Parenteral Nutrition - TPN

ORDERING TPN

1. Order should be placed daily by 1200
2. TF order (mL/kg/day) = all continuous infusions + enteral feeds (Do not include trophic feeds)
3. EPIC TPN volume order = TF minus enteral feeds, lipids, and infusions (ex. PAL/UAC fluid, continuous med infusions)
4. Enter as "NEW" with **NEONATAL TPN PANEL** or "REORDER"- 2200 start time for either
5. **DO NOT** modify infusion rate of current order – use **NURSING ORDER** to communicate changes
6. **These parameters are not for ELBWs. Please refer to ELBW-specific guidelines for those infants.**

CALORIES

Goal

- Parenteral 90-110 kcal/kg/day
- Protein to energy ratio of 1 g to 25-33 Kcal

Energy Density

- IV glucose 3.4 kcal/g
- Protein 4 kcal/g
- Fat (SMOF 20%) 10 kcal/g or 2 kcal/mL

Intravenous Fluid Volume (Day of Birth)

- < 37 weeks = 80 mL/kg/day
- ≥ 37 weeks = 60 mL/kg/day

CARBOHYDRATE (GLUCOSE)

- **Begin Glucose Infusion Rate (GIR) at 4-6 mg/kg/min (no lower than 3.5 mg/kg/min)**

PROGRESSION OF GIR

- Progress GIR by 1-2 mg/kg/min daily
- Maximum GIR 12-14 mg/kg/min

MAXIMUM DEXTROSE % (BASED ON TYPE OF ACCESS)

PIV: D12.5% (max osmolarity 1000 mOsm/L)

Central (Broviac, PICC, UAC or UVC line): D35%

Midline PICC: D15% (max 1000 mOsm/L)

PROTEIN

- **Begin at total of 2.5 to 3 g/kg/day**

2.5% AMINO ACID SOLUTION WITH D10W (D10AA)

- For PIV, UVC, PICC, includes heparin
- Continue if TPN can't be ordered by 1200
- See Amino Acid Solutions for total protein/GIR
- Do not order as KVO in infants > 1 kg

3.6% AMINO ACID SOLUTION (ISOTONIC AA/IAA)

- Administer via UAC or PAL, includes heparin
- CONTAINS NO DEXTROSE (glucose source needed)
- Include Isotonic AA in total daily protein
- See Amino Acid Solutions for total protein content

PROGRESSION OF PROTEIN FOR NON-ELBWS

- Progress to goal by day of life 2
  1. If **BW < 1250 g**: goal 3.5 g/kg/day
  2. If **BW ≥ 1250g:** goal 3 g/kg/day
- >1.5 g/kg/day (from parenteral and/or enteral feeds) meets essential amino acid needs
- May decrease if metabolic/renal concerns
- May increase to a max of 4 g/kg for surgical patients or with poor growth

FAT (SMOF/Intralipid)

- **Begin at 0.5-1 g/kg/day**
- Ensure lipids are initiated by 48 hours and avoid stopping and starting lipids to prevent essential fatty acid deficiency

PROGRESSON OF FAT

- Progress by 1 g/kg/day to final goal 3 g/kg/day

ELECTROLYTES AND MINERALS

SODIUM

- **Maintenance: 2-5 mEq/kg/day**
- Add sodium to TPN/maintenance fluids at 24 hrs
- Use sodium acetate if BW < 1.5 kg or with acidosis
- Transition to sodium chloride with age
- Serum sodium lab values reflect the infant's fluid and sodium balance

POTASSIUM

- **Maintenance: 1-3 mEq/kg/day**
- Add K+ to TPN/maintenance fluids at 24 hrs
- If 24 HOL labs will not be back before TPN deadline, add K+ unless infant is anuric
- 1 mMol of potassium phosphate = 1.47 mEq of potassium in the TPN

MAGNESIUM:

- **Maintenance: 0.25-0.5 mEq/kg/day**
- Can be elevated if magnesium given prenatally
- Begin when serum magnesium is ≤ 2.0 mg/dL
- Must correct hypomagnesemia to correct hypocalcemia

CALCIUM

- **Maintenance: 2-4 mEq/kg/day**
- 200 mg of Calcium Gluconate = 1 mEq Ca^{2+}
- Add 1 mEq/kg/day to TPN on day of birth
- Optimal ratio of Ca:Phos should be 2:1
- Ratio of Ca:Phos can be adjusted based on labs
- Use caution with calcium provision via a PIV

PHOSPHORUS

- **Maintenance: 1-2 mmol/kg/day**
- Works with calcium for bone formation

ACETATE

- Will assist in correcting acidosis
- Adjust ratio of chloride & acetate based on clinical status and serum electrolytes

CHLORIDE

- Add once the infant is older and/or initial metabolic acidosis is resolved

OTHER TPN COMPONENTS

Heparin: 0.5 units/mL

Cysteine: recommend 20-40 mg/g protein

- Increase to 40 mg/g to improve Ca:P solubility

MVI: 2 mL/kg; max is 5 mL

Trace elements: To be added soon after birth

OTHER CONSIDERATIONS

- Monitor electrolytes when substrates are manipulated in the TPN
- **Prolonged TPN**: monitor electrolytes weekly; monitor liver function (LFTs/T/Dbili) every 2 weeks
- **Cholestasis** or **renal dysfunction**: discuss with pharmacist/RD adjusting TPN additives
- **For questions:** Consult pharmacist/RD

Parenteral Nutrition - Clear Fluids

- Epic order: **NEONATAL CUSTOM IV FLUID BUILDER**
- D10 with 10 mEq NaCl and 10 mEq KCl per 500 mL bag at 120 ml/kg/day gives GIR 8.3 mg/kg/min + 2.4 meq/kg/day of NaCl and KCl
- May add Calcium Gluconate (in mg); no Phos
- *Add heparin if central line*
- Note: D10AA is a clear fluid

Enteral Nutrition Guidelines

- See relevant feeding pathway for details
- Non-nutritive, trophic feeds are 10-20 mL/kg/day

GOALS

CALORIES

- 110-130 kcal/kg/day

PROTEIN

- **PRETERM** > 3.5 g/kg/day
- **TERM** ≥ 1.5 g/kg/day

WHAT TO FEED

Mother's Own Milk (MOM)

- Colostrum (Oral Immune Therapy) is given to all NCCC infants
- Donor human milk (DHM) is generally provided until 36 weeks PMA, as a bridge to establishment of breastfeeding for term infants, and in high risk infants.

EXCLUSIVE HM (FORTIFICATION WITH PROLACTA)

- Indicated for BW < 1 kg or GA < 29 weeks
- Cream HM can add additional 2 kcal/oz
- At 34 weeks PMA, transition to fortification with LHMF (24 kcal/oz)

LIQUID HUMAN MILK FORTIFIER (LHMF)

- Bovine base fortifier (hydrolyzed protein)
- Use to fortify HM to 24 kcal/oz
- At 36 weeks PMA, transition to fortification with Neosure (24 kcal) or appropriate formula

FORMULA CONSIDERATIONS

UNC Formulary = Abbott products

PRETERM FORMULA

Similac Special Care (SSC)

- Standard caloric density is 24 kcal/oz, may be fortified with SSC 30 kcal/oz to achieve higher caloric density

PRETERM DISCHARGE FORMULA

Similac Neosure

- Standard caloric density is 22 kcal/oz
- Used as fortification of MOM starting at 36 weeks PMA (24 kcal), and/or in preparation for discharge

TERM FORMULA

Similac Total 360 / Similac Advance

- Standard caloric density is 20 kcal/oz

PEPTIDE BASED / SEMI-ELEMENTAL FORMULA

- For suspected malabsorption, formula intolerance
- Nutramigen, Alimentum, Pregestimil (not on formulary)

ELEMENTAL FORMULA

- Used for infants with GI impairment including protein intolerance, short-gut syndrome (Elecare)

LOW SOLUTE FORMULA

- Similac PM 60/40 formula
- Lower minerals (phosphorus, iron, calcium) usually used in infants with renal impairment.

HIGH MCT OIL FORMILA

- Enfaport (83% MCT) OR Monogen (84% MCT)
- Used for lymphatic malformations, chyle leaks, and fatty acid oxidation disorders.

SOY BASED FORMULA

- Not recommended for preterm infants

MODULAR ADDITIVES

- To increase **CALORIES**: Liquigen, MCT oil (not on formulary), cream
- To increase **PROTEIN**: liquid hydrolyzed protein

MICRONUTRIENT CONSIDERATIONS

MULTIVITAMINS (MVI)

- If < 2.5 kg: MVI 0.25 mL twice daily without iron
- If on **PROLACTA**: MVI 0.5 mL twice daily
- If ≥ 2.5 kg: may use multivitamin with iron (0.5 mL twice daily). Do not use a separate Fe supplement

FERROUS SULFATE (AS ELEMENTAL IRON)

- Supplement with 3 mg/kg/day divided BID

WEIGHT GAIN GOALS

- Related to GA, birth and current weight and length
- Follow infant growth charts closely

GROWTH CHARTS *(available as activity in Epic)*

- Use **FENTON** growth chart for **PRETERM** infants
- Use **WHO** growth chart for **TERM** infants

NUTRIENT CONTENT PER 100 ML

FEEDINGS	kcal	Pro *g*	Na *mEq*	K *mEq*	Ca *mg*	Phos *mg*	Vit D *IU*	Fe *mg*
HM *(20 kcal/oz)*	66	1	0.8	1.4	28	14.2	2	0
HM+LHMF *(24 kcal/oz)*	80	2.5	1.4	2.9	123	68.5	116	0.4
HM+LHMF *(26 kcal/oz)*	87	2.7	1.5	2.9	140	78	127	0.9
HM+Prolacta *(24 kcal/oz)*	82	1.9	2.6	2.3	121	65	1.6	0.1
HM+Prolacta *(26 kcal/oz)*	90	2.4	2.6	2.4	123	67	2.4	0.1
HM+Prolacta *(28 kcal/oz)*	98	2.9	2.6	2.4	125	66	3.2	0.1
HM+Neosure *(24 kcal/oz)*	80	1.3	1	1.9	37	21	10	0.3
SSC (HP) *(24 kcal/oz)*	80	2.7	1.5	2.7	145	80	122	1.5
Neosure *(22 kcal/oz)*	73	2.1	1.1	2.7	78	46	52	1.3
Neosure *(24 kcal/oz)*	80	2.3	1.2	3	84	49.6	56	1.4
SSC *(30 kcal/oz)*	100	3	1.9	3.3	180	100	150	1.8

HM = Human Milk **SSC** = Similac Special Care **HP** = High Protein

PRETERM DISCHARGE

Infants should receive nutrients appropriate for their PMA (see Post Discharge Nutrition Guidelines)

FORTIFICATION STRATEGIES

Breastfeeding

- Feed 2-3 bottles per day of HM fortified to 24 kcal/oz using preterm discharge formula powder ***OR*** preterm discharge formula 22/24 kcal/oz

Human Milk (Bottle Feeding)

- Fortify all HM with preterm discharge formula powder to 24 kcal/oz
- Feed 2-3 bottles per day of preterm discharge formula 22/24 kcal/oz

Formula (Bottle Feeding): Similac Neosure 22 kcal/oz

DISCHARGE CONSIDERATIONS

- Individualized approach to optimize growth
- Pre-discharge discussion with parents and team
- Post discharge intervention
  1. Until growth indices are all > -2 SD (WHO chart)
  2. Minimum of 12 weeks after discharge if BW < 1.25 kg or if < 2 kg at discharge

Revised 2026 Price/Levy/Blake/Taylor/Frazer/Maynor/Girton/MacCabe