

# Nutrient Shortages in the Neonatal Population

## Introduction

Ongoing nutrient shortages continue to pose challenges to providing adequate nutrition to neonatal patients due to higher macro- and micronutrient requirements as well as lack of in utero nutrient accrual in the preterm neonate. This population is uniquely susceptible to the impacts of nutrient shortages.

This fact sheet addresses:

- Nutrient requirements for proper growth and the progression of feeding in the early neonatal period, including nutrient requirements for proper growth
- Select long-term impacts nutrient shortages have on the neonatal population and their correlation with malnutrition
- Challenges and strategies in providing adequate nutrients during times of nutrient shortages

*These recommendations do not constitute medical or other professional advice and should not be taken as such. To the extent that the information published herein may be used to assist in the care of patients, this is the result of the sole professional judgment of the attending healthcare professional whose judgment is the primary component of quality medical care. The information presented is not a substitute for the judgment by the healthcare professional. Circumstances in clinical settings and patient indications may require actions different from those recommended in this document, and in those cases, the judgment of the treating professional should prevail. ASPEN does not endorse any particular brand of products mentioned herein.*

## Nutrient Requirements and Progression to Enteral Feeding in the Early Neonatal Period

Parenteral and Enteral Energy and Macronutrient Requirements\*<sup>1, 2</sup>

Age	Parenteral				Enteral	
	Energy (kcal/kg/day)	Protein (g/kg/day)	Dextrose (mg/kg/min)	ILE (g/kg/day)	Energy (kcal/kg/day)	Protein (g/kg/day)
Preterm	85-111	Initiate: 1-3 (max: 3-4) Goal: 3-4	Initiate: 6-8 Advance: 1-2 per day Goal: 10-14 (max: 14-18)	Initiate: 0.5-1 Advance: 0.5-1 Goal: 3 (max: 0.15 g/kg/hr)	110-130	3.5-4.5
Late Preterm	100-110				120-135	3-3.2
Term	90-108	Initiate: 2.5-3 Goal: 2.5-3		Initiate: 0.5-1 Advance: 0.5-1 Goal: 2.5-3 (max: 0.15 g/kg/hr)	105-120	2-2.5

\*These values represent typical reference ranges for adequate intake. Doses should be individualized based on patient specific parameters and clinical conditions.

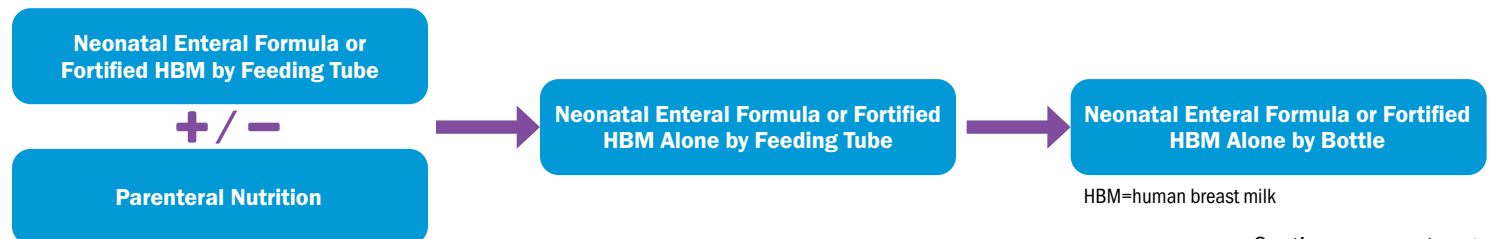
Parenteral and Enteral Adequate Intake Daily Requirements for Select Micronutrients\*<sup>1</sup>

Age	Parenteral					Enteral				
	Zinc (mcg/kg)	Copper (mcg/kg)	Selenium (mcg/kg)	Iron (mg elemental/kg)	Vitamin D (IU)	Zinc (mg)	Copper (mcg)	Selenium (mcg)	Iron (mg elemental)	Vitamin D (IU)
Preterm/Term	400/250	20	2-3	Not routinely provided	400	2	200	15	0.27	400

\*These values represent typical reference ranges for adequate intake. Doses should be individualized based on patient specific parameters and clinical conditions.

## Neonatal Feeding Progression

If the neonate is unable to meet nutritional needs orally, nutrition support may be needed. One example of progression to oral feeding is shown below:



Continues on next page

## Long-term Impact, Challenges and Strategies for Providing Adequate Nutrients During Periods of Shortage

	Long-term Clinical Impact of Shortage if Deficiency Present	Management Challenges	Strategies to Provide Adequate Nutrients During Period of Shortage <sup>3,4</sup>
<b>Zinc</b>	<ul style="list-style-type: none"> <li>• Alopecia</li> <li>• Diarrhea</li> <li>• Impaired wound healing</li> <li>• Night blindness</li> <li>• Dermatitis</li> <li>• Glucose intolerance</li> <li>• Delayed sexual maturation</li> <li>• Growth retardation</li> <li>• Impaired taste and smell sensation</li> <li>• Severe skin rash with acrodermatitis enteropathica</li> <li>• Anorexia</li> <li>• Immune compromise</li> </ul> <p><i>Special note: Essential component in premature neonates with documented deficiencies during shortages</i></p>	<ul style="list-style-type: none"> <li>• Differences in dosing based on patient weight for individual component</li> <li>• Need to maintain consistency in dosing units and nomenclature on order records, compounding devices, and product labels</li> <li>• May require product dilution to measure dose</li> <li>• Confirm enteral options contain nutrient and at daily enteral maintenance dose</li> </ul>	<ul style="list-style-type: none"> <li>• Consider switching to oral or enterally administered multivitamin/multi-mineral supplement when oral/enteral intake is initiated                             <ul style="list-style-type: none"> <li>» Not all products contain full spectrum of trace elements nor daily enteral maintenance dose</li> </ul> </li> <li>• Reserve IV multi-trace element products for those patients receiving PN or those with therapeutic medical need for intravenous trace elements                             <ul style="list-style-type: none"> <li>» Patients at greatest risk include premature neonates</li> </ul> </li> <li>• If IV multi-trace element product no longer available, administer individual parenteral trace element entities                             <ul style="list-style-type: none"> <li>» Routine use of IV adult multi-trace element products in neonatal and pediatric patients not recommended</li> <li>» Use full dose of IV adult multi-trace element product for children &gt; 5 years of age</li> </ul> </li> <li>• Monitor for signs and symptoms of deficiency</li> </ul>
<b>Copper</b>	<ul style="list-style-type: none"> <li>• Neutropenia</li> <li>• Leukopenia</li> <li>• Hypochromic, microcytic anemia unresponsive to iron</li> <li>• Impaired transferrin formation</li> <li>• Secondary iron deficiency</li> <li>• Osteoporosis</li> <li>• Bone pain</li> <li>• Epiphysial separation</li> <li>• Hair loss</li> <li>• Loss of skin pigmentation</li> <li>• Cardiac and nervous system abnormalities</li> </ul> <p><i>Special note: Historical concern for toxicity in patients with hyperbilirubinemia has led to under-recognition of deficiencies, which can lead to severe consequences particularly in premature neonates</i></p>		
<b>Selenium</b>	<ul style="list-style-type: none"> <li>• Alopecia</li> <li>• Growth retardation</li> <li>• Reproductive failure</li> <li>• Cardiomyopathy</li> <li>• Musculoskeletal pain and myopathy</li> <li>• Abnormal thyroid function and hormone homeostasis</li> <li>• Myosotis</li> <li>• Hemolysis</li> <li>• Impaired cellular immunity</li> </ul> <p><i>Special note: Historically not found in neonatal and pediatric multi-trace element products, which can lead to omission when changing between products</i></p>		

Table continues on next page

### References

1. Institute of Medicine (US) Panel on Micronutrients. Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc. Washington (DC): National Academies Press (US); 2001.
2. ASPEN. Appropriate dosing for parenteral nutrition: ASPEN recommendations. 2019. [https://www.nutritioncare.org/uploadedFiles/Documents/Guidelines\\_and\\_Clinical\\_Resources/PN%20Dosing%201-Sheet-Nov%202020-FINAL.pdf](https://www.nutritioncare.org/uploadedFiles/Documents/Guidelines_and_Clinical_Resources/PN%20Dosing%201-Sheet-Nov%202020-FINAL.pdf)
3. ASPEN. 2021 Parenteral Nutrition Multivitamin Product Shortage Considerations. [https://www.nutritioncare.org/Guidelines\\_and\\_Clinical\\_Resources/Product\\_Shortages/2021\\_Parenteral\\_Nutrition\\_Multivitamin\\_Product\\_Shortage\\_Considerations](https://www.nutritioncare.org/Guidelines_and_Clinical_Resources/Product_Shortages/2021_Parenteral_Nutrition_Multivitamin_Product_Shortage_Considerations). Accessed on September 19th, 2021.
4. ASPEN. 2016 Parenteral Nutrition Trace Element Product Shortage Considerations. [http://www.nutritioncare.org/Guidelines\\_and\\_Clinical\\_Resources/Clinical\\_Practice\\_Library/Parenteral\\_Nutrition\\_Trace\\_Element\\_Product\\_Shortage\\_Considerations](http://www.nutritioncare.org/Guidelines_and_Clinical_Resources/Clinical_Practice_Library/Parenteral_Nutrition_Trace_Element_Product_Shortage_Considerations). Accessed on September 19th, 2021.
5. Goldberg DL, et al. Identifying Malnutrition in Preterm and Neonatal Populations: Recommended Indicators. *Journal of the Academy of Nutrition and Dietetics*. 2018;118(9):1571-1582.

## Long-term Impact, Challenges and Strategies for Providing Adequate Nutrients During Periods of Shortage *(Continued from page 2)*

	Long-term Clinical Impact of Shortage if Deficiency Present	Management Challenges	Strategies to Provide Adequate Nutrients During Period of Shortage <sup>3,4</sup>
<b>Iron</b>	<ul style="list-style-type: none"> <li>Poor physical growth</li> <li>Gastrointestinal disturbances</li> <li>Thyroid dysfunction</li> <li>Altered immunity</li> <li>Temperature instability</li> <li>Anemia</li> <li>Neurodevelopmental delay</li> </ul> <p><i>Special note: Not currently available in multi-trace element products in the US, which often leads to lack of recognition as an essential trace mineral in premature neonates</i></p>	<ul style="list-style-type: none"> <li>Need to maintain consistency in dosing units and nomenclature on order records, compounding devices, and product labels                             <ul style="list-style-type: none"> <li>» Product often dosed in elemental iron instead of iron salt form</li> <li>» Amount of elemental iron is specific to iron salt formulations</li> </ul> </li> <li>May require product dilution to measure dose</li> </ul>	<ul style="list-style-type: none"> <li>Use enteral formulations when patient can tolerate; watch for possibility of GI upset related to use of enteral iron products</li> <li>Iron must be added separately to parenteral nutrition solution</li> <li>Be cautious with stability and compatibility of solutions containing iron</li> <li>Require test dose prior to administration due to possibility of anaphylactic reaction</li> </ul>
<b>Vitamin D</b>	<ul style="list-style-type: none"> <li>Osteoporosis with rickets</li> <li>Secondary hyperparathyroidism</li> </ul>	<ul style="list-style-type: none"> <li>Individual parenteral formulation not available to add to PN solution</li> <li>Hard to tailor dose for patient needs since only available as intravenous multivitamin product</li> <li>Differences in dosing based on patient weight for individual component</li> <li>Need to maintain consistency in dosing units and nomenclature on order records, compounding devices, and product labels</li> </ul>	<ul style="list-style-type: none"> <li>Providing adequate bone minerals, including calcium, magnesium, phosphorus, and vitamin D, is a priority in preterm neonatal nutrition.</li> <li>Consider switching to oral or enterally administered multivitamins when oral/enteral intake is greater than 50% of needs</li> <li>Reserve pediatric IV multivitamins for children &lt; 2.5 kg or &lt; 36 weeks gestational age (GA)</li> <li>Consider use of adult IV multivitamins for children during the shortage                             <ul style="list-style-type: none"> <li>» Use 5 mL of adult multivitamins in all children weighing ≥ 2.5 kg or ≥ 36 weeks GA while saving pediatric product for smaller neonates in order to conserve supply</li> </ul> </li> <li>If no pediatric IV multivitamins are available,                             <ul style="list-style-type: none"> <li>» Infants &lt; 2.5 kg or &lt; 36 weeks gestation should receive adult IV multivitamin at daily dose of 1 mL/kg up to a maximum of 2.5 mL/day</li> <li>» Supplement intravenous vitamin K daily (total daily dose = 200 mcg).</li> <li>» These products contain propylene glycol, polysorbate, and aluminum</li> <li>» Clinical judgement must prevail by weighing potential vitamin deficiencies against potential toxicities</li> </ul> </li> </ul>

### Key Messages

- Use neonatal specific criteria for assessing malnutrition that differ from the pediatric malnutrition assessment guidelines.<sup>5</sup>
- During shortages, neonatal populations should be given high priority in consideration to receive products in shortage due to their dependence on PN and lack of adequate nutrition stores.
- Careful attention should be placed on dosing since requirements differ amongst patients. Pay close

attention to dosing units and nomenclature to avoid confusion and errors.

- Small doses of various individual intravenous products may require dilutions to be utilized to measure doses accurately.
- Transition to enteral products as tolerated is encouraged but products must be closely screened to ensure various multivitamin and trace elements are included in these enteral products at adequate daily recommended doses.

- Monitoring for signs and symptoms of deficiencies is key in managing product shortages.
- Modifications in enteral feeding strategies, such as earlier initiation, faster advancement, or earlier human milk fortification, may aid in providing additional nutrition during parenteral nutrient shortages.