baselines
- Complete assessment of feeding plan provided by the neonatal unit within 1 week of discharge with repeated growth measurements.
- Repeat growth measurements with feeding assessment 1-2 times per week until growth well established
- Labs, as indicated: BMP, Ca, Phos, ferritin, alk phos, 25-OH-vitamin D

General Guidelines

- If steady growth along adequate percentile, increase breastfeeding episodes and/or decrease caloric density.
- Transition from fortified breast milk to breastfeeding if good growth and intake from the breast once older than 52 weeks gestational age.
- If mother’s milk no longer available, change to discharge formula at appropriate caloric density based on current intake and growth velocity.
- Encourage offering small amounts more every 2-3 days to facilitate increased intake.
Red Flags

• Growth velocity
  • < 20 g/day if weight > 1.8 kg
  • < 18 – 22 g/kg/day if weight < 1.8 kg

• Decreasing percentile or z-score for weight, length, or head circumference

• Not maintaining consistent volume intake of at least 140 mL/kg/day

MUSC NICU Feeding Clinic

• Candi Jump, MD, Pediatric Gastroenterologist
• Registered dietitians
• 843-876-1444 for an appointment or referral
Summary

• Due to variability in nutritional status at discharge, an individualized approach is highly recommended for all preterm infants.

• The continued use of human milk and breastfeeding should be supported and encouraged.

• Careful follow-up is needed to ensure appropriate growth and to avoid overcorrection which may be associated with long-term negative outcomes.

Selected References


Selected References


Questions?

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