



Clinical Center
Nutrition Support Handbook

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Introduction

This handbook of enteral and parenteral nutrition provides general information about the use of pediatric and adult nutrition support at the Clinical Center. It includes practical guidelines for the assessment, planning, and delivery of nutrition to patients on parenteral and enteral formulations. It is not intended to be a complete resource of information regarding metabolism or the diversity of complications that may arise with enteral or parenteral alimentation. Nutrition and pharmacy staff are available for consultation regarding specific problems.

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Indications and Contraindications

Enteral feeding: provision of liquid formula diets by tube into the GI tract

Indications:

- Protein/Calorie malnutrition and inadequate oral intake
- Well nourished but oral intake <50% of required for >7-10 days
- Mechanical GI tract dysfunction/disorders
- Transition between TPN and oral feeding
- Hypermetabolic condition

Contraindications:

- Intractable vomiting
- Intestinal obstruction
- Upper GI tract hemorrhaging
- High risk for respiratory aspiration
- Severe intractable diarrhea
- Significant bowel resection
- Prognosis not warranting aggressive nutritional support

Parenteral nutrition- provision of some or all nutrients intravenously

Indications:

- Dysfunctional GI Tract
- Bowel Rest
- Severe malnutrition or hypermetabolism-unable to meet protein/calorie needs by enteral route
- Alternative to enteral route in critical situation to avoid uncertainties of nutrient uptake and utilization

Contraindications:

- Treatment anticipated less than 7-10 days
- Functioning GI Tract
- Inability to obtain venous access
- Prognosis not warranting aggressive nutritional support

Access for Parenteral Nutrition--Peripheral (PPN) or Central (TPN)

Considerations for TPN

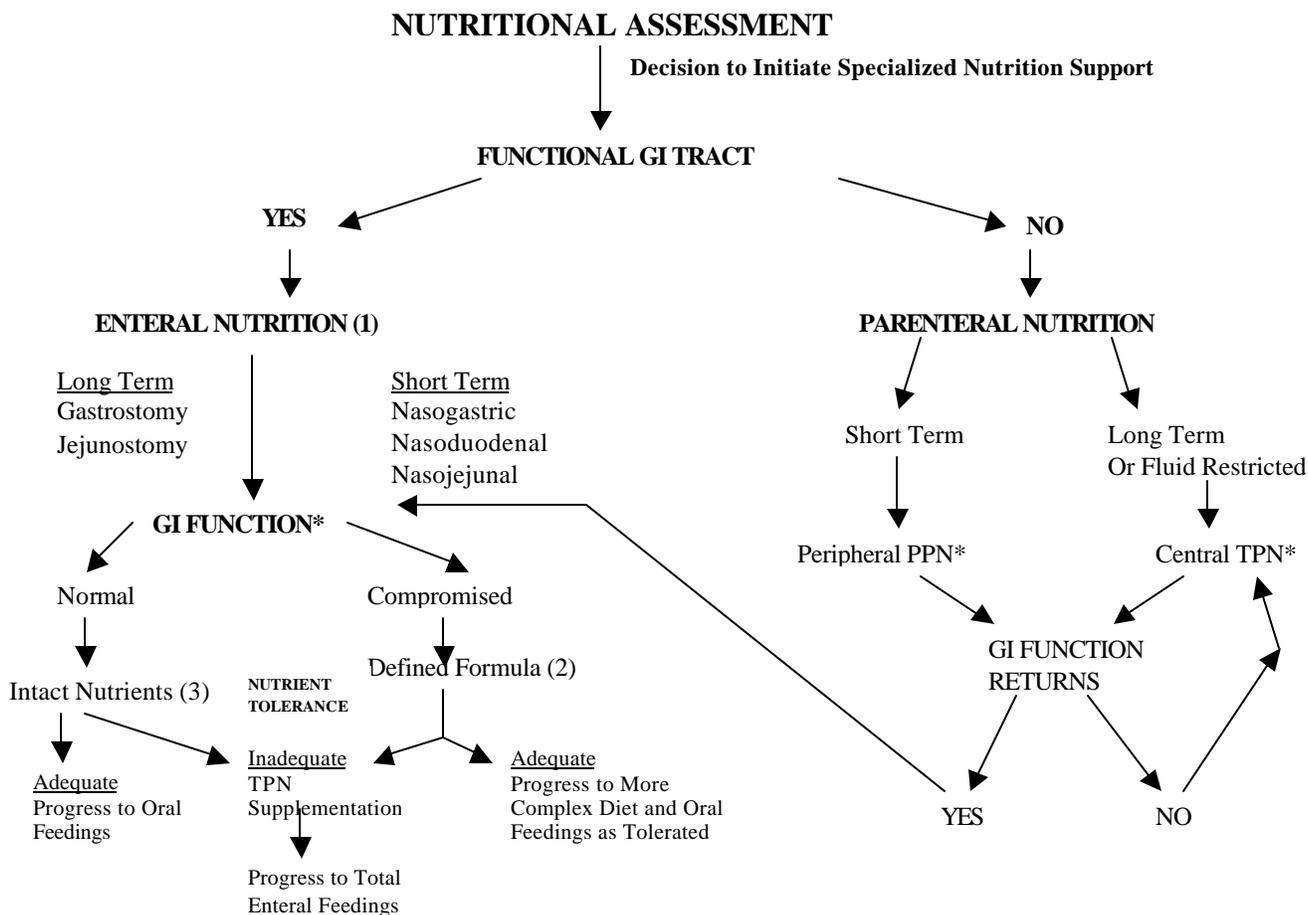
- Long term support; >7-10 days
- Useful for severe nutritional depletion and/or increased nutrient needs
- Solution concentration can be >1000 milliosmoles per liter
- Requires surgical procedure for central venous catheterization

Considerations for PPN

- Short term support; 5-10 days
- Useful when central line insertion is otherwise contraindicated; requires good peripheral venous access
- Requires a high percentage of calories from fat (30-60%) and a high fluid volume (3 liters) to reach upper calorie limit (2000 kcal/day)
- May be used as transitional feeding modality to provide maintenance calorie needs for short time frame.
- Solution concentration should be limited to 900 millimoles per liter

Access	Final Dextrose Concentration	Dextrose Calories/Liter
TPN	D20-D35	680-1190
PPN	D5-D10	170-340

ALGORITHM FOR ROUTES TO DELIVER NUTRITION SUPPORT



The algorithm describes the thought process for determining the appropriate nutrition support regimen. If the patient has a functional GI tract, then enteral rather than parenteral nutrition should be considered. Parenteral nutrition is indicated in situations such as obstruction, peritonitis, intractable vomiting, active pancreatitis, short-bowel syndrome, or ileus. For short term enteral nutrition, a nasogastric, nasoduodenal, or nasojejunal tube is appropriate. For long-term enteral nutrition, a gastrostomy or jejunostomy tube is indicated. When choosing an enteral formula, if the GI tract is functioning, then an intact nutrient formula is recommended, but if GI function is compromised then a defined formula should be considered. For short term parenteral support, peripheral (PPN) can be considered, but for long term or fluid restricted support, then Central TPN is necessary. As GI function normalizes, transitioning can be made from parenteral to enteral then to oral nutrition.

*Formulation of enteral and parenteral solutions should be made considering organ function (e.g., cardiac, renal, respiratory, hepatic).

1. Feedings may be more appropriate distal to the pylorus if the patient is at increased aspiration risk.
2. Elemental low/high fat content, lactose-free, fiber-rich, and modular formulas should be provided according to patient's GI tolerance.
3. Polymeric, complete formulas, or pureed diets are appropriate.

From: "Guidelines for the use of Parenteral and Enteral Nutrition in Adult and Pediatric Patients," JPEN, Vol 17 #4 (suppl) July-Aug, 1993 p 75-A

Determining Calorie, Protein, and Fluid Needs

Calorie and Protein Needs (Pediatrics)

Age (years)	Calories/kg	gm. protein/kg
0-1	100-110	2.5-3.0
1-3	100	1.5 -3.0
4-6	90	1.2-3.0
7-10	70	1.0-2.5
11-14	40-60	1.0-2.0
15-18	40-45	1.0-2.0

Please consult the dietitian for estimation of the calorie and protein needs for children who are significantly above or below the weight/height standard for their age.

Helpful Clinical Center Pediatric Web sites:

<http://www.cc.nih.gov/ccc/pedweb/pedsstaff/index2.html> (general pediatric staff resources)

<http://www.cc.nih.gov/ccc/pedweb/pedsstaff/tpn.html>

<http://www.cc.nih.gov/ccc/pedweb/pedsstaff/ivf.html>

Calorie and Protein Needs (Adults)

Age (years)	Calories/kg*	gm.protein/kg**
>18	20-45	0.8-2.0

Calories/kg*

Use actual body weight or adjusted weight (formula below) if patient is obese (BMI > 30)

Adjusted Weight Formula=IBW + (0.25 x (actual body weight-IBW))

IBW = Ideal Body Weight When calculating IBW, use a BMI of 25
Unit of weight = kg

20 calories/kg - wasting, malnutrition

25 calories/kg - maintenance

30-35 calories/kg - anabolism in moderate depletion

40-45 calories/kg - anabolism in severe depletion

FOR A MORE PRECISE MEASUREMENT OF BASAL OR RESTING CALORIE NEEDS, THE METABOLIC CART SHOULD BE CONSULTED.

**gm. Protein/kg:

0.5-0.8 gm. protein/kg- hepatic encephalopathy or renal failure (without dialysis)

0.8-1.0 gm. protein/kg- no significant stress

1.1-1.5 gm. protein/kg- moderate stress

1.5-2.0 gm. protein/kg- severe stress

1.2-1.5 gm. protein/kg- peritoneal dialysis

1.0-1.2 gm protein/kg- hemodialysis CVHD and CVVH

Fluid Requirements

Methods to determine maintenance requirements:

- 1 ml free water/1 calorie ingested
- Use Reference weight (chart below)

Reference Weight	Fluid
5.0 – 10 kg	1500- 1800 ml/m ² /day
10 - 30 kg	1500 ml/m ² /day
Adolescents	1500 ml/m ² /day
Adults	1500 ml/m ² /day

Considerations regarding fluid requirements:

- Increased fluid may be necessary for conditions causing greater losses such as diarrhea, fever, high output fistulas, large draining wounds and diabetes insipidus.
- Other conditions such as hepatic or renal failure, congestive heart failure, pulmonary edema or head injury may necessitate a fluid restriction.
- Consider addressing and managing a disturbance of fluid volume, concentration or composition *prior* to initiating a nutrition support regimen, for example when:

Sodium	<125	or	>155	mmol/L
Potassium	<3	or	>6	mmol/L
Chloride	<85	or	>115	mmol/L
Bicarbonate	<15	or	>35	mmol/L
Calcium (total)	<2	or	>3	mmol/L
Magnesium	<0.5	or	>2	mmol/L
Phosphorus	<1.8	or	>4.7	mg/dl

- While fine-tuning of electrolytes can be made via a parenteral nutrition regimen when it makes sense physiologically, any major aberrations of electrolyte status, especially if symptomatic, should be managed outside of the nutrition support regimen.

Metabolic Cart Consult Service

- The Critical Care Medicine Department, in conjunction with Pharmacy and Nutrition Departments, provides a Metabolic Cart Consult Service to accurately determine resting energy expenditure and caloric needs for patients who are receiving nutrition support. Formulas commonly used to estimate energy expenditure may not accurately predict energy expenditure for some of the patients commonly seen at the Clinical Center.
- The metabolic cart permits the individualization of a patient's nutrition support regimen based on the energy expenditure of his/her disease process. Individualizing nutrition support regimens will hopefully prevent the unintentional under- or over-feeding of patients and provide them with the appropriate mixture of nonprotein calories. The consultants will provide a written interpretation of the results of the metabolic cart study.
- The patients receiving nutrition support who would benefit from a metabolic cart study include critically ill patients, pediatric patients, bone marrow transplant patients, post-operative surgery patients, and patients scheduled for discharge on home nutrition support regimens. The metabolic cart study will be performed in the patient's room and takes approximately 30 minutes. The only requirement is that patients scheduled for a metabolic cart study must be at bed rest for one hour before the study.
- Metabolic cart studies will be performed at times to accommodate special patient needs.
- To initiate a consult: Call 496-1520 to request a time for your patient. If possible, scheduling should be done at least 48 hours in advance.

Parenteral Nutrition Macro and Micronutrient Requirements

	<i>Infant/Children (0.5-30kg)</i>	<i>Adolescents (> 30kg)</i>	<i>Adults</i>
Water	1500-1800 ml/m ² /d	1500 ml/ m ² /d	1500 ml/ m ² /d
Energy	70-110 cal/kg/d	40-60 cal/kg/day	25-45 cal/kg/d
Dextrose			
<i>Initial</i>	5-10% (50-100 g/L)	5-10% (50-100 g/L)	10-15% (100-150 g/L)
<i>Advance</i>	5% (50 g/L)	5% (50 g/L)	5-10% (50-100 g/L)
<i>Max</i>	12-15 mg/kg/min 20-35% (200-350 g/L)	7-14 mg/kg/min 20-35% (200-350 g/L)	4-6 mg/kg/min 20-35% (200-350 g/L)
Protein			
<i>Initial</i>	1 g/kg/d	1 g/kg/d	At goal *
<i>Advance</i>	0.5-1 g/kg/d	1 g/kg/d	-
<i>Max</i>	3 g/kg/d	2 g/kg/d	2 g/kg/d
IV Fat			
<i>Initial</i>	1 g/kg/d	1 g/kg/d	At goal *
<i>Advance</i>	1 g/kg/d	1 g/kg/d	-
<i>Max</i>	2-4 g/kg/d	2-3 g/kg/d	2 g/kg/d (60% of T.Cal)
Sodium	2-4 mEq/kg/d	2-3 mEq/kg/d	60-150 mEq/d max 155 mEq/l
Potassium	2-3 mEq/kg/d	1.5-3 mEq/kg/d	40-240 mEq/d max 80 mEq/l
Magnesium	0.3-1 mEq/kg/d	0.2-0.3 mEq/kg/d	8-24 mEq/d
Calcium	0.5-2.5 mEq/kg/d	0.5-1 mEq/kg/d	10-40 mEq/d max 30 mEq/l
Phosphorus	0.5-2 mM/kg/d	0.5-1.3 mM/kg/d	15-50 mM/d max 30 mmol/l
Trace Metals			
<i>Pediatric</i>	0.2 ml/kg/d (10 ml/max)	0.2 ml/kg/d (10 ml/max)	----
<i>Adult</i>	----	----	1 ml/d
Multi-vitamins			
<i>Pediatric</i>	5 ml/d	----	-----
<i>Adult</i>	----	10 ml (1 dose)/d	10 ml (1 dose)/d
Selenium	2 mcg/kg/d (40 mcg/max)	2 mcg/kg/d (40 mcg/max)	40 mcg

*Begin at lower dose if malnourished

Managing TPN Complications

Complications	Possible Cause	Intervention
Hyperglycemia	Glucose exceeds insulin Steroid therapy Diabetes, Trauma	Control hyperglycemia, advance slowly Add insulin Less kcal from CHO; add insulin
Hyperosmolar, hyperglycemic, nonketotic dehydration (HHND) and coma	Hyperglycemia, glucosuria, coma	Stop parenteral feeding; hydrate. Give insulin if necessary; correct electrolytes.
Hypoglycemia	Decreased insulin need	Increase dextrose
Hyperkalemia	Decreased renal function; potassium; low cardiac output; K ⁺ sparing diuretic	Control potassium; look drug/nutrient interactions
Hypokalemia	Anabolism; medications that waste potassium; GI losses	Increase potassium
Hyperphosphatemia	Too much PO ₄ ; renal insufficiency	Monitor and decrease PO ₄
Hypophosphatemia	Too little PO ₄ ; anabolism	Monitor and increase PO ₄
Hypercalcemia	Excess administration of Calcium or vitamin D	Decrease amount; look for drug/nutrient interactions, i.e. thiazide diuretics
Hypocalcemia	Increased need; hypoalbuminemia	Increase amount; check serum magnesium and vitamin D and albumin

Hypertriglyceridemia	Intolerance	Monitor and reduce amount; run in over longer time period
Essential fatty acid deficiency	Inadequate lipids	Increase lipids
Prerenal azotemia	Excess protein	Decrease protein; Increase non-protein kcal
Hyperammonemia	Hepatic dysfunction	Decrease protein

Adapted from: review of Dietetics Registered Dietitian's Examination Study Manual. Aspen Publication. Page 1:165, 1993.

Ordering Parenteral Nutrition

- There are no standard solutions for TPN at the Clinical Center. Each bottle is customized to the patient's special needs.
- Dextrose and Amino Acids need to be ordered daily by 2 PM, so they can be delivered to the patient care unit by 6 PM. Orders for outpatients or patients who will be discharged on TPN should be entered before 11 am so they can be ready for pick-up after 3 PM.
- Order fat emulsion only once, unless the order needs to be changed.

Discontinuation of Parenteral Nutrition Infusion

If the infusion must be interrupted or stopped suddenly and the patient is NPO, the infusion rate should be reduced by one-half for at least one hour or the parenteral nutrition solution may be replaced by a 10% dextrose solution.

When the parenteral nutrition infusion is to be discontinued, this should be done either by gradually decreasing the dextrose infusion over 1-2 days or by stopping the parenteral nutrition solution if adequate calorie intake via the GI tract is ensured.

Conversion to Cyclic Parenteral Nutrition Infusion

The parenteral nutrition infusion can be shortened to less than 24 hours after electrolyte deficits are replaced, fluid balance is established, and tolerance to macronutrients is documented.

The infusion period can be shortened at first to 18-20 hours. Blood glucose determinations should be done just before tapering, when the solution is terminated, and 1/2-1 hour later. The infusion period can be further decreased over the next 24-48 hours until the infusion is given over 10-12 hours. When a short cycle time requires a high infusion rate, it is best to utilize a pump that can be programmed to taper the infusion rate by increments over 1-2 hours at the beginning and end of each infusion.

Starting Tube Feeding

Guidelines for Initiation and Advancement of Continuous and Intermittent Tube Feeding

Age	Initial Infusion	Advance	Goal
Continuous Feeds			
0-12 mo	1-2mL/kg/hr	1-2 mL/kg/q2-8h	6mL/kg/hr
1-6 yr	1mL/kg/hr	1mL/kg/q2-8h	4-5mL/kg/hr
>7 yr-adult	25mL/hr	25mL/q2-8h	100-150mL/hr
Intermittent Feeds			
0-12 mo	10-15mL/kg/q2-3h (30-60mL)	10-30mL/feed	20-30mL/kg/q4-5h
1-6 yr	5-10mL/kg/q2-3h (60-90mL)	30-45mL/feed	15-20mL/kg/q4-5h
>7 yr-adult	90-120mL q3-4h	60-90mL/feed	330-480mL/q4-5h

Source: Adapted from Wilson SE, Pediatric Enteral Feeding, in Grand RJ, Stephen JL, Dietz WH (eds), Pediatric Nutrition, Boston Butterworth, 1987, p.771.

Residuals/Preventing or Decreasing Risk of Aspiration

- Check gastric residuals (NG or G-tubes) every 4 hours, or before each intermittent feeding, and hold tube feeding for at least 2 hr for residuals >200cc. It is not necessary to check residuals for intestinal tubes (eg Dobhoff). Residuals should be evaluated in conjunction with other signs/symptoms of potential intolerance e.g. distention, bloating.
- Elevate head and shoulders at least 30-45 degrees for continuous feeds; 90 degrees during and 1 hour after intermittent feeds.

For recommendations for tube feeding selection and progression schedule, contact the Clinical Dietitian.

Specific nutrient content of tube feeding products is available in the Clinical Center Nutrition Department Enteral Formulary, which is located in the Diet Manual.

Managing Tube Feeding Complications

Complications	Possible Cause	Intervention
Diarrhea	Volume overload Hyperosmolar	Change to drip if bolus. Dilute, then increase solution as tolerated.
	Lactose Malabsorption	Change to lactose-free product. Consider lactose-free or other formula (MCT oil.) Give enzymes.
	Protein-calorie malnutrition Medications Contamination Decreased bulk Infection	Use isotonic solution. Evaluate and change as necessary. Change all equipment and solution. Change to fiber-enriched formula. Send stool for O&P,C. difficile
	Vomiting	Stop feeding. Maintain hydration and electrolytes by vein.
Nausea	Delivery rate too fast	Decrease rate, then advance as tolerated
	Positioning Delayed gastric emptying	Elevate head of bed at least 30-45; lay patient on right side. Stop feeding for 2 hours. Increase physical activity. Give meds to stimulate motility.
	Nutrient intolerance GI obstruction	Lactose-free or low-fat formula. Stop feeding.
Aspiration	Patient lying flat	Elevate head and shoulders. Change to transpyloric feeding.
Constipation	Dehydration Lack of fiber	Monitor intake/output; add water Change to fiber-enriched formula.
Overhydration	Hyponatremia Inadequate hydration	Decrease feeding rate. Increase concentration. Change formula; add water; decrease protein content.
Hyperglycemia	Insulin deficiency; Dehydration	Slow rate: give insulin, monitor blood glucose and urine fractionals. Increase fat content and decrease CHO.

Hypoglycemia	Sudden interruption of feeding	Gradually taper off feeding. Monitor blood glucose.
Hyperkalemia	Renal	Consider renal formula
Hypokalemia	Diarrhea; refeeding syndrome	Give potassium and monitor potassium levels.
Hyperphosphatemia	Renal insufficiency	Change formula; use phosphate binder
Hypophosphatemia	Refeeding Syndrome	Monitor phosphorus, advance feeding slowly
Weight gain (undesired)	Excess fluid, kcal, electrolyte imbalance	Decrease amount and concentration; monitor.
Weight gain (desired) e.g., children, depleted adults	Positive calorie and nitrogen balance	Continue feeding

Adapted from: Review of Dietetics Registered Dietitian's Examination Study Manual. Aspen Publication. Page 1:164, 1993.

Suggested Nutrition Support Laboratory Monitoring Parameters

Parameters	Baseline	Maintenance		
		Daily	2 times/week	1 time/week
Weight	X	X		
Fluid Balance (I/O's)	X	X		
Prealbumin	X		X	
Acute Care Panel	X	X		
Mineral Panel	X		X	
Hepatic Panel	X		X	
Triglycerides	X			X
UUN/N balance	As indicated	As indicated		

*Acute Care Panel=Sodium, Potassium, Chloride, Total CO₂, Creatinine, Glucose, BUN

*Hepatic Panel=Alk Phos, ALT (SG PT), AST (SGOT), Total Bili

*Mineral Panel=Albumin, Calcium, Magnesium, Phosphorus

Interpreting Laboratory Monitoring of Response to Nutrition Support

Lab	Normal Range	Interpretation
Prealbumin	16-34 mg/dl	<p>Mild depletion: 10-15 mg/dl Moderate depletion: 5-10 mg/dl Severe depletion: <5 mg/dl</p> <p>Increased in chronic renal failure</p> <p>Decreased in acute catabolic states, post operative states, hyperthyroidism, protein-losing enteropathy, and infection/inflammation</p>
Triglycerides	0-9 yrs: no reference range 10-29 yrs: 10-140 mg/dL 30-39 yrs: 10-150 mg/dL 40-49 yrs: 10-160 mg/dL 50-59 yrs: 10-190 mg/dL 60+ yrs: no reference range	<p>Useful indicator of lipid tolerance in individuals receiving total parenteral nutrition</p> <p>Triglyceride level should be checked at least 4 hours after the lipid infusion is completed to accurately assess clearance</p> <p>Triglyceride level <400 mg/dl is acceptable for continuing lipid infusion</p> <p>May be increased in non-fasting specimen, primary hyperlipoproteinemias secondary hyperlipoproteinemias such as: diabetes mellitus, nephrotic syndrome, chronic renal failure, acute pancreatitis, use of steroids and acute myocardial infarction</p> <p>May be decreased in malnutrition or hyperthyroidism</p>

Interpreting Laboratory Monitoring of Response to Nutrition Support

Lab	Normal Range	Interpretation
Urea Nitrogen (urine)	12-20 g/24hr	<p>Nitrogen balance is estimated by: [24 hr nitrogen intake - (UUN + 4gm Nitrogen)] and can be used to assess degree of metabolic stress and estimate nitrogen need</p> <p>Desired Nitrogen balance for anabolism= +4-6 gm</p>

Macronutrient Components of TPN

Substrate	Product Availability	Caloric Density	Requirement	Complications of Substrate Intolerance
1. Carbohydrate (dextrose as monohydrate)	70% (70 g/100mL)	3.4 Cal/gm	Final Dextrose concentration D20-D35% (tpn) (20-35G/100ml) D5-D10% (ppn) (5-10G/100ml)	Hyperglycemia Liver enzyme abnormalities Pulmonary dysfunction Glucosuria recurrent phlebitis
2. Lipid (emulsion of soybean or sunflower oil)	20% (20g/100ml)	10 cal/gm 2.0 cal/ml	2-4% of total calories from fat to prevent deficiency usually 30% of total calories; no more than 60% of total calories	Hyper triglyceridemia Liver enzyme abnormalities
3. Protein (crystalline amino acids)	15% 15gm/100ml	4 cal/gm	Non Protein Calorie: gm. Nitrogen 150-200: 1	Azotemia Liver enzyme abnormalities

Daily volume and electrolyte composition of gastrointestinal tract secretions

Electrolytes (mmol/L)						
	Volume (L)	H ⁺	Na ⁺	K ⁺	Cl ⁻	HCO ³⁻
Saliva	0.5-1.0	0	30	20	10-35	0-15
Stomach	1.0-2.5	0-120	60	10	100-120	0
Bile	0.5	0	140	5-10	100	40-70
Pancreatic	0.75	0	140	5-10	70	40-70
Small Intestine	2.0-4.0	0	110	5-10	100	25
Large Intestine						

Calcium and Phosphorus in TPN

A. Calcium and Phosphorus Compatibility

Several factors influence the amount of calcium and phosphorus that can be added to a given volume of TPN including volume of fluid, pH of the solution, mixing procedures, and amino acid concentration,

A limiting factor in supplementation of calcium and phosphorus is the compatibility of calcium and phosphorus salts, which if given in large doses may result in crystalline precipitation and possible catheter occlusion.

The I.V. room pharmacist will contact you if there is any question about the calcium and phosphorus compatibility in the TPN.

B.
$$\text{Ca}^{++}_{\text{corrected}} = [(4\text{-albumin}) \times 0.2 \text{ mM/L}] + \text{Ca}^{++}_{\text{uncorrected}}$$

Equivalents for Commonly Used TPN Electrolytes

Salt	Unit	mEq	Elemental Mineral
Ca Gluconate	1 gm	4.65	90 mg
Ca Chloride	1 gm	13.65	272 mg
Mg Sulfate	1 gm	8	99 mg
Phosphate	1mmol	2	31 mg

TPN Multivitamin/Trace Metal Preparation

Adult Multivitamin Preparation

Per 10 ml dose:

Ascorbic Acid	100 mg
Vitamin A (retinol)	1 mg
Vitamin D (ergocalciferol)	5 mcg
Thiamine (vitamin B ₁)	6 mg
Riboflavin (vitamin B ₂)	3.6 mg
Pyridoxine (vitamin B ₆)	6 mcg
Niacinamide	40 mg
Dexpanthenol	15 mg
Vitamin E	10 mg
Biotin	60 mcg
Folic Acid	600 mcg
Cyanocobalamin(vitamin B ₁₂)	5 mcg
Vitamin K	150 mcg

Pediatric Multivitamin Preparation

Per 5 ml dose:

Ascorbic Acid	80 mg
Vitamin A (retinol)	0.7 mg
Vitamin D (ergocalciferol)	10 mcg
Thiamine (vitamin B ₁)	1.2 mg
Riboflavin (vitamin B ₂)	1.4 mg
Pyridoxine (vitamin B ₆)	1 mg
Niacinamide	17 mg
Dexpanthenol	5 mg
Vitamin E	7 mg
Biotin	20 mcg
Folic Acid	140 mcg
Cyanocobalamin(vitamin B ₁₂)	1 mcg
Vitamin K	200 mcg

Adult Trace Metal Preparation

Per 1 ml dose:

Zinc	5 mg
Copper	1 mg
Manganese	0.5 mg
Chromium	10 mcg

Pediatric Trace Metal Preparation

Per 1 ml dose (maximum dose: 10 ml)

Zinc	1 mg
Copper	0.1 mg
Manganese	25 mcg
Chromium	1 mcg

Selenium - see page 11 for guidelines for TPN supplementation

Check with the pharmacist or dietitian for recommendations when supplemental micro-nutrients above standard doses are needed.

Approximate Osmolarity of Parenteral Nutrition Components

Component	Osmolarity
Amino Acid	100 mOsmol/%
Calcium gluconate	1.4 mOsmol/mEq
Dextrose	50 mOsmol/%
Lipid emulsion	1.7 mOsmol/g
Magnesium sulfate	1 mOsmol/mEq
Potassium (as chloride, acetate, or phosphate)	2 mOsmol/mEq
Sodium (as chloride, acetate, or phosphate)	2 mOsmol/mEq

**From: Nutrition Support Handbook: A compendium of products with guidelines for usage.
Harvey Whitney Books Co. K. Teasley-Strausburg, MS, RPh, pg 137,1992**