Enteral Feeding Guidelines

1. Feeds may be **delayed up to 72 hrs from birth** to avoid use of formula (due to physiologic delay in establishing milk supply). Partial feeds may be given as parent's own milk becomes available.
2. For unwell or preterm infants, initiate feeds within the first 24 hrs **with parent's own milk OR donor EBM** (if eligible) unless contraindicated.
3. Facilitate maternal milk expression (ideally with a **double electric pump**) within six hours after birth
4. Assess for **oral feeding readiness** beginning at 32 wks PMA (see algorithm on SharePoint for details)

Weight (g)	Initiation of Feeds	Increase Feeds		Days to FF*
		Bolus	Continuous	
500-749	1 ml q4h x 72h			10-13
	1 ml q2h x 48h			
		1 ml q24h	0.5 ml q24h	
750-999	1 ml q2h x 96h			10-12
		1.5 ml q24h	0.75 ml q24h	
1000-1249	1 ml q2h x 72h	1 ml q12h	0.5 ml q12h	9-10
1250-1499	2 ml q2h x 24h	1 ml q8h	0.5 ml q8h	6-7
1500-1749	3 ml q3h x 24h	1.5 ml q6h	0.5 ml q6h	6
1750-1999	4 ml q3h x 24h	1 ml q3h	0.3 ml q3h	5-6
2000-2499	5 ml q3h x 24h	2 ml q3h	0.7 ml q3h	4
≥ 2500	6 ml q3h x 24h	3 ml q3h	1 ml q3h	3

Infants >48hrs AND born ≥37 wks GA & BWt ≥2500 g:
If there are no identified feeding risk factors, may individualize feeding advancement (e.g. start 5-10 ml q3h and increase 5-8 ml q3h OR ad lib feeds with a minimum TFI)

*Days to full feeds (FF) = TFI ~150 ml/kg/d

Feeding Options

If parent's own milk is not available, feed:
- **Donor EBM for eligible infants** (consent required)
- **<2 kg:** Enfamil Premature A+ with Iron
- **Birth weight <1.2 kg, now >2 kg:** EnfaCare with Iron
- **>2 kg:** Enfamil A+ with Iron

Special Considerations:
- **IUGR/SGA Infants:** Use birth weight to guide feeding
  - Trophic feed duration may be extended & may need to slow advances (especially if born <29 wks)
- **High Risk Infants (significant congenital heart disease/PDA, intestinal ischemia concerns, polycythemia, exchange transfusion):**
  - Use 1-2 weight categories below weight for feeding
- **Infants receiving indomethacin or ibuprofen for PDA management** (feeding plan at neonatologist's discretion)
  - If feeding, provide feeds at volume of ~15 ml/kg/d

Fortification

- **Inclusion criteria for vascular access removal at TFI 120:** tolerating advancing feeds, require vascular access for IV nutrition ONLY; not anticipated to develop feeding intolerance
- **Contraindications to vascular access removal at TFI 120:** infants with ostomies, history of NEC, feeding intolerance, hypoglycemia **– fortify once tolerating FF; remove vascular access once demonstrating tolerance of fortified feeds**
- **EBM fed preterm infants:** fortify with HMF to **0.74 kcal/ml** at **enteral TFI 120; after 24-48 hrs**, fortify to **0.8 kcal/ml**
- **Preterm formula fed infants:** change from 0.68 kcal/ml to **0.8 kcal/ml at enteral TFI 120-140**
- **Term infants** do not routinely require fortification

Macronutrient Modules

PolyCal: Carbohydrate (CHO) – corn maltodextrin
- Used for hypoglycemia management
- 0.96 g CHO and 3.84 kcal per gram powder
- Approximate CHO content when added to EBM:

Concentration (kcal/ml)	0.74	0.8	0.85	0.9
CHO (g/L)	87.5	103.5	117.5	131.3

LiquiProtein: extensively hydrolyzed protein
- Standard addition to fortified donor EBM (2 mL/100 ml dEBM)
- May be added to increase protein intake as indicated
- 1.0 g protein and 4.0 kcal per 6 mL

Nutrient Content per Litre

Nutrient	Expressed Breast Milk (EBM)				Standard Formulas					Therapeutic Formulas	
	Mature EBM (Donor EBM)	Fortified EBM: EBM +Similac LHMF (Liquid Human Milk Fortifier)		Fortified EBM: EBM + EnfaCare	Enfamil A+ Premature (Preterm Formula)		Enfamil A+ EnfaCare (Post-Discharge Formula)	Enfamil A+ (Term Formula)		Good Start (Whey)	PURAMINO A+ (Free AA) / Nutramigen A+ (Hydrolyzed Casein)
Concentration kcal/ml	0.68	0.74 (1pk HMF: 50ml EBM)	0.8 (1pk HMF: 25ml EBM)	0.8	0.68	0.8	0.74	0.68	0.8	0.67	0.68
Energy kcal/L	680	745	800	809	680	810	740	680	810	670	680
Protein g/L	12 (9)	20.0	26.7	15.8	20	24	21	14	17	15	18.9
Fat g/L	39	39.3	39.5	46	34	41	39	36	43	34	36
Carbohydrate g/L	72	79.1	85.0	85	74	89	77	76	88	75	72/70
Sodium mmol/L	7.8	11.1	13.8	9.9	17.1	20	11.3	7.9	9.5	7.8	13.8
Potassium mmol/L	13.5	22.1	29.3	17.1	17	20	20	18.7	22	18.4	19
Calcium mmol/L	7	20.0	30.8	11.2	28	33	22	13.2	15.8	11	15.9
Phosphorus mmol/L	4.5	14.1	22.6	7.5	18.1	22	15.8	9.4	11.3	7.8	11.3
Iron mg/L	0.4	2.4	4.0	3	12.2	14.6	13.3	12.2	14.6	10	12.2
Vitamin D IU/L	20	655	1183	122	1620	1950	520	410	490	400	340

NICU Nutrition Guidelines

July 2020

Weekly Nutrition Rounds: Tuesdays at 2 PM

Normal Growth Rates

	Preterm	Term (First 3 months)
Initial Weight Loss	≤15%	≤10%
	Maximum weight loss is expected to occur by ~4-6 days of life	
Weight Gain	Birth weight usually regained by 10-14 d	
	15-20 **g/kg**/d	20-30 g/d
Length	1 cm/wk	0.69-0.75 cm/wk
Head Circumference	23-30 wks: 1 cm/wk 30+ wks: 0.5 cm/wk	0.5-1 cm/wk

Monitor Growth using above and appropriate growth chart:
- Fenton (preterm infants)
- WHO (term infants; preterm infants >50 wks PMA)

At full feeds, continue weekly nutrition labs for preterm and surgical infants:
- **Q Monday:** Na, K, Cl, glucose, iCa, P, ALP, urea ± bili
- Once stable, may reduce frequency to every other week

Enteral Nutrient Requirements

Nutrient	Preterm Infants		Term Infants
	<1 kg	>1 kg	
Fluid (ml/kg/d)	135-200		120-180
Energy (kcal/kg/d)	110-135		90-120
Protein (g/kg/d)	4-4.5	3.5-4	1.5-2.5
Vitamin D (IU/d)	400-1000		400-800
Calcium (mmol/kg/d)	3-5		
Phosphate (mmol/kg/d)	1.9-4.5		
Iron (mg/kg/d)	2-3		
Sodium (mmol/kg/d)	3-5		
Potassium (mmol/kg/d)	1.7-3.4		

DONOR EBM (dEBM)

Consent and Documentation Required
See algorithm on SharePoint

Eligibility Criteria (any one of):
- Birth weight ≤2000 g
- Gestational age at birth ≤33+6 wks
- Cardiac or GI surgery within first 4 wks of life
- Post NEC

Discontinuation:
- Preterm infants: at 38 wks PMA
  - May extend to 40 wks PMA if SGA (<10th %^{ile})
- Other infants: 4 wks of therapy OR taking 50% of feeds at the breast or by bottle

Wean off donor EBM over **48-72 hrs:** mix half volume dEBM and half volume appropriate formula (at same kcal/ml)

Elemental Iron Supplementation

(Ordered as Ferrous Fumarate)
1 ml = 20 mg elemental iron

Initiation & Duration	• Start at ~2-4 wks postnatal age and once full feeds reached • Continue until 12 mo. corrected age • Do not hold post PRBC transfusion
Maintenance Requirement (from feeds + supplements)	• Birth weight <2 kg: 2-3 mg/kg/d • Birth weight 2-2.5 kg: 1-2 mg/kg/d **Additional iron supplement needed** = maintenance requirement – intake from feeds
Approximate Amount of Iron Provided by Feeds Calculated at TFI of 160 ml/kg/d	• **EBM + Similac Liquid HMF** 0.74 kcal/ml → 0.4 mg/kg/d 0.8 kcal/ml → 0.6 mg/kg/d • **EBM + Enfamil A+ EnfaCare** 0.74 kcal/ml → 0.3 mg/kg/d 0.8 kcal/ml → 0.5 mg/kg/d • **Enfamil A+ Premature with Iron** 0.68 kcal/ml → 2 mg/kg/d 0.8 kcal/ml → 2.3 mg/kg/d • **Enfamil A+ EnfaCare** 0.74 kcal/ml → 2.1 mg/kg/d 0.8 kcal/ml → 2.3 mg/kg/d • **Enfamil A+** 0.68 kcal/ml → 2 mg/kg/d 0.8 kcal/ml → 2.3 mg/kg/d

Vitamin D Supplementation

(Ordered as Cholecalciferol)

Initiation & Duration	• Consider initiating at 50% full feeds • Goal intake: minimum 400 IU/d • Continue until 12 mo. corrected age
Supplement Required	**Patient Weight and Feed Type** Calculated at TFI of 160 ml/kg/d
400 IU	• **<1.1 kg** on 0.8 kcal/ml EBM + LHMF • **<2 kg** on 0.74 kcal/ml EBM + LHMF • **<2.4 kg** on Enfamil A+ EnfaCare • EBM fortified with formula • Term breastfed • Enfamil A+ (if intake <500 ml/d)
200 IU	• **<1.25 kg** on Enfamil A+ Premature • **1.1 – 2.1 kg** on 0.8 kcal/ml EBM + LHMF • **>2 kg** on 0.74 kcal/ml EBM + LHMF • **>2.4 kg** on Enfamil A+ EnfaCare • Term formula fed (if intake 0.5-1L/d)
None	• **>1.7 kg** on Enfamil A+ Premature • **>2.1 kg on** 0.8 kcal/ml EBM + LHMF • Term formula fed (if intake >1L/d)

METABOLIC BONE DISEASE SURVEILLANCE

RD screens all patients

Screen positive for AT RISK status if:
1. GA <30 wks AND/OR Birth weight <1250 g
2. Received, or is anticipated to receive, PN >21 d

NICU Metabolic Bone Disease (Osteopenia) Panel initiated in Epic:
Includes bedside alert stickers and parent information pamphlet

Parenteral Nutrition (PN)

- PN orders are due by **2 PM daily** at the latest
- **PN Pharmacy Contact:** call extension 306702
- **Weekdays:** RD evaluates all patients on PN
- **Weekends/Stat Holidays:** MDs/NPs to assess their patients' PN needs. **If anticipate changes:** call PN Pharmacy ASAP in AM to place hold
  - **No hold** = current orders will automatically be dispensed, no go-ahead necessary

When Should PN Be Initiated?

- **Initiate PN +/- lipids soon after birth if it is anticipated the infant's GI tract will not be used for a significant period of time**
  (within the first 24 hours of life for infants <1.5 kg)
- **Infants <1.5 kg**
  - **In the first 24 hrs of life,** start **NICU Electrolyte-Free PN (available 24 h/d)** AA (Primene) 25 mmol/L, Dextrose 100 g/L, Ca 12 mmol/L (± lipids)
- **After 24 hrs**, add other electrolytes, trace elements, vitamins and acetate
  - **Standard 25/100 (available 24h/d):**
    AA (Primene) 25 g/L, Dextrose 100 g/L, Na 25 mmol/L, K 20 mmol/L, Ca 12 mmol/L, Mg 3 mmol/L, P 12 mmol/L, Acetate 8 mmol/L, Zn 46 mcMol/L
  - **CUSTOM 2-in-1 PN solutions are available during PN pharmacy hours ONLY (10 AM-2 PM)**
    - Indicated when standard PN solutions cannot meet nutritional requirements (fluid restriction, electrolyte abnormalities, complex medical conditions)
- **PN should not be used solely to correct electrolyte disturbances when not otherwise required for nutrition support**

Maximum Calcium/Phosphorus

- Calcium (Ca) and phosphorus (P) requirements may exceed solubility, leading to precipitation and embolization or catheter occlusion
- Amino acids (AA) increase acidity of PN solution; as AA concentration increases, more Ca and P can be added into the solution
- Some examples of Ca/Phos ratios at the following AA:

Amino Acid (g/L)	Ca:P or P:Ca (mmol/L)
25	13:13 12:14
30	15:15 12:17
35	16:16 12:20
40	17:17 15:19
45	18:18
50	19:19
55	20:20
60	21:21

Initiation and Advancement of PN

	Amino Acids (g/kg/d)		Lipids (g/kg/d)	Dextrose (mg/kg/min)	
	Preterm	Term		Preterm	Term
Initial Dose*	1.5-2.5	1.5-2	0.5-1	5-8	
Advance Daily	1	1	1	1-2	1-3
Goal	3.5-4	2.5-3.5	3	10-16	11-12
Energy Provided	4 kcal/g		20% SMOF: 2 kcal/ml	3.4 kcal/g	
Energy Goals	Preterm: 110-80 kcal/kg/d Term: 100-80 kcal/kg/d By day 4, PN provides ~80-90 kcal/kg/d				
SMOFlipids	• Soybean/Medium Chain Triglyceride/Olive/Fish Oil				
PN Lab Schedule (must be ordered)	• **Q Monday:** Gas, Na, K, Cl, glucose, AST, ALT, ALP, bilirubin, iCa, P, Mg, Cr, urea, intralipid • **Q Thursday:** Gas, Na, K, Cl, glucose, urea, intralipid				

Intralipid Level	• Gold standard measure of IV fat clearance (triglyceride is a less accurate measure)
	• Check for tolerance at 2 g/kg/d fat before advancing lipids
	• **Falsely elevated** by hemolysis or due to lipid contamination from samples drawn from central lines infusing lipids; these levels should be repeated by capillary sampling or from the central line with a larger pre-draw volume to clear the catheter of lipid
	• Elevated levels:
	  • 1-1.5 g/L: **Action:** decrease lipid dose by half and repeat level within 24h
	  • >1.5 g/L: **Action:** discontinue lipids for 24h; repeat level: if normal, restart at lower dose, monitor				

Good to Know…	• **Glucose Infusion Rate (GIR)** (mg/kg/min) for continuous infusions
	= **rate** (ml/hr) **x dextrose** (g/L**) **÷ 60** (min/hr) **÷ wt** (kg)
	• **Order PN rate as range (0-max rate):**
	  • Nutrient calculations in Epic are based on this max rate – may not reflect actual intake
	• **Max rate of range:** Based on a safe amount of protein, dextrose (GIR), electrolytes and/or acetate
	  • Allows for improved nutrition if TFI increases overnight/on the weekend OR if infusions are weaned
	• **Fat**: infants with cholestatic liver disease benefit from fat restriction **(≤2.5 g/kg/d)**
	• IV lipids do not enter the lymphatic system – can be used with chylothorax
	• **Peripheral IV access:** maximum osmolarity 1050 mOsm/L, Dextrose 125 g/L, K 60 mmol/L (depending on other PN constituents)				

*Infants who **previously tolerated full feeds or full PN:** consider starting close to goal requirements when reinitiating PN (e.g. after surgery or if placed NPO)

Electrolyte and Mineral Intake*

Nutrient	Initial Dose (mmol/kg/d)	Maintenance Requirements (mmol/kg/d)		
		Intermediate Phase*	Stable/Growing Phase	
			Preterm Infants	Term Infants
Sodium	0-3	2-5	3-5	2-3
Potassium	0-2	1-3	2-5	1.5-3
Chloride	As needed to maintain acid-base balance			
Calcium	0.5-1	Same as stable/growing phase	1-2	0.25-2
Phosphorus	0-1		1-2	0.5-2
Magnesium	0-0.25		0.15-0.25	0.15-0.25
Acetate	• As needed to maintain acid-base balance • Sodium acetate/potassium acetate should be substituted for chloride to provide a source of bicarbonate for infants with metabolic acidosis (acetate is metabolized by the liver to produce bicarbonate in a 1:1 molar ratio) • No acetate in PN = ↑ chloride ions in PN; High acetate in PN = ↓ chloride ions in PN • **Maintenance 1-2 mmol/kg/d; Treatment: 2-4 mmol/kg/d; generally avoid exceeding 6 mmol/kg/d** • Hospital default 2:1 chloride:acetate OR max acetate may be unsafe for NICU patients → **ALWAYS enter actual mmol/L desired** unless NO acetate desired (then choose "Maximize Chloride")			
PN Multivitamin	• Multivitamin Pediatric (vitamin K 0.2 mg/bag) – for patients <2 kg OR on PN >6 wks • Multivitamin with Vitamin K (vitamin K 0.2 mg/bag) – standard multivitamin for patients >2 kg			
Trace Elements	• Trace element mix is added daily (3.1 ml/bag) • Contains: copper 6.3 umol/L, iodine 0.47 umol/L, chromium 0.076 umol/L, selenium 0.25 umol/L			
Zinc	• 46 umol/L zinc is usually added to PN • Additional zinc (i.e. 92 umol/L) may be added if clinically indicated (stomas, short bowel, burns, wounds)			
Iron	• Not routinely added to PN solutions for preterm infants • Can be added after 4 wks postnatal age (18 umol/L) **no need to remove post PRBC transfusion**			

***Some infants **may require greater intakes** of both minerals and electrolytes

PN Calculations

STEP 1 – Calculate hourly fluid rate (ml/hr)*:
= TFI (ml/kg/d) **x wt** (kg) **÷ 24** (hr/d)
*This is the total including lines running heparin, continuous IV meds, maintenance fluid, PN, lipids, feeds

STEP 2a – Order lipid (20% SMOFlipid or 30% Intralipid) in g/kg/d & **note hourly rate (ml/hr) calculated by Epic**

STEP 2b – Calculate actual lipid intake provided by rate:
= rate (ml/hr) **x 24** (hr/d) **x lipid** (g/ml) **÷ wt** (kg)
20% SMOFlipid = 0.2 g/ml 30% intralipid = 0.3 g/ml

STEP 3a – Determine hourly PN rate (ml/hr):
= hourly fluid rate (ml/hr) **minus hourly lipid rate, heparin rates, other infusions, feeds, etc.**

STEP 3b – Determine daily PN volume (ml/d) and enter into Epic next to Volume:
= PN rate (ml/hr) **x 24** (hr/d)

STEP 4 – Calculate Desired Intakes:
for nutrients other than dextrose:

$$= \frac{\text{desired intake (g/kg/d OR mmol/kg/d) x wt (kg)}}{\text{daily PN volume (ml/d)}} \times 1000 \text{ ml/L}$$

for dextrose concentration (g/L), **continuous infusions only:**

$$= \frac{\text{desired GIR (mg/kg/min) x 60 (min/hr) x wt (kg)}}{\text{hourly PN rate (ml/hr)}}$$

**g/L is same as mg/ml → 100 g/L = 100 mg/ml dextrose = D10W

STEP 5 – Calculate max rate (ml/hr)
** Based on safe amount of protein for DOL and on safe amount of GIR/electrolytes/acetate**
(calculation below is for nutrients other than GIR)

$$= \frac{\text{desired intake (g/kg/d OR mmol/kg/d) x wt (kg)}}{\text{nutrient concentration (g OR mmol/ml)}} \div 24 \text{ hr/d}$$

STEP 6 – Select vitamins, mineral mixture, and zinc (plus iron, if appropriate)

STEP 7a – Replace run-at rate with range (0-max rate):

STEP 7b- Recalculate daily volume using max rate (ml/d)
= [max rate x 24 hours] +100 **OR**
= 250 ml, whichever value is greater

CHANGING EXISTING ORDERS (PN and/or Lipids)
- **Indications:** changes to PN composition; dosing weight; IV access (central → peripheral); max rate; lipid dose
- **Use MEDICATIONS tab → select current PN or lipid row → click Reorder Rx** (copies previous order); order rate as range; change 24h volume (see 7b above)
- **Exception:** changing from Standard PN solution to Custom 2-1 OR vice versa → must initiate as a new PN order from **ORDERS tab**

DISCONTINUING PN AND/OR LIPIDS
- **Call PN Pharmacy if new bag not needed**
- DO NOT discontinue from orders unless no longer infusing

COMMON CONVERSIONS (IV Fluids, Lipids)

0.2%NS: 34 mmol/L Na = 0.034 mmol/ml Na
0.45%NS: 77 mmol/L Na = 0.077 mmol/ml Na
0.9%NS: 154 mmol/L Na = 0.154 mmol/ml Na

D5W = 50 g/L D10W = 100 g/L D12.5W = 125 g/L