Enteral Feeding Guidelines

1. Initiate feeds within the first 24 hours with mother's own milk, or donor human milk if eligible, unless contraindicated.
2. Partial volume feeds may be given as mother's own milk becomes available if not eligible for donor human milk to avoid formula in first days of life.
3. Facilitate maternal milk expression as soon as possible after birth using electric pump (temporary hand expression if pump not available).
4. Consult lactation consultant within 48 hours of admission to facilitate milk expression.

Weight (g)	Initiation of Feeds	Increase Feeds	Days to FF*
< 750g	~10 mL/kg/d x 48 hrs (1 ml q4h)	~15 mL/kg/d (1 mL q24h)	< 750g: 10-13
	~20 mL/kg/d x 48 hrs (1 ml q2h)	Consider ~10 mL/kg/d (= 1 weight category below)	
750-999	~15 mL/kg/d x 72 hrs (1 ml q2h)		750-999g: 12-15 days
1000-1499	~20 mL/kg/d x 48 hrs (2 ml q2h)	~20 mL/kg/d (1 ml q12h)	12-15 days
≥1500g	~20 mL/kg/d x 24 hrs		3-8 days
1500-1749	4 ml q3h x 24 hrs	~20 mL/kg/d (1 ml q6h)	
1750-1999	4 ml q3h x 24 hrs	~35 mL/kg/d (1 ml q3h)	
2000-2499	5 ml q3h x 24 hrs	~60 mL/kg/d (2 ml q3h)	
≥ 2500	≥6 ml q3h x 24 hrs	~80 mL/kg/d (≥3 ml q3h)	

*Days to full feeds (FF) = TFI ~160 ml/kg/d

Additional Considerations

- Offer oral feeding as per the **Oral Feeding Decision Algorithm - NICU** Guideline
- Consider **ad lib feeds** for infants ≥48 hours AND born ≥37 weeks gestation AND ≥2500g if no feeding risk factors present
- **High risk infants** (e.g. significant congenital heart disease, significant PDA, polycythemia, post-exchange transfusion, SGA/IUGR infants born < 29 weeks gestation, or other intestinal ischemic concerns)
  - Consider using 1 weight category below current weight
- **Post ≥ stage 2 NEC**: refer to **Feeding Management Guideline Post Stage 2 and 3 Necrotizing Enterocolitis** for additional details:
  - Use 1 weight category below current dosing weight; fortify at 100 mL/kg/d
- Hold feeds at initiation volumes ("trophic") for infants with documented **diastolic steal/flow reversal** on echocardiogram (e.g. hemodynamically significant patent ductus arteriosus or cyanotic heart disease)

Feeding Options

If mother'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
- **>2 kg:** Enfamil A+

Feed fortification for premature infants (≤32 wk GA):
- At enteral TFI of 80 mL/kg/d, fortify with HMF to 0.74 kcal/mL
- After 48 hours, increase fortification to 0.8 kcal/mL

Formula fed premature infants (donor EBM declined)**:**
- Fortify to 0.8 kcal/mL at enteral TFI 120 mL/kg/d

Macronutrient Modules

PROTEIN MODULES

LiquiProtein: extensively hydrolyzed protein
- Standard addition to fortified donor EBM (2 mL/100 ml dEBM)
- 1.0 g protein and 4.0 kcal per 6 mL

Beneprotein: whey protein isolate (milk)
- 0.86 g protein and 3.57 kcal per gram of powder

NON-PROTEIN MODULES

MCT Oil
- 7.7 kcal per 1 mL

Polycal: Carbohydrate (CHO) – corn maltodextrin
- Used for hypoglycemia management or to increase energy
- 0.96 g CHO and 3.84 kcal per gram powder

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

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	78	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

SickKids

NICU Nutrition Guidelines

February 2023

Weekly Nutrition Rounds: Tuesdays at 2 PM

Normal Growth Rates

	Preterm	Term (First 3 months)
Initial Weight Loss	≤15%	≤10%
Weight Gain	Birth weight usually regained by 10-14 d	
	17-21 **g/kg**/d (<1500g)	25-42 g/d
Length	24-32 wks: 1.4 cm/wk 34+ wks: 0.7 cm/wk	0.8-1.1 cm/wk
Head Circumference	24-32 wks: 1 cm/wk 34+ wks: 0.4 cm/wk	0.4-0.7 cm/wk

Monitor Growth using above and appropriate growth chart:
- Fenton (preterm infants)
- WHO (term infants; preterm infants >50 weeks PMA)
- Aim for proportionate **z-scores** for all anthropometrics

At full feeds, <u>continue weekly nutrition labs</u> for preterm and surgical infants:
- **Q Monday:** glucose, Na, K, Cl, iCa, P, ALP, urea ± bilirubin & LFTs, urine Na, K, Cl (monitor until normal); CBC (every other week)

Enteral Nutrient Requirements

Nutrient	Preterm Infants (<1500 g)	Term Infants
Fluid (ml/kg/d)	140-200	120-180
Energy (kcal/kg/d)	110-130	105-120
Protein (g/kg/d)	3.5-4.5	1.5-2.5
Vitamin D (IU/d)	400-1000	400-1000
Calcium (mmol/kg/d)	3.0-5.5	
Phosphate (mmol/kg/d)	2.3-3.9	
Iron (mg/kg/d)	2.0-3.0	
Sodium (mmol/kg/d)	3.0-8.0	
Potassium (mmol/kg/d)	2.0-5.0	

DONOR EBM (dEBM)

Consent and Documentation in Epic Required

Eligibility Criteria (any <u>one</u> of):
- Birth weight ≤2000 g
- Gestational age at birth ≤33+6 weeks
- Cardiac or GI surgery within first 4 weeks of life
- Post NEC
- HIE (while cooled and if meets NICU-specific criteria)

Discontinuation:
- As per NICU Nutrition Team
- Preterm infants: at 36 weeks PMA

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

Probiotic
(Ordered as FloraBaby)

Initiation	• Initiate with trophic feeds (discontinue at discharge)
Indications	• GA <35 weeks • Post-recovery from NEC • Surgical GI infants
Contraindications	• NPO • Active NEC • Bloody stools • Suspected or confirmed congenital immune deficiency

Vitamin D Supplementation
(Ordered as Cholecalciferol)

Initiation	• Initiate supplement when starting to advance feeds • Goal intake: 400-1000 IU/d
Duration	• Continue until 12 mo. corrected age
Not required if:	• **>1.7 kg** on Enfamil A+ Premature • **>2.1 kg on** 0.8 kcal/ml EBM + LHMF • Term formula fed (if intake >1L/d)

Elemental Iron Supplementation
(Ordered as Ferrous Fumarate)

Initiation	• Enteral preferred over parenteral • Start at 2 weeks postnatal age <u>and</u> once full fortified feeds reached (Consider initiating at 3 weeks postnatal age if on partial feeds) • Do not hold post-PRBC transfusion
Maintenance Requirement	• Birth weight <2 kg: 2-3 mg/kg/d (Continue for 12 months) • Birth weight 2-2.5 kg: 1-2 mg/kg/d (Continue for 6 months)
Monitor	• Monitor iron status and adjust enteral iron dosing accordingly

Sodium Supplementation
(Ordered as Sodium Chloride)

Initiation	• Indicated for preterm and infants with altered bowel integrity (stoma, bowel resection, previous NEC)
Maintenance Requirement	• Initiate supplementation at 2 mmol/kg/d (divided Q6H) • Titrate intake based on labs
Monitor	• Monitor urine and serum electrolytes at the same time • Maintain uNa 30-50 mmol/L and uNa>uK

METABOLIC BONE DISEASE SURVEILLANCE

RD screens all patients

Screen positive for AT RISK status if:
1. GA <30 weeks 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

Parenteral Nutrition (PN)

- PN orders are due by **2 PM daily** at the latest
- **PN Pharmacy Contact:** call extension 306702
- **RD Coverage:** RD evaluates all patients on PN
- **No RD Coverage:** 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?

- **Infants <1.5 kg:** In the first 24 hrs of life, start **NICU Electrolyte-Free PN** with lipids
- **Term infants** not expected to use GI tract for full nutrition support **within 3-7 days**
- PN should not be used solely to correct electrolyte disturbances when not otherwise required for nutrition support

PN and Lipid Solutions

Available 24 hours/day
- **NICU Electrolyte- Free PN** - AA (Primene) 25 g/L, Dextrose 100 g/L, Ca 12 mmol/L
  - After 24 hours, switch to Standard 25/100 or Custom 2-in-1 PN
- **Standard 25/100 -** 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 µmol/L
- **SMOFLIPID (20% lipid)**

Available during TPN Pharmacy hours (10am-2pm)
- **CUSTOM 2-in-1 PN**
  - Indicated when standard PN solutions cannot meet nutritional requirements

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 soluble Ca/Phos ratios:

Amino Acid (g/L)	Ca:P or P:Ca (mmol/L)
20	12:12
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)	Glucose Infusion Rate (Dextrose) (mg/kg/min)	
	Preterm	**Term**		**Preterm**	**Term**
Initial Dose*	1.5-2.5	1.5-2	0.5-1	4-8	
Advance Daily	1	1	1	1-2	1-3
Goal	3.5-4	2.5-3.5	3	10-14	5-12
Energy Provided	4 kcal/g		20% SMOF: 10 kcal/g (2 kcal/ml)	3.4 kcal/g	
Fluid Goals	**Preterm** (<1500g)**:** 160 mL/kg/d **Term:** 100-140 mL/kg/d				
Energy Goals	**Preterm:** 90-120 kcal/kg/d **Term:** 75-100 kcal/kg/d				
SMOFLIPID	• Soybean/Medium Chain Triglyceride/Olive/Fish Oil				
PN Lab Schedule	• **Q Monday:** Gas, glucose, Na, K, Cl, Cr, bilirubin, iCa, P, Mg, ALP, AST, GGT, urea, intralipid (weekly); CBC (every other week) • **Q Thursday:** Gas, glucose, Na, K, Cl • Consider urine electrolytes (urine Na, K, Cl) for infants with altered intestinal absorption				

Intralipid Level	• Gold standard measure of IV fat clearance (triglyceride is a less accurate measure)
	• Elevated levels (confirm sampling appropriate):
	  • 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) **÷ weight** (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 OR if infusions are weaned
	• **Fat**: infants with cholestatic liver disease benefit from fat restriction **(≤2.5 g/kg/d)**
	• SMOFLIPID does 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				

*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)		Intermediate Phase (mmol/kg/d)		Stable/Growing Phase* (mmol/kg/d)	
	Preterm Infants	**Term Infants**	**Preterm Infants**	**Term Infants**	**Preterm Infants**	**Term Infants**
Sodium	0-3	0-2	2-5	2-3	3-7	2-3
Potassium	0-3		1-3		1-5	1.5-3
Chloride	0-3		2-5	2-3	3-5	2-3
Calcium	0.8-2.0		Same as stable/growing phase		1.6-2.5	0.8-1.5
Phosphorus	0-2.0				1.6-2.5	0.7-1.3
Magnesium	0-0.2				0.2-0.3	0.1-0.2
Acetate	• As needed to maintain acid-base balance, consider fluid balance when managing metabolic acidosis • 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** • For NICU patients, **ALWAYS enter actual mmol/L desired** unless NO acetate desired (then choose "Maximize Chloride"); do **NOT** use "Maximize Acetate"					
PN Multivitamin	• Multivitamin Pediatric (vitamin K 0.2 mg/bag) – for patients <2.5 kg OR on PN >4 weeks • Multivitamin with Vitamin K (vitamin K 0.2 mg/bag) – standard multivitamin for patients >2.5 kg					
Trace Elements	• Trace element mix is added daily (3.1 ml/bag) • Contains: copper 6.3 µmol/L, iodine 0.47 µmol/L, chromium 0.076 µmol/L, selenium 0.25 µmol/L					
Zinc	• 92 µmol/L zinc is usually added to PN • Additional zinc may be added if clinically indicated (stomas, short bowel, burns, wounds)					
Iron	• Enteral iron is preferred over parenteral iron • Can be added after 3 weeks postnatal age (36 µmol/L) **no need to remove post-pRBC transfusion**					
Long-Term PN	• Long-term PN considered when patient requires PN for > 4 weeks • Additional micronutrients (Se, carnitine, vitamin K) may be added to PN • Additional monitoring as per **Nutritional Monitoring for Inpatients of Long-Term Parenteral Nutrition**					

***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)
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

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 PN ORDERS
- **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
- **Call PN Pharmacy if new bag not needed**
- DO NOT discontinue Order unless no longer infusing

COMMON CONVERSIONS

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
3%NS: 513 mmol/L Na = 0.513 mmol/ml Na

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

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