



# Parenteral Nutrition Formula Calculations and Monitoring Protocols

1 gr Dextrose  $\longrightarrow$  3.4 kcal

1 gr Lipid  $\longrightarrow$  10 kcal

1 gr A.A  $\longrightarrow$  4 Kcal



# Evaluation of a PN Order

PN 15% dextrose, 4.5% a.a. 3% lipid  
@ 100 cc/hour for 24 hours.

- ◆ Total volume = 2400 ml
- ◆ **Dextrose:**  $15\text{g}/100\text{ ml} * 2400\text{ ml} = 360\text{ g}$
- ◆  $360\text{ g} \times 3.4\text{ kcal/gram} = \mathbf{1224\text{ kcals}}$
- ◆ **Lipids**  $3\text{ g}/100\text{ ml} \times 2400\text{ ml} = 72\text{ g lipids}$
- ◆  $72 \times 10\text{ kcals/gram} = \mathbf{720\text{ kcals}}$



# Evaluation of a PN Order

- ◆ **Amino acids:**  $4.5 \text{ grams}/100 \text{ ml} * 2400 \text{ ml}$   
 $= 108 \text{ grams protein}$
- ◆  $108 \times 4 = \mathbf{432 \text{ kcals}}$
- ◆  $1224 + 720 + 432 = 2376 \text{ total kcals}$
- ◆ **Lipid is 30% of total calories**
- ◆ **Dextrose is 51.5% of total calories**
- ◆ **Protein is 18% of total calories**



# Example Calculation 2-in-1

## Nutrient Needs / day:

**Kcals: 1800. Protein: 88 g. Fluid: 2000 cc/ day**

**$1800 \text{ kcal} \times 30\% = 540 \text{ kcal from}$**

**Lipid (10%):**

–  $540 \text{ kcal} / 1.1 \text{ (kcal/cc)} = 491 \text{ cc/24 hr} =$

**20 cc/hr 10% lipid (round to 480 ml)**

- ◆ Remaining fluid needs:  $2000\text{cc} - 480\text{cc} =$   
**1520 cc**

# Protein Calculations

Remaining fluid needs:  $2000\text{cc} - 480\text{cc} =$   
**1520cc**

Protein:  $88\text{ g} / 1520\text{ cc} \times 100 =$   
5.8% amino acid solution

$88\text{ g.} \times 4\text{ kcal/gm} = 352\text{ kcals}$  from  
protein

◆ Remaining kcal needs:  $1800 - (528 + 352)$   
 $= 920\text{ kcal}$



# Dextrose Concentration

- ◆ Remaining kcal needs:  $1800 - (528 + 352) = 920$  kcal
- ◆  $920 \text{ kcal} / 3.4 \text{ kcal/g} = 270$  g dextrose
- ◆  $270 \text{ g} / 1520 \text{ cc} \times 100 = 17.7\%$  dextrose solution
- ◆ Rate of Amino Acid / Dextrose:
- ◆  $1520 \text{ cc} / 24\text{hr} = 63 \text{ cc/hr}$

**TPN recommendation: Suggest two-in-one PN 17.7% dextrose, 5.8% a.a. @ 63 cc/hr with 10% lipids piggyback @ 20 cc/hr**





# Re-check calculations

TPN recommendation: Suggest two-in-one  
PN **17.7% dextrose, 5.8% a.a. @ 63 cc/hr**  
with **10% lipids piggyback @ 20 cc/hr**

$$63 \text{ cc/hr} \times 24 = \mathbf{1512 \text{ ml}}$$

$$1512 * (.177) = 268 \text{ g } \mathbf{D} \times 3.4 \text{ kcals} = \mathbf{911}$$

kcals

$$1512 * (0.058) = \mathbf{88 \text{ g } a.a.} \times 4 \text{ kcals} = \mathbf{352}$$

$$20 \text{ cc/hr } \mathbf{lipids} * \mathbf{24} = 480 * 1.1 \text{ kcals/cc} = \mathbf{528}$$

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**1791**



# Sample Calculation 3-in-1

- ◆ **Nutrient Needs / day:**

- **Kcals: 1800, Protein: 88 g Fluid: 2000 cc**

- ◆ **Lipid** :  $1800 \text{ kcal} \times 30\% = \mathbf{540 \text{ kcal}}$

- $540 \text{ kcal} / 10 \text{ kcal per gram} = \mathbf{54 \text{ g}}$

- $54 \text{ g} / 2000 \text{ cc} \times 100 = \mathbf{2.7\% \text{ lipid}}$

- ◆ **Protein: 88 g / 2000 cc x 100 = 4.4% amino acids**

- ◆  $88 \text{ g} \times 4 = \mathbf{352 \text{ kcals from protein}}$





# Sample Calculation 3-in-1(cont)

**Dextrose: 908 kcal** (1800 – 540 - 352)

–  $908/3.4 \text{ kcal/g} = \mathbf{267 \text{ g dextrose}}$

–  $\mathbf{267 \text{ g}} / 2000 \text{ cc} \times 100 =$

**13.4% dextrose solution**

– **Rate of infusion:** Amino Acid / Dextrose/Lipid:  
 $2000 \text{ cc} / 24\text{hr} = \mathbf{83 \text{ cc/hr.}}$


– **TPN prescription:** Suggest TNA 13.4%  
dextrose, 4.4% amino acids, 2.7% lipids at  
83 cc/hour provides 88 g. protein, 1800 kcals,  
2000 ml fluid

# Acute Inpatient PN Monitoring

<b>Parameter</b>	<b>Frequency</b>		
	<b>Daily</b>	<b>3x/week</b>	<b>Weekly</b>
<b>Glucose</b>	Initially	√	
<b>Electrolytes</b>	Initially	√	
<b>Phos, Mg, BUN, Cr, Ca</b>		Initially	√
<b>TG</b>			√
<b>Temperature</b>	√		
<b>Bili, LFTs</b>		Initially	√



# Inpatient Monitoring PN



<b>Parameter</b>	<b>Frequency</b>		
	<b>Daily</b>	<b>Weekly</b>	<b>PRN</b>
<b>Body Weight</b>	Initially	√	
<b>Nitrogen Balance</b>		Initially	√
<b>HGB, HCT</b>		√	
<b>Catheter Site</b>	√		
<b>Lymphocyte Count</b>	Initially		√
<b>Clinical Status</b>			√

**PRN** : Pro – Re – Nata = when necessary



# Monitoring: Nutrition

## Serum Hepatic Proteins

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### Parameter

### Time

**Albumin**

**19 days**

**Transferrin**

**9 days**

**Prealbumin**

**2 – 3 days**

**Retinol Binding Protein**

**~12 hours**



# Osmolarity Quick Calculation

To calculate solution osmolarity:

- ◆ (A). multiply grams of **dextrose per liter by 5**
- ◆ (B). multiply grams of **protein per liter by 10**
- ◆ (C). add A & B
- ◆ add 300 to 400 to the answer from “C”.  
(Vitamins and minerals contribute about 300 to 400 mOsm/L.)



# Is the solution compoundable?

- ◆ TPN is compounded using 10% or 15% amino acids, 70% dextrose, and 20% lipids
- ◆ The TPN prescription must be compoundable using standard base solutions
- ◆ This becomes an issue if the patient is on a fluid restriction



# Is the Solution Compoundable?

What is the minimum volume to compound the PN prescription?

**Example:**    **75 g    AA**  
                  **350 g    dextrose**  
                  **50 g    lipid**  
                  **2000 ml fluid restriction**

AA:  $\frac{10 \text{ g}}{100 \text{ ml}} = \frac{75 \text{ g}}{X \text{ ml}} = 750 \text{ ml using } 10\% \text{ AA}$

OR divide 75 grams by the % base solution,  $75 \text{ g} / .10$



# Is the solution compoundable?

**Dextrose:**  $\frac{70 \text{ g}}{100 \text{ ml}} = \frac{350 \text{ g}}{X \text{ ml}}$      $x = 500 \text{ ml}$

**Lipid:**      $\frac{20 \text{ g}}{100 \text{ ml}} = \frac{50 \text{ g}}{x \text{ ml}}$       $X = 250 \text{ ml}$

**Total volume = 750 ml AA + 500 ml D + 250 ml lipid + 100 ml (for electrolytes/trace) = 1600 ml (minimum volume to compound solution)**

**Tip: Substrates should easily fit in 1 kcal/ml solutions**





# Is this solution compoundable?

PN prescription:

**AA 125 g**

**D 350 g**

**Lipid 50 g**

**Fluid restriction 1800 ml/day**



# Is this solution compoundable?

**AA:**  $\frac{10 \text{ g}}{100 \text{ ml}} = \frac{125 \text{ g}}{X \text{ ml}} = \mathbf{1250 \text{ ml}}$  (125 /. 10)

**Dextrose:**  $\frac{70 \text{ g}}{100 \text{ ml}} = \frac{350 \text{ g}}{X \text{ ml}}$  x = **500 ml** (350/.70)

**Lipid:**  $\frac{20 \text{ g}}{100 \text{ ml}} = \frac{50 \text{ g}}{x \text{ ml}}$  X = **250 ml** (50/.20)

**Total volume** = 1250 ml AA + 500 ml D + 250 ml lipid + 100 ml (for electrolytes/trace) = **2100 ml** (minimum volume to compound solution)

**Verdict: not compoundable in 1800 ml.**

**Action: reduce dextrose content or use 15% AA base solution if available** (could deliver protein in 833 ml of 15%)

