

ICU RAPID RESOURCE 2: TPN TIPS (pg 1)

LINE 1 (per 24 hr) *				HOW TO WRITE TPN: STEPS ...	EXAMPLE:
Amino Acid Solution 10% (with lytes)		mL		<p>1) Identify energy (kcal) needs: See next page over (Calorie Calculator).</p> <p>2) Distribute energy (kcal) between PRO/CHO/FAT: See "Substrate Distribution" (a), (b), or (c) below.</p> <p>3) Convert energy (kcal) into gms: See "Energy Value" below.</p> <p>4) Convert gms into solution and volume: See "Available Solutions" below. Round off PRO and CHO to closest 10g multiple; FAT to closest 25g multiple.</p> <p>5) Determine essential additives:</p> <p>Electrolytes: Requirements vary with body wt, nutritional status, organ function, disease process, losses, etc. In the absence of renal dysfunction AA with lytes is usually appropriate.</p> <p>Potassium Acid Phosphate: Individualize dose. In malnourished pts (normal renal function) an additional 15 – 30 mmol is a reasonable addition.</p> <p>Sodium Chloride: Individualize dose.</p> <p>Potassium Chloride: Individualize dose.</p> <p>Magnesium Sulphate: Individualize dose. In malnourished pts (normal renal function) an additional 20 – 40 mEq (5g) is a reasonable addition.</p> <p>Calcium Gluconate: 9 mEq (standard)</p> <p>Vitamins: MVI – 12: 10 mL (standard). (10 mL provides Vit A 3300 IU; Vit D 200 IU; Vit E 10 IU; Vit C 100 mg; folate 400 ug; niacin 40 mg; riboflavin 3.6 mg; B₁ 3 mg; pyridoxine 4 mg; B₁₂ 5 ug; pantothenic acid 15 mg; biotin 60 ug). Vitamin K: Protocol 10 mg Q Wed (standard)</p> <p>Trace minerals: Trace Solution: 1 mL (standard) (1 mL provides: zinc 5mg; copper 1 mg; manganese 0.5 mg; chromium 10 mcg).</p> <p>6) Medications: Ranitidine: Individualize dose. Usual dose (normal renal function) 150 mg. Insulin: Individualize ... see caution.</p>	<p>2000 kcal</p> <p>SUBSTRATE DISTRIBUTION (a) PRO: 20% = 400 kcal CHO: 50% = 1000 kcal FAT: 30% = 600 kcal</p> <p>PRO: 400 kcal ÷ 4.0 kcal/g = 100g CHO: 1000 kcal ÷ 3.4 kcal/g = 294g FAT: 600 kcal ÷ 10 kcal/g = 60g</p> <p>PRO: 1000 mL 10% AA (100g) CHO: 600 mL D₅₀W (300g) FAT: 250 mL 20% lipid (50g)</p>
Amino Acid Solution 10% (without lytes)		mL			
Dextrose 50%		mL			
Dextrose 20%		mL			
Potassium Acid Phosphate (K+ 4.4 mEq/mL, P 3mmol/mL)		mmol P			
Sodium Chloride		mEq Na			
Potassium Chloride		mEq K			
Magnesium Sulphate		mEq Mg			
Calcium Gluconate		mEq Ca			
MVI – 12		mL			
Vitamin K		mg			
Folic Acid		mg			
Trace Element Solution		mL			
Zinc Sulphate		mg			
Ranitidine		mg			
Infusion Period		24 hours			
LINE 2 (per 24 hr) *					
Fat Emulsion (Note: order in multiples of 125 mL)		mL			
Infusion Period		24 hours			
<p align="center">Additional vitamins (vitamin C, thiamine), minerals (selenium), electrolytes (sodium acetate, potassium acetate, sodium acid phosphate) and medications (insulin) can be ordered in this section. See "How to write TPN" for further information.</p>					
10% AA Solution (Travasol)	With Lytes (1 litre)	Without lytes (1 litre)	ORDERING/ADMINISTERING TPN:		
Na mEq	70	0	<p>1) All changes to the TPN order are highlighted by an asterisk (*).</p> <p>2) All orders are signed by an MD.</p> <p>3) All orders are sent to the main Pharmacy.</p> <p>4) All TPN is administered via central access.</p> <p>5) All TPN is delivered to the unit of origin in a 2-in-1 or 3-in-1 solution.</p> <p>6) All TPN is delivered over ≤ 24 hrs.</p>		
K mEq	60	0			
Mg mEq	10	0			
PO ₄ mmol	30	0			
Cl mEq	70	40			
Acetate mEq	150	87			
<p><u>Questions? Ask a Dietitian</u></p>					

Electrolytes: TPN can cause significant electrolyte shifts. Intracellular redistribution is more pronounced in malnourished and/or alcoholic pts. Serum K, Mg, PO₄ may be normal in the unfed (catabolic) state but ↓ quickly with TPN initiation.

Managing electrolytes in the malnourished pt (refeeding risk):

- 1) Correct low levels before starting TPN.
- 2) Limit initial energy intake to ≤20 kcal/kg TPN day 1; ↑ to 25 kcal/kg when lytes normal; ↑ to final energy goal by TPN day 5.
- 3) Once lytes normal x 48 hr with TPN at final energy goal, ↓ daily monitoring.

Renal Failure:

- 1) Caution advised when adding K, Mg, and/or PO₄ to the TPN solution.
- 2) Provide repletion dose of K, Mg, and/or PO₄ separate from the TPN solution.

Acid/base disorders:

- 1) Use potassium acetate vs potassium chloride as indicated.
- 2) Use sodium acetate vs sodium chloride as indicated.

Vitamins: Additional vit C and thiamine (100 mg usual dose), and folate (1 mg usual dose) can be added to the TPN as indicated (e.g. malnourished; alcoholic).

Trace minerals: Additional zinc (5 – 10 mg usual dose) can be added to the TPN as indicated (e.g. high output fistula; diarrhea). Selenium can be added to the TPN as indicated (e.g. severe malnutrition, high output fistula, and/or long term PN).

Insulin: Caution!! When in doubt do not add to TPN solution; use insulin protocol.

Substrate	a) Substrate Distribution (High PRO)	b) Substrate Distribution (Moderate PRO)	c) Substrate Distribution (Low PRO)	Energy Value (kcal)	Available Solutions	Minimum Dose	Maximum Dose
PRO	20%	15%	10%	4.0 kcal/g	10% AA: 10g PRO/100 mL	0.6 g/kg/day	2.5 g/kg/day
CHO	50%	55%	60%	3.4 kcal/g	D ₂₀ W: 20g CHO/100 mL D ₅₀ W: 50g CHO/100 mL	100 g/day	7 g/kg/day
FAT	30%	30%	30%	10 kcal/g	20%: 20g FAT/100 mL	100 g/week	1.5 g/kg/day

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DETERMINING ENERGY REQUIREMENTS: CALORIE CALCULATOR

TABLE 1

AGE	SEX	STRESS LEVEL	ENERGY (Kcal)
18 - 25	M	Mild Mod High	2150 2300 2650
	F	Mild Mod High	1700 1850 2150
26 - 35	M	Mild Mod High	2050 2200 2600
	F	Mild Mod High	1650 1800 2100
36 - 50	M	Mild Mod High	1950 2100 2400
	F	Mild Mod High	1600 1700 2000
51 - 70	M	Mild Mod High	1800 1950 2250
	F	Mild Mod High	1450 1550 1850
71 - 90	M	Mild Mod High	1650 1800 2050
	F	Mild Mod High	1400 1500 1750

HOW TO USE TABLE

Step # 1: Refer to Table 1; select patient age and gender.
Step # 2: Go to Table 2; identify appropriate stress level.
Step # 3: Return to Table 1; read across to the corresponding goal energy requirement.
Step # 4: Table 1 based on weight of 60 - 65 kg for ♀ and 70 - 75 kg for ♂. Refer to Table 3 to modify energy (kcal) for patients who do not fall within this weight range.

Note! In significantly malnourished pts, the initial energy goal (kcal) should not exceed 20 kcal/kg. Refer to section 5 (pg over) "Managing electrolytes in the malnourished pt".

TABLE 2

STRESS LEVEL	EXAMPLES - CLINICAL CONDITION
NONE - MILD	overdose stroke <10% burn-injury mild infection minor elective surgery
MOD	10 - 20% burn-injury significant surgery moderate pancreatitis
HIGH	>20% burn-injury severe infection major surgery multiple trauma severe pancreatitis severe CHI

TABLE 3

BODY MASS	WEIGHT (Kg)	ADJUST ENERGY
VERY SMALL	F <40 M <55	- 250 kcal
SMALL	F 40 - 55 M 55 - 65	- 125 kcal
LARGE	F 70 - 80 M 80 - 100	+ 125 kcal
VERY LARGE	F >80 M >100	+ 250 kcal

*Obese pts: use corrected wt.
 (ABW - IBW) x 0.25 + IBW*

Calorie Calculator developed by: J. Greenwood, RD.

GI COMPLICATIONS: IDENTIFICATION AND MANAGEMENT

COMPLICATION	POSSIBLE ETIOLOGY	SYMPTOMS	TREATMENT	PREVENTION
Fatty liver (hepatic steatosis)	<ul style="list-style-type: none"> Excess kcal Unbalanced TPN (excess CHO) Chronic infections 	<ul style="list-style-type: none"> ↑ liver enzymes within 1- 3 weeks of TPN initiation 	<ul style="list-style-type: none"> ↓ kcal Provide cyclic TPN (deliver over < 24 h) Rule out all possible causes Transition to EN/oral intake ASAP 	<ul style="list-style-type: none"> Avoid over feeding Provide balanced TPN Avoid CHO >7 g/kg/day Early EN
Cholestasis	<ul style="list-style-type: none"> Precise etiology unknown (? impaired bile flow; lack of intraluminal stimulation of hepatic bile secretion; excess substrate). 	<ul style="list-style-type: none"> ↑ serum alk phosphatase Progressive ↑ serum bilirubin Jaundice 	<ul style="list-style-type: none"> ↓ kcal Rule out other causes Transition to EN/oral feedings ASAP 	<ul style="list-style-type: none"> Avoid overfeeding Early EN
GI atrophy	<ul style="list-style-type: none"> Lack of enteric stimulation → villous atrophy 	<ul style="list-style-type: none"> Bacterial translocation 	<ul style="list-style-type: none"> Transition to enteral/oral feedings ASAP 	<ul style="list-style-type: none"> Early EN

ADDITIONAL RESOURCES:

ASPEN board of directors guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. *JPEN* 2002; 26(1): 1SA - 137SA
 Mirtallo J, et al. Safe practices for parenteral nutrition. *JPEN* 2004; 28:S39-S70

METABOLIC COMPLICATIONS: IDENTIFICATION AND MANAGEMENT

COMPLICATION	POSSIBLE ETIOLOGY	SYMPTOMS	TREATMENT	PREVENTION
Hyperglycemia	<ul style="list-style-type: none"> Rapid infusion CHO solution Diabetes Sepsis/infection Steroids Pancreatitis 	<ul style="list-style-type: none"> BG > 11 mmol/L Metabolic acidosis 	<ul style="list-style-type: none"> Initiate insulin ↓ CHO in TPN 	<ul style="list-style-type: none"> Slow initiation and advancement of CHO especially pts with DM Provide balanced TPN
Hypoglycemia	<ul style="list-style-type: none"> Abrupt TPN termination Insulin overdose 	<ul style="list-style-type: none"> Weakness Sweating Palpitations Lethargy Shallow respirations 	<ul style="list-style-type: none"> Administer CHO 	<ul style="list-style-type: none"> Taper TPN and/or provide CHO from alternate source (tube feed, oral intake) Monitor BG after TPN termination
Hyperkalemia	<ul style="list-style-type: none"> ↓ renal function Excessive K intake Hemolysis Metabolic acidosis K sparing drugs 	<ul style="list-style-type: none"> Diarrhea Tachycardia Cardiac arrest Paresthesia 	<ul style="list-style-type: none"> ↓ K intake Provide K binder If metabolic acidosis change potassium and sodium chloride to acetate alternative 	<ul style="list-style-type: none"> Monitor serum levels. Correct acid-base disorder Assess for drug nutrient interactions (i.e. K sparing diuretics)
Hypokalemia	<ul style="list-style-type: none"> Inadequate K intake ↑ loss (diarrhea, NG loss, diuretics) Refeeding malnourished pt Low Mg Metabolic alkalosis Steroids 	<ul style="list-style-type: none"> Nausea Vomiting Confusion Arrhythmias Cardiac arrest Respiratory depression Paralytic ileus 	<ul style="list-style-type: none"> ↑ K in TPN Correct acid - base disturbance Discontinue NG suction if possible Resolve diarrhea ↓ kcal/CHO in TPN 	<ul style="list-style-type: none"> Provide 1-2 mEq/kg K per day (unless contraindicated) Slow initiation of TPN (especially CHO) in malnourished and/or alcoholic pt
Hypernatremia	<ul style="list-style-type: none"> Inadequate free water Excessive Na intake Excessive water loss 	<ul style="list-style-type: none"> Thirst ↓ skin turgor ↑ serum Na, urea, hematocrit 	<ul style="list-style-type: none"> ↑ free water intake ↓ Na intake 	<ul style="list-style-type: none"> Provide optimal free water Avoid excess Na Monitor fluid status

COMPLICATION	POSSIBLE ETIOLOGY	SYMPTOMS	TREATMENT	PREVENTION
Hyponatremia	<ul style="list-style-type: none"> Excessive fluid intake Dilutional states (CHF, SIADH) Excessive Na loss (vomiting, diarrhea) 	<ul style="list-style-type: none"> Edema Wt gain Muscle weakness CNS dysfunction (irritability, apathy, confusion, seizure) 	<ul style="list-style-type: none"> Restrict fluid intake ↑ Na intake if deficient 	<ul style="list-style-type: none"> Avoid over hydration Provide 40-60 mEq/day per 1000 kcal unless contraindicated Monitor fluid status
Hypermagnesemia	<ul style="list-style-type: none"> Excessive Mg intake Renal insufficiency 	<ul style="list-style-type: none"> Respiratory paralysis Hypotension Premature ventricular contractions Lethargy Cardiac arrest 	<ul style="list-style-type: none"> ↓ Mg in TPN 	<ul style="list-style-type: none"> Monitor serum levels
Hypomagnesemia	<ul style="list-style-type: none"> Refeeding malnourished pt Alcoholism Diuretics use ↑ loss (diarrhea) Drugs (cyclosporin) DKA 	<ul style="list-style-type: none"> Cardiac arrhythmias Tetany Convulsions Muscular weakness 	<ul style="list-style-type: none"> Mg supplementation ↓ kcal/CHO in TPN 	<ul style="list-style-type: none"> Provide 8-20 mEq Mg per day Slow initiation and advancement of TPN (esp. CHO) in malnourished and/or alcoholic pts Monitor serum levels
Hyperphosphatemia	<ul style="list-style-type: none"> Excessive PO₄ administration Renal dysfunction 	<ul style="list-style-type: none"> Paresthesia Flaccid paralysis Mental confusion Hypertension Cardiac arrhythmias Tissue calcification 	<ul style="list-style-type: none"> ↓ PO₄ in TPN 	<ul style="list-style-type: none"> Monitor serum levels
Hypophosphatemia	<ul style="list-style-type: none"> Refeeding malnourished pt Alcoholism ↑ loss (diarrhea, large NG loss) DKA 	<ul style="list-style-type: none"> Respiratory failure Cardiac abnormalities CNS dysfunction Difficulty weaning from ventilator 	<ul style="list-style-type: none"> ↑ PO₄ in TPN ↓ kcal/CHO in TPN 	<ul style="list-style-type: none"> Monitor serum levels Provide 20 - 40 mmol PO₄ per day. Initiate TPN (especially CHO) slowly in malnourished pts
Hypertriglyceridemia	<ul style="list-style-type: none"> Excessive lipid Sepsis Meds (cyclosporine) 	<ul style="list-style-type: none"> Serum TG > 4.0 mmol/L 	<ul style="list-style-type: none"> ↓ TPN lipid ↑ infusion time 	<ul style="list-style-type: none"> Pre TPN: assess for pre-existing hx of ↑ TG Limit lipid to <1 g/kg/day
Prerenal azotemia	<ul style="list-style-type: none"> Dehydration Excess PRO intake 	<ul style="list-style-type: none"> Elevated serum urea 	<ul style="list-style-type: none"> ↑ fluid intake ↓ PRO load ↑ nonprotein kcal 	<ul style="list-style-type: none"> Monitor serum urea